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DOWNFLOW FORCED-CONVECTION BOILING OF WATER IN UNIFORMLY HEATED TUBES

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Contents

DOWNFLOW FORCED-CONVECTION BOILING OF WATER IN UNIFORMLY HEATED TUBES

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August 21, 1961

ABSTRACT

Local heat-transfer coefficients and local, total two-phase pressure drops have been measured in the downflow forced-convection (net) boiling of water in electrically heated tubes. The tubes used were 0.719 and 0.472 in. i.d., with lengths of 5.67 and 4.69 ft, respectively. The flow variables cover the following ranges:

Variable	Symbol	Range
Mass flux	G	110 to 700 lbm/sec ft^2
Heat flux	q	13,800 to 88,000 BTU/hr ft^2
Quality (mass fraction vapor)	x	0 to 19%
Boiling number $\left(= \frac{q}{h_{fg}G}\right)$	Bo	$0.24 \cdot 10^{-4}$ to $1.9 \cdot 10^{-4}$
Pressures		15.8 to 68.2 psia

Boiling heat transfer results are compared to the correlations of Dengler, Mumm, and Schrock and Grossman. New boiling heat-transfer correlations are derived, the skeleton of these being the following general dependence:

$$h_B \sim G^{0.6}\, q^{0.3}\, x^{0.4}.$$

Large effects due to two-phase thermal entrance phenomena were observed. These effects are discussed with reference to previous experi-

ments in forced-convection boiling.

Local, total two-phase pressure gradients are correlated by the method of Schrock and Grossman. Individual pressure gradients are also predicted by several methods.

On the basis of heat-transfer and pressure-drop observations, the flow and vaporization mechanisms are discussed.

A design procedure is derived, and typical results are discussed.

I. INTRODUCTION

A. General Introduction

The interest in boiling, or more completely, heat transfer with change of phase, has increased greatly over the past several years. The main reason for this increased interest is the ability of boiling systems to attain large heat fluxes while employing relatively small temperature differences. For instance, in some boiling systems the heat flux is proportional to the fourth power of the temperature difference. In contrast, the heat flux obtained with forced-convection heat transfer without change of phase is essentially proportional to the first power of ΔT. The increased heat flux of the boiling system has, however, been accompanied by great, if not insolvable, analytical difficulties. These difficulties stem from the complex fluid-dynamic phenomena associated with the boiling process, and the fact that the fluid dynamic problem cannot be treated separately from the heat transfer problem. For example, the large heat fluxes observed with nucleate pool boiling are considered to be a result of disturbances in the thermal boundary layer caused by the formation, growth, and detachment of vapor bubbles. The same reasoning has been advanced for the large heat fluxes observed with subcooled boiling.*

It is well known that heat-transfer coefficients for one-phase systems vary almost linearly with mass velocities in the region of the heat-transfer surface. It is natural, therefore, that in the search for higher performance heat transfer systems, attempts would be made to combine the mechanisms of boiling and high-speed forced convection. This report deals with the net vaporization phenomena associated with the forced flow of a saturated liquid down through a uniformly heated tube.

The main objectives of this work are to experimentally measure heat-transfer coefficients and pressure drops, correlate them with flow variables, and present design procedures. Then, from this work it was hoped that an insight might also be gained into the actual mechanisms involved.

Practical applications for such a heat-transfer system include cooling nuclear reactors and rocket motors, conversion of sea water

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* Subcooled, surface, or local boiling are the names given to the phenomenon that takes place when a heat transfer surface is sufficiently above the saturation temperature while the bulk of the surrounding liquid is subcooled. Vapor bubbles are formed at the heated surface, but as they leave this region and penetrate the cooler surroundings they collapse and condense. There is no net generation of vapor with subcooled boiling. The terms net or bulk boiling refer to vaporization processes where vapor is a net product, as distinguished from subcooled boiling.

to fresh water, and concentration of fruit juices and other food products.[1] Although an upflow system could be used in any of the proposed applications, there is one consideration which may favor the downflow system. Because of hydrostatic head, in an upflow system employing relatively long tubes, boiling might be prevented in the inlet region of the tubes. In some cases this inefficient use of heat-transfer surface may be intolerable.

B. Forced-Convection Vaporization Phenomena

When a liquid is introduced into a heated tube, it first experiences warming by forced convection. Then when the bulk fluid temperature reaches a level somewhat below the saturation temperature, subcooled boiling may occur at the tube wall. (The effect of the subcooled boiling may be very small if the tube wall temperature is not appreciably above the bulk fluid temperature.) Finally when the bulk temperature reaches the saturation temperature, net boiling commences and vapor appears in the flow stream. From this point to the exit of the tube, or to the point where all liquid has been converted to vapor, the two-phase bulk fluid temperature continuously decreases. This temperature drop is due to hydrodynamic pressure losses and the fact that thermal equilibrium between phases is wholly or partially maintained. That is, the bulk two-phase fluid temperature is dependent on the pressure existing in the tube.

Within the boiling region of the tube several complex interacting processes occur simultaneously:

1. Heat is transferred from the tube wall into the two-phase

mixture, the net effect of this heat transfer being the formation of vapor. It is not known whether the vaporization mechanism resembles that of nucleate boiling or if there is some other mechanism, *e.g.* evaporization, at existing vapor-liquid interfaces. The mechanism is surely not that of film boiling as temperature differences are not large enough.

2. Vapor is also formed by flashing. Because of the flow system pressure drop and the criteria of thermal equilibrium between phases, a considerable amount of vapor is formed by flashing of saturated liquid. The mechanism for this vaporization process is not known either.

3. There are large two-phase-flow friction losses. From many experimental studies, it is well known that frictional pressure losses for two-phase flows are usually very large in comparison with those obtained in ordinary one-phase turbulent flow.

4. The generation of vapor also leads to large pressure losses. With the generation of vapor, the overall specific volume of the two-phase mixture increases, and there is a corresponding acceleration of some part of the flow field. Because of momentum considerations, this acceleration causes an additional pressure loss. The magnitude of the pressure loss depends on the relative accelerations imparted to the vapor and liquid. Hydrostatic head must also be considered in pressure loss descriptions.

5. The acceleration due to vapor formation has the added effect of increasing flow velocities and turbulent mixing. Both of these situations tend to increase pressure losses and heat-

transfer coefficients.

These effects will be greatest when the difference between vapor and liquid densities is large; i.e. for low pressures. For this reason, the pressure range below 100 psia to atmospheric was chosen for this investigation.

From velocity considerations it is expected that heat-transfer coefficients would increase with increasing mass velocity G and increasing vapor fraction x. Additionally, from pool boiling studies it seems reasonable that there would also be some dependence on ΔT or, in the case of a uniformly heated tube, the heat flux q. For an experiment where G and q are fixed, but x increases along the tube length, it is expected that local heat-transfer coefficients would increase with length.

C. Thermal Entrance Regions

Before proceeding to a review of previous work in heat transfer in forced-convection boiling, some discussion of thermal entrance regions is warranted. It is not the purpose of this report to study in detail two-phase thermal entrance regions, but to at least recognize the existence and effects of such phenomena. Consider the fully-developed turbulent flow of a liquid in a tube. Let the liquid first flow through an unheated portion of the tube and then into a heated region. Assuming the thermal contribution of fluid friction to be small, the liquid everywhere in the unheated portion of the tube will be isothermal. As the liquid enters the heated section of the tube, at first only the layer of fluid at the heated wall is warmed, while the bulk of the liquid is still isothermal. As the liquid proceeds downstream and the warming process continues, the thickness of the warmed layer increases and the radius of the isothermal region becomes smaller. At some point downstream, the warmed layer -- called the thermal boundary layer-- has grown to the extent that it fills the entire tube and there no longer is an isothermal region of fluid. The length of tube from the entrance of the heated section to the point where the thermal boundary layer completely fills the tube is called the thermal entrance length. Any point downstream from the thermal entrance region is said to have full-developed heat-transfer conditions. From the physical description of the entrance phenomenom, it should be evident that heat transfer in the entrance region is not typical of the fully-developed region. Heat transfer coefficients in the entrance region vary from very large (approaching ∞) down to the fully-developed value.[2,3] This is due to the large thermal gradients existing in the fluid adjacent to the tube wall; theoretically the gradient at the entrance to the heated region is infinite.

If the flow at the entrance to the heated section of the tube is a two-phase mixture or a saturated liquid (or a nearly saturated liquid), the entrance phenomena will occur in conjunction with two-phase vaporization processes. Neither the effect of this superposition of mechanisms nor the length of the entrance region are accurately known. However, there will surely be some entrance phenomena that will not be typical of fully developed conditions.

D. Previous Work in Forced-Convection Boiling

There has been very little work published on the subject of forced-convection boiling; especially all of the work that has appeared has been experimental. This work is summarized below.

There have also been attempts to extend pool boiling and one-phase forced-convection correlations to this subject. In view of the radical departure of the physical picture of forced-convection boiling from either of these two regimes, it is difficult to find merit in this latter approach. This view is also held by Staley and Baker.[4]

1. Dengler[5] and Dengler and Addoms[6]

Dengler used water in an upflow system consisting of a 1-in.-i.d., 20-ft.-long, vertical copper tube. Five 3-ft.-long steam jackets were spaced along the tube and 21 thermocouples were embedded in the tube wall. Local heat fluxes were determined by collecting steam condensate from the specially designed steam jackets. Local pressures were obtained at stations between the steam jackets by a manometer system. Saturated liquid was introduced to the test section with outlet pressures ranging from 7.2 to 29 psia. Mass fluxes were varied from 12.2 to 280 lbm/sec ft^2. The mass vapor fraction (quality), x, varied from 0 to 100%. Local volumetric vapor fractions were determined by a radio-active-tracer technique.

Dengler and Addoms postulated that the local heat-transfer coefficients at low flow rates and qualities are governed by the combined influence of boiling and forced convection. As the linear velocity of the vapor-liquid mixture increases, it was proposed that that nucleate boiling mechanism is suppressed, and a forced-convection heat transfer mechanism is the dominant factor. Their correlation for the region of suppressed nucleate boiling was

$$\frac{h_B}{h_o} = 3.5\, X_{tt}^{-0.5} , \qquad \text{(I-1)}$$

where h_o is the heat-transfer coefficient that would be obtained if the flow were all liquid; it is calculated from the Dittus-Boelter equation[7]

$$h_o = 0.023\, \frac{k_\ell}{D_i}\, Re_T^{0.8}\, Pr_\ell^{0.4} . \qquad \text{(I-2)}$$

The physical properties are those of the liquid evaluated at the local saturation temperature, and the Reynolds number, DG/μ_ℓ, is based on the total mass flow rate. The Lockhart-Martinelli parameter X_{tt} is defined by[8]

$$X_{tt} = \left(\frac{\rho_g}{\rho_f}\right)^{0.5} \left(\frac{\mu_f}{\mu_g}\right)^{0.1} \left(\frac{1-x}{x}\right)^{0.9} . \qquad \text{(I-3)}$$

This was originally developed for the correlation of pressure drop in two-phase, two-component isothermal flow.* Its possibility as a correlating parameter for heat transfer in two-phase flow was suggested by Lockhart and Martinelli.

In the entrance regions of the test section, heat-transfer coefficients were significantly larger than those predicted by Eq. (I-1). Dengler postulated that this was the region in which the nucleate boiling mechanism was predominant, whereas downstream,

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* The sub-tt refers to turbulent-turbulent in categorizing the types of flow of the vapor and liquid phases. Only for the very slow flows was any other regime observed.

with higher linear velocities, boiling was suppressed. A temperature difference to initiate nucleate boiling, ΔT_i, was defined by

$$\Delta T_i = 10(V_{avg})^{0.3} \qquad \text{(I-4)}$$

and was applied as a criteria for nucleate boiling. The average stream velocity V_{avg} was defined by material balance relations and measured volumetric vapor fractions. Dengler obtained no correlation between the liquid velocity and ΔT_i when both liquid and vapor velocities were assumed equal. Then ΔT_i was nondimensionalized in an arbitrary manner, and the data were correlated by multiplying h_B/h_o by the factor

$$0.673\left[(T_w - T_b - \Delta T_i)\left(\frac{dP}{dT}\right)_{sat.} \frac{D}{\sigma}\right]^{0.1} \qquad \text{(I-5)}$$

when the factor was greater than one. Although this factor was used to reduce the scatter of the data, its physical significance is not immediately apparent. Thermal entrance effects were not mentioned. From the results of Siegel and Sparrow,[2] the first boiling section of about 36 in. (which contributed one of the five data points for each run) contained a thermal entrance region of some 24 in. In view of the relationship of data points in the first heated region to the correlation, it is suggested that thermal entrance effects form a more plausible explanation than the proposed mechanism. It should also be mentioned, that since each one of the 36-in. boiling sections was used to obtain one value of the heat-transfer coefficient, these values are not true local coefficients.

2. Mumm[9]

Mumm used water in an electrically heated, horizontal, stainless steel tube; it was 0.465 in. i.d. and 7 ft. long. Local heat-transfer coefficients were obtained for exit qualities up to 60% and for pressures from 45 to 200 psia. Heat fluxes ranged from $5 \cdot 10^4$ to $2.5 \cdot 10^5$ BTU/hr. ft.^{2}, and mass fluxes ranged from 70 to 280 lbm/sec ft^2. Local heat-transfer coefficients for qualities less than 40% were correlated by

$$Nu_B = \left[4.3 + 5 \cdot 10^{-4} \left(\frac{V_{fg}}{V_f}\right)^{1.64} x \right] \left(\frac{q}{Gh_{fg}}\right)^{0.464} (Re_\ell)^{0.808}, \quad \text{(I-6)}$$

with a standard deviation of $\pm 10\%$. Here the V's are specified volumes. The quantity (q/Gh_{fg}) was first introduced by Davidson[10] and has been called the boiling number, Bo.

3. Schrock and Grossman[11,12]

Schrock and Grossman used water in an upflow system. They used electrically heated test sections of 0.1162-in., 0.2370-in., and 0.4317-in. i.d. Length varied from 15 to 40 in. Mass fluxes for the small tubes varied from 197 to 911 lbm/sec.ft.^{2}; and for the largest tube, 49 to 69. Heat fluxes for the small tubes were $6 \cdot 10^4$ to $1.45 \cdot 10^6$ BTU/hr. ft.^{2}, and for the large tubes $0.65 \cdot 10^5$ to $2.46 \cdot 10^5$. Pressures ranged from 42 to 505 psia, and exit qualities up to 59%. During the initial stages of the project, heat transfer data were correlated in two flow regimes. For very low vapor qualities where nucleate boiling was considered predominant, the correlation was

$$\frac{h_B}{h_\ell} = 1.15 \cdot 10^{-5} \, q \quad \text{(I-7)}$$

The scatter of the data was large in this region. The authors believed that the relatively high coefficients obtained with the low qualities were not due to entrance effects. When the inception of net boiling occurred well within the heated test section ($\ell/D \sim 60$), the same effects were still observed. At higher qualities a vapor core-liquid annulus type of flow was postulated. These data were correlated with the Martinelli parameter

$$\frac{h_B}{h_\ell} = 2.5\, X_{tt}^{-0.75} \quad . \tag{I-8}$$

Here h_ℓ is the local, nonboiling heat-transfer coefficient that would be obtained if the liquid in the two-phase mixture were actually flowing alone and filling the tube. It was also calculated by the Dittus-Boelter equation.

In the final stages of their work, the correlation was modified. It was postulated that heat transfer is dependent on both boiling and forced-convection regimes. The boiling number and the Martinelli parameter, respectively, were used to express these contributions:

$$\frac{Nu_B}{Re_\ell^{0.8} Pr_\ell^{1/3}} = 1.7 \cdot 10^2 \left[\left(\frac{q}{G h_{fg}} \right) + 1.5 \cdot 10^{-4}\, X_{tt}^{-2/3} \right] . \tag{I-9}$$

The standard deviation was $\pm 35\%$.

4. Natural-Circulation Boiling in Vertical Tubes

Guerrieri and Talty presented data for the boiling of several organic liquids in natural-circulation vertical-tube evaporators.[13] Tube diameters were 0.75 in. and 1.0 in.; tube lengths were about 6 ft. Heat fluxes were low (up to 17,400 BTU/hr. ft^2). Outlet qualities varied from 2.8 to 11.6%. Heat-transfer coefficients were correlated in a manner similar to that of Dengler:

$$\frac{h_B}{h_\ell} = 3.4\ X_{tt}^{-0.45} \qquad \text{(I-10)}$$

A correction factor for nucleate boiling was also introduced. The physical significance of this correction is somewhat more apparent than that of the one used by Dengler:

$$\text{Correction Factor} = 0.187\ (r^*/\delta)^{-5/9} \qquad \text{(I-11)}$$

where r^* is the calculated radius of the minimum size of thermodynamically stable bubble for a given degree of superheat, and δ is the thickness of the laminar layer of liquid along the wall. When (r^*/δ) was greater than 0.049, it was physically interpreted to mean that flow velocities near the wall were large enough to prevent nucleation of vapor bubbles.

5. Evaporation of Refrigerants

Some work on the evaporation of refrigerants in forced flow through tubes has appeared in the literature. The data presented are usually for relatively low mass fluxes (less than 150 lbm/sec ft.^{2}) and low heat fluxes (20,000 BTU/hr ft.^{2}). However, vapor fractions (x) up to and over 90% are common. One recent paper summarizes previous work and presents new data.[14] In the experiments, the difference between inlet and outlet vapor fractions was usually about 15%. Average heat-transfer coefficients were correlated by:

$$\frac{h_B D_i}{k_\ell} = 0.0225 \left(\frac{GD_i}{\mu_\ell}\right)^{0.75} \left(\frac{J\ \Delta x\ \lambda}{L}\right)^{0.375} \qquad \text{(I-12)}$$

where Δx is the change of vapor fraction x over the test section length L, λ is the latent heat of vaporization, and J is the mechanical equivalent of heat. As pointed out in the Discussion section of the paper, the measured coefficients were not true local coefficients, but average values. Also it was pointed out that true local coefficients would depend on the value of x rather than Δx.

6. Sterman, Morozov, and Kovalev

Sterman describes forced-convection boiling work carried on in the U.S.S.R.[15] Data are presented for both the boiling of water up to 90 atmos. and the boiling of 95% ethyl alcohol at 2 atmos. The boiling tubes used were 120 to 140 mm (4.7 in.) in length and 16 mm (0.63 in.) in diameter. They were electrically heated by using the tube itself as a resistance element. To insure an adiabatic condition at the outer tube wall, the tubes were insulated and then completely surrounded by adjustable guard heaters. Heat fluxes up to 179,000 BTU/hr ft.^{2} were employed. Superficial velocities were about 6 to 10 ft/sec, and volumetric vapor fractions were varied from 0 to 26.9%. It was stated that there was no effect due to increasing vapor fraction. However, there was no statement made as to the magnitude of the mass vapor fraction; at low pressures this could easily be less than 1%. Heat-transfer coefficients were correlated according to the following relation

$$\frac{Nu_B}{Nu_\ell} = 6150\left[\left(\frac{q}{h_{fg} v_o \rho_g}\right)\left(\frac{\rho_g}{\rho_f}\right)^{1.45}\left(\frac{h_{fg}}{C_p T_s}\right)^{1/3}\right]^{0.7}, \qquad \text{(I-13)}$$

where the Nusselt numbers are for boiling and nonboiling (liquid only), v_o is the superficial velocity, and T_s is the saturation temperature. All of the above bracketed quantities are dimensionless.

E. Pressure Drop in Forced-Convection Boiling

The total pressure gradient*--$(dp/d\ell)_{tpt}$, the pressure drop per unit length of flow channel--in forced-convection boiling is the sum of three contributions: friction losses, acceleration losses due to momentum changes, and losses (or gains) due to the hydrostatic head of the contents of the flow channel. Friction losses may be considered independently of the other two contributions; i.e. it was believed that local friction losses in the boiling system could be estimated from studies dealing with adiabatic two-phase flow. Acceleration and hydrostatic head losses are both dependent on holdup; i.e. they are dependent on the velocities of the two phases and the fraction of the flow channel occupied by each phase. The holdup can be expressed in terms of the volumetric vapor fraction α or the slip ratio ψ (the ratio of the average vapor velocity to the average liquid velocity). Because holdup values were not measured in this experiment, it was hoped published correlations could be used.

1. Two-Phase-Flow Frictional Pressure Loss

Recently much work on adiabatic two-phase-flow friction losses has appeared in the literature. Most of the work has been experimental, resulting in empirical correlations. As only total pressure-gradient values were obtained in the work reported here,

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* Unless otherwise specified the pressure gradient is a local or a point value.

and there was no accurate means of testing friction-loss correlations, a full discussion of these papers here is not worthwhile. In conjunction with nuclear-reactor design work, Marchterre reviews some of these papers.[16] One of the earliest, and still one of the most quoted papers is that of Lockhart and Martinelli.[8] They obtained two-phase friction losses in pipes, using dissimilar liquids and gases. They correlated their results with two parameters, Φ_ℓ and X_{tt}. Here Φ_ℓ is defined by

$$\Phi_\ell = \left[\frac{\left(\frac{dp}{d\ell}\right)_{tpf}}{\left(\frac{dp}{d\ell}\right)_\ell}\right]^{1/2} . \qquad \text{(I-14)}$$

It is the square root of the ratio of the two-phase frictional pressure gradients to the pressure gradient that would be obtained if the liquid phase filled the pipe and were flowing alone. Parameter X_{tt} was defined by Eq. (I-3) in the previous section. The square of Φ_ℓ can be considered a friction factor multiplier.

Some of the friction-loss papers have been theoretical, but each has had as its basis some idealized flow model. Calculations based on two of these models are discussed in Chapter V.

2. Holdup Data

Very little applicable two-phase holdup data have been published; of those published there are no papers dealing with a downflow system. Lockhart and Martinelli in their pressure drop work obtained holdup data for dissimilar gases and liquids in horizontal pipes. Dengler obtained steam-water holdup data for his upflow boiling system. Marchaterre and Petrick review steam-water holdup data used in nuclear-reactor design.[16] As most of the latter set of data are for high (2000 psia) or moderate pressures and not for a downflow system, they would not apply directly to this report. However, the authors do summarize the holdup data in terms of the slip ratio. Briefly, slip ratios at 150 psig are all above 2.0, approaching it as a limit; they decrease with increasing superficial liquid velocity and increase with increasing quality. Even though these curves for upflow or horizontal systems cannot be applied directly to a downflow system, it seems reasonable that the observed trends would be obtained in all systems. The results of calculations in which the slip ratio was arbitrarily specified are discussed in Chapter V.

3. Total-Pressure-Gradient Correlations

Martinelli and Nelson extended the work of Lockhart and Martinelli to the boiling system.[17] This extension consisted of empirically modifying friction-factor multiplier values and vapor-fraction values to be more consistent at higher pressures. Then frictional and accelerational pressure gradients were added and integrated over the length of the boiling tube. In this graphical integration, the heat flux and the vapor fraction were arbitrarily specified. The resulting pressure drop values (the pressure drop over the entire tube) were plotted against average pressure level and exit quality. In order to set limits on pressure-drop values, the procedure was carried out twice; once for the so-called homogeneous or fog-flow model where liquid and vapor velocities are assumed equal, and the second time for the modified volumetric vapor fraction data obtained by Lockhart and Martinelli. This latter case is sometimes referred to as the slip or stratified flow model. The first case would supposedly set the upper limit on pressure drop. Comparing boiling pressure drop results from work at Argonne National Laboratory,[18,19] the Martinelli-Nelson method for the homogeneous flow model does set an upper limit, while the predictions of pressure drop from the slip model are only fair. For design work at Argonne, modifications of the method have been suggested.[16]

Schrock and Grossman correlated total pressure gradient values[11,12,20] in the manner of Lockhart and Martinelli (the total pressure gradient replaced the frictional gradient in the definition of Φ_{ℓ}), and presented a simplified design procedure. Ninety-five percent of their data were correlated to $\pm 15\%$. Using Dengler's holdup correlation, they also obtained frictional pressure gradients. The correlation of this data was not nearly as good as that for the total pressure gradient; probably due to the inapplicability of the holdup data.

R. Sani, this author's coworker, correlated the total pressure gradient values taken in the early stages of this experiment.[21] The best straight line through the data gave the relation,

$$\frac{\left(\frac{dp}{d\ell}\right)_{tpt}}{\left(\frac{dp}{d\ell}\right)_{\ell}} = 30\, X_{tt}^{-1.39} \qquad \text{(I-15)}$$

Agreement with the upflow correlation of Schrock and Grossman is satisfactory.

II. EXPERIMENTAL EQUIPMENT

A. General Flow System

The flow system consisted of a semi-closed loop. Distilled water was pumped from storage tanks through a rotameter system and then through two steam-fed heaters in series. At the outlet of the second heater, the temperature and pressure were controlled so that the flowing water was always subcooled, i.e., below its boiling point at the existing pressure. This location, called station 1, was the reference point for energy balances used to determine conditions downstream in the boiling test section. The stream pressure was then reduced by adjustment of a globe valve in the flow line, and consequently a certain amount of liquid flashed into vapor.* Immediately down-stream from this "flashing" valve was a length of glass pipe which was used to observe the two-phase flow pattern. The two-phase mixture was conducted down into the boiling test section, which was made from a thin-walled stainless steel tube. The test section was heated by using it as an electrical resistance heating element. It was fitted with pressure

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* In a few runs the temperature at station 1 was not high enough to allow flashing. In such runs, only liquid phase entered the test section, and the vapor phase was initiated somewhere in the heated region of the tube.

taps at frequent intervals along its length and thermocouples were soldered to it to obtain outside tube-wall temperatures; the test section, its connecting piping, and electrical cables were thermally insulated with woven asbestos tape and glass wool. The high-speed, two-phase mixture from the test section outlet was then conducted horizontally into a vapor-liquid cyclone separator. The separated vapor product was condensed and cooled, and returned to storage tanks; simultaneously the liquid product from the separator was cooled in two heat exchangers and also returned to storage.

Figure 1 shows the schematic flow diagram in which the pieces of equipment are displayed similarly to their actual appearance and location. Figures 2 through 6 are photographs of the equipment.

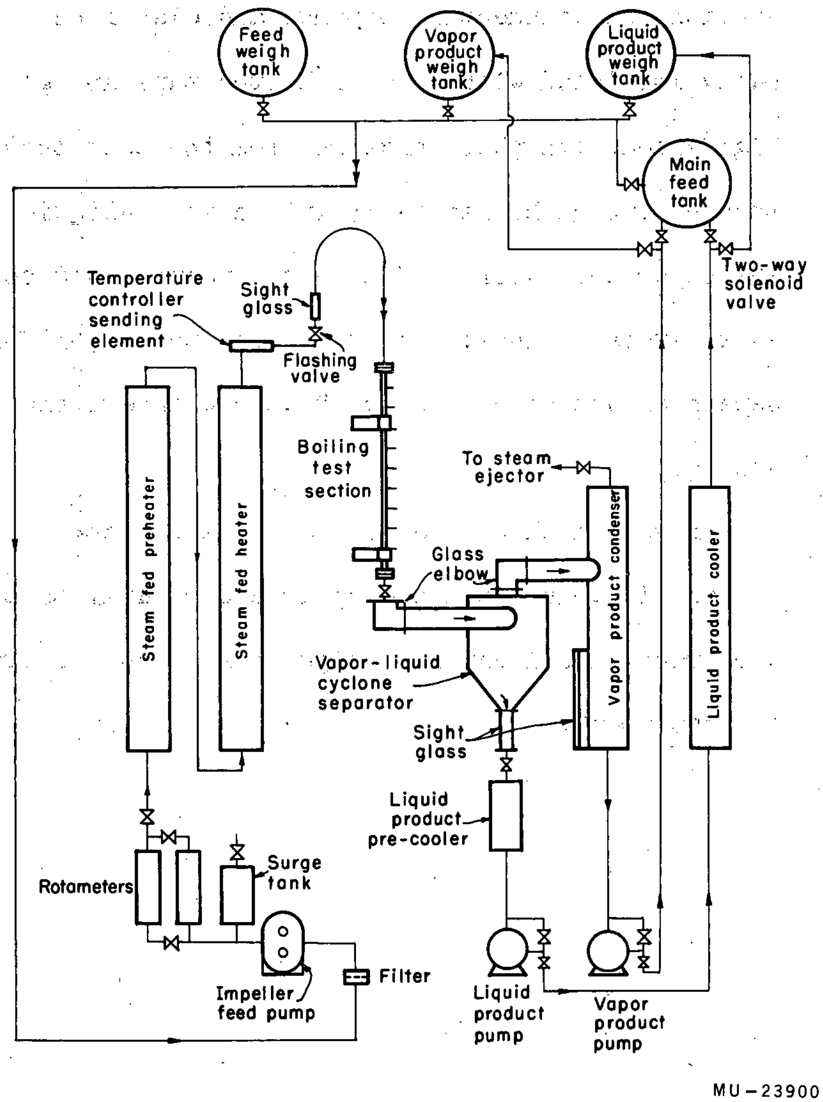

Fig. 1. Schematic diagram of the flow system.

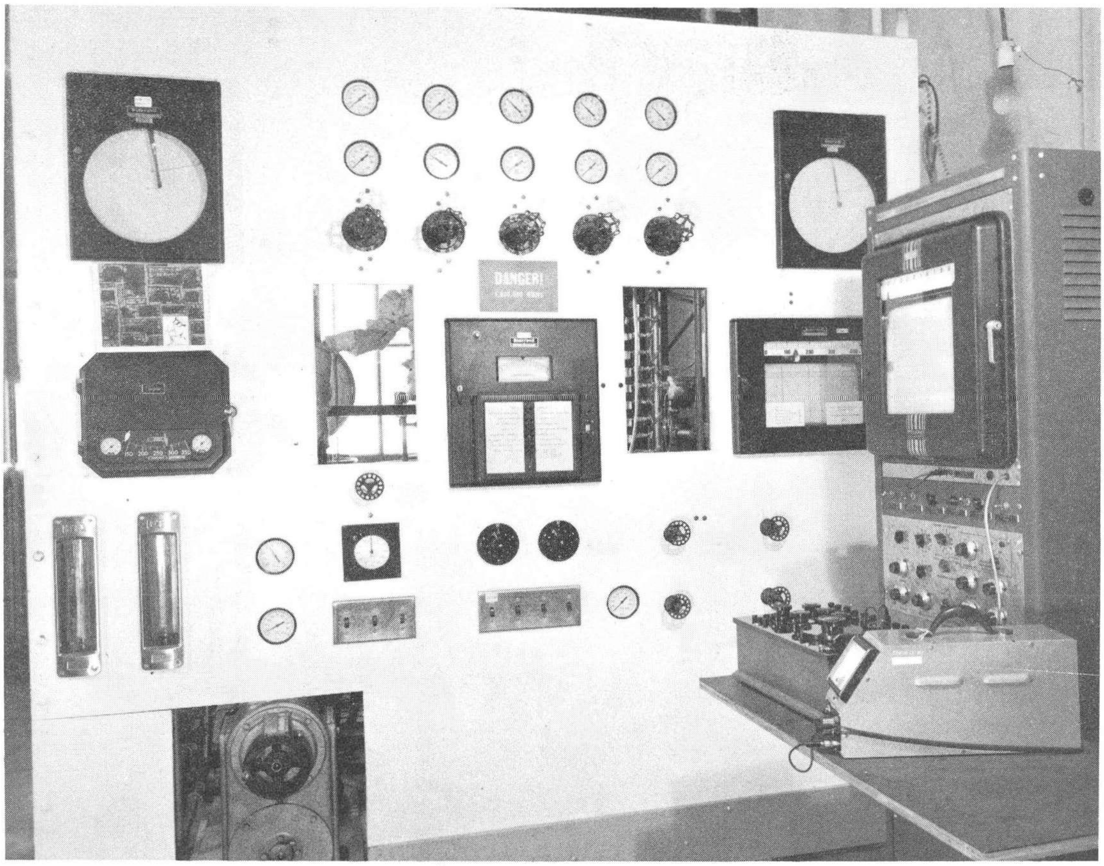

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Fig. 2. Flow-system control panel and data-collection instruments.

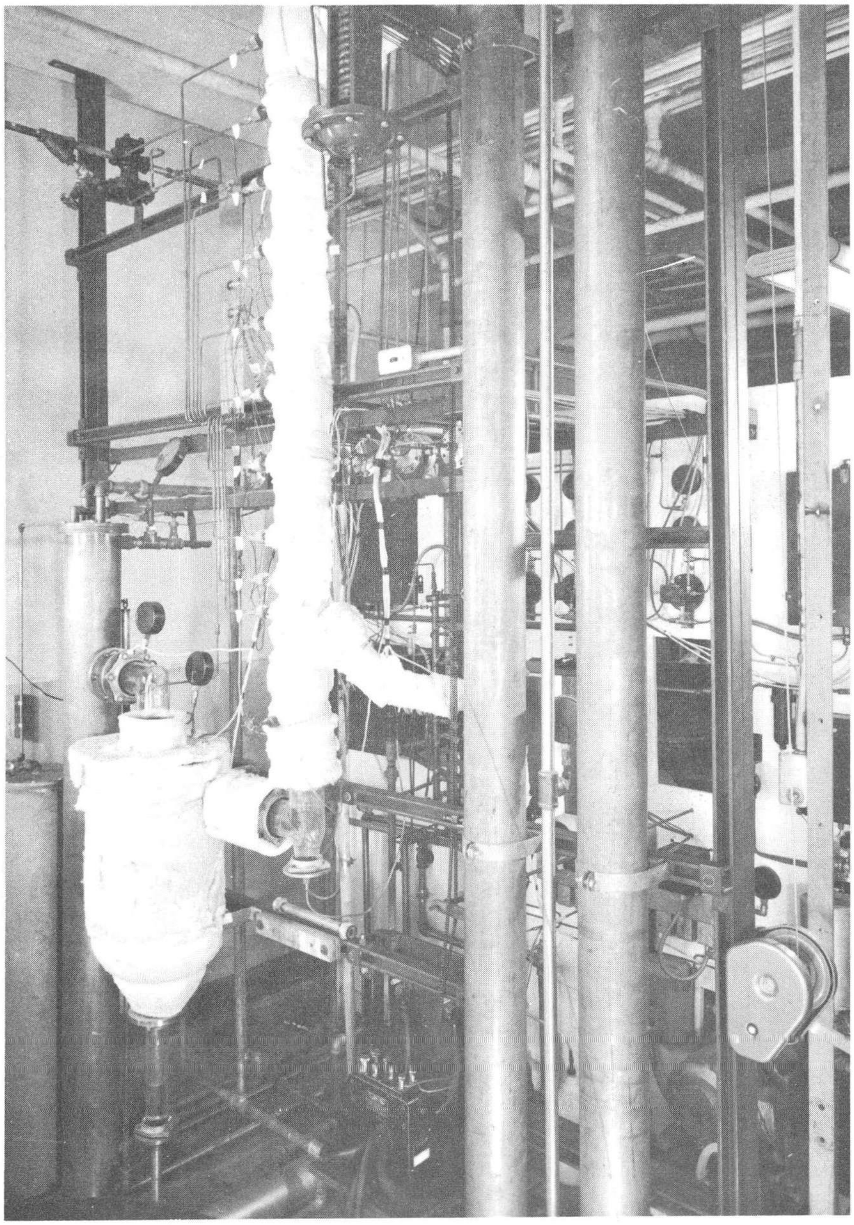

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Fig. 3. Flow-system equipment.

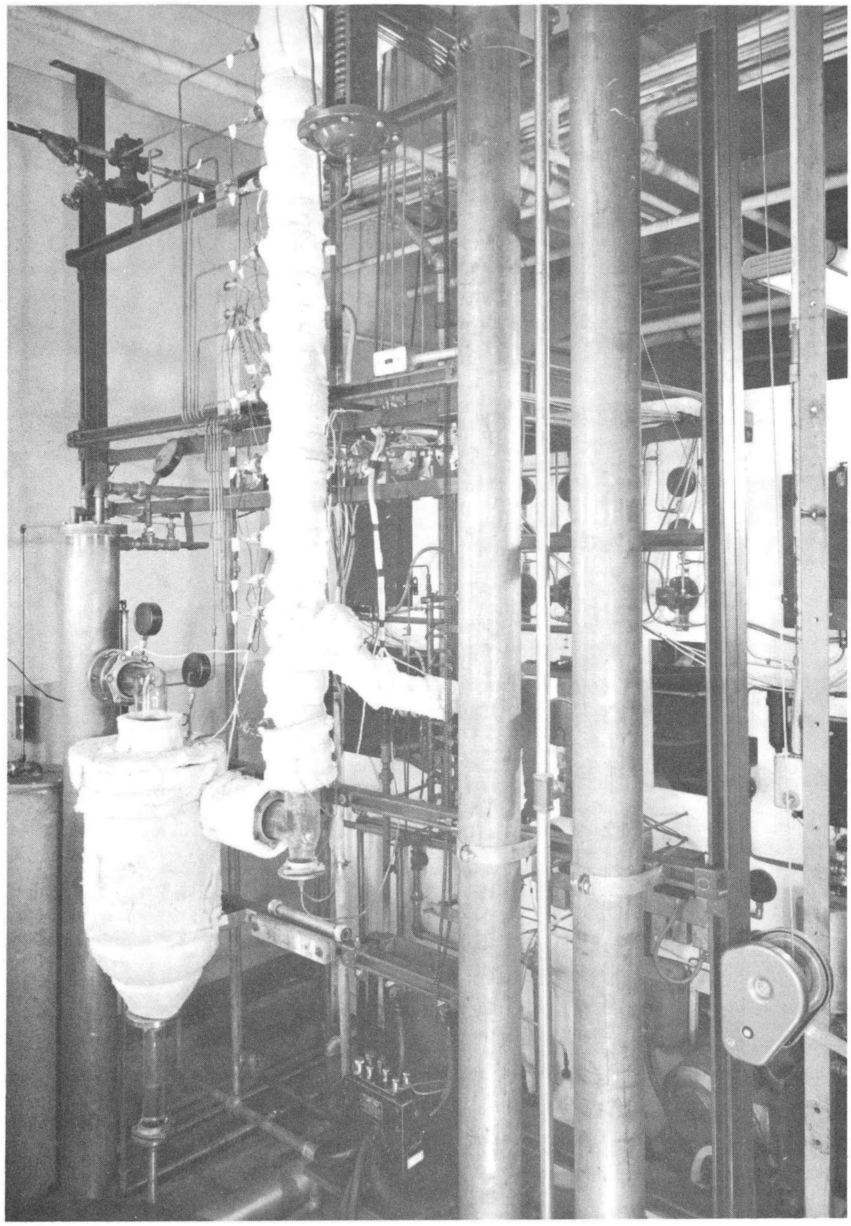

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Fig. 3. Flow-system equipment. Right to left: the two steam-fed heaters, the insulated test section, the vapor-liquid separator, the condenser, and the liquid-product cooler.

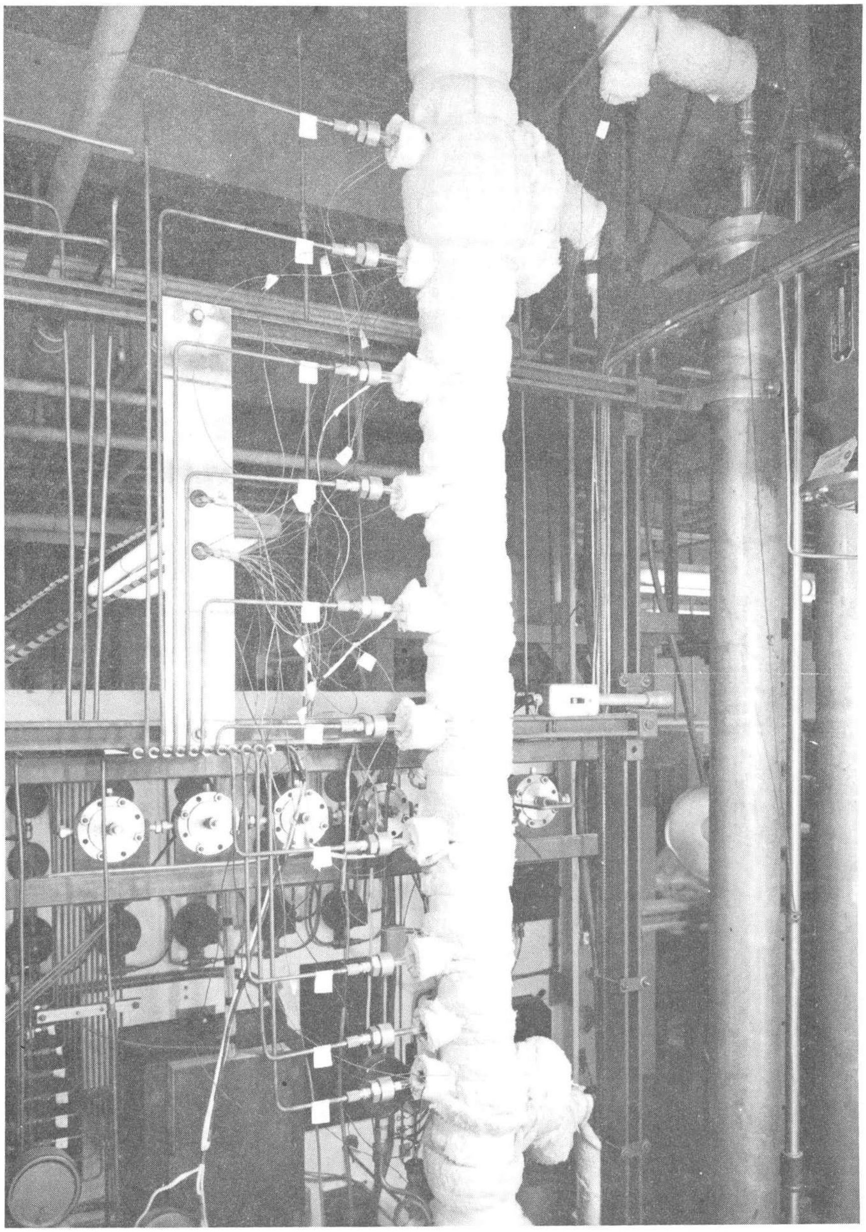

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Fig. 4. The insulated test section No. 2 showing pressure-tap connecting tubes.

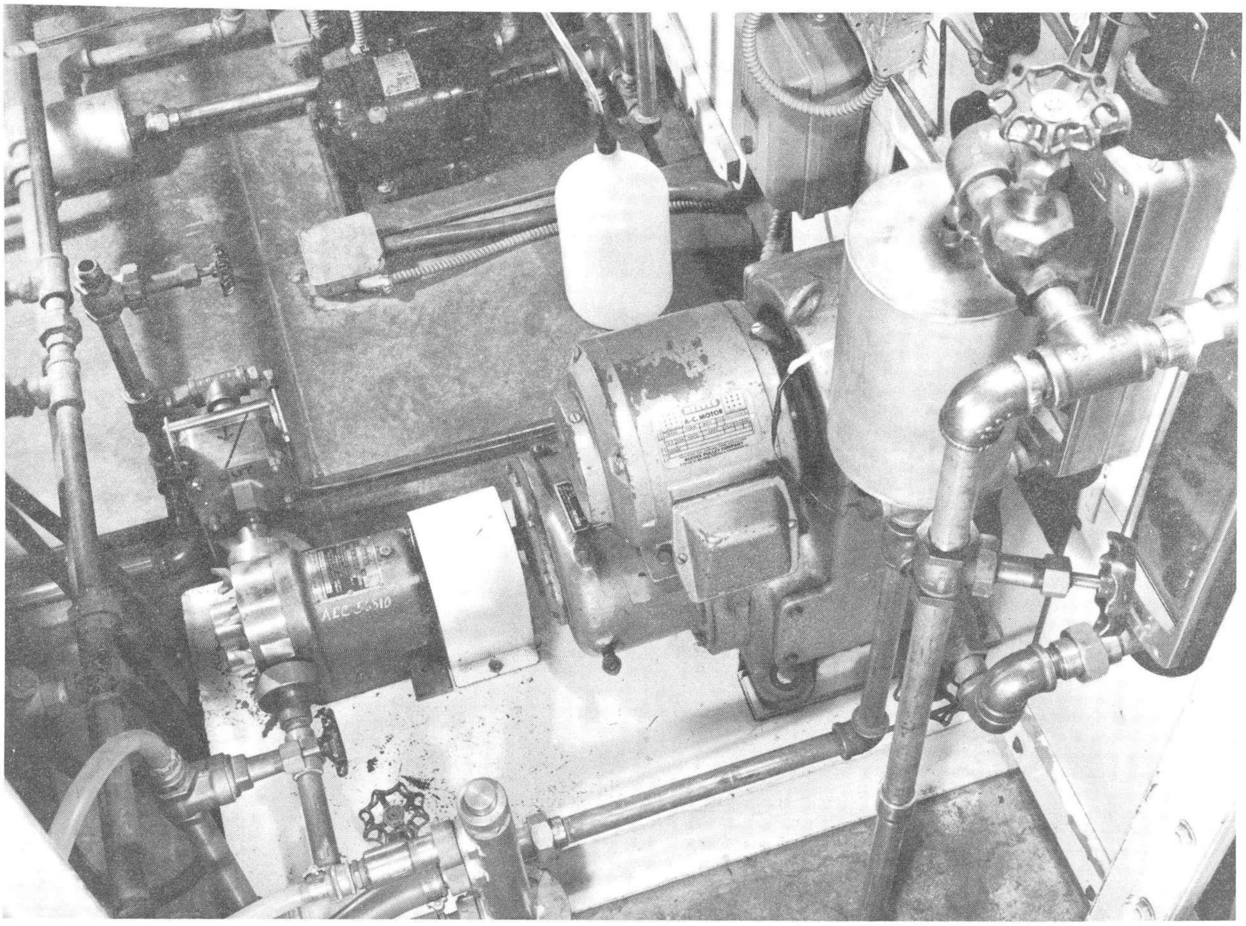

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Fig. 5. Pumping machinery.

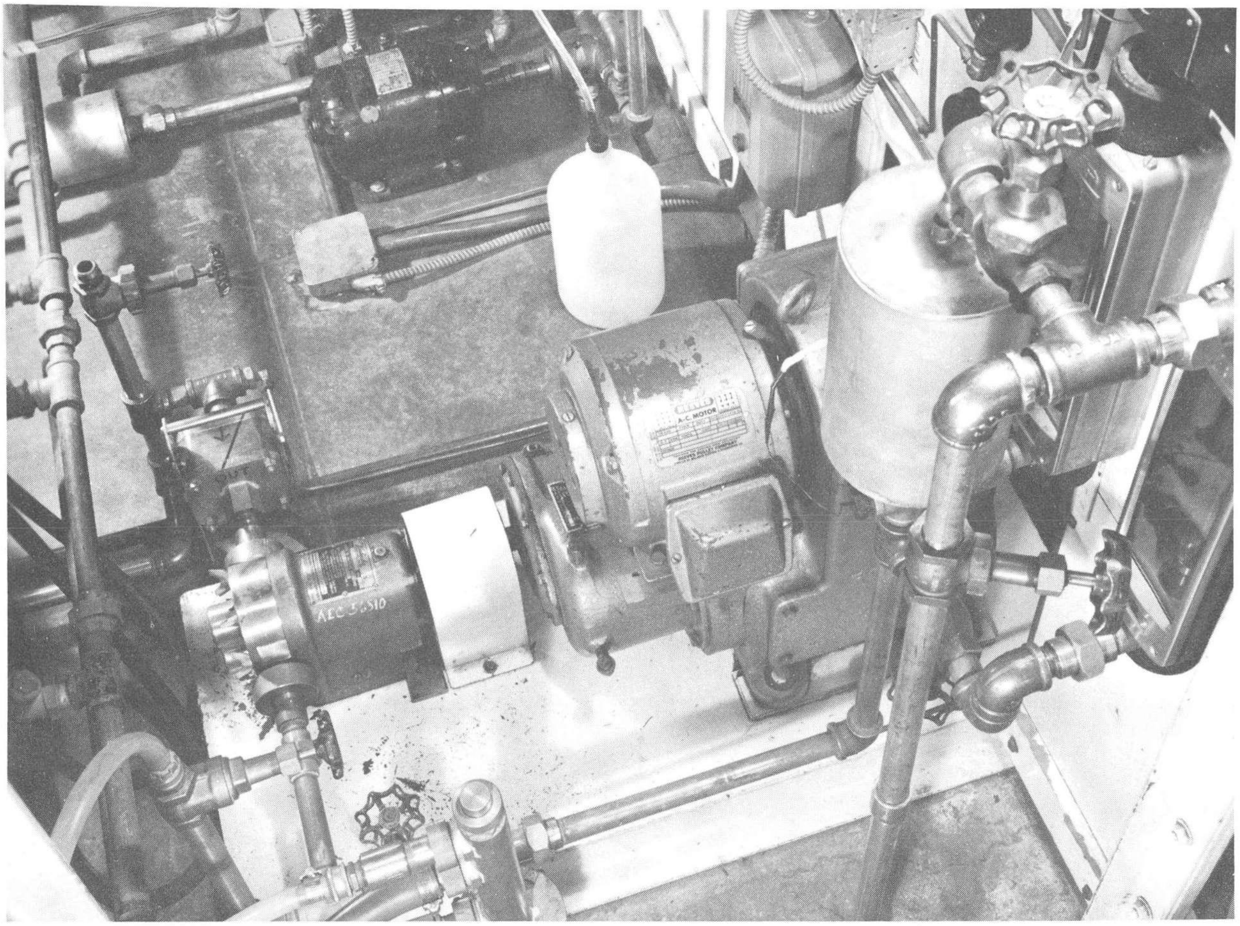

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Fig. 5. Pumping machinery; the feed pump is in the left foreground.

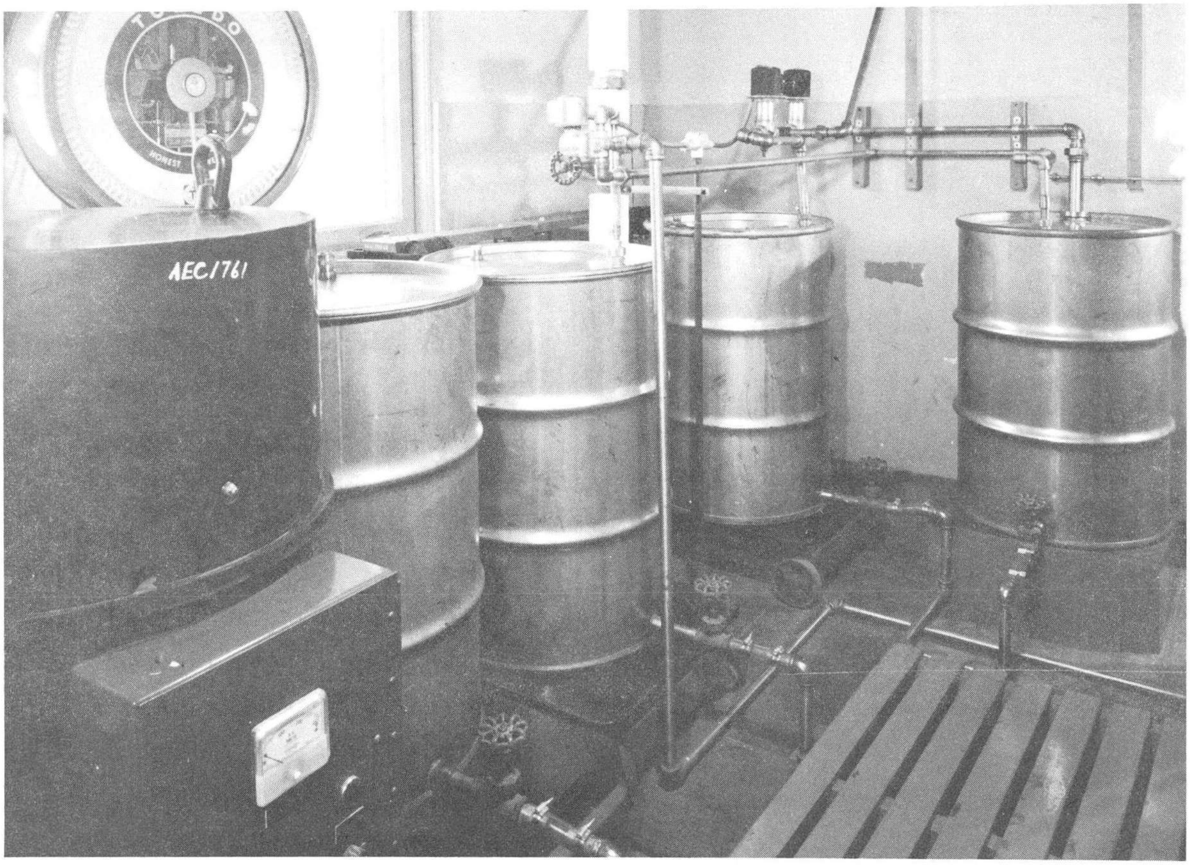

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Fig. 6. Storage barrels and the induction regulator.

B. Flow-System Equipment

The storage system consisted of four 55-gallon stainless steel barrels. Three of these barrels were mounted on platform scales, while the fourth was mounted on a fixed stand. The auxiliary feed weight tank was mounted on a 1000-lbm Toledo dial scale which had a guaranteed accuracy to within 0.5 lbm. It was used for rotameter calibration, for checks on the other two scales, and optionally, for feed-rate determination. The vapor-product weight tank and the liquid-product weight tank were each mounted on 1000-lbm Detecto beam balances. The main feed tank was mounted on the stationary platform.

Each barrel was connected to the feed-pump manifold system by silver soldering a 3/4 in. stainless steel pipe coupling to the barrel side just above its lower rim. A hole was cut through the barrel side and a 3/4 in. globe valve attached to the coupling. Each globe valve was then attached to the feed manifold by about a 4-in. length of 1-1/4-in.-o.d. tygon tubing. This type of flexible coupling disturbed the scale readings by less than the stated accuracy of the scale. The feed manifold and all other piping were constructed with 3/4-in. 304 stainless steel pipe and fittings.

By means of a two-way solenoid valve mounted on the piping system above the vapor-product weigh tank, the condensed vapor product (pumped from the condenser) was directed either into the vapor-product barrel or into the main feed tank. Both connections were made through the barrel tops; the connection to the vapor-product weigh tank was made with a length of tygon tubing to permit accurate weighing, while the connection to the main feed barrel was with rigid stainless steel piping. By a similar arrangement, the cooled liquid product could be directed into the liquid-product weigh tank or the main feed tank.

A filter was connected between the feed-pump inlet and the feed manifold. The filtering element consisted of a 3-1/4 in.-diam. piece of fine-mesh stainless steel screen held tightly in place within the filter body. The feed pump was a Waukesha 10 DO stainless steel sanitary impeller pump. At 700 rpm it was rated at 3750 lbm/hr of water at a discharge pressure of 60 psig and 5000 lbm/hr at zero discharge pressure. It was driven by a 1 hp Reeves Vari-Speed Motodrive (No. 3201-C-18)--a variable-speed pulley drive with a range of 148 to 885 rpm. In order to smooth out small fluctuations in the flow rate, a surge tank was connected to the outlet line of the pump. This surge tank was constructed of brass tubing 6 in. in diameter and 10 in. high; in operation, trapped air occupied approximately one-half of the tank volume. Two Fischer and Porter Flowrators (rotameters) were mounted on the control panel for flow-rate measurement. They were connected so that either one could be used, or both could be used in parallel. Each was rated at 5.7 gal/min of water, and were previously calibrated by use of the auxiliary feed-weigh tank and the Toledo scale.

Feed water, normally at or slightly above room temperature, was heated by pumping it through two steam-fed heaters in series. The steam shells of these vertically mounted heaters were made from 5-in.-diam. brass tubes, each about 11 ft. high. The warming feed water was contained in tube bundles within each shell. The bundles were composed of four 1/2-in., 16-gauge, copper tubes, 10 ft. long. The steam entered the top of the shells and was controlled by 3/4-in., 150 psig, Spence reducing valves with remote-control pilot valves which were mounted on the control panel. Crane 1/2-in. inverted-bucket steam traps were connected to the bottom of the shells. The feed temperature at the outlet of the second heater was controlled by means of a Taylor indicating temperature-controller (Model 162 RM 123) with proportional and reset modes. This controller actuated a Taylor pneumatic diaphragm valve (Model 4VQ255) located in the heater steam line, downstream from the Spence reducing valve. The outlet temperature sensing was accomplished by a mercury-bulb thermometer (in a stainless steel case) which was entirely immersed in the flow stream. The controlled range of this instrument was 150 to 350°F.

The flashing valve, whose function was described in the first paragraph of this chapter, was mounted in the vertical piping above the second heater (about 18 in. below the laboratory ceiling). The valve itself was a standard 3/4-in. needle-type globe valve. Immediately above the flashing valve, in a specially constructed support, a 3-in. length of Pyrex high-pressure glass tubing served as a sight glass. The tube was 1 in. in diameter, and had a wall thickness of 1/8-in. A U-tube, made from 7/8-in. copper tubing, was connected to the sight glass outlet and served to direct the flow stream downward into the boiling test section.

The test section and the method of connection to it are described in the next section of this chapter.

The connecting piping at the bottom of the test section introduced the high-speed, two-phase flow mixture into a 3-in. Pyrex glass pipe elbow. The elbow functioned as a sight glass besides its main purpose of conducting the flow horizontally into the vapor-liquid cyclone separator. In addition, by means of an outlet at the bottom of the elbow (which actually made the elbow into a glass pipe T), the test section could be cleaned with a long brush or inspected with a borescope. In operation, this opening was closed and served as support for a thermocouple probe. The separator was made entirely of stainless steel. It was approximately 12 in. in diameter and its over-all length was about 27 in. Figure 7 schematically shows the test section connecting piping and the vapor-liquid separator. From published investigations using cyclones for vapor-liquid separation, it was noticed there is one drawback to this design which is not experienced in gas-solid (dust) separations.[22,23,24,25] This drawback is due to inward radial velocity components near the top of the separator body. Since liquid droplets adhere to the separator top, the inward velocity components tend to move liquid to the center of the cyclone. Such droplets creeping inwardly along the top of the separator meet the tube that forms the vapor-outlet duct. Then under the influence of gravity, they run down the side of this duct, and at its lower lip (where the vapor velocity is rather large) the drops are easily entrained in the vapor and removed from the separator. In order to prevent this phenomena, a water-tight trough was constructed around the

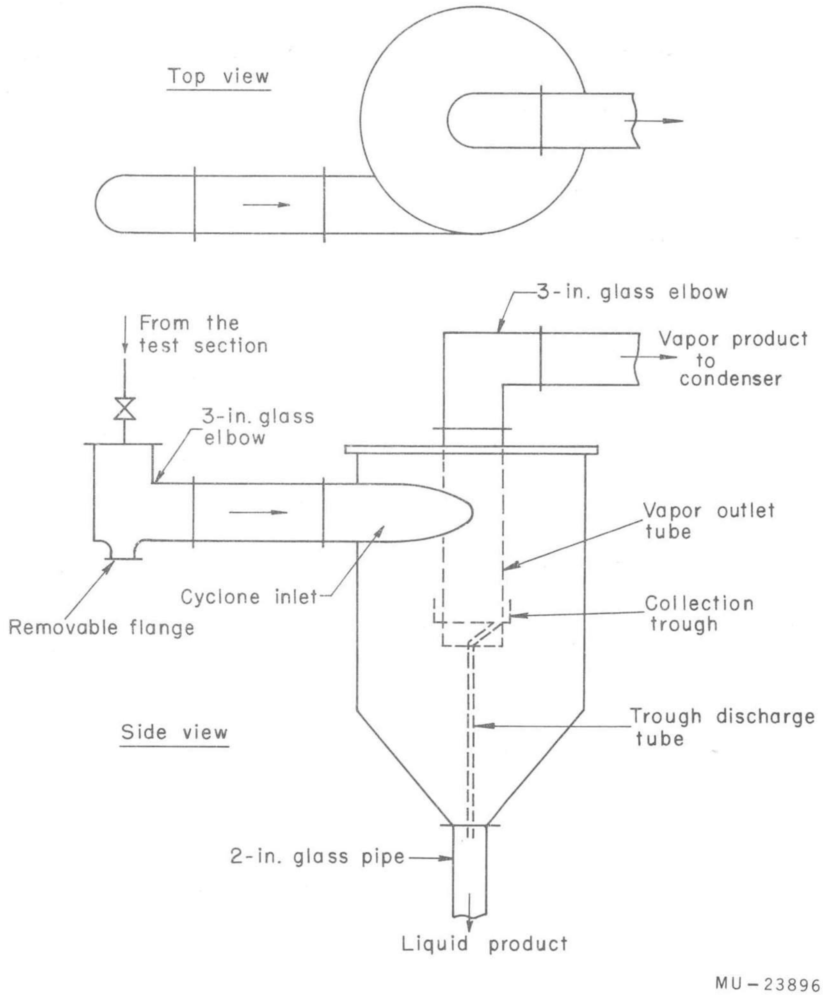

Fig. 7. Schematic diagram of the lower connecting piping to the test section and the vapor-liquid separator.

outside and near the lower end of the vapor-outlet tube. A 3/8-in. stainless steel tube removed liquid collecting in this trough and discharged it at the cyclone liquid outlet. In order to test the cyclone, a soluble salt was dissolved in the feed water, and a portion of the liquid vaporized in the test section. Tests for the salt in the condensed vapor product were negative. Additionally, another 3-in. Pyrex pipe elbow was connected to the vapor-outlet tube. No entrainment during any of the runs was noticed. However, a small amount of liquid which condensed in the glass elbow was infrequently noticed dripping back into the separator body.

The vapor product from the separator was condensed in a vertical shell-and-tube condenser-subcooler. The shell was made from 6-in. brass tubing and contained twelve 1-in. 16-gauge copper tubes, each 6 ft. long. The tubes were arranged to provide two tube passes for cooling water--down through six tubes, up through the other six. Since it was desired to cool the condensate as much as possible, the liquid level was maintained about 12 in. above the condenser outlet by using a sight glass outside the condenser shell. At the top of the condenser were connections for venting to the atmosphere or to a steam ejector. The liquid product from the separator flowed by gravity into a 12-in. length of 2-in. Pyrex glass pipe. In order to prevent vapor removal at this point, a visible liquid level in the glass pipe was necessary. This was most easily maintained by adjustment of a globe valve immediately below the glass pipe.

The liquid was then cooled in a small shell-and-tube precooler (in order to prevent cavitation in the pump) and pumped through the main cooler. Cooling was accomplished in the latter cooler in a coiled 50-ft. length of 1-in. copper tubing. Cooling water flowed outside this coil and within a 7-in. brass shell. Both product streams were then pumped to their respective solenoid-valve systems and to storage tanks.

Both liquid- and condensed-vapor-product pumps were Jabsco rubber-impeller pumps driven at 1750 rpm. The liquid-product pump was a 1-in. bronze model (No. 777), and the vapor-product pump was a 1/2-in. bronze model (No. 1673). Each pump was connected with a valved outlet-to-inlet bypass line which was used for gross flow-rate adjustment, and secondly, a needle globe valve on the outlet piping for fine flow-rate adjustment.

C. Boiling Test Sections

Each of the two test sections used in this experiment were made from thin-walled stainless steel tubing. Test section No. 1 was made from type-304 stainless tubing, nominally 0.75-in. o.d. and 0.016 in. wall thickness. Its heated length was 68 in. Test section No. 2 was made from type 321 stainless tubing, nominally 0.50-in. o.d. and with 0.016-in.-thick-wall. Its heated length was 56-5/16 in. Figure 8 schematically shows the test sections with their actual measurements. Each test section (about 6 ft. long) was cut from the middle of a 10-ft. piece of tubing. Small samples, from the unused portions at each end of the tubing, were mounted in bakelite and lucite in the same manner that metallurgical specimens are mounted for microscopic analysis. Each sample was carefully sanded and polished, and then, by means of a microscope with a

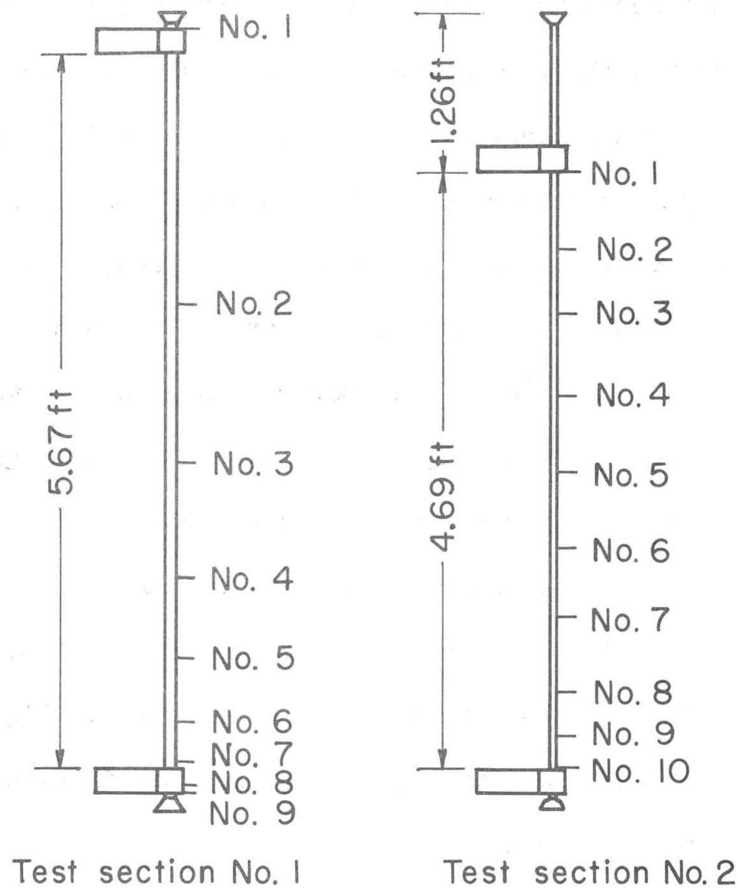

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FIG. 8 TEST SECTION DIMENSIONS AND PRESSURE TAP LOCATIONS

	Test Section No. 1	Test Section No. 2
Outside diameter (in.)	0.7502	0.5036
Inside diameter (in.)	0.7194	0.4716
Wall Thickness (in.)	0.0154	0.0160
Heat Transfer Area (ft^2)	1.07	0.58
Distance in feet from the entrance of the heated section to the pressure tap		
No. 1	- 0.17	0.0
No. 2	1.97	0.58
No. 3	3.19	1.17
No. 4	4.10	1.75
No. 5	4.77	2.33
No. 6	5.28	2.91
No. 7	5.62	3.49
No. 8	5.78	4.08
No. 9	5.84	4.44
No. 10	----	4.69

calibrated eye piece, the wall thickness was measured. These measurements were made at some eight to twelve equally spaced points around the circumference of the sample. The arithmetic average of all measurements was accepted as the value for the wall thickness. From one sample to another, a deviation of as much as 14% was noticed. The deviation in any one sample was always less than 10%. The outside diameter of a test section was determined by direct measurement (with micrometers) about every two inches along the heated section length. The arithmetic average of such measurements was accepted as the value for the outside diameter. The maximum deviation in these measurements was less than 1%. The inside diameter was measured indirectly by subtraction using the wall thickness and the outside diameter. Figure 9 shows test section No. 1 and two specimens, mounted in bakelite, for wall-thickness measurement.

Electrical connection to the test section was by two copper bus bars which were machined to fit tightly around the test section and then silver-soldered to it. The bus bars were large enough to insure a uniform current density at the two ends of the heated portion of the tube. Tri-Clover conical fittings were used to connect the test section to the inlet and outlet piping, while keeping the tube electrically isolated from this piping. Figures 10 and 11 show the conical end connections and bus-bar installation.

Pressure taps were constructed by first boring a 0.040-in. hole (No. 60 drill size) in the test section tube, and then care-

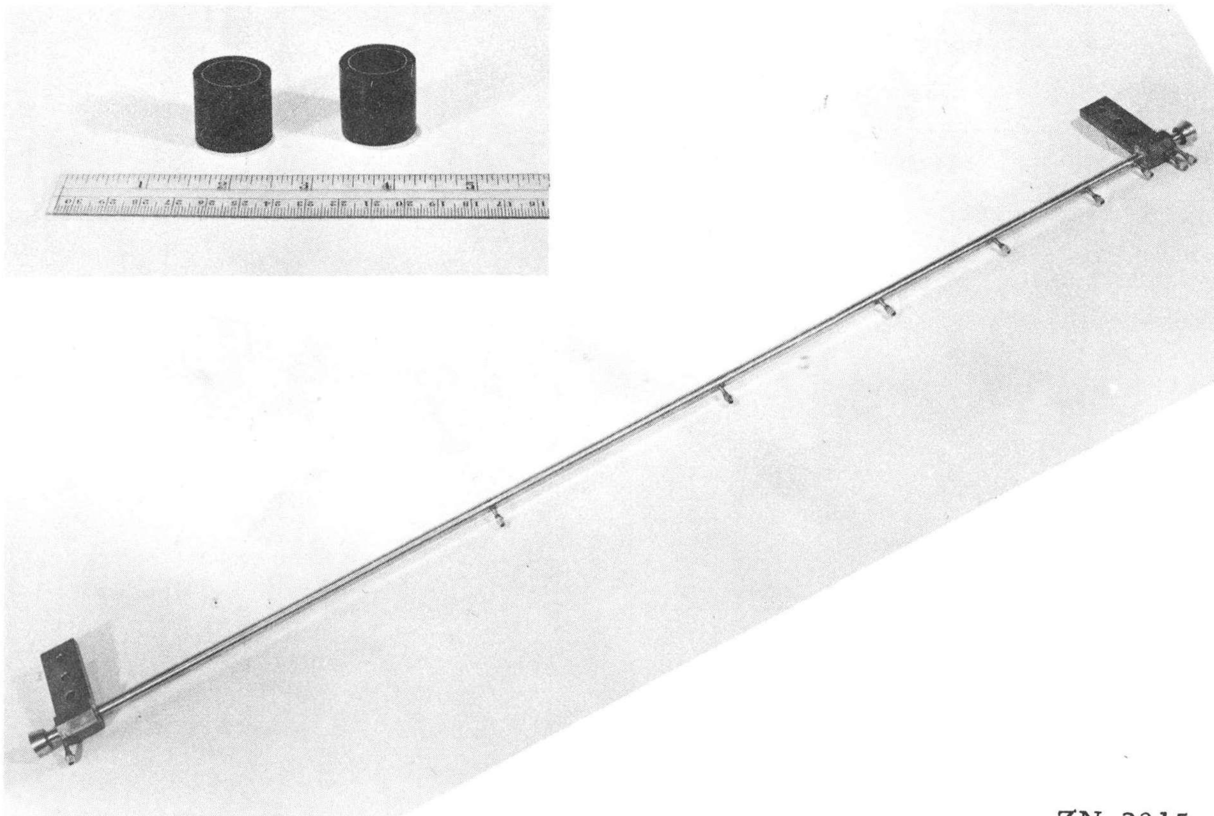

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Fig. 9. Test section No. 1 with two specimens mounted in Bakelite for microscopic wall-thickness measurement.

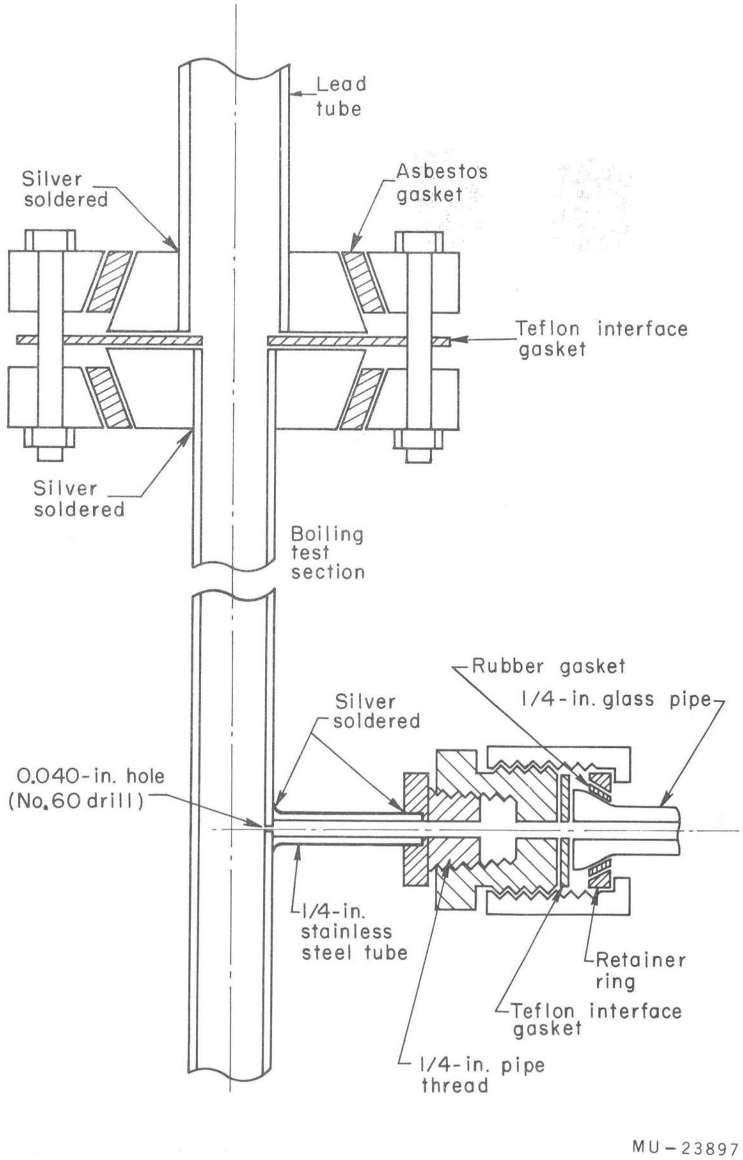

Fig. 10. Test-section end-connection and pressure-tap connection.

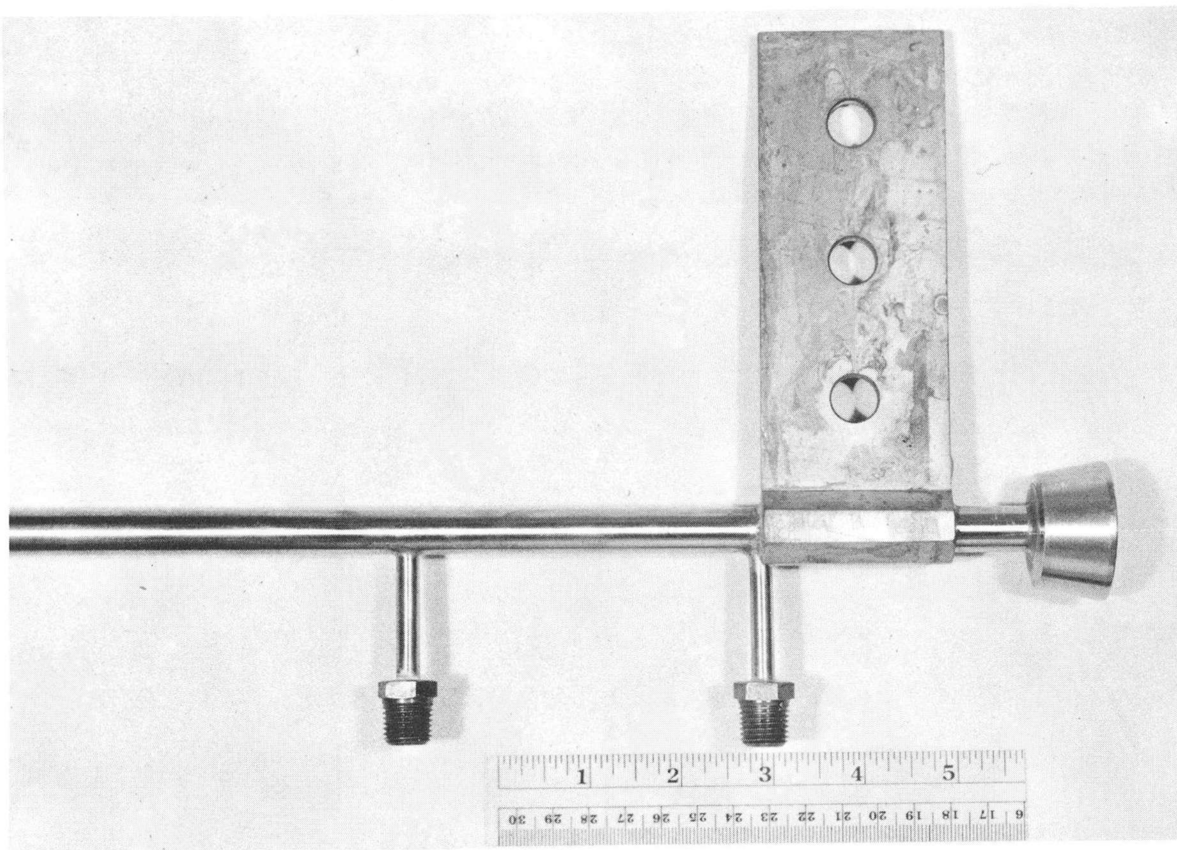

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Fig. 11. Lower end of test section No. 2 showing the conical end fitting, bus-bar installation, and pressure-tap installation.

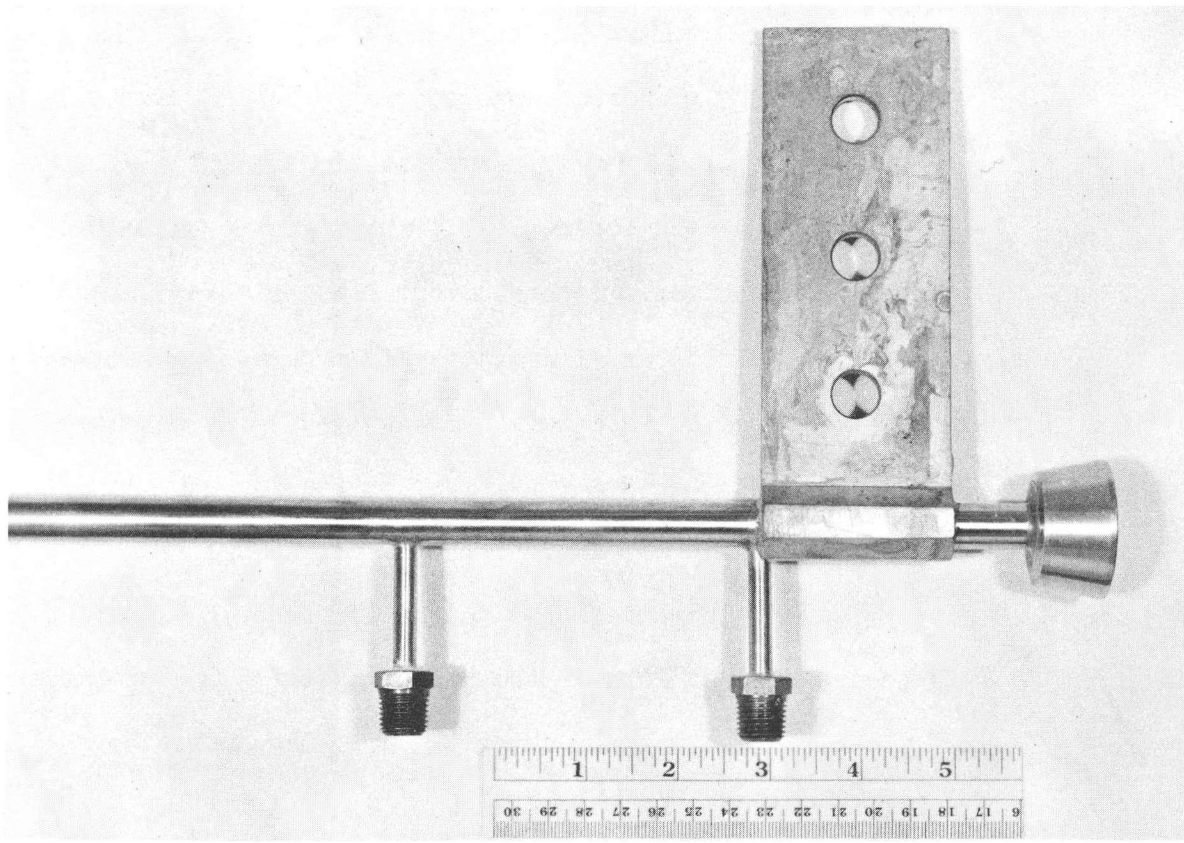

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Fig. 11. Test-section end construction.

fully silver-soldering a short length of 1/4-in. stainless steel tubing to the wall. By means of Fischer and Porter 1/4-in. glass pipe and fittings, pressure taps were connected to the 1/4-in. copper tubing from the pressure measuring system. The glass pipes served as sight glasses to insure that pressure-tap lines contained no entrapped air, and also served to electrically isolate the test section. Figure 10 schematically shows the pressure-tap construction and connection. Before a test section was mounted, it was carefully cleaned, and inspected with a borescope. If any of the pressure-tap holes were burred or plugged, they were carefully sanded with fine grit emergy paper or steel wool. At some of the pressure taps, it was noticed that a very small ridge had formed at the rim of the hole. The height of such ridges was estimated to be less than 1/20th of the hole diameter. The probable cause of these ridges is that during the drilling operation the last portion of the metal to be cut by the drill bit was, instead, actually bent inward. In such cases, sanding was continued until the tube wall was satisfactorily smooth.

It was necessary to obtain fully-developed fluid dynamic conditions at the entrance of the heated portion of the test section. A length of unobstructed straight pipe equal to 20 pipe diameters was assumed sufficient for this purpose. With test section No. 1, the fluid-dynamic entrance section was formed by reaming out the connecting piping above the test-section inlet. However, since test section No. 2 was of smaller diameter, the upper bus bar was located some 15 in. below the tube inlet. The entrance length was then formed by the test section itself.

Twelve to 18 copper-constantan thermocouples were soft-soldered to the outside wall of the test section. The thermocouple junctions were formed by tightly twisting the cleaned ends of the 24-gauge duplex wires, then cutting away any unneeded wire, and finally soldering to the tube. Care was taken to obtain good contact with the stainless tube and to keep the twisted-wire junction and the bulb of solder as small as possible. To diminish longitudinal heat conduction from the thermocouple junction, the thermocouple wires were wrapped around the tube three or four times before leading them to the measuring circuit. These wrappings were then taped to the tube wall with Scotch-brand, pressure-sensitive, high-temperature, glass tape. Near the entrance to the heated portion of the tube, the thermocouples were closely spaced in order to gather data on the <u>thermal</u> entrance conditions associated with forced-convection boiling. Down the rest of the tube length, thermocouples were evenly spaced about 6-in. apart, except where the proximity of a pressure tap might give spurious values. In all cases the thermocouple was positioned on the opposite side of the tube from the pressure taps.

The test section, its connecting piping (especially the inlet piping upstream to the flashing valve), and the electrical cables attached to the bus bars were thermally insulated. The insulation consisted of two or three wrappings of 2-in. Johns-Mansville asbestos woven tape and several layers of glass wool. The total thickness of insulation varied from 4 to 7 in. The vapor-liquid separator was also insulated with glass wool.

In order to prevent sagging or buckling during operation, the test section was maintained in tension. The connecting piping below the test-section outlet was firmly anchored to the equipment framework, while the upper connecting piping was relatively free to move. A vertical upward force was maintained on this upper piping by a wire-rope, pulley, and winch arrangement.

D. Electrical Power Supply

Electrical current was supplied to the test section from an air-cooled stepdown transformer. With a primary voltage of 230v at 150 amp, its rated output was 40v and 875 amp. The primary voltage was regulated by a motor-driven General Electric induction regulator operating on 60-cycle, 220-v current. It was rated at 25 kva. However, the power factor of each of the two transformers was about 0.80, and thus the maximum power at the test section was only about 15kw. With test section No. 1, the maximum observed readings were 29.45v and 506.4 amp. The resistance of the test section was approximately 0.058 ohm. With test section No. 2, the maximum readings were 33.3 v and 453.9 amp; and approximate resistance of 0.073 ohm. One side of the transformer secondary was grounded by connecting a metal strap from the bottom of the test section to the equipment framework. Figure 12 schematically shows the test-section power supply.

E. Instrumentation

1. Temperature Measurement

Two thermocouple systems were used in the experiment. Iron-constantan thermocouples were used in the operation of the equip-

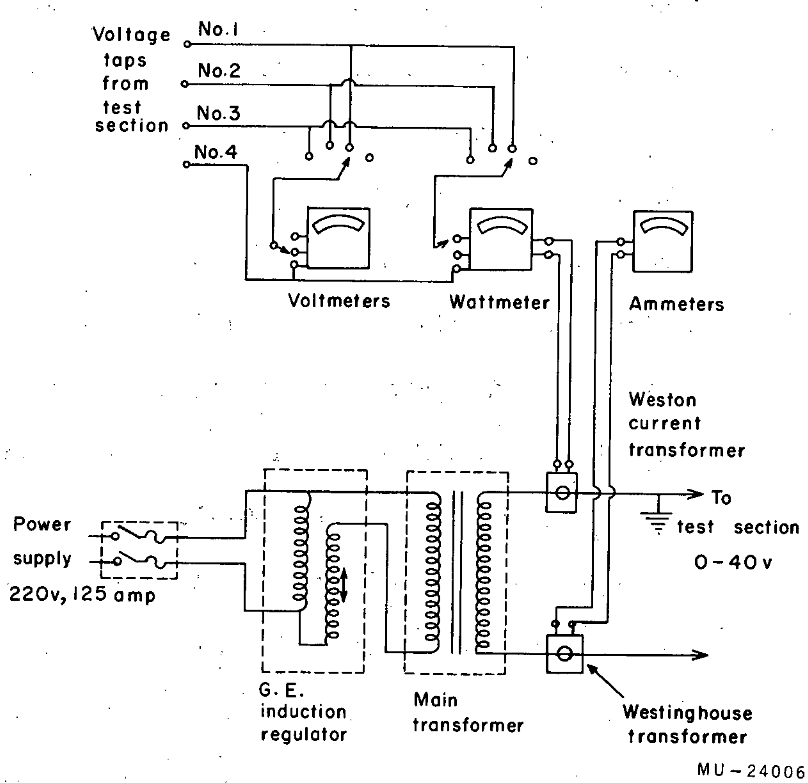

Fig. 12. Power-measuring circuit and the test-section power supply.

ment, while copper-constantan thermocouples were employed for the collection of data. The first set of couples were silver-soldered into stainless steel wells at several points in the flow system. To reduce the effect of heat conduction from the thermocouple junctions, each well was immersed at least 3 in. in the flow stream. The leads from these thermocouples were connected to terminal strips in an insulated junction box. In order to eliminate temperature gradients across the terminal strips, the junction box was fitted with a copper door and back. From the terminal strips, the thermocouple leads were connected to an 18-point Minneapolis-Honeywell-Brown temperature indicator (Model 156-X-G2-P18). The capacity of the instrument was extended by connecting a pair of Leeds and Northrup rotary 12-point thermocouple switches to two of the 18 points. Six key thermocouples were continuously monitored by a 6-point Minneapolis-Honeywell-Brown temperature recorder (Model 156-X-G2-PG-X-23). These six thermocouple readings were used in the determination of steady-state conditions and for the detection of any operational upset. The range of both the Brown instruments was 0 to 400°F; the stated accuracy was 0.2% of full span.

The second set of thermocouples (copper-constantan) consisted of up to 18 couples soldered to the test section and four couples immersed in the flow stream. The couples in the flow stream were installed in stainless steel wells similar to those used for the iron-constantan couples. One thermocouple was in the flow stream before the flashing valve (at station 1), another was in the inlet piping above the test section, and the final two were located in the outlet piping below the test section. All couples were made from 24-gauge Leeds and Northrup thermocouple wire, insulated with an enamel-glass combination. The thermocouple leads were connected to terminal strips located in a heavy-gauge copper chassis box. This copper chassis, which was located in a relay rack near the control panel, contained most electrical circuitry used in data collection. It contained two independent information channels, each having two inputs. There were three inputs for thermocouple signals and one input for the signal voltage of a pressure transducer. These inputs were controlled by a main selector switch. By use of Leeds and Northrup rotary thermocouple switches, each of the three thermocouple inputs could accommodate 12 pairs of leads. Each input signal could be bucked with a DC voltage (bias voltage) or attenuated by a known percentage (span adjustment). The span was adjusted by use of a 100k Helipot potentiometer (0.1%). Voltage drop across this large resistance was equivalent to a loss of less than 0.1°F at a measured temperature of 350°F (thermocouple voltage of 8.064 mv). A means was provided to switch any bias voltage to channel 1 for measurement; this was also controlled by the main selector switch. Circuitry for the control of the pressure-transducer supply voltage was also contained in the chassis. The chassis box itself was mounted to the relay rack by its nonconducting, fiberboard, front panel. It was thermally insulated with glass wool. The data collection instrumentation and circuit are shown in Figs. 13 and 14.

Each copper-constantan thermocouple was connected to its own cold-junction thermocouple. The cold-junction apparatus consisted of a large Dewar flask for an ice bath, the wooden Dewar top, and several 1/8-in. stainless steel tubes protruding through the top, down into the ice bath. Cold junctions were soldered into the closed stainless tubes and electrically isolated from each other by application of several coats of red Glyptal insulating enamel.

Two types of instruments were used to measure the output thermocouple, pressure transducer, or bias voltages. A 0 to 1-mv, Leeds and Northrup, Speedomax-G recorder (guaranteed accuracy $\pm$ 0.5% of full scale) was used where a continuous trace of the signal was desired, or, for greater accuracy, a precision, Rubicon, laboratory type B potentiometer (with a suitable null detector) was employed. However, when heating current was flowing in the test section, it was impossible with the millivolt recorder to measure the output voltages from the copper-constantan couples actually soldered to the heated tube. The following explanation is given. It is known that excessive ac voltages across the input terminals of a dc chopper amplifier can completely desensitize it. Secondly, in practice it is quite difficult to satisfactorily isolate such electronic equipment from ground. Therefore, since the thermocouples were in direct contact with an ac voltage at the test section, alternating current flowing down the lead wires apparently desensitized the dc amplifier in the millivolt recorder. However, these thermocouples were satisfactorily read with the Rubicon potentiometer by using a light-beam galvanometer as a

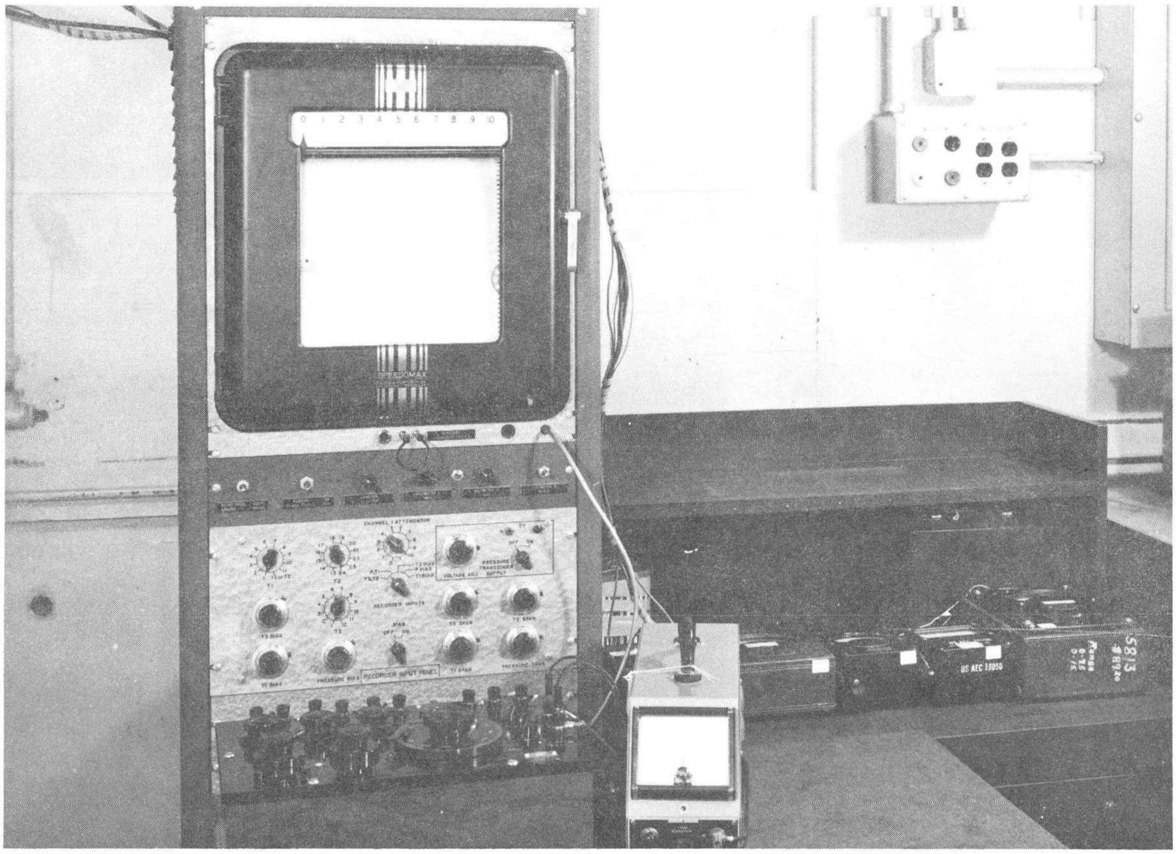

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Fig. 13. Data-collection instrumentation.

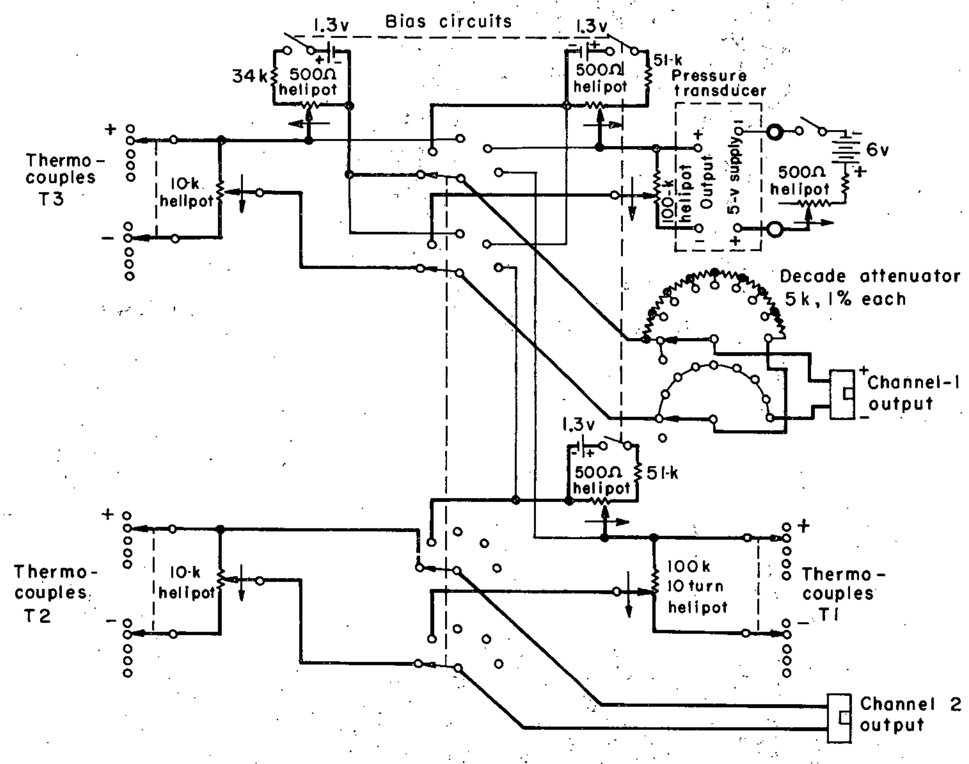

Fig. 14. Data-collection circuitry.

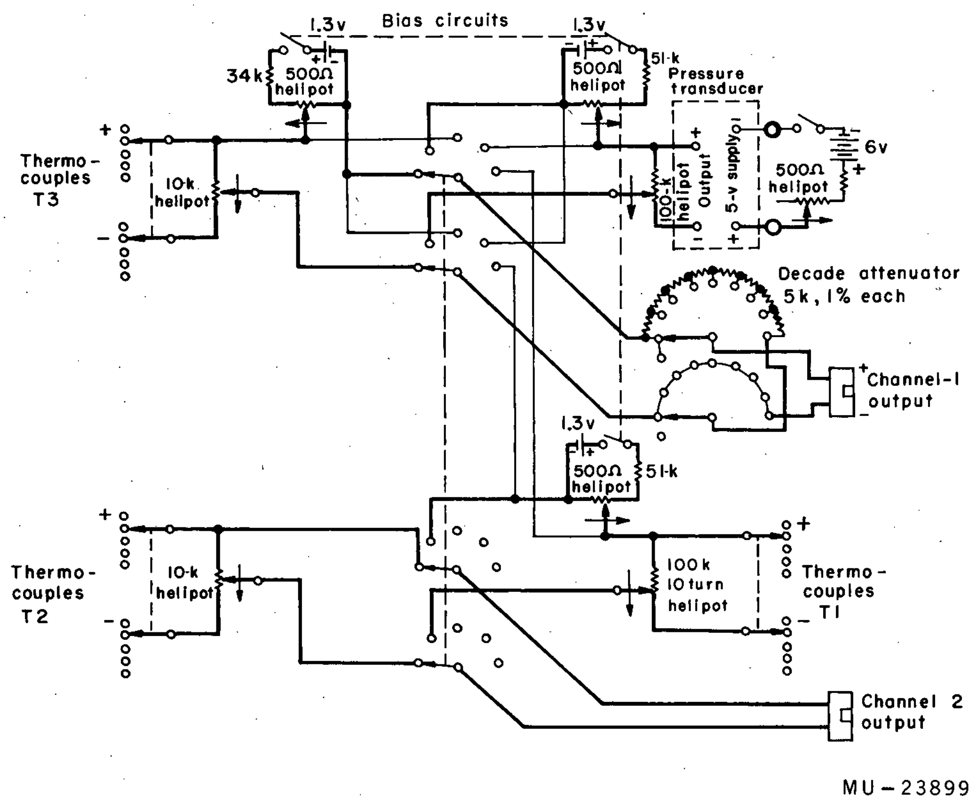

Fig. 14. Data-collection circuit. This circuit was enclosed in a heavy copper chassis box.

null detector. For the first series of runs (up to Run 67.0) this method of measurement was used for thermocouples, while the millivolt recorder (ungrounded) was used for pressure measurements.

The disadvantages of a light-beam galvanometer are well known. For the second set of runs it was decided that a faster, more accurate, null detection device had to be used. A Minneapolis-Honeywell electronic null indicator was chosen (Model 104W1-G). Even though this instrument contained a seemingly adequate filter for ac, its sensitivity, when heating current was flowing in the test section, was no better than 4°F. After consultation with an electrical engineer, a satisfactory external filter was devised. It consisted of a 500-μf low-leakage capacitor across the input terminals of the Rubicon potentiometer, and a 7-μf capacitor from the negative potentiometer input terminal to the ground terminal of the null indicator. The null indicator was operated ungrounded. The 500-μf capacitor served as a short circuit to ac across the potentiometer input terminals. Consequently, the ac voltage difference across these terminals was very small. The function of the other capacitor is more obscure and deals with the internal filter of the null indicator. This arrangement gave a normal sensitivity of about 0.1°F (the rated sensitivity of the null indicator was 0.001 μamp/mm). Thermocouple readings made with the null indicator were compared with those made using the light-beam galvanometer. The comparison was quite good whether heating current was on or not.

The copper-constantan thermocouples were calibrated in place with the heating current off by conducting live steam from one of the heater shells into the closed-off test section. The valve at the bottom of the test section was opened slightly to permit removal of condensate and inerts, with negligible pressure drop down the tube length. After a suitable warm-up period, thermocouple readings were compared with values obtained from pressure measurements (assuming saturated conditions). The agreement was satisfactory (within 0.2°F), and no corrections were made to the published calibration tables. This calibration also helped to establish the adequacy of the test-section thermal insulation. Unfortunately, no workable method was known for thermocouple calibration with heating current on.

Over a period of days as data collection progressed, it was noticed that three or four thermocouples on the test section gave consistently lower readings than the other couples. That is, when thermocouple readings were plotted versus tube length, a smooth line could be drawn through the rest of the thermocouples while these three or four in question fell 2 to 4°F below the curve. These thermocouples were removed from the tube, inspected, and resoldered to the tube in approximately the same location. They still gave lower readings. As no explanation was apparent, in later runs their readings were either not taken or they were ignored.

2. <u>Pressure measurement</u>

A 5/8-in. diaphragm Consolidated Electrodynamics Corporation pressure transducer (Type 4-313A) formed the heart of the pressure-measuring system. The range of the transducer was 0 to 150 psi absolute, and its guaranteed linearity was 0.75% of full scale.

Its rated output was 20 mv with a dc excitation of 5v. Electric current was supplied by a battery of eight 1-1/2-v dry cells delivering approximately 6 v. This 6-v supply was reduced to the required 5 v by a 10-turn 500-ohm Helipot potentiometer. The transducer current was about 14 ma.

Mounted in its adaptor, the transducer was connected to the center of a specially constructed manifold. This manifold was made from a 1-in. brass tube about 30 in. long, and was mounted vertically behind an open window in the control panel. At even intervals, fifteen 1/8-in. Hoke needle valves were silver soldered into the tube wall. The tube ends were sealed, tapped, and also fitted with Hoke valves. The lower valve was connected by small-diameter copper tubing to the feed-pump outlet; the upper valve was connected to the drain. The rest of the manifold valves were connected by 1/4-in. copper tubing directly to pressure taps in the flow system, or to the 1/4-in. glass pipes attached to the test section pressure taps. Two drain tubes were connected to the transducer adaptor. By opening the three drain valves and allowing feed water to flow through the bottom valve, air could be purged from the manifold. In a similar manner, by opening the other manifold valves, the pressure tap lines could also be purged (the purged air and water flowed into the test section). Because the pressure transducer was sensitive to temperature gradients across its case, the transducer, its adaptor, and connecting piping were thermally insulated with glass wool. Cooling coils were soldered to the manifold, and an iron-constantan thermocouple was installed near the transducer connection.* Figure 15 is a schematic diagram of the pressure-measuring system; Figure 16 is a photograph of the transducer manifold.

The transducer was calibrated by a dead-weight gauge tester over the pressure range 14.7 to 94.7 psia. It was mounted permanently in the same adaptor that was to be connected to the manifold. This was done to eliminate changes in the calibration due to different conditions of mounting; the transducer was slightly sensitive to nonuniform stresses over its case. During calibration, the supply voltage was checked many times and adjusted when necessary. The voltage was measured with the precision Rubicon potentiometer. The calibration was made with the same measuring circuitry and equipment used in data collection. Therefore, any small voltage loss occurring in such circuitry would be incorporated in the calibration. The results of three calibration runs were fitted to a straight line by a least-squares technique. The standard deviation was 0.108 psi, which is considerably lower than the guaranteed linearity. It is believed this value could be improved with a more stable transducer power supply.

During actual operation of the equipment, the power supply was standardized in the following manner. The atmospheric pressure was determined from a barometer located behind the control panel.

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* In the first series of runs the cooling coils had not yet been installed. However, an equally effective, although more cumbersome, method of cooling was used. This is described by R. Sani.[21]

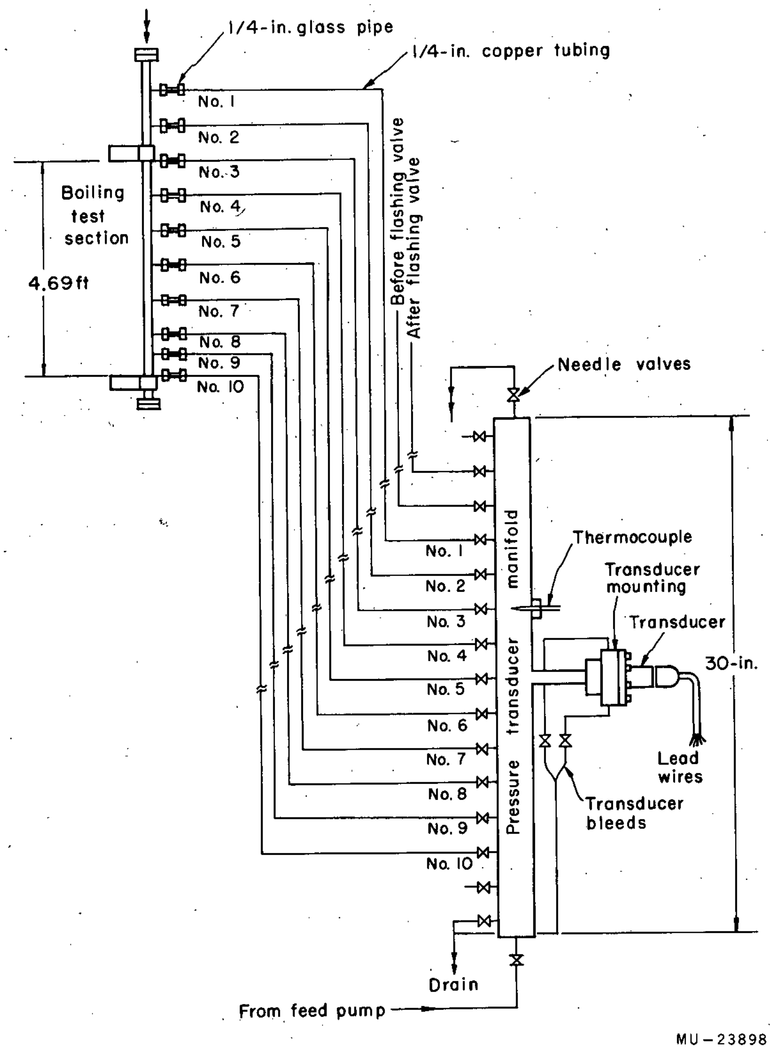

Fig. 15. Schematic diagram of the pressure tap connecting lines and the pressure transducer manifold. Cooling coils around the manifold are not shown.

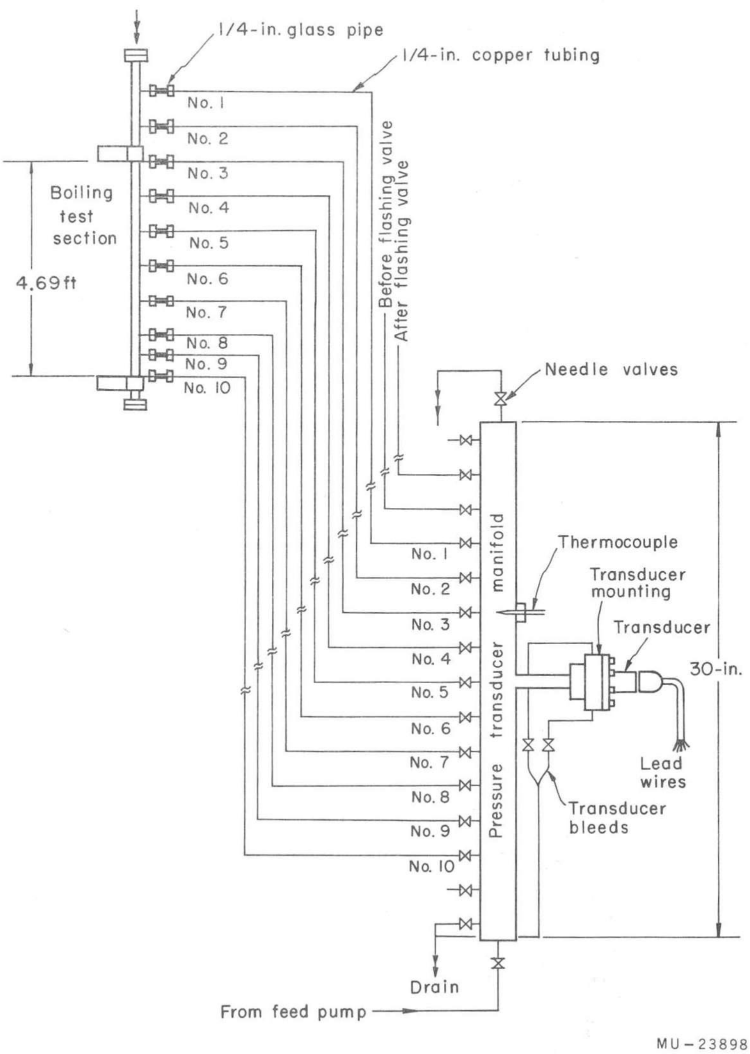

Fig. 15. Schematic diagram of the pressure-tap connecting lines and the pressure-transducer manifold.

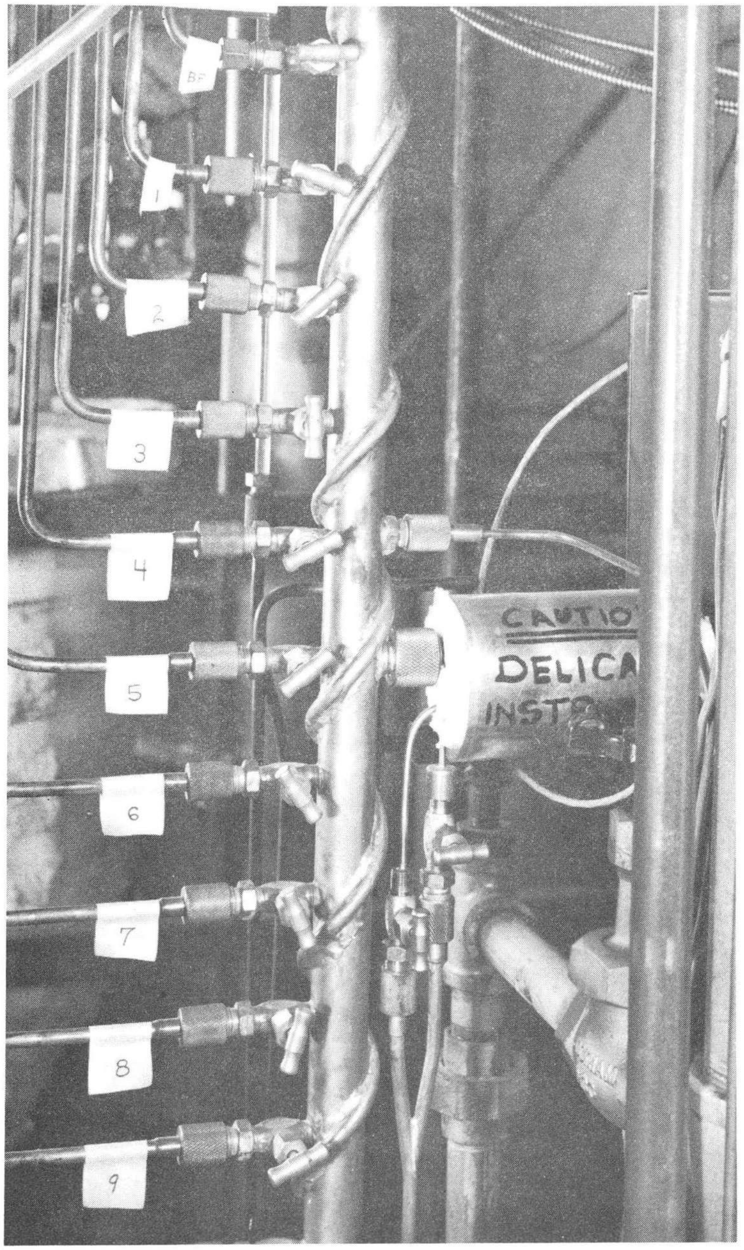

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Fig. 16. Pressure-transducer manifold.

This value was converted to pounds per square inch absolute and entered into the calibration equation (as psia), and the transducer output (mv) was obtained. Then with the transducer manifold drained and open to the atmosphere, the supply voltage was adjusted until the transducer output was equal to the above calculated value of (mv). The Rubicon potentiometer was used for this purpose.

Contributions to the pressure readings due to the hydrostatic head of liquid in the connecting tubing to the transducer manifold are discussed in Chapter IV, Data Reduction.

3. Electric-Power Measurement

Two voltmeters, two ammeters, and a wattmeter were used to measure the electrical quantities necessary to evaluate heat generation in the test section. The meters and individual scales of the meters were controlled by a small switch panel located in the data-collection relay rack.

Voltage tap wires were connected along the length of the test section. The end taps were placed outside the bus bars while the other taps were equally spaced along the heated portion of the tube. Low-resistance lead wire connected the taps to a switching arrangement which allowed measurement between any tap and the bottom (grounded) tap. Two Weston precision ac voltmeters were used. One (Model 341) had voltage scales of 0 to 7.5 v and 0 to 15 v with a calibrated accuracy of 0.25%; the other (Model 433) had scales of 0 to 30 v and 0 to 60 v with 0.75% accuracy

Two Weston precision ac ammeters were used for current measurements. One (Model 433) had two scales: 0 to 2.5 and 0 to 5 amp; the other (Model 155) had a 0 to 10-amp range. Both had a calibrated accuracy of 0.5% of full scale. They were connected to a Westinghouse current transformer (Type CT-2.5 with a current ratio of 800/5) mounted on top of the main power transformer.

The same taps used for voltage measurement were connected through the switch panel to a Weston precision wattmeter (Model 432). This instrument had 0 to 250- and 0 to 500-watt scales with a calibrated accuracy of 0.5% of full scale. The copper cables to the lower test section bus bar were conducted through the core opening of a Weston current transformer (Model 327). The secondary of this transformer was connected to the current terminals of the wattmeter; the current ratio of the transformer with this hookup was 600/5. With 60-cycle current, the transformer-ratio correction (0.9998) and the phase-angle correction (leading $0^{o}1'$) were negligible. The dissipation in the wattmaker was less than 1% of the power in the wattmeter circuit. The power factor over the test section calculated from these measurements ranged from 0.957 to 0.996. Figure 12 shows schematically the power supply and electrical measuring systems.

III. EXPERIMENTAL PROCEDURE

For each experimental run there were three independent quantities to be specified: the flow rate, the heat flux, and the thermal conditions at the test-section entrance. This third condition was usually stated in terms of weight fraction of vapor, but, when liquid alone entered the test section, it could be specified in terms of the amount of subcooling. The three conditions were related to experimentally measured quantities: the flow rate to a rotameter reading, the heat flux to a wattmeter reading, and the thermal condition to a specific liquid-outlet temperature at heater No. 2. The last specification was computed by a simplified energy balance and was entered as the set point of the temperature controller. These three conditions essentially set the operating conditions for the run.

The equipment was started and allowed to warm up for a period of 45 min. to an hour. In this time it was necessary to attain the preset operating conditions and then stabilize the operation at this point. Before data could be taken, it was necessary to adequately define this stabilized condition; i.e. steady state. Several criteria were observed. Among these, the following three were of prime importance: First, it was necessary that the feed water be satisfactorily degassed. To accomplish this it was arbitrarily decided that the entire contents of the main feed tank should be circulated through the equipment at least twice (released air was vented at the vapor condenser). Second, the temperatures of the entering feed water and the returned products should be about equal; and third, all monitored temperatures, especially at the outlet of heater No. 2 (station 1), should be steady. Other criteria included the stability of the flow rate, the stability of the liquid levels below the vapor separator and in the condenser, and the constancy of the electrical measurements. Also, it was necessary that the flashing valve be so adjusted that the pressure at station 1 was 5 to 10 psi over the saturation pressure. It should be noted that, once grossly adjusted, the feed rate was more easily controlled with a needle globe valve (located just downstream from the rotameters) than by adjustment of the variable-speed drive.

Data were taken in the following general pattern. Rotameter and electrical readings were recorded, and the time of day noted. The Rubicon potentiometer was balanced against the standard cell, and the first 12 copper-constantan thermocouples were read. After rotameter and electrical readings were again recorded, the last 12 Cu-Co thermocouples were read. This procedure was repeated until all couples had been read twice, a span of about 30 to 40 min. In most runs, the two sets of temperature readings agreed within 0.25°F. While temperatures were being recorded, the flow system and the six monitored iron-constantan thermocouples were occasionally checked, and when needed, adjustments were made. Of these adjustments, the flow rate was of primary importance.

After the first two sets of thermocouple readings were taken, the pressure transducer and manifold were readied. The pressure-transducer supply voltage was first standardized (by the procedure explained in Section E-2, Chapter II), and the manifold temperature recorded. This was done with the transducer manifold open to the atmosphere. Air was then purged from the manifold by allowing water, from the feed pump, to flow up through the manifold and out the drain lines. In a similar manner, air was purged from each pressure-tap line; each line was flushed with water until air bubbles were no longer visible in the 1/4-in. glass pipe connection to the pressure tap. Then all manifold valves were closed and the operation was allowed to restabilize (the introduction of relatively cool water into the test section during the flushing operating caused a mild operational upset). During this time-- about 10 minutes-- the transducer manifold was cooled to its original temperature.

With all the criteria for steady state again satisfied, pressure measurements were made using the 0 to 1-mv recorder. In order to impress a certain pressure signal on the transducer, it was only necessary to open the needle valve in the line that connected the pressure tap and the transducer manifold. Then, to display the transducer output voltage on the 0 to 1-mv recorder, it was necessary to buck this signal with a suitable dc voltage. In practice, pressures were close enough in magnitude so that one bucking voltage could be used to display several pressure signals. After each set of pressures were recorded, the bucking voltage was read on the Rubicon potentiometer. Occasionally, as a check on the precision of the measurements, one pressure signal was recorded twice with two different bucking voltages. If these measurements were made at two widely spaced time, they also served as a check on the operational stability of the equipment. In most cases, the two results were in good agreement. Figure 19 is a reproduction of a strip chart used for pressure readings.

Immediately following the pressure measurements, the copper-constantan thermocouples were read for the third time (following the procedure used for the first two readings). As a rule, this completed a run. However, if a check of the flow rate was desired, weight rates of the condensed vapor product and of the liquid product were then taken.

The operational stability of the equipment was generally such that it was common for thermocouple readings from the three sets of data to agree within $1/2^{O}F$ over a 2-hr period. This was certainly true when the vapor fraction entering the test section was large. In such cases the temperature before the flashing valve (station 1) could vary by as much as $2^{O}F$ without appreciably affecting downstream conditions. This is due to the large ratio of latent heat to sensible heat. In runs where the flow entered the test section subcooled, the stability was not as good; the point where vapor first formed in the test section was very sensitive to the temperature at station 1 and to the flow rate. These runs were usually characterized by scattered thermocouple readings in this region.

The copper-constantan thermocouples immersed in the flow stream were very steady and were easily read on the Rubicon potentiometer. However, the thermocouples soldered directly to the heated tube wall were often more difficult to read. As is natural in boiling or turbulent processes, the temperatures and pressures fluctuated.* Although the mean value of such quantities is of prime importance, it would be instructive to have some knowledge about the magnitude and frequency of the oscillations. The light-beam galvanometer used in the first set of runs gave no hint as to the magnitude of the temperature oscillations. But, in the second set of runs, the Minneapolis-Honeywell null indicator was fast enough to give a good reproduction, at least in a relative manner. The Leeds and Northrup millivolt recorder was also fast enough (1-sec pen travel across the full scale) that pressure fluctuations could be qualitatively examined. Generally there was a high degree of correlation between temperature and pressure fluctuations. The temperature fluctuations varied from very small to as large as $\pm 4^{\circ}F$, with a frequency of many cycles per second. The largest fluctuations were usually associated with lower flow rates; even larger fluctuations were observed with flow rates so low that "slugging" occurred. In reading the thermocouples, the mean value was obtained by visually determining when the pointer was oscillating evenly about the null position. In most instances, a sensitivity of $0.25^{\circ}F$ was obtained, even though oscillations were as large as 2 to $3^{\circ}F$. In some cases, however, the oscillations were so large that adequate sensitivity was not obtained, and the validity of these data is questioned.

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* Buchberg et.al.[26] present calculations which show that temperature fluctuations of the tube wall due to the 60-cycle heating current would be about $0.5^{\circ}F$.

About every five or six runs the test section was cleaned with a long-handle bristle brush and ordinary household cleanser. It was then thoroughly rinsed with distilled water. After each cleaning the feed was changed; the new feed material was composed of fresh distilled water and any condensed vapor product that had been collected in the vapor-product weigh tank. On the basis of conductivity measurements, the condensed vapor product contained less contaminants than the distilled water. No precise conductivity measurements were made (the conductivity probe was uncalibrated), but relative conductivity measurements were often used to compare the feed water to the house distilled water as the minimum standard. Occasionally, hot trisodium phosphate solution was circulated through the test section and the two steam-fed heaters. This was done to clean the inside tube surfaces of the heaters as well as the test section.

IV. DATA REDUCTION

A. Evaluation of the Inside-Wall Temperature

In order to calculate local heat-transfer coefficients from a solid surface to a fluid, one must evaluate both local heat fluxes and local surface temperatures. In this respect, electrical resistance heating has a distinct advantage: with proper procedures both of these quantities can be determined by relatively accurate but simple measurements. Thermal insulation of the heated area (as the insulation of the test sections in this experiment) is necessary for two reasons. First, the insulation provides that essentially all of the heat generated in the test section will be transferred into the fluid stream. Second, by insuring an adiabatic condition at the outer tube wall, the insulation gives an excellent situation for temperature measurement. A thermocouple probe inserted in this region would not appreciably disturb heat flow, nor would there be a great uncertainty about its location in a nonuniform temperature field. By proper specification of the heat generation, with the measured outside-wall temperature, and an adiabatic condition, the appropriate heat conduction equation can be solved, yielding the inside-wall temperature.*

The differential equation governing heat generation and conduction in the test section is

$$\frac{1}{r} \frac{d}{dr} \left[r \cdot k(T) \frac{dT}{dr} \right] = - \frac{3.41304}{V_m} \cdot Pw = - \omega. \qquad \text{(IV-1)}$$

Boundary conditions are:

$$r = r_o \; ; \quad \left(\frac{dT}{dr} \right) = 0, \text{ adiabatic outer wall} \qquad \text{(IV-2)}$$

$$r = r_o \; ; \quad T = T_o, \text{ the outside-wall temperature is constant.} \qquad \text{(IV-3)}$$

Here T is the temperature in ^{o}F; r is the radius in feet; k(T) is the thermal conductivity as a function of temperature, BTU/hr ft ^{o}F; Pw is the power in watts expended in the test section; and

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* This experiment was originally set up to use a steam-jacketed, copper, finned tube as a test section. Pressure measurements were to be made by several pressure taps as in the present experiment, while tube-wall temperatures were to be obtained by imbedding thermocouples in the tube wall. It was hoped that thermal resistances of the dropwise-condensing steam and the copper finned tube would be negligible, and mean wall temperatures would closely approximate the inner-wall temperatures. However, the local heat flux along the tube varied so greatly that satisfactory limits could not be placed on the heat-transfer coefficient values nor the inner-wall temperatures. This experimental test section was abandoned for the present electrical-resistance-heated test sections.

V_m is the volume of heated metal in the test section. The conversion factor from watts to BTU/hr is 3.41304.

Assumption made in the derivation and solution of Eq. (1) are:

1. Steady-state conditions
2. Circular symmetry
3. Negligible longitudinal heat conduction
4. Adiabatic outer wall (boundary condition 1)
5. Uniform heat generation throughout the heated volume of metal, as expressed by the term on the right side of Eq. (IV-1)
6. Negligible electrical capacitance and inductance effects.

Another assumption as to the form of k(T) is needed before a solution can be obtained. If a linear form for k(T) is used in Eq. (IV-1),

7. $k(T) = k_o\,(1 + \alpha T)$,

the differential equation is non linear. However, a solution is known (derived in Appendix A):

$$T_o - T_i = \frac{\omega}{2k_o}\left[r_o^2 \ln\frac{r_o}{r_i} - \frac{1}{2}(r_o^2 - r_i^2)\right] - \frac{\alpha}{2}(T_o^2 - T_i^2). \quad \text{(IV-4)}$$

Equation (IV-4) is not explicit for the unknown T_i. Noting that the average thermal conductivity is (from assumption 7)

$$k_{avg} = k_o\left[1 + \alpha\,\frac{T_o + T_i}{2}\right], \quad \text{(IV-5)}$$

we can rearrange Eq. (IV-4):

$$T_o - T_i = \frac{\omega}{2}\left[r_o^2 \ln\frac{r_o}{r_i} - \frac{1}{2}(r_o^2 - r_i^2)\right]\frac{1}{k_o\left[1 + \frac{\alpha}{2}(T_o + T_i)\right]}. \quad \text{(IV-6)}$$

Equation (IV-6) is simply the solution that would be obtained if k(T) were originally assumed constant at k_{avg}; i.e., it is the constant-properties solution for the thermal conductivity evaluated at the average wall temperature.

Before proceeding to the iterative procedure used in the numerical determination of T_i from Eq. (IV-6), some discussion of the assumptions is warranted. Although tube-wall temperatures fluctuated around a mean value, it is believed that the steady-state equation (assumption No. 1) would give an accurate value for the mean inside-wall temperature. Certainly as far as mean values are concerned, steady-state conditions were adequately maintained. In view of the 15% (maximum) deviation in tube-wall thickness, the second assumption (circular symmetry) is difficult to totally justify. It will be discussed further in the section in this chapter on experimental error. The third assumption of negligible longitudinal heat flow is easily and convincingly documented. By using temperature vs length curves from actual runs, values of the longitudinal heat flow in the thin-walled tube were calculated. A typical value was 0.006 BTU/hr, or about 1×10^{-5}% of the radial heat flux. The adiabatic outer-wall condition (assumption No. 4) is substantiated by heat balances and insulation-loss calculations which show heat losses from the test section to be less than 1% of the total heat input.

It is believed the assumption of uniform heat generation throughout the volume of heated metal is valid in spite of the variation in wall thickness. This is based on two conditions. First, power dissipation, determined by voltage measurements, was always linear with test-section length (see Figure 17). Second, both the thermal conductivity and the electrical resistivity of the stainless steels used in test sections had very weak temperature dependences [the thermal conductivity : $k = k_o (1 + 5.32 \cdot 10^{-4} T)$; the electrical resistivity: $\rho = \rho_o (1 + 5.6 \cdot 10.^{-4} T)$], and in all runs the temperature drop through the wall was less than $10^{o}F$.

The assumption of negligible electrical capacitance and inductance is substantiated by power-factor measurements, the lowest being 0.957.

The thermal conductivity of type-304 stainless steel was obtained as a function of temperature from three sources. Figure 18 shows the temperature dependence and the relation of the three sets of data. A least-squares straight line was drawn through these data:

$$k = 8.44 \, (1 + 5.32 \cdot 10^{-4}) \, \frac{\text{BTU}}{\text{hr ft } {}^{o}\text{F}} \, . \qquad \text{(IV-7)}$$

Very little data was found for the conductivity of type-321 or type-347 stainless steel (type 321 is a titanium-stabilized variation of type 347).[27] However, in the course of heat-transfer work at UCLA, the available data was compared to experimental results.[26] The conclusion from this work was that the thermal conductivities of types 304, 321, and 347 are nearly the same. Their working equation was

$$k = 8.50 \, (1 + 5.17 \cdot 10^{-4} \, T). \qquad \text{(IV-8)}$$

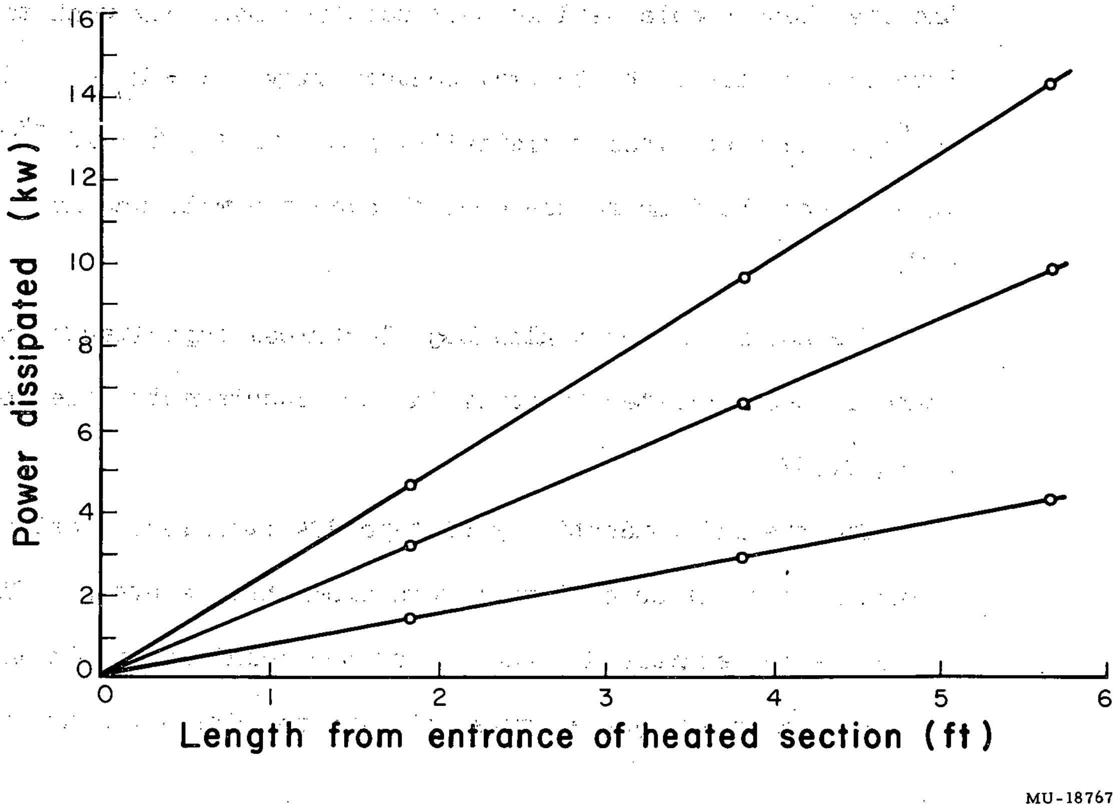

Fig. 17. Power dissipation along the tube length.

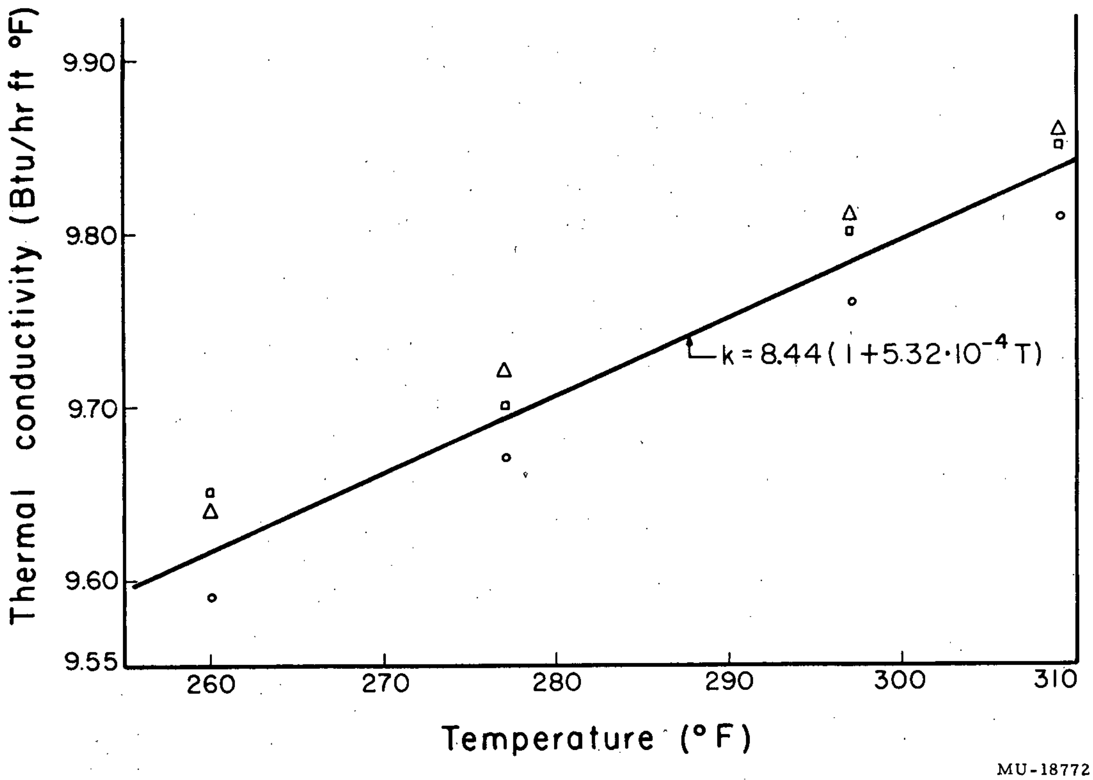

Fig. 18. Thermal conductivity of type-304 stainless steel:
- △ National Bureau of Standards
- □ Dickerson and Welsh, Trans. Am. Soc. Mech. Engrs. 80, 746 (1958).
- o Metals Handbook, Section 20, 20 (1939).

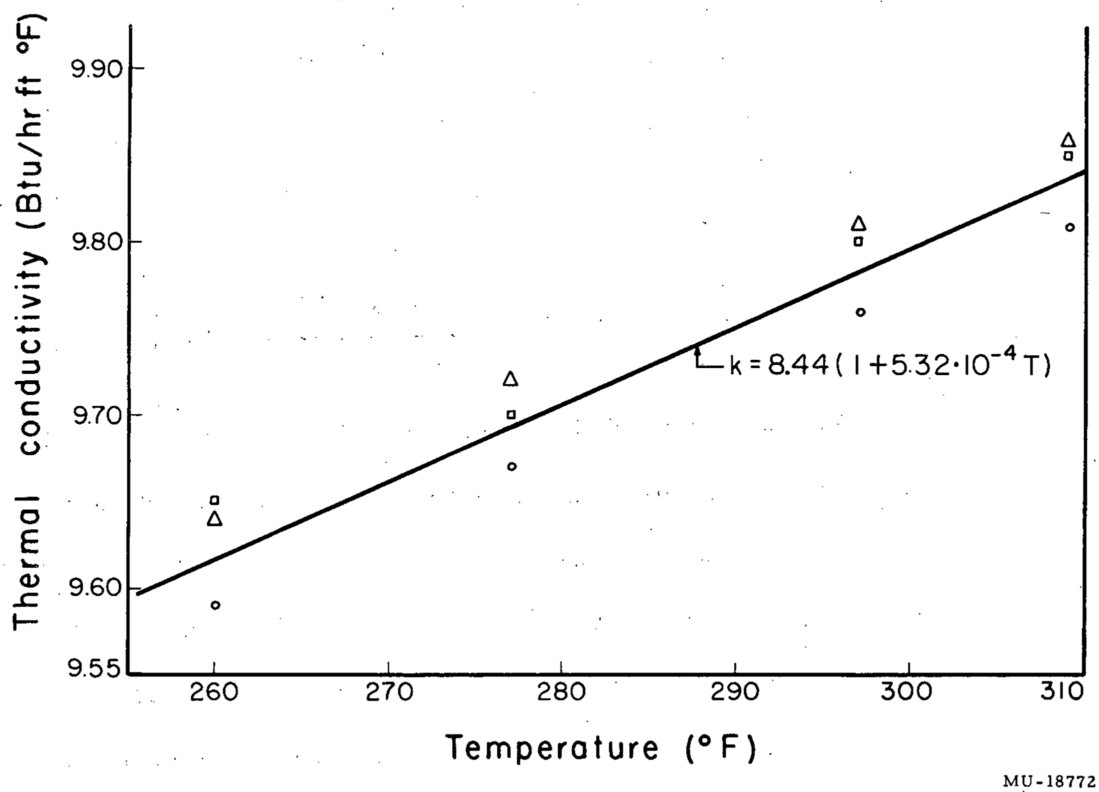

Fig. 18. Thermal conductivity of type-304 stainless steel.

For type 347 Schrock and Grossman[11] use $k = 8.30(1 + 5.79 \cdot 10^{-4}T)$ Equation (IV-7) was used for both test section No. 1 (type 304) and test section No. 2 (type 321). For preliminary work, the electrical resistivity of type-304 stainless steel was evaluated:[27]

$$\rho = 69.4\,(1 + 5.6 \cdot 10^{-4}T)\ \mu\text{ohm cm.} \qquad \text{(IV-9)}$$

For computation of the inside-wall temperature, the geometric quantities and other constants in Eq. (IV-6) were grouped together:

$$T_o - T_i = C_1 \frac{Pw}{\left[1 + \dfrac{5.32 \cdot 10^{-4}(T_o + T_i)}{2}\right]} \qquad \text{(IV-10)}$$

Here Pw was obtained directly from the wattmeter reading. An iterative procedure was used to obtain T_i. First, with the known value of T_o used in place of T_i on the right side of the equation, an initial value of T_i was obtained. Then, this value was used in the right side, and a new T_i was obtained. This procedure was repeated until the absolute value of the difference of two succeeding trials was less than 0.0001°F. This calculation was actually performed by digital computers, but hand solutions showed very rapid convergence, three iterations usually being sufficient.

B. Pressure Measurement, Heat Flux, and Heat-Transfer Coefficient

The pressure-transducer calibration equation is

$$\text{psia} = a\,(\text{mv}) + b, \qquad \text{(IV-11)}$$

where a = 7.422 and b = 3.657. The standard deviation is 0.108 psi. For pressure measurement at run conditions, the equation was modified to include the hydrostatic head of liquid in the lines connecting the pressure taps to the transducer manifold:

$$\text{psia} = a\left[mv_R - (mv_o - mv_a)\right] + b \qquad \text{(IV-12)}$$

where mv_R is the total transducer output at run conditions. The quantity $(mv_o - mv_a)$ is a constant for each pressure tap. It depends upon the difference in elevation between the pressure tap and the transducer, and the conditions that the connecting tubing was filled with liquid and that the transducer was operating according to its calibration. The derivation of Eq. (IV-12) and the methods of measurement of $(mv_o - mv_a)$ are presented in Appendix B.

Evaluation of the bulk-fluid temperature at a point in the test section followed from the pressure calculation for this point and was based on the assumption of thermodynamic equilibrium. That is, it was assumed that, at any point in the test section where vapor and liquid were both present, the two phases were in equilibrium. Therefore, the measured pressure would be the saturation pressure and by use of an equation of state (or steam tables) the saturation temperature T_B could be obtained.*

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* This is a common assumption in two-phase flow work; however, this author has seen very little discussion or verification of it. In order to give some justification to this assumption, specially constructed thermocouple probes were inserted up into the boiling test section. Temperatures measured in this way agreed well with the pressure measurements. However, it was evident that flow conditions were significantly disturbed so that such thermocouple probes could not be used to gather heat-transfer data.

The heat flux was obtained from the power measurement

$$q = \frac{3.41304 \cdot Pw}{A_h} , \qquad \text{(IV-13)}$$

where A_h is the heat transfer area in ft.^{2} The heat transfer coefficient was then obtained from

$$h_B = \frac{q}{(T_i - T_B)} . \qquad \text{(IV-14)}$$

C. The Energy Balance

The mass vapor fraction or quality, x, (x is the fraction of the total flow at a certain point that is vapor) at some location in the boiling test section was obtained by an energy balance. The reference point for this balance was station 1, before the flashing valve, where the flow was subcooled liquid. The terminal point of the energy balance was at the point in question in the boiling test section. The energy balances, conveniently grouped for an iterative solution for x, is

$$x = \left[\frac{h_1 - h_f + \frac{v_1^2}{2g_c J} + \frac{Q}{W} \frac{\ell}{L} + \frac{1}{J} \frac{g}{g_c} (\ell + z_1)}{h_g - h_f} \right] - \left[\frac{x \frac{v_g^2}{2g_c J} + (1-x) \frac{v_f^2}{2g_c J}}{h_g - h_f} \right] , \qquad \text{(IV-15)}$$

where h's are enthalpies (BTU/lbm), v's are velocities (ft/sec), Q is the total heat transfer (BTU/hr), W is the flow rate (lbm/hr), ℓ/L is the fraction of the total test-section length from the entrance to the point in question, and z_1 is the difference in elevation between station 1 and the test-section entrance (ft.). Subscripts g and f stand for saturated vapor and liquid, respectively, and subscript 1 refers to station 1.

Equation (IV-15) is not explicit for x, as x appears in two terms on the right side. These terms represent the kinetic energies of liquid and vapor in the test section. Their numerical evaluation requires knowledge of the velocities v_g and v_f. These velocities cannot be calculated directly as they require holdup data not obtained in the experiment. However, they may be satisfactorily estimated by introducing the "slip ratio", $\psi = v_g/v_f$, into material balance relations, and then specifying a suitable value for it (usually $\psi = 1.0$ or 2.0). For any conceivable value of ψ, the magnitude of the kinetic terms was small compared to other terms in the energy balance. Therefore, in the determination of x, the specification of ψ was not of great importance.

The value of x was obtained by an iterative procedure. This procedure was initiated by ignoring the kinetic-energy terms and obtaining a value of x directly. Then this value, along with values of v_g and v_f, from the material-balance relations was substituted into the right-side of Eq. (IV-15), yielding a second value of x. This value could then be resubstituted (along with new values of v_g and v_f) into Eq. (IV-15) to obtain still another value of x. Any number of repetitions of this step could then follow. Convergence of this procedure was rapid; the desired agreement between succeeding values of x was usually obtained by the third iteration. Since this calculation was actually performed by an IBM-709 data-processing system, five iterations were made before the final value of x was accepted. The derivations of the energy balance and the material balance relations are given in Appendix C.

Thermodynamic and physical properties of the liquid and vapor were evaluated by use of steam tables and the knowledge of the saturation temperatures T_B and T_1 (T_1 was actually a few degrees below the saturation temperature but pressure corrections to these properties were negligible).

D. Reduction of the Raw Data and Digital Computation

Most of the data reduction calculations were performed by an IBM-709 data-processing system. However, the raw experimental data and the first steps of data reduction were processed by hand. Rotameter readings and electrical measurements were converted to flow rate and power values, respectively. Thermocouple millivolt readings were edited, averaged (over the two-hour period of data collection), and converted to temperature values. These values were plotted against ℓ, the length from the entrance of the heated portion of the test section, and a smooth curve was drawn through the points. The recorded pressure signals were evaluated by graphically determining the mean values of the recorded traces. (Figure 19 is a reproduction of the recorder traces of Run 172.0). To these values were added the appropriate bias (bucking) voltages to obtain the full pressure-transducer output voltages (mv_R). Pressures were then obtained using Eq. (IV-12) of this chapter. These pressures were also plotted

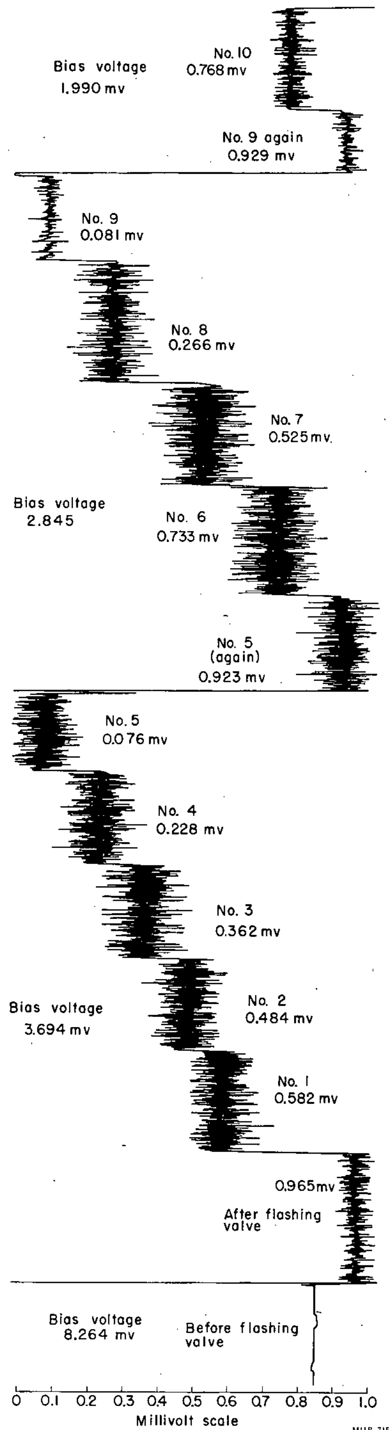

Fig. 19. Reproduction of the pressure recordings for Run 172.0. The 0-1 mv scale width is 9-1/2 in. and amounts to 7.42 psi. The recorder chart speed was 2 in. /min.

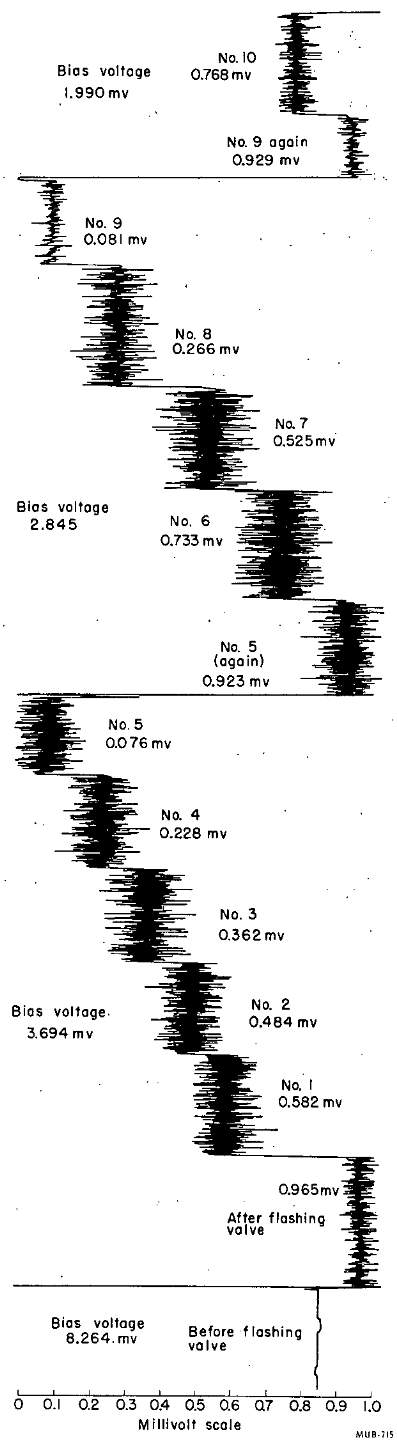

Fig. 19. Pressure recordings for Run 172.0.

versus ℓ, and a smooth curve was drawn. Total pressure-gradient values $[-(dp/d\ell)_{tpt}]$ were then obtained by graphically differentiating this curve.* The pressure gradient values were also plotted versus ℓ. Figures 20 through 25 show experimental temperatures and pressures for several runs.

There were two tests on the reliability of the experimental data. The first test involved the constancy of temperature and electrical measurements over the data-collection period. Usually this test was made as data was taken; if the data was not constant over a sufficient period of time, run conditions were altered slightly, and data collection deferred to a leter time. The second test consisted of a comparison of pressure values derived from temperature measurements of the two-phase flow and of pressures derived from the transducer. This also served as a test of the assumption of thermal equilibrium between liquid and vapor in the two-phase flow mixture. For test section No. 1 there was only one temperature measurement which could be used for this comparison; one thermocouple was inserted in the flow stream just above the test-section entrance. For test section No. 2, in addition to this one thermocouple, two thermocouples were soldered to the unheated portion of the test section (the fluid dynamic entrance region). These latter two couples give bulk fluid

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* Several numerical methods for this differentiation were tested. However, no method was nearly as reliable as the graphical method.

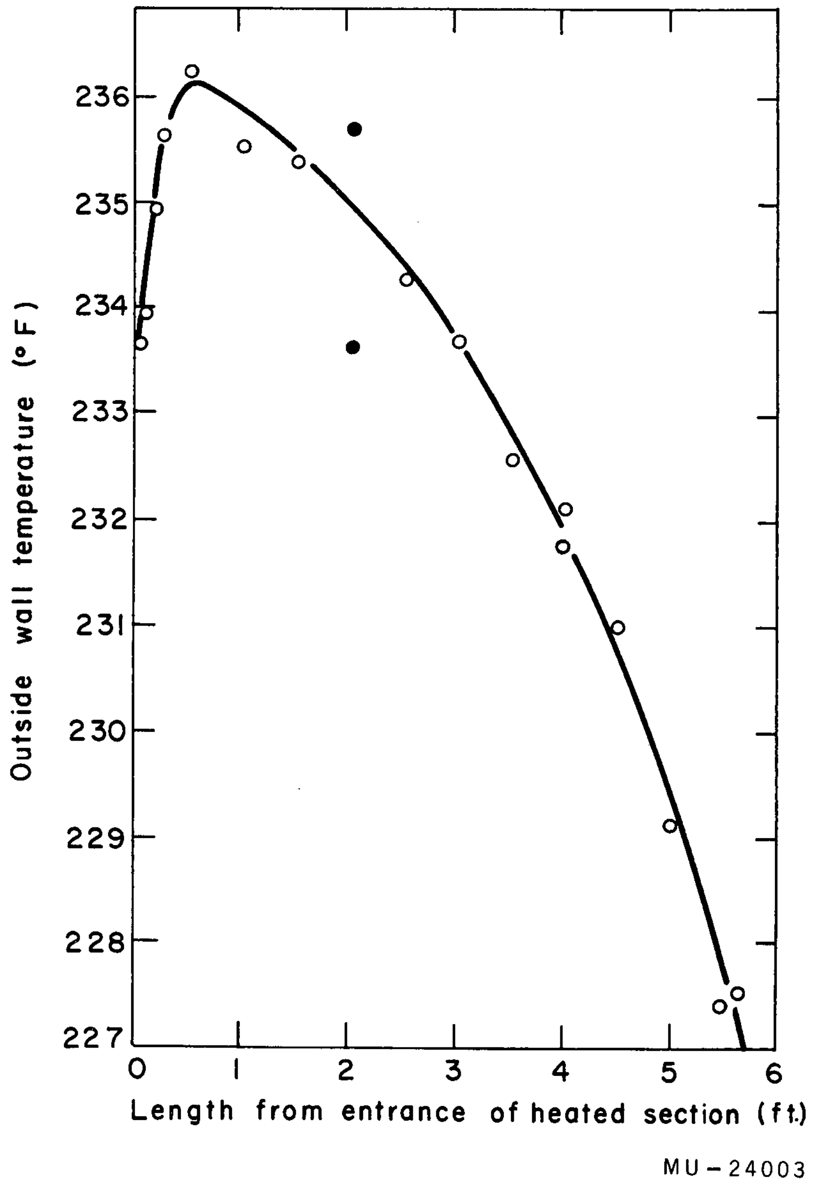

Fig. 20. Outside-tube-wall temperatures for Run 102.0.

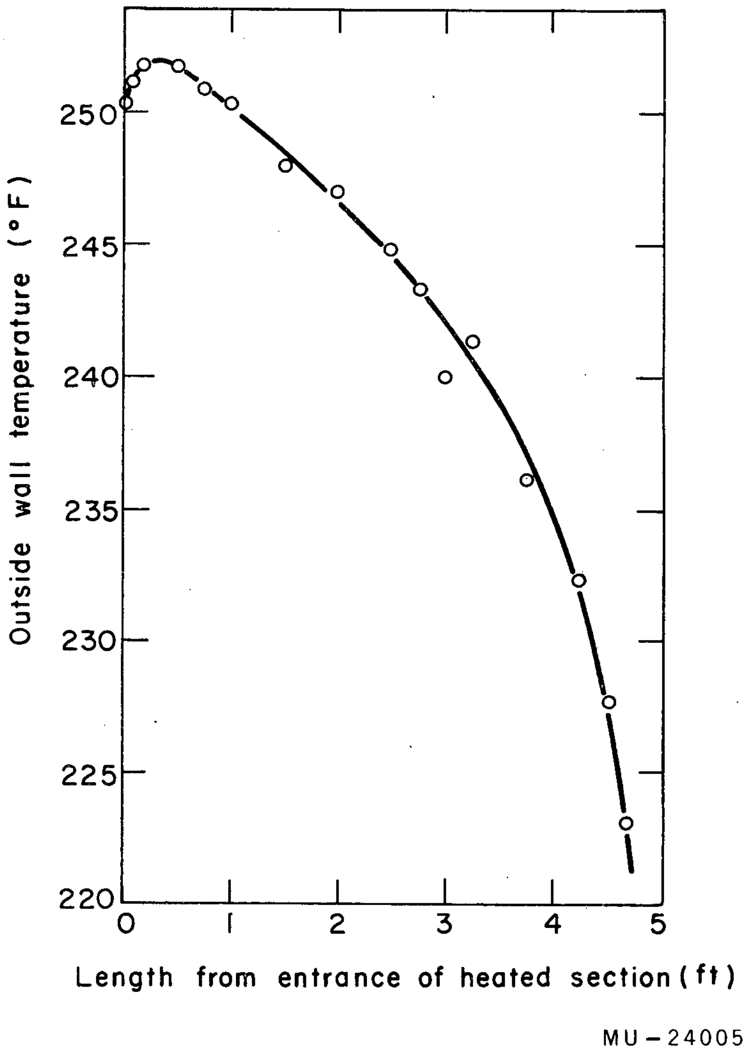

Fig. 21. Outside-tube-wall temperatures for Run 172.0.

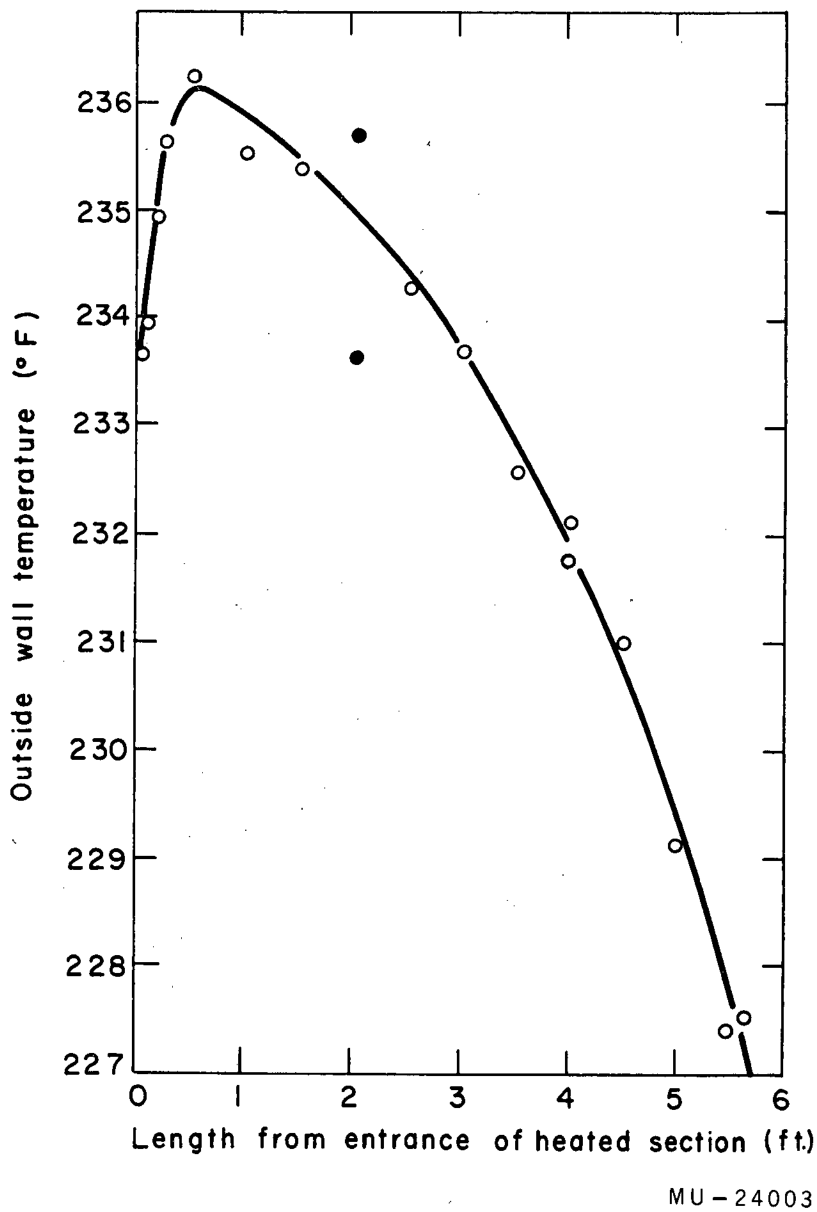

Fig. 20. Outside-tube-wall temperatures for Run 102.0.

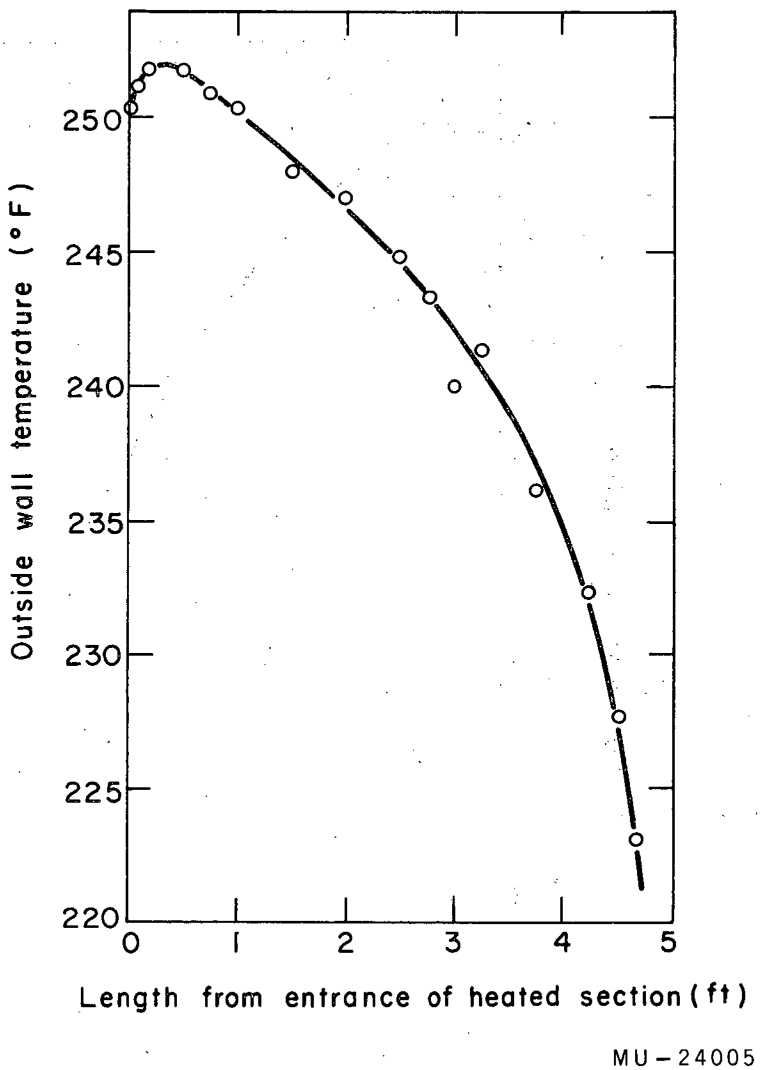

Fig. 21. Outside-tube-wall temperatures for Run 172.0.

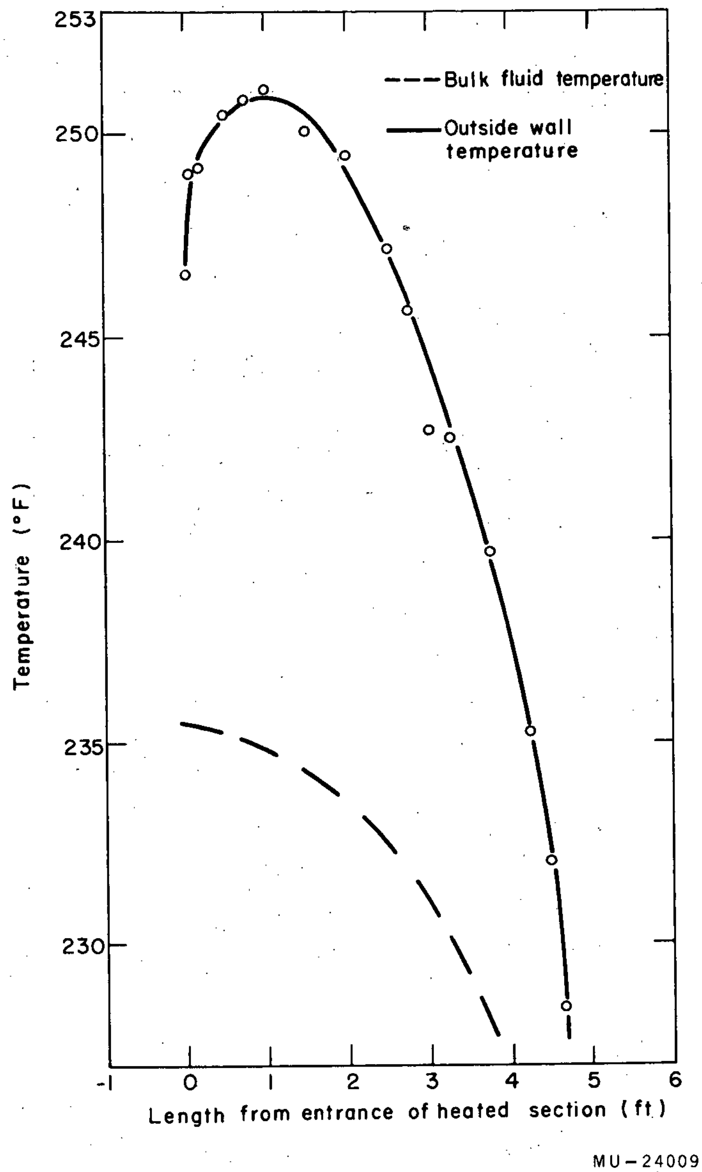

Fig. 22. Outside tube-wall and bulk-fluid temperatures for Run 150.0 with test section No. 2. The flow rate was 1055 lbm/hr. The quality varied from 0.2 to 3.5%. This run shows a rather large entrance effect.

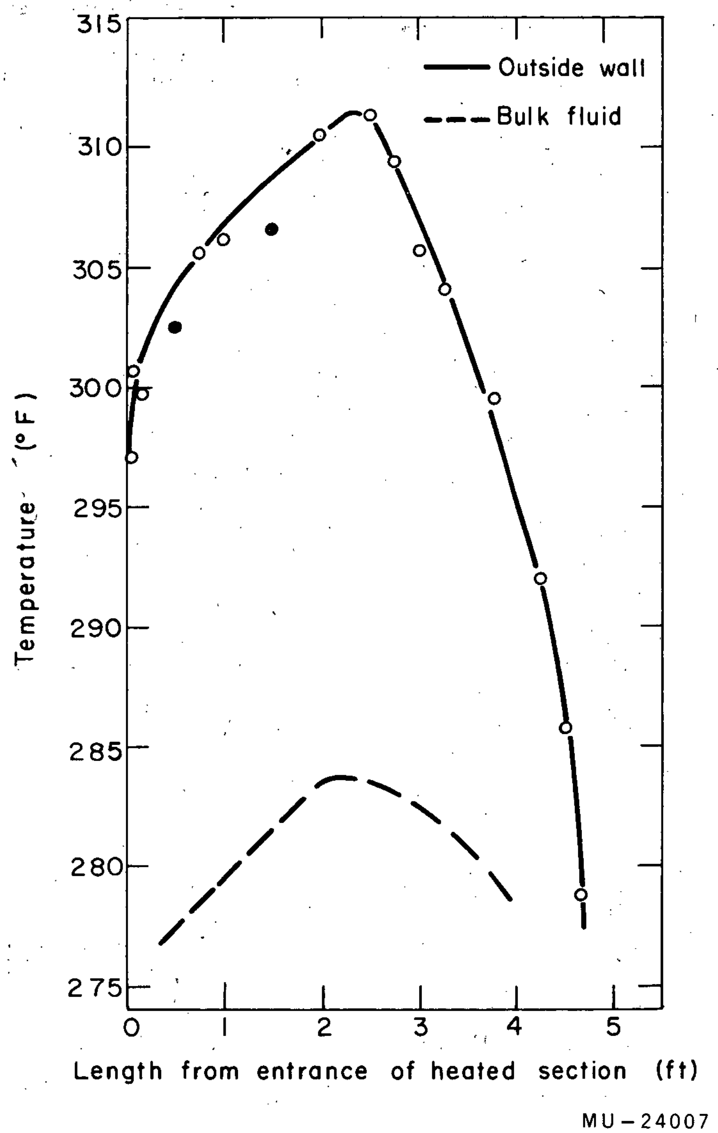

Fig. 23. Outside tube-wall and bulk-fluid temperatures for Run 165.0 with test section No. 2. In this run, net vaporization was initiated in the test section. The flow rate was 2755 lbm/hr. The exit quality was 2.5%. Temperature readings marked ● were ignored.

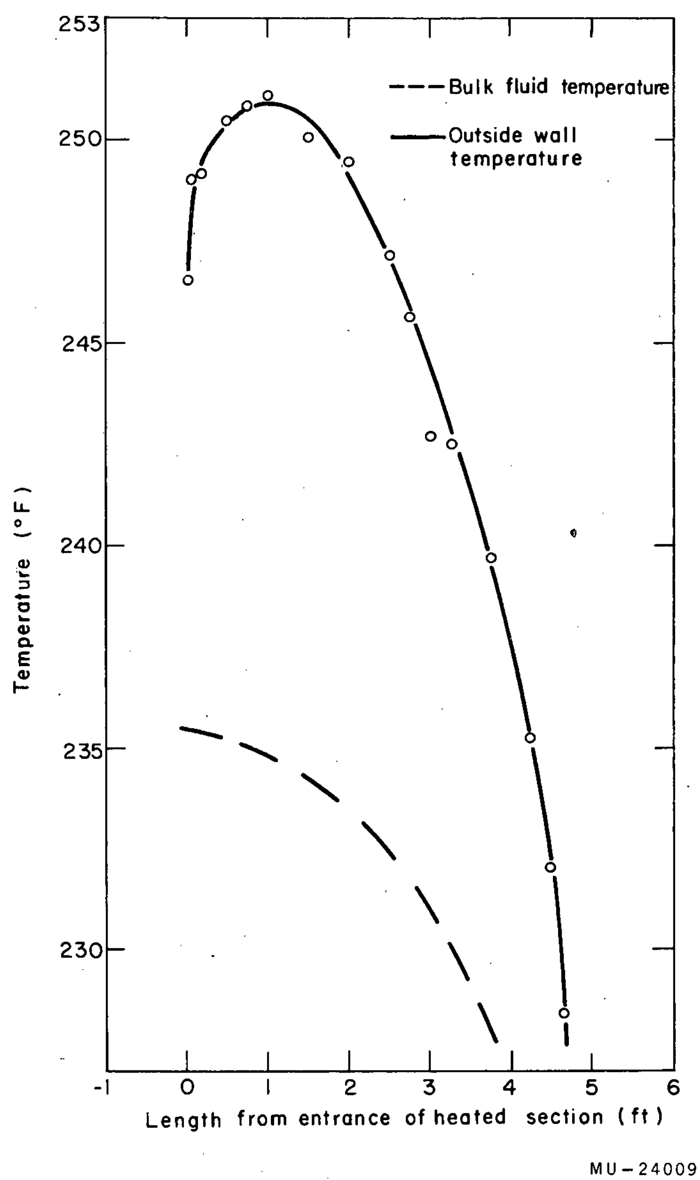

Fig. 22. Outside-tube-wall temperatures for Run 150.0.

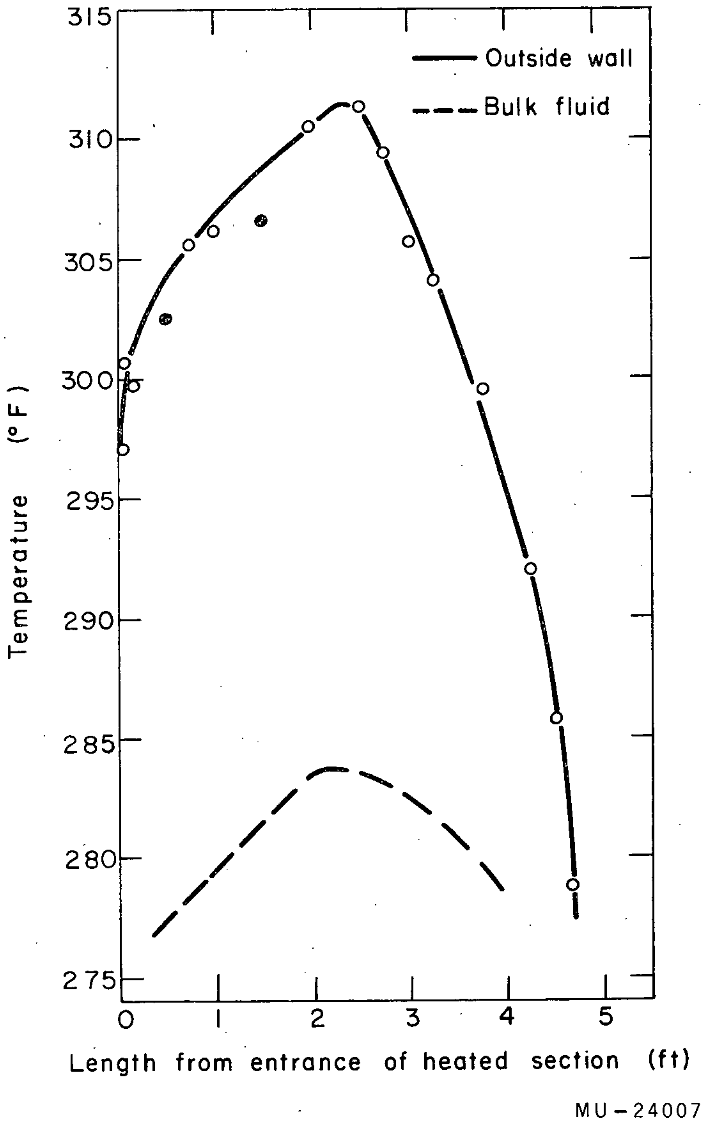

Fig. 23. Outside-tube-wall and bulk fluid temperatures for Run 165.0.

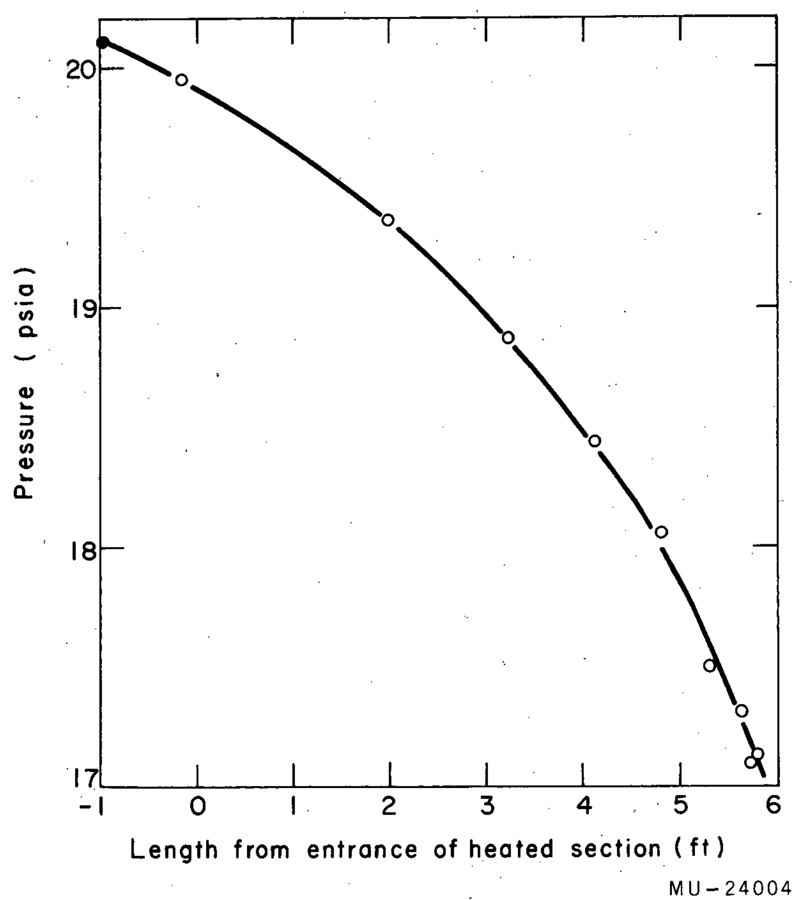

Fig. 24. Measured pressures for Run 102.0 with test section No. 1. The point marked ● was obtained from a thermocouple reading.

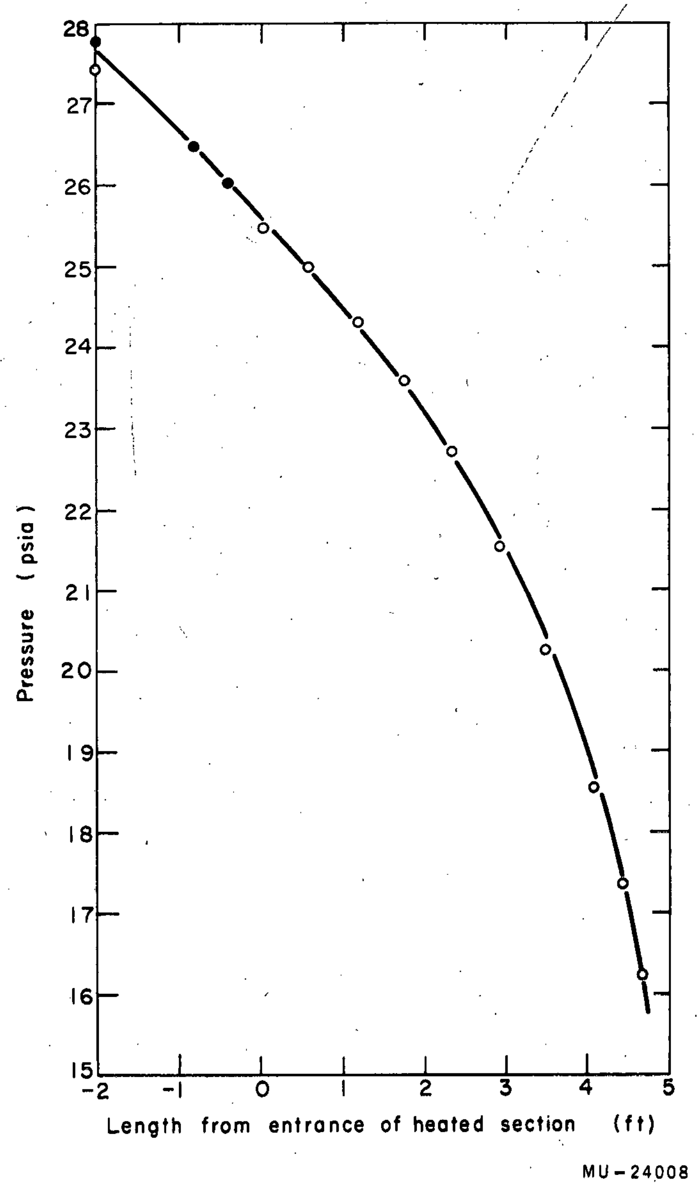

Fig. 25. Measured pressures for Run 172.0 with test section No. 2. Points designated ● were obtained from thermocouple readings and constitute the pressure-temperature check.

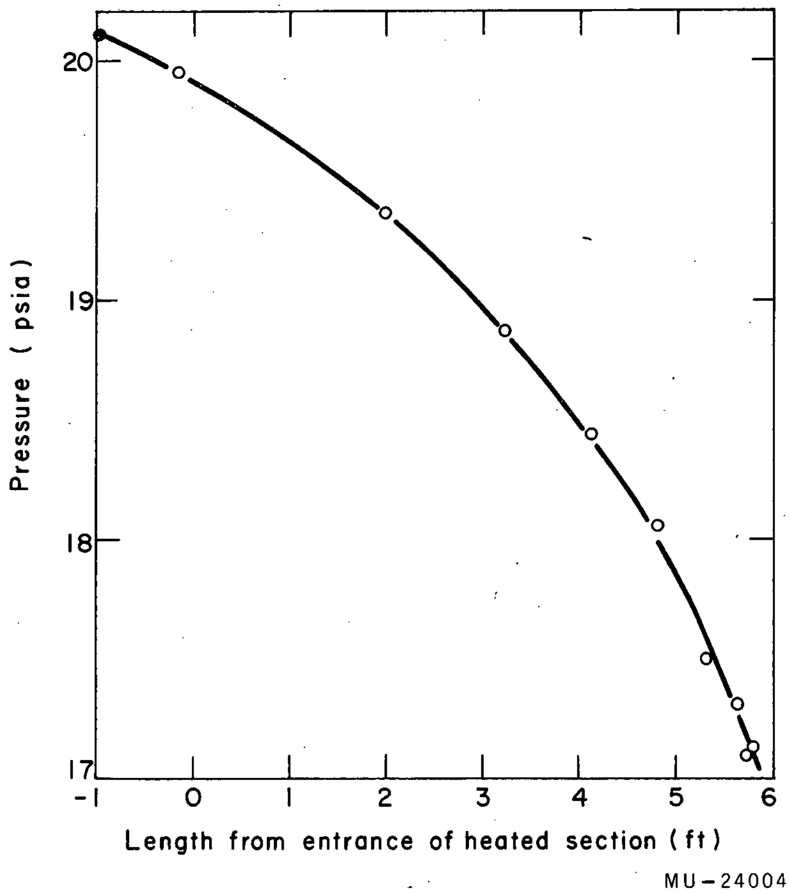

Fig. 24. Measured pressures for Run 102.0.

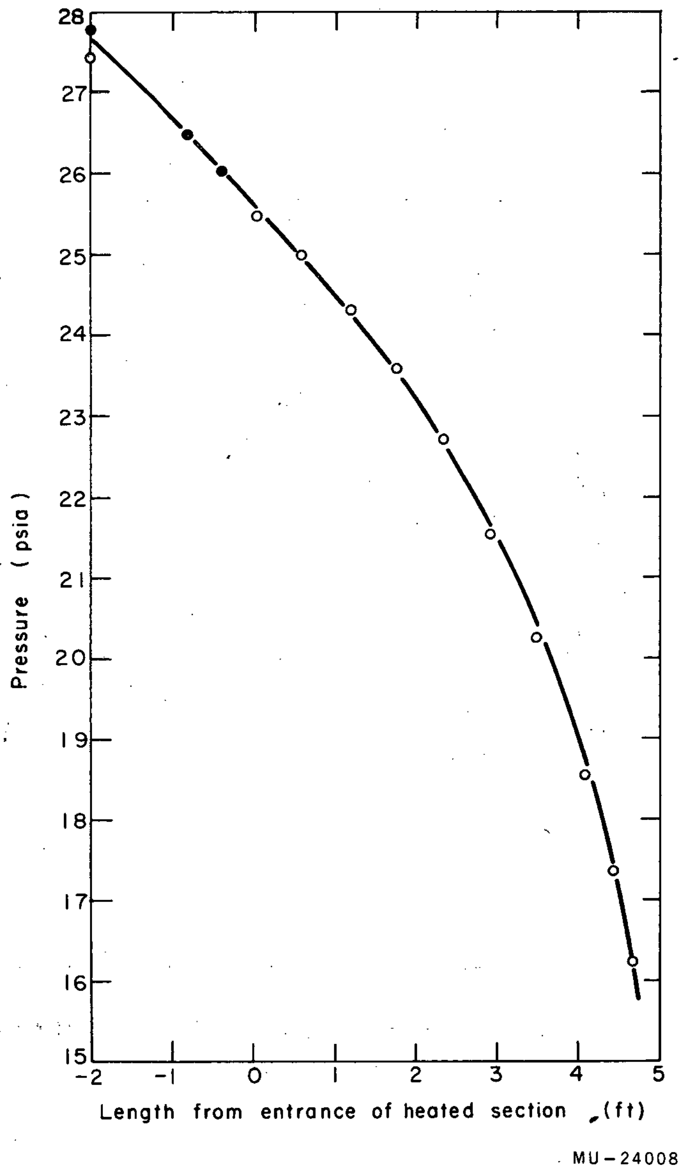

Fig. 25. Measured pressures for Run 172.0.

temperatures, since the test section was well insulated. The temperatures were converted to saturated pressures by steam tables, and these values were plotted on the pressure vs length curve. If agreement was not good, the run was rejected. Of all the runs for test section No. 2, only one run was rejected, while three were barely acceptable. (Run 151.0 was rejected. It was repeated and denoted as Run 151.1. The pressure-temperature check for this run was good.) Figures 24 and 25 show the pressure-temperature tests.

Data corresponding to several points along the test-section length were read from the plotted graphs and entered on IBM cards. Data to completely specify the conditions at one test-section location were placed on one card. This included the run identification, power, flow rate, temperature T_1 before the flashing valve, the position ℓ, the outside-wall temperature, the saturation pressure, and the total pressure gradient. Data points were selected about every 3 in. near the heated-section entrance and about every 6 in. down the rest of the tube.

A complete set of thermodynamic and physical-property data of water was also entered on punched cards. This data was in tabular form; entries were made at 4° intervals for the temperature range 160° to 348°F. Saturated temperatures, pressures, enthalpies of vapor and liquid, and densities of vapor and liquid were taken from Keenan and Keyes.[28] The thermal conductivity, viscosity, and Prandtl number for saturated liquid water were taken from the AEC Reactor Handbook.[29,16] The thermal conductivity and viscosity of saturated steam were calculated from equations given by the National Bureau of Standards.[30] The heat capacity of saturated steam was calculated from an equation given in the Japanese Steam Tables.[31] To complete the input-data package for the computer program, test-section measurements and properties were entered on IBM cards.

The data-reduction program was an IBM-709 Fortran program; the program is listed in Appendix E. The program first assigns test-section constants and then assigns thermodynamic and physical properties according to the value of the saturation pressure (PSIA). The inside-wall temperature is calculated from Eq. (IV-10) using the procedure outlined in Section A of this chapter. The heat flux and boiling heat-transfer coefficient are obtained from Eqs. (IV-13) and (IV-14). The energy balance Eq. (IV-15) is then solved for the quality x by the procedure outlined in Section C. The rest of the program deals with quantities useful for correlation purposes. These calculations are discussed in the next chapter. Appendix F contains the tabulated output of the data-reduction program for all boiling runs.

E. Estimate of Experimental Error

The estimate of the possible error of the heat-transfer coefficient h_B was obtained in the following manner. The equation used to calculate h_B was rearranged by substituting Eqs. (IV-10) and (IV-13) into Eq. (IV-14):

$$h_B = \frac{3.41304\ Pw}{A_h\left[T_o - \dfrac{C_1 Pw}{(1 + 5.32 \cdot 10^{-4} T_o)} - T_B\right]} \qquad \text{(IV-16)}$$

Several sets of representative data were substituted into Eq. (IV-16) to obtain a set of values for h_B. For each quantity appearing in Eq. (IV-16), a reasonable or, if possible, a maximum limit of error was assumed. Then, in a variety of patterns, these error increments were combined with the original values of the selected data, and new values of h_B were obtained. The two sets of heat-transfer-coefficient values were compared, and percentage differences calculated.

The limit of error in the power measurement was obtained from the stated accuracy of the wattmeter (0.5% of the 250-watt full scale). If we assume negligible error in the current transformer and negligible loss of power in the wattmeter circuit, the limit of error in the power measurement would be 150 watts. The largest percentage error would occur in low power readings; therefore to be conservative, the lowest power used in the experiment was chosen, i.e. P_w = 5000 watts. As discussed earlier, the wall thickness of test section No. 2 measurements had a $\pm 7.5\%$ maximum deviation from the mean value (the standard deviation was $\pm 3.9\%$). Since the maximum deviation in the outside-diameter measurements was less than 1%, the outside radius r_o was assumed to have negligible error. Using the accepted value of r_o and the extreme values of r_i (from the extremes of wall thickness), both A_h and C_1 were recomputed.

The value of T_B was obtained directly from pressure measurements by use of steam tables; its error is entirely dependent on those measurements. The standard deviation in the pressure-transducer calibrations was 0.108 psi. The calibration procedure was believed to be comparable to the procedure used for pressure measurements during run conditions, and therefore a limit of error of 0.4 psi should be conservative. (The error in the evaluation of the pressure contribution due to liquid in the lines connecting pressure taps and the transducer manifold is believed to be small.) The largest error in T_B would occur at lower pressures, where the slope of the T-P curve is large.

The outside-wall temperature T_o is the least certain of all measured quantities. The tube-wall thermocouples had been calibrated against steam pressures with no ac current flowing in the test section. Even though in this calibration the agreement was good (0.2°F), under run conditions there are several phenomena associated with the heating current which make the thermocouple performance uncertain. The problem of ac current in the thermocouple leads and how it affects measurements was discussed in Chapter II, Section E-1. There is the question of the temperature gradient at the outside wall and the related question of the location of the thermocouple junction in this gradient. The test sections were well insulated and, even though it is known that an adiabatic condition was not established at the outside wall, it is believed the temperature gradient was negligibly small. As the thermocouples were soft-soldered to the tube, there was no problem of penetration of the thermocouple junction into the tube wall. There is also the question of electrical-current flow through the thermocouple junction. Certainly there would be some electrical current flowing through the junction as it is in direct electrical contact with the tube, and it is of lower electrical resistance. Just how much the current density in the test section is disturbed, and how much electrical heating of the thermocouple junction there is, is not known.* In view of these questions, an uncertainty of $\pm 1.0^{\circ}F$ was chosen for T_o in these calculations.

The error calculations showed that the variation in wall thickness made up only a small portion of the uncertainty of h_B. Even when the extreme values of r_i were used, the deviation in the temperature drop through the tube wall, ΔT_w, was only $\pm 8\%$. Since at maximum power, ΔT_w is less than $7^{\circ}F$, this amounts to a maximum uncertainty of $\pm 0.6^{\circ}F$. The possible error in the power measurement was also only a small contribution to the over-all uncertainty of h_B. The largest uncertainty in the experiment is in the calculation of ΔT_B, the temperature difference between the inside wall and the bulk fluid:

$$\Delta T_B = T_o - \Delta T_w - T_B$$

---

* From the results of the nonboiling runs made with test section No. 1, it is believed that the effect of electrical heating in the thermocouple junction is small. The nonboiling results are discussed in Chapter V, Section A; the observed coefficients were in very good agreement with those predicted by the Dittus-Boelter[7] and Sieder-Tate[32] correlations.

If we discount any error in ΔT_W, ΔT_B is obtained from two independent measurements. The errors in the determination of T_O and T_B are such that they could possibly cancel each other or be additive. Here then lies the largest uncertainty of the experiment.

The results of the error calculations may be summarized: With a ΔT_B of $3^{O}F$, the error in h_B could be over 100% if the errors in T_O and T_B are of opposite sign (case 1). However, if these errors are in the same direction, the error in h_B (including errors in Pw and r_i) may range from 1 to 50% (cases 2). For ΔT_B of $6^{O}F$, case 1 gives percentage errors of 50%, while cases 2 give errors of 1 to 20%. For ΔT_B of $10^{O}F$, the maximum deviation (case 1) reduces to 30%, and for ΔT_B of $17^{O}F$, the maximum deviation is 19%. It is hoped that these limits of error are conservative, since the error increments and the quantities themselves were chosen to give as large a percentage error as feasible. There is reason to believe that the uncertainty of h_B is represented more reliably by calculations where errors in T_O and T_B tended to cancel (cases 2). This reason is the very good pressure-temperature checks obtained with the raw data of most runs.

V. DISCUSSION

A. Nonboiling Heat Transfer

A series of nonboiling heat-transfer runs were made in the early stages of the experiment. The purpose for these runs was two-fold. First, it was desired to establish the validity of the expressions for one-phase heat-transfer coefficients used by other authors; some boiling heat-transfer correlations are actually based on the nonboiling correlations. Second, it was desired to characterize the one-phase, turbulent, thermal-entrance region.

The average heat-transfer coefficients were correlation by the Dittus-Boelter[7] and Sieder-Tate[32] correlations to $\pm 8.7\%$ and $\pm 3.7\%$, respectively. Data with large wall-to-fluid temperature differences could be better correlated by use of the Sieder-Tate equation because of the viscosity correction factor. Figures 26 and 27 show the comparison of data for test section No. 1 and the two correlations. No nonboiling runs were made with test section No. 2. However, in the boiling runs where the feed to the test section was subcooled, it was possible to obtain nonboiling coefficients. The Dittus-Boelter equation predicted these values well, although it was felt that a coefficient of 0.022 in the correlation was more appropriate than 0.023. For test section No. 2, the value 0.022 in the Dittus-Boelter equation was subsequently used. In these runs there seemed to be no subcooled boiling.

In the thermal-entrance region, nonboiling heat-transfer coefficients and measured wall-to-fluid temperature differences

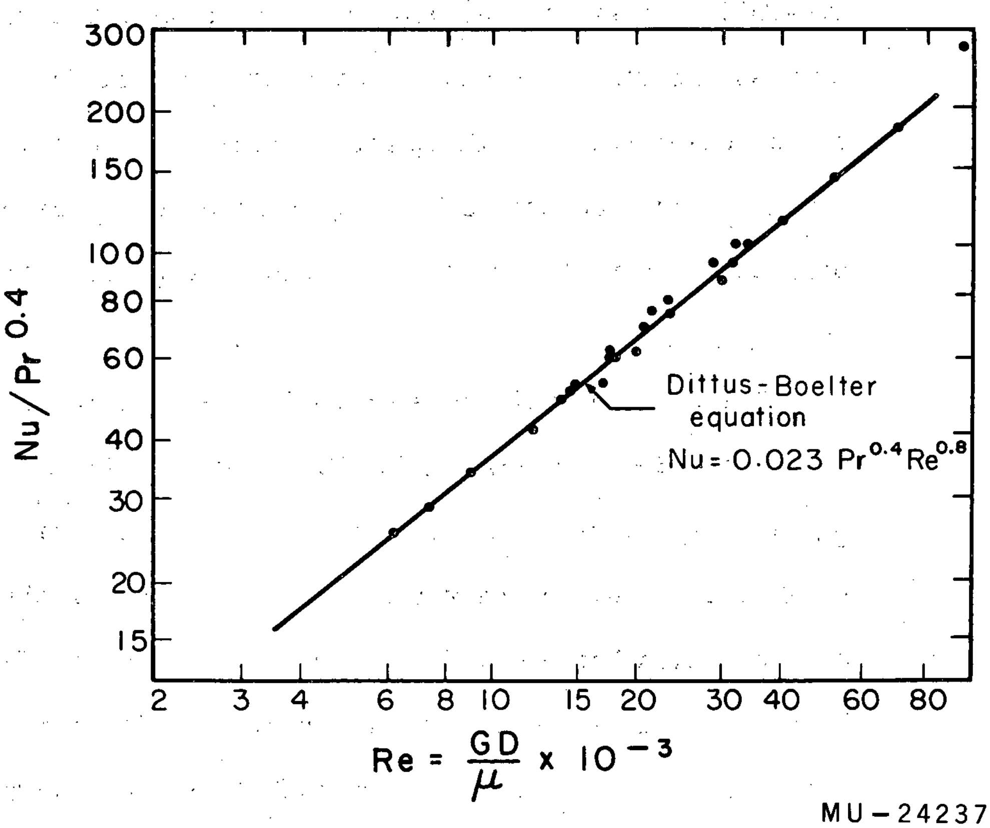

Fig. 26. Comparison of nonboiling heat-transfer data with the correlation of Dittus and Boelter.

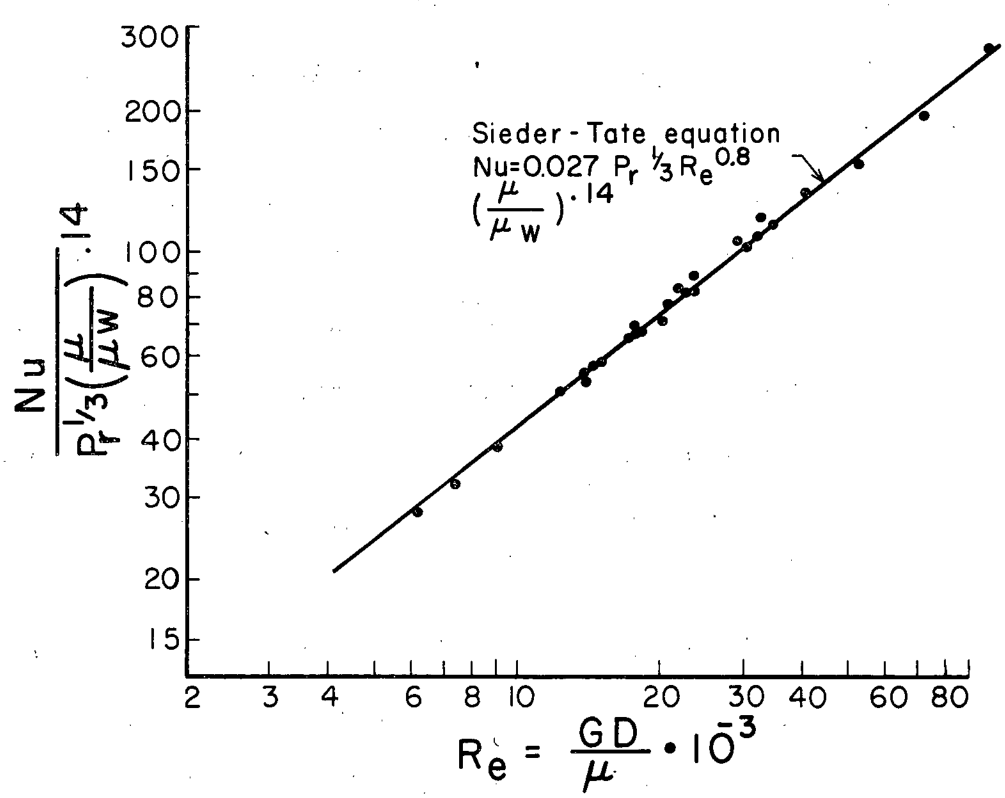

Fig. 27. Comparison of non-boiling heat-transfer data with the correlation of Sieder and Tate.

were compared with the theoretical predictions of Siegel and Sparrow[2] and Diessler.[3] Under conditions where axial and radial variations of fluid properties with temperature were negligible, the comparison with the theory of Siegel and Sparrow was good. The condition of constant fluid properties was obtained by using high flow rates, low heat fluxes, and bulk-fluid temperatures over 150°F. Above 150°F, the temperature dependency of the liquid viscosity is much less than at room temperature. Figure 28 shows the comparison between measured temperature differences and those predicted by Siegel and Sparrow. The run conditions were Pr = 1.86 and Re - 98,000. In runs where the condition of constant fluid properties was not met, the comparison with the theory of Diessler was more favorable. In such runs there was more Reynolds-number dependence than predicted by the former theory.

Thus the relatively high heat-transfer coefficients and low temperature differences that were observed near the entrance to the heated test section were due to thermal entrance effects, and other processes such as axial heat flow were negligible.

Table I gives the data from the nonboiling runs with test section No. 1.

B. Boiling Heat Transfer

Boiling heat-transfer runs were made at several levels of flowrate, heat flux, and vapor fraction, with both the 0.72-in.

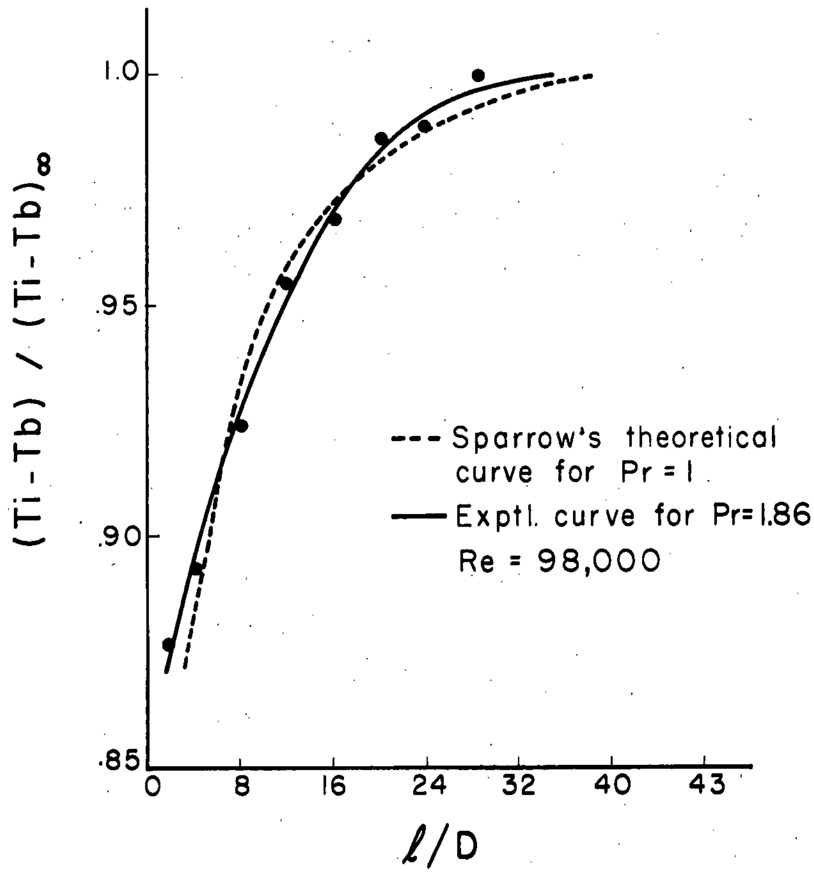

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Fig. 28. Comparison of thermal-entrance effects for test section No. 1 with the theory of Siegel and Sparrow. The ordinate is the ratio of the observed temperature difference to the fully developed temperature difference.

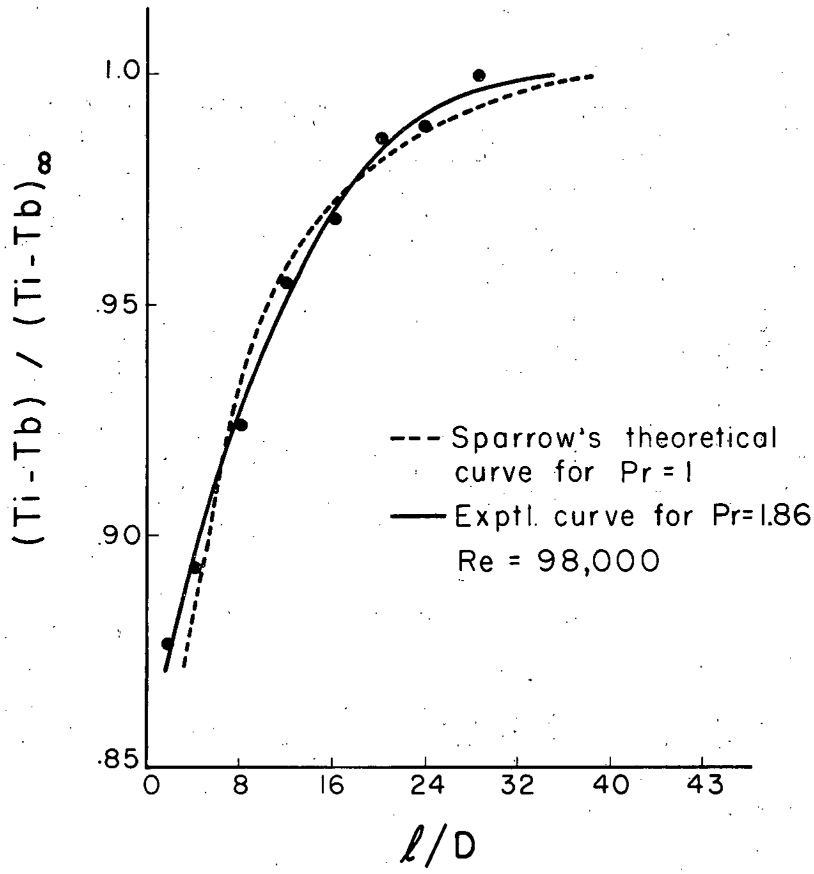

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Fig. 28. Comparison of thermal-entrance effects with the theory of Siegel and Sparrow.

Table I. Data from the nonboiling runs with test section No. 1 (3/4-in. diam). Quantities in the table are averaged over the fully-developed heat transfer region.

Run No.	T_i (^oF)	T_b (^oF)	ΔT (^oF)	G $\left(\frac{lbm}{sec\ ft^2}\right)$	q $\left(\frac{BTU}{hr\ ft^2}\right)$	h_ℓ $\left(\frac{BTU}{hr\ ft^{2\,o}F}\right)$	Nu	Re	Pr	$\left(\frac{\mu_b}{\mu_w}\right)^{.14}$	k_b $\left(\frac{BTU}{hr\ ft\,^oF}\right)$	μ_w c.p.	Heat loss (%)
1	92.0	85.4	6.6	165	4,590	700	118	18,300	5.40	1.011	0.355	0.746	1.8
1-b	86.8	82.9	3.9	301	4,430	1140	192	32,200	5.69	1.006	0.354	0.793	0.4
2	89.5	84.4	5.1	218	4,760	930	158	23,800	5.47	1.001	0.355	0.768	0.7
2-b	90.7	83.5	7.2	301	9,000	1250	212	32,600	5.65	1.002	0.354	0.758	1.1
3	93.6	84.1	9.5	113	5,040	530	89.5	12,300	5.49	1.016	0.355	0.733	2.2
3-b	89.9	82.1	7.8	275	8,880	1140	194	29,200	5.66	1.013	0.353	0.765	1.2
4	103.1	85.8	17.3	56.1	5,120	300	49.9	6,240	5.34	1.027	0.356	0.663	3.3
5	96.5	84.3	12.2	83.1	4,980	410	68.9	9,080	5.47	1.020	0.355	0.710	3.7
6	85.2	80.9	4.3	294	4,740	1100	187	30,700	5.74	1.008	0.353	0.807	1.1
7	89.5	81.6	7.9	138	4,850	610	104	14,600	5.68	1.013	0.353	0.768	1.2
8	87.6	81.2	6.4	191	4,900	770	130	20,100	5.72	1.015	0.353	0.786	2.3
9	97.4	82.6	14.8	69.3	5,080	340	58.1	7,420	5.59	1.024	0.354	0.703	3.0
10	86.7	79.7	7.0	167	4,920	700	120	17,200	5.83	1.012	0.353	0.793	2.5
11	90.4	83.8	6.6	164	4,690	710	120	17,700	5.54	1.012	0.354	0.759	2.1
12	103.3	83.7	19.6	164	14,540	740	126	17,700	5.54	1.031	0.354	0.663	1.7
13	107.8	85.0	22.8	136	14,210	620	105	15,000	5.43	1.036	0.355	0.630	2.0
14	101.4	83.6	17.8	192	14,790	830	141	20,800	5.53	1.028	0.354	0.674	1.2
15	99.1	83.5	15.6	220	13,840	890	150	23,600	5.56	1.027	0.354	0.684	5.5
16	122.2	95.1	27.4	113	15,210	560	92.4	13,900	4.78	1.040	0.360	0.548	3.0
17	95.1	81.5	13.6	205	12,270	900	153	21,600	5.66	1.023	0.353	0.721	3.1
18	187.9	179.7	8.2	206	10,570	1290	200	52,700	2.57	1.008	0.388	0.329	1.8
19	187.6	183.5	4.1	269	6,650	1620	250	70,900	2.09	1.003	0.389	0.330	1.4

and 0.47-in.-i.d. test sections.* It was desired to cover as large a range of vapor fraction as possible, but the available electrical power was limited and did not allow the generation of large quantities of vapor within the test section itself. Therefore by use of the steam-fed heaters and the flashing valve arrangement, vapor fractions at the test-section entrance of up to 10% could be obtained. The entering vapor fraction, flow rate, and heat flux were the externally controlled variables in each run.

The reduced data for all runs is tabulated in Appendix F. Almost every run shows the same general behavior: local heat-transfer coefficients at the heated section inlet are large, decrease to a minimum, and finally rise steadily to the outlet of the tube. Since the entering vapor fraction was varied over a large range, it is quite certain that the large coefficients at the entrance and their subsequent decrease down the tube are due to thermal entrance effects.† From physical reasoning it seems plausible that, in any boiling run, heat-transfer coefficients in

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* Pressure was not an independent variable in this experiment. At the outlet of the test section's lower connecting piping, the pressure was always atmospheric.

† The entering vapor fraction of some runs was in many cases larger than outlet fractions of other runs which employed the same flow rate and heat flux.

the fully-developed region would increase down the length of the tube; i.e. they would increase with increasing vapor fraction and linear velocity. Therefore one might define the thermal-entrance region as the portion of the heated tube from the entrance to the point where the minimum coefficient is observed. In some cases this definition will include almost the entire tube length. However, in most cases this results in thermal-entrance lengths on the order of those observed for nonboiling heat transfer (an arbitrary rule specifies the length be equal to about 24 pipe diameters). It is not known whether the rather large lengths are due to experimental error or to inaccurate specification of the actual two-phase entrance criteria, or whether the two-phase entrance lengths are actually as variable as evidenced by these runs. Entrance lengths can also be determined by inspection of the inside-wall-temperature curves. Without the entrance phenomena and with continually decreasing bulk temperatures but increasing coefficients, one would expect continually decreasing inside-wall temperatures. However, in most runs a maximum is observed in these curves. Figure 29 shows several inside-wall temperature profiles for differing ranges of vapor fraction. The maximum temperatures do not always occur at or near the point of minimum heat-transfer coefficient.

Using either method to characterize thermal-entrance regions, the same general conclusions can be drawn:

1. There is only a slight increase in magnitude of thermal-

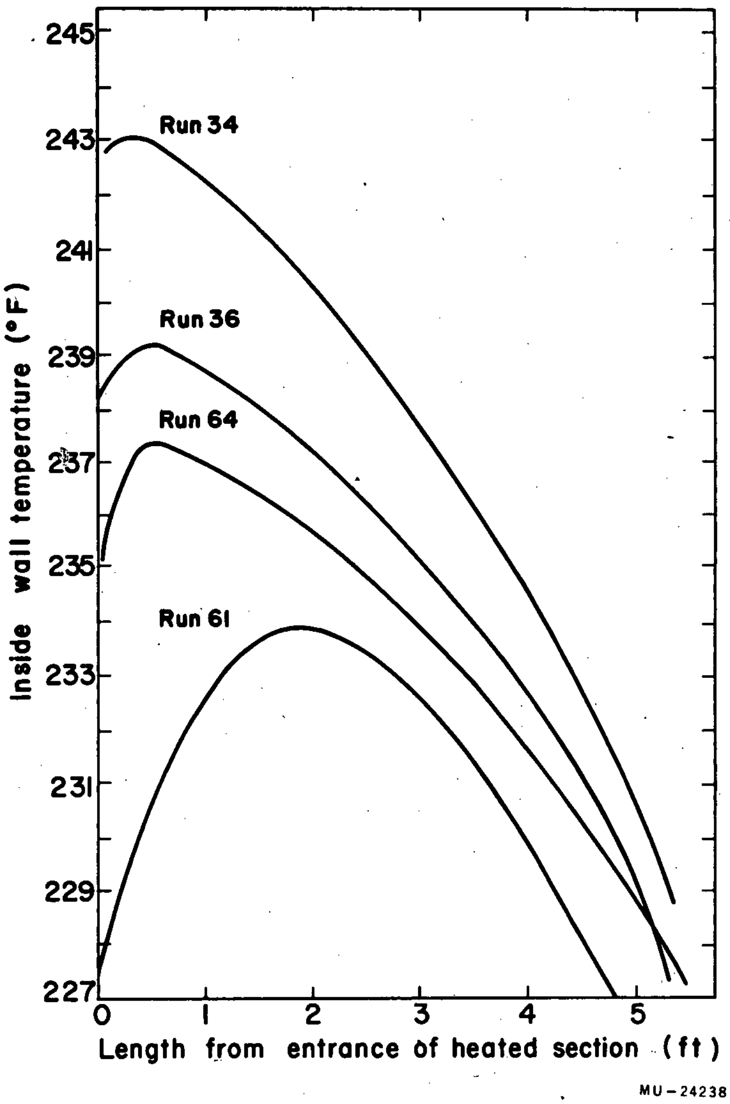

Fig. 29. Inside-wall temperature profiles for runs with several ranges of vapor fraction x, showing various thermal-entrance lengths with G = 110 lbm/sec ft^2 and q = 31,470 BTU/hr ft^2.

Run	x(%)
34	7.1 - 11.4
36	4.5 - 8.6
64	3.6 - 7.5
61	0.4 - 3.6

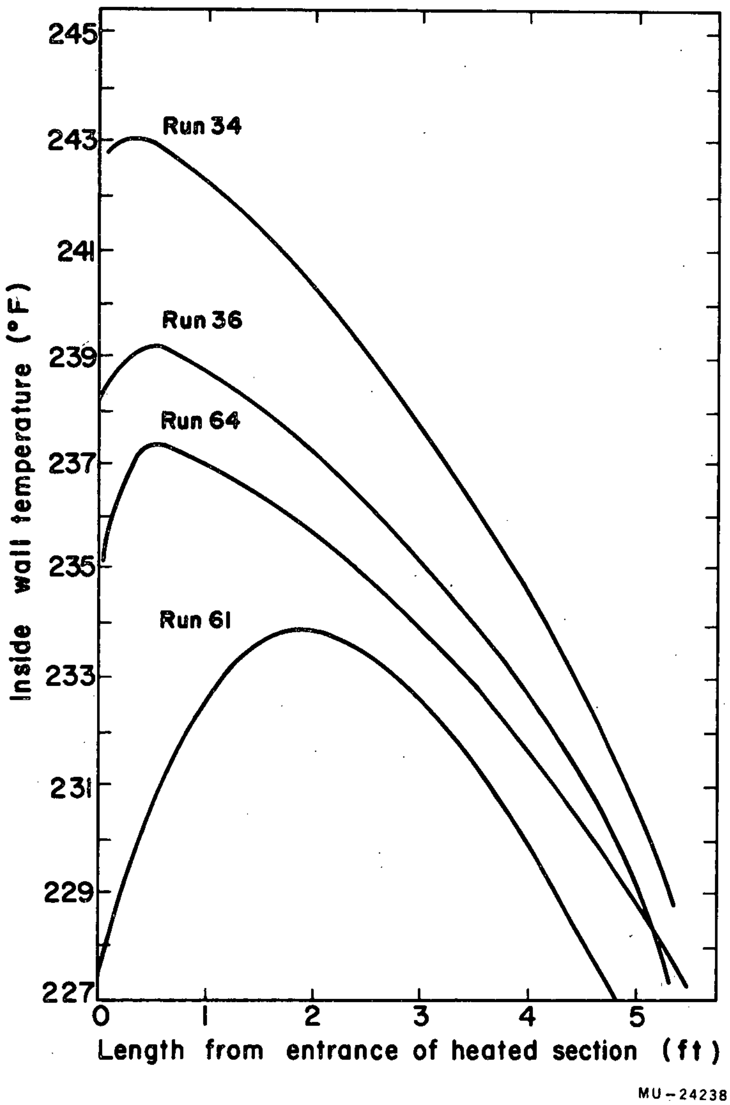

Fig. 29. Inside-wall-temperature profiles for runs with several ranges of vapor fraction x, showing various thermal-entrance lengths.

entrance effects with increasing heat flux.*

2. There is an inverse dependence of entrance length with heat flux.
3. There is a decrease in the magnitude of effects but little change in length with increasing flow rate.
4. Both the magnitude of effects and length seem to vary inversely with vapor fraction.

It must be stressed that these conclusions are based only on the inspection of the data presented in Appendix F.

In many runs it was noticed that heat-transfer coefficients increased pronouncedly near the tube outlet. It is not known whether these extreme increases are due to some special phenomena, or if these large coefficients result purely from the same processes that occur throughout the tube. Where these large coefficients are observed, large total-pressure gradients are also observed. For heat-transfer-coefficient comparison and correlation in this report, all values obtained in the thermal-entrance regions are neglected. Coefficients at the tube outlet that were considered abnormally high were also deleted. At present, the only justification for this latter deletion is that these data points did not correlate with the majority of points.

Some attempts were made to correlate the observed data by combining the Dittus-Boelter equation with pool-boiling correla-

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* Thermal entrance effects mean the departure of the heat-transfer coefficient or inside-wall temperature curves from the expected monotonically increasing or decreasing curves, respectively.

tions. In all cases, the observed trends were not correctly predicted, and this method of correlation was discontinued.

Net-boiling data were compared to the correlation of Mumm (Figure 30). For each run there was a definite trend in the data, but the over-all scatter was very large. It seems that the basic character of the Mumm correlation is well founded, but the final grouping of variables and their exponents is inappropriate.

Dengler's correlation [Eq. (I-1)] was compared with the present data. In most cases the Dengler correlation was about 40% high. This might be attributed to the inaccuracy of Dengler's local heat fluxes, which were obtained by collection and measurement of condensate from steam jackets. However, the correlation did indicate the importance of the Martinelli parameter X_{tt}.

The present data compared quite variably with the initial Schrock and Grossman correlation. Figure 31 shows this comparison. Basing their correlation on data points in the lower X_{tt} range (higher x, neglecting those points of low vapor fraction) they obtained the equation

$$\frac{h_B}{h_\ell} = 2.5\, X_{tt}^{-0.75} \quad . \tag{V-1}$$

For the range X_{tt} less than 1.5, agreement is excellent. The least-squares line for the data of Runs 100.0 to 172.0 of this report is

$$\frac{h_B}{h_\ell} = 2.72\, X_{tt}^{-0.581} \quad . \tag{V-2}$$

For comparison, Dengler obtained

$$\frac{h_B}{h_o} = 3.5\, X_{tt}^{-0.5} \quad . \tag{V-3}$$

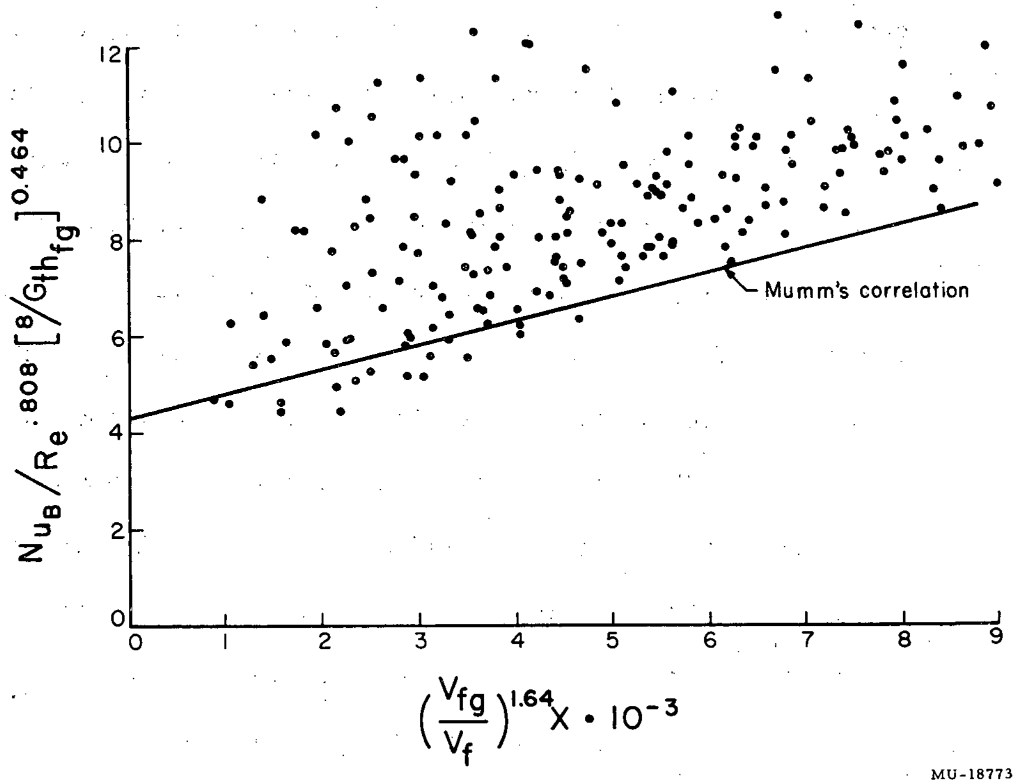

Fig. 30. Comparison of the present boiling data with Mumm's correlation.

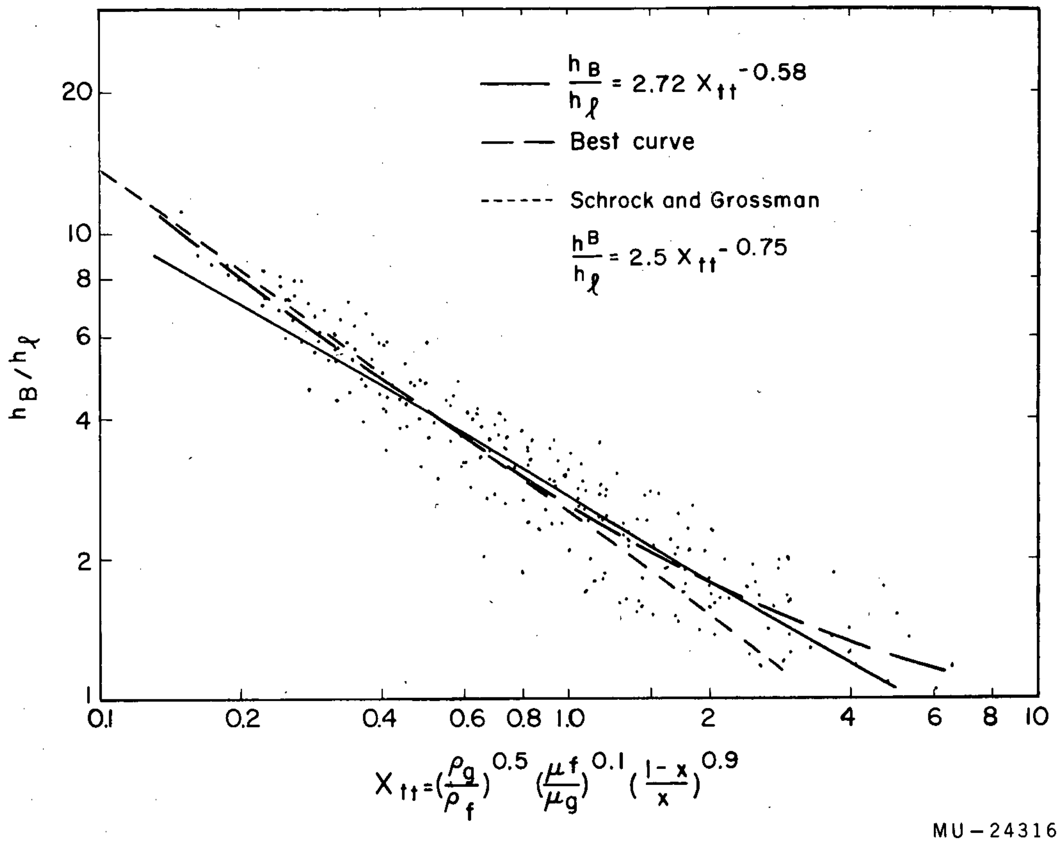

Fig. 31. Correlation of boiling heat-transfer coefficients using the Martinelli parameter X_{tt}. The data of Runs 100.0 to 172.0 are presented.

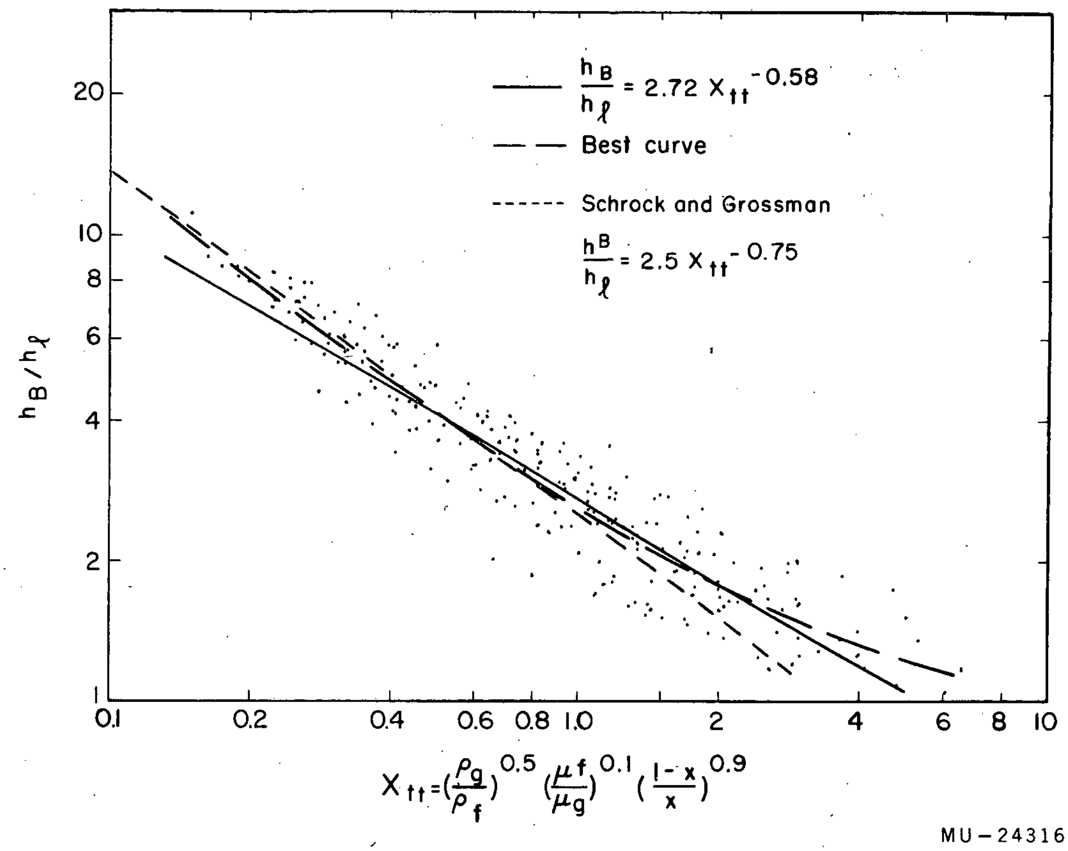

Fig. 31. Correlation of boiling heat-transfer coefficients using the Martinelli parameter X_{tt}.

When plotting the data for Fig. 31, it was consistently observed that within one run, or a set of runs with the same heat flux, there was indeed a good correlation. However, with runs of differing heat flux, it was evident that q was a significant parameter. The curves for runs of higher heat flux were displaced vertically above those of lower heat flux. Simple calculations showed a dependence of $q^{0.3}$. Schrock and Grossman using a much larger range of heat fluxes also observed this trend of the data. Actually the trend was so strong (with boiling numbers as large as 16×10^{-4}) that the plot resembled a friction-factor plot, Bo being the parameter. They postulated that the Martinelli parameter X_{tt} correctly represented forced-convection contributions and that the heat flux or some group including it was necessary to represent boiling contributions. Using the boiling number, Bo, they modified their correlation [Eq. (I-9)].

This latter correlation provided a definite correlation for the data of this report, but as seen in Fig. 32, the data are approximately 200% above the correlation line. The equation for the data of Runs 100.0 to 172.0 is

$$\frac{Nu_B}{Re_\ell^{0.8} Pr_\ell} = 320 \left[Bo + 1.5 \cdot 10^{-4} X_{tt}^{2/3}\right], \qquad \text{(V-4)}$$

whereas Schrock and Grossman obtained a coefficient of 170. Besides the differences of upflow and downflow and the difference in size of boiling tubes, the main difference in the two experiments is the pressure range used. Schrock and Grossman employed pressures up to 505 psia, where the volume change on vaporization

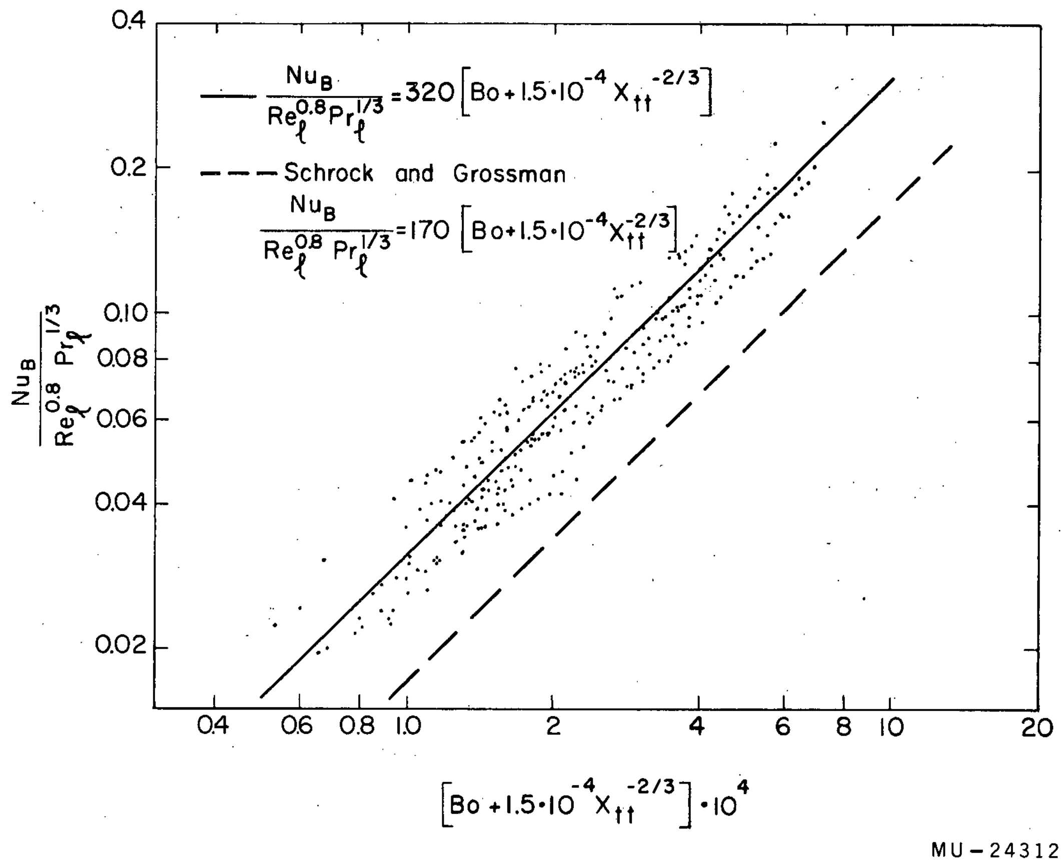

Fig. 32. Comparison of the present boiling heat-transfer coefficients with the second correlation of Schrock and Grossman.

is 1/2 to 1/4 that obtained at low pressures in this study. It is possible that [Eq. (V-4)] above does not adequately display this pressure dependence.

The boiling number, $q/h_{fg}G$, can be considered as the ratio of perpendicular mass flux away from the wall due to boiling (q/h_{fg}) to the total mass flux (G). If this ratio were stated in volumetric terms, a modified boiling number would result which would indeed display a large pressure dependence:

$$Bo_m = \frac{q}{h_{fg}\rho_g} \Big/ \frac{G}{\rho_f} = Bo \ \frac{\rho_f}{\rho_g} . \qquad \text{(V-5)}$$

The boiling number can also be interpreted as a measure of the suppression of nucleate boiling; nucleate boiling would be more likely at high boiling numbers. It should be noted that the significance of the boiling number does not depend upon nucleate boiling, but only on any vaporization process due to the transfer of heat. Neither of the boiling numbers takes into account the flashing of saturated liquid.

After comparison of the heat-transfer data with correlations devised by other experimentors, a project was initiated to study the various dependences on flow variables and to construct and compare new correlations. All computations were performed by an IBM-709 data-processing system, using a least-squares, stepwise, multiple-regression subroutine. The data used were edited to exclude points in the thermal entrance region, points near the tube outlet when coefficients seemed anomolously large, and points from runs whose P-T checks were not good. The initial stages of correlation involved the use of the raw dimensional quantities, e.g., q, G, x, D_i and the physical properties of water. For q, G, and x the exponents were generally consistent:

Variable	Exponent
q	0.3
G	0.45-0.70
x	0.4

(It is interesting to note that Mumm in his early correlation work obtained $q^{0.464}$ and $G^{0.344}$.) The dependence on the diameter D_i was not as consistent as desired, so that for later correlations it was decided to include it in the Reynolds number or the Nusselt number.

The multiple-regression routine was written so that when a variable was not significant at a specified level, it was deleted from the computation. This was usually the case when physical and thermodynamic properties of water were entered. This is not to say that such properties are not significant, but that their magnitudes varied so little throughout these experiments that no dependence could be defined. When the properties were included in the final correlation by the subroutine, the standard deviations of the coefficients (or exponents) were generally of the same order of magnitude. That is, the uncertainties of the coefficients were as large as the coefficients themselves.

The liquid-phase, Prandtl number exponents were large (1.0 to 3.0) but there is a natural bias included in these values. As the bulk-fluid temperatures decreased down the tube length, the Prandtl number rose slightly (at 212°F, $Pr_\ell = 1.75$; at 350°F, $Pr_\ell = 1.02$). With the heat-transfer coefficients also increasing with length, the Prandtl-number dependence was obscure. As there was no reproducible value for the Prandtl exponent, the value 0.4 was adopted. The various physical properties were used only as they appeared in arbitrarily selected dimensionless groups.

Table II summarizes the better correlations. The error referred to in the table is the difference between the observed heat-transfer coefficient h_B and the one calculated by the correlation. The average heat-transfer coefficient was 5039 BTU/hr ft^2 ^oF. The notation and units are the same as that used throughout this report. Figures 33 through 36 graphically show the comparison of data points with correlations 1, 3, 4, and 8.

Correlations 8, 9, 10, and 12 are of the form of the final Schrock and Grossman correlation; in fact, correlation 10, uses the same groups. It is interesting to note the comparison of the coefficients; for the first coefficient, 154, Schrock and Grossman obtained 170; for the second coefficient, 0.0542, they obtained 0.0255. This result agrees with that discussed previously (see Fig. 32). These coefficients show that for most of the data of this report, the boiling-number term is not nearly as important as the term involving X_{tt}.

The dependence of G, q, and x has been determined adequately for the range of variables employed in this experiment. However, it is felt that the ranges of these three variables are still limited as far as advancing a general correlation for design. (The heat flux is particularly limited in this experiment, the upper limit being 88,000 BTU/hr ft^2.) Also there has been no

Table II. Boiling heat-transfer-coefficient correlations[a]

Correlation No.	Correlation	Average error	Standard deviation of error	Average percentage error
1	$\text{Stanton No.} = 0.003377\,(Re_\ell^{0.106}\,Bo_m^{0.296}\,X_{tt}^{-0.457}\,Pr_\ell^{0.4})$	519	455	10.8
2	$h_B = 4.192\,(Re_\ell^{0.455}\,q^{0.289}\,x^{0.379}\,Pr_\ell^{0.4})$	564	617	10.8
3	$\text{Stanton No.} = 0.0608\,(Re_\ell^{-0.035}\,Bo_m^{0.282}\,x^{0.391}\,Pr_\ell^{0.4})$	575	469	11.8
4	$Nu_B = 0.0340\,(Re_\ell^{0.934}\,Bo_m^{0.281}\,X_{tt}^{-0.459}\,Pr_\ell^{0.4})$	607	479	12.3
5	$h_B = 7.661\,(Re_\ell^{0.842}\,Bo^{0.318}\,X_{tt}^{-0.444}\,Pr_\ell^{0.4})$	638	658	12.7
6	$\text{Stanton No.} = 1.7310\,(Re_\ell^{-0.258}\,Bo^{0.186}\,x^{0.362}\,Pr_\ell^{0.4})$	671	532	13.4
7	$Nu_B = 0.6630\,(Re_\ell^{0.783}\,Bo_m^{0.268}\,x^{0.382}\,Pr_\ell^{0.4})$	698	527	14.1
8	$\dfrac{Nu_B}{Re_\ell^{0.8}Pr_\ell^{1/3}} = 0.1935\,(Bo_m + 0.05539\,X_{tt}^{-0.581})$	706	625	14.2
9	$\dfrac{Nu_B}{Re_\ell^{0.8}Pr_\ell^{1/3}} = 0.1706\,(Bo_m + 0.05299\,X_{tt}^{-2/3})$	736	624	14.4
10	$\dfrac{Nu_B}{Re_\ell^{0.8}Pr_\ell^{1/3}} = 153.8\,(Bo + 0.05419\,X_{tt}^{-2/3})$	755	650	14.9
11	$h_B/h_\ell = 2.721\,(X_{tt}^{-0.581})$	785	732	15.7
12	$\dfrac{Nu_B}{Re_\ell^{0.8}Pr_\ell^{1/3}} = 167.10\,(Bo + 0.05722\,X_{tt}^{-0.581})$	806	713	16.1

[a] The Reynolds number Re_ℓ is based on liquid properties and the local liquid flow rate.

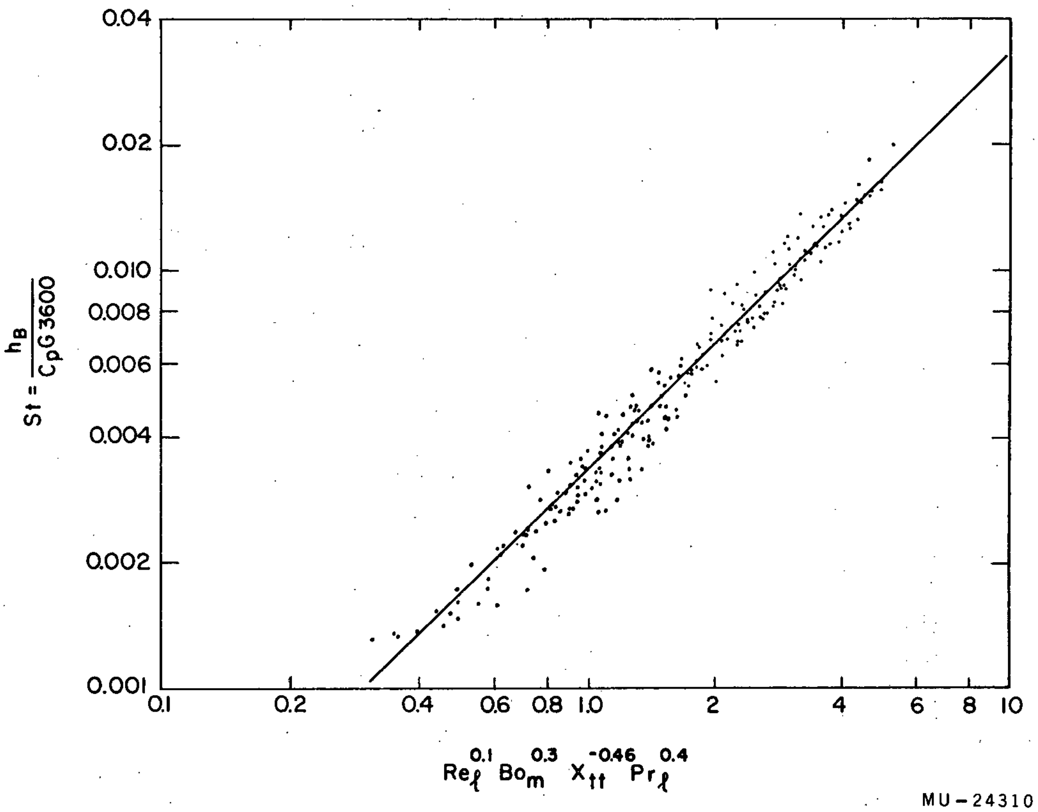

Fig. 33. Graphical presentation of boiling heat-transfer correlation No. 1.

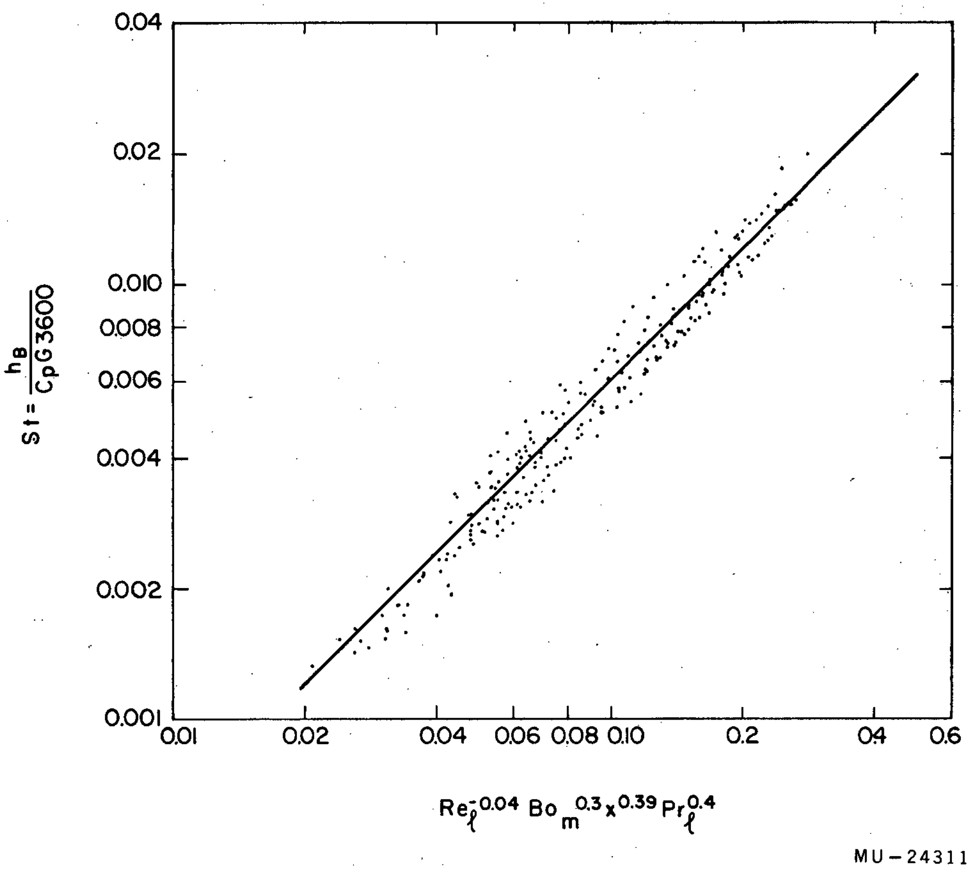

Fig. 34. Graphical presentation of boiling heat-transfer correlation No. 3, with $St=0.0608\ Re_\ell^{-0.04} Bo_m^{0.3} x^{0.39} Pr_\ell^{0.4}$.

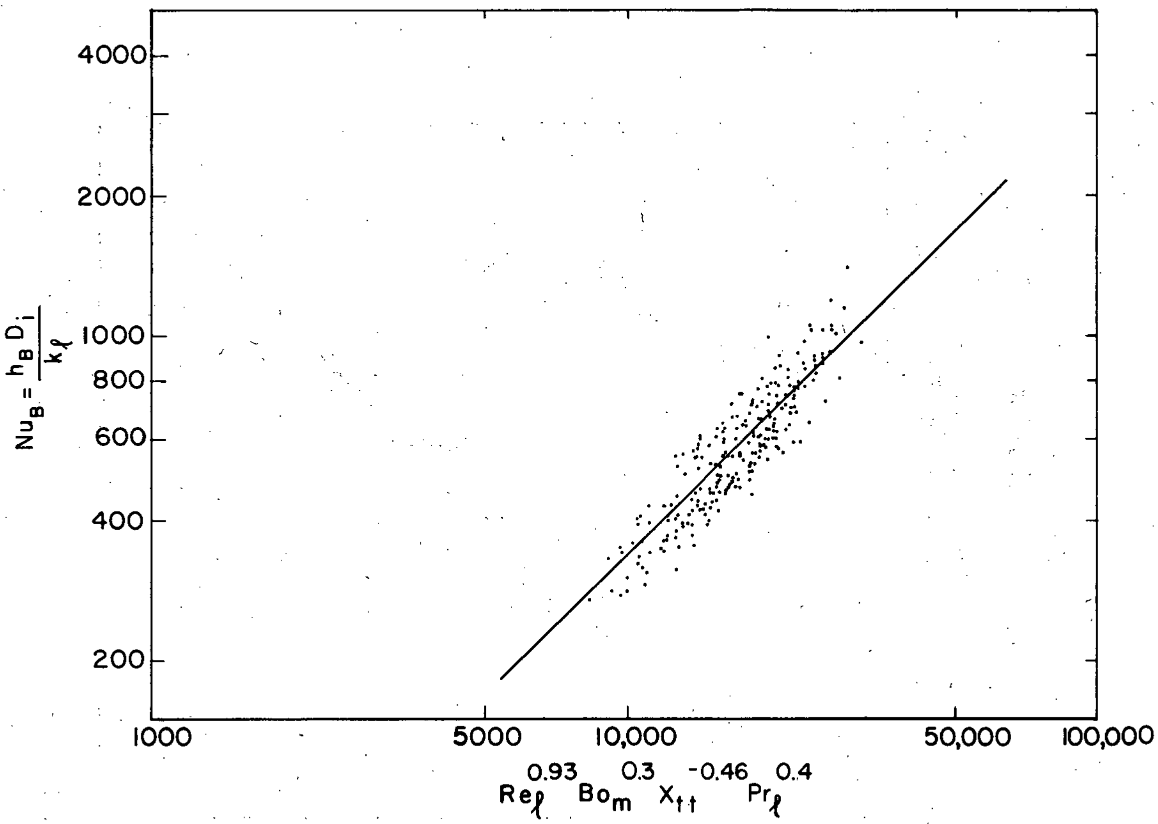

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Fig. 35. Graphical presentation of boiling heat-transfer correlation No. 4, with

$$Nu_B = 0.0340\ Re_\ell^{0.93} Bo_m^{0.3} X_{tt}^{-0.46} Pr_\ell^{0.4}.$$

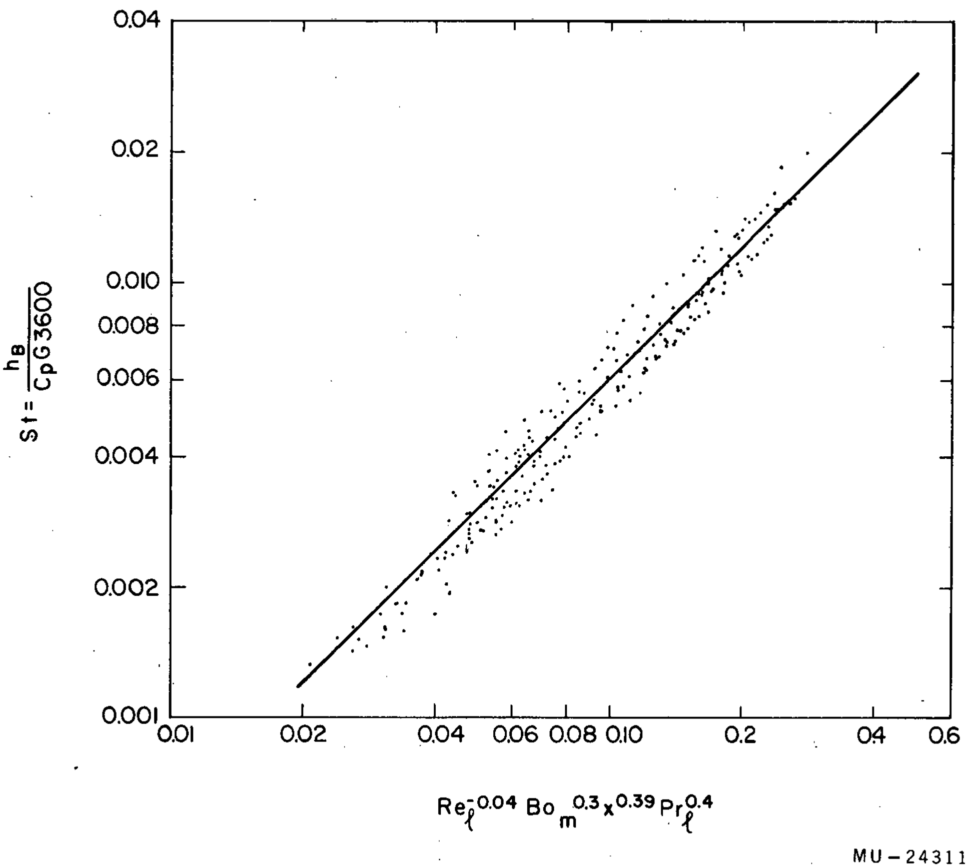

Fig. 34. Graphical presentation of boiling heat-transfer correlation No. 3.

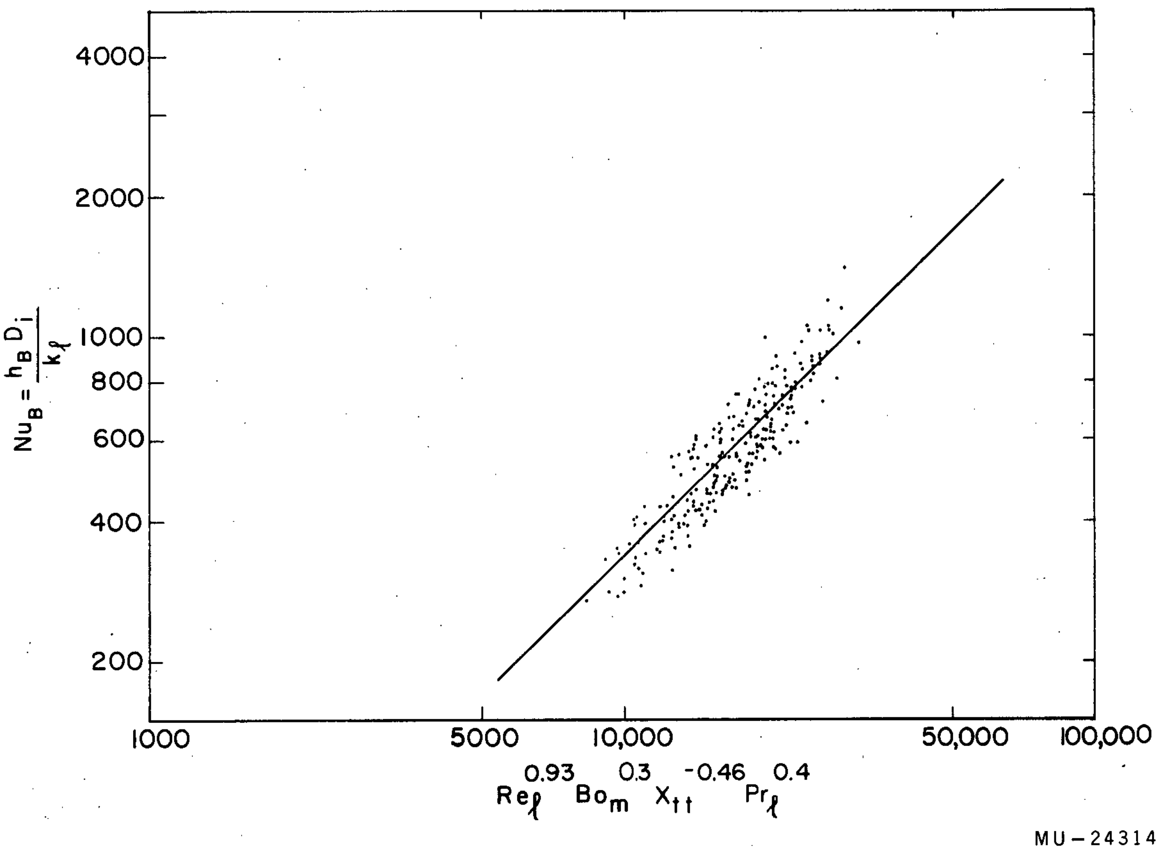

Fig. 35. Graphical presentation of boiling heat-transfer correlation No. 4.

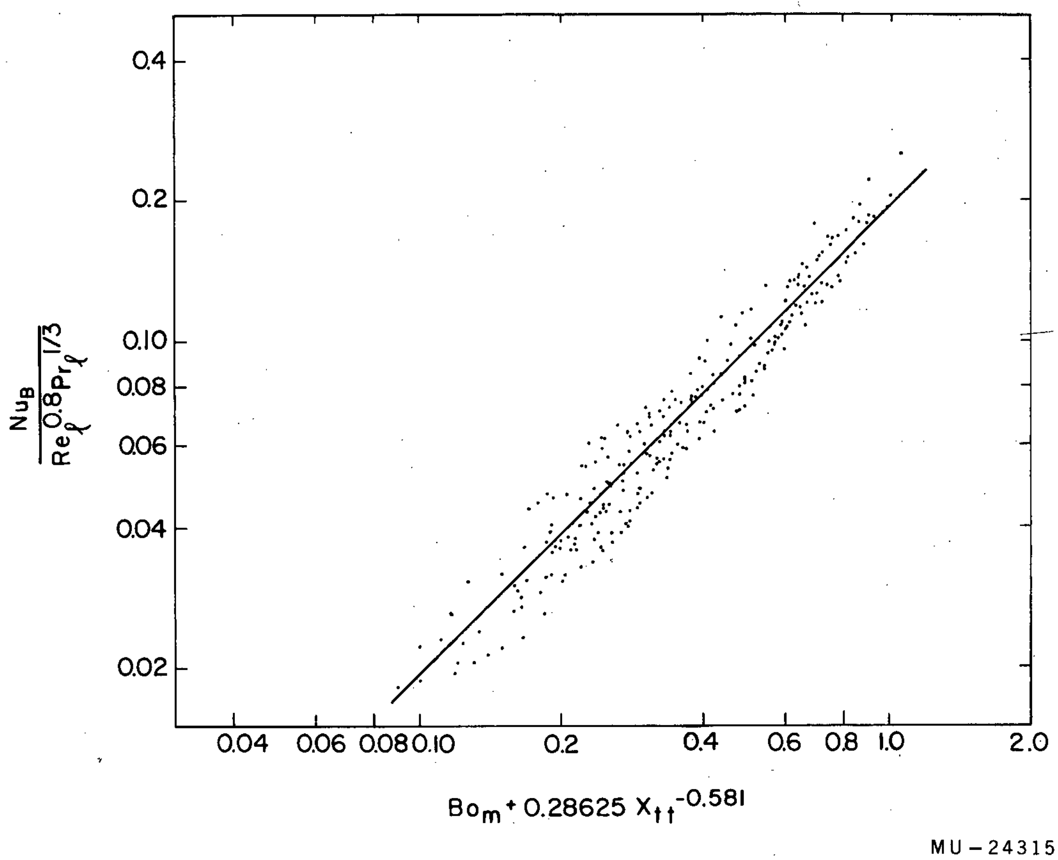

Fig. 36. Graphical presentation of boiling heat-transfer correlation No. 8, with

$$\frac{Nu_B}{Re_\ell^{0.8} Pr_\ell^{1/3}} = 0.1935\ Bo_m + 0.05539\ X_{tt}^{-.581}\ .$$

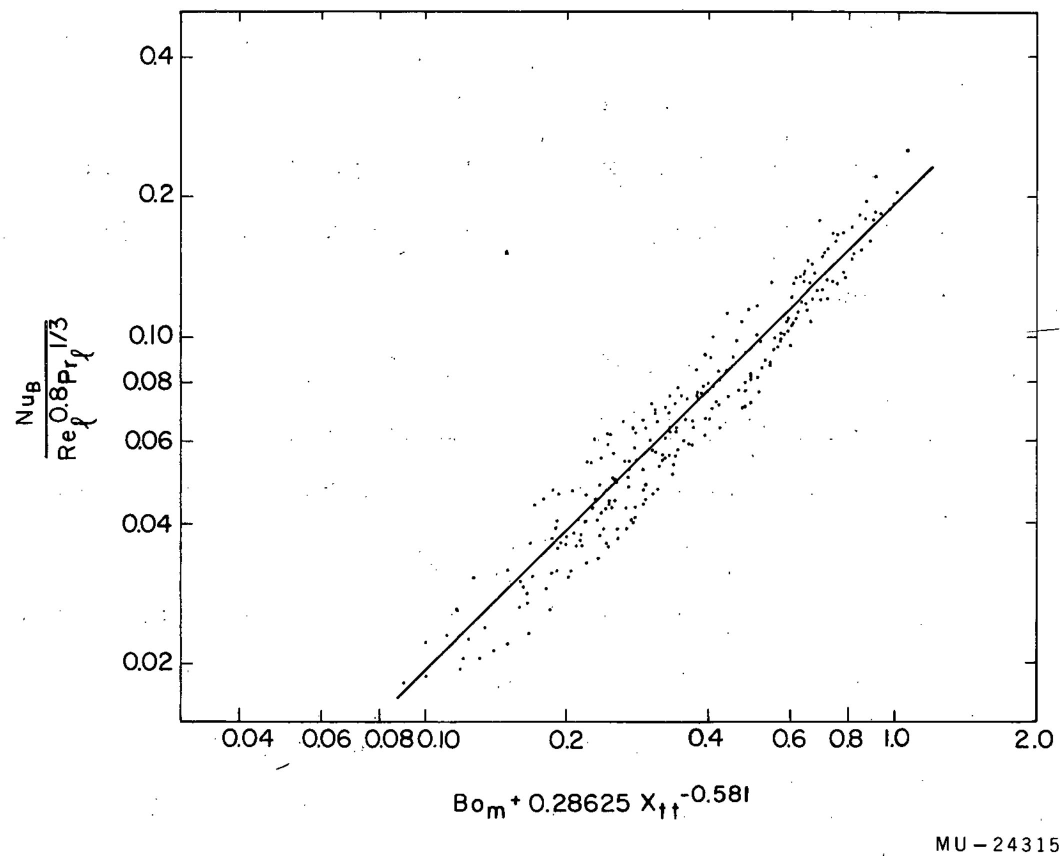

Fig. 36. Graphical presentation of boiling heat-transfer correlation No. 8.

determination of the dependence of physical properties, especially as the modified boiling number is concerned.* Future work should include a comparison of medium-pressure data (such as that of Schrock and Grossman) and low-pressure data. Certainly the effect of pressure is an important one for both heat transfer and pressure drop. In addition, to increase the generality of correlations and adequately define physical property dependences, other fluids should be used.

C. Boiling Pressure Drop

1. Correlation of total pressure gradients

Point values of total pressure gradients were obtained by graphically differentiating the pressure vs length curves. As in the work of Schrock and Grossman these total gradients were correlated with the Martinelli parameter X_{tt}. Figure 37 shows this correlation. The pressure gradient was put in dimensionless form by dividing it by the frictional pressure gradient that would be expected if the liquid phase were flowing alone and filling the tube. The liquid-phase gradient obtained by use of the Blausius friction-factor formula,

$$f = 0.3164\, Re_{\ell}^{-1/4}, \qquad (V\text{-}6)$$

---

* In similar correlation forms, the modified boiling number, Bo_m, usually was better than Bo (by comparison of the standard deviations of the correlated variable). Because of the limited pressure range used, this result cannot be considered general. Refer to Table II.

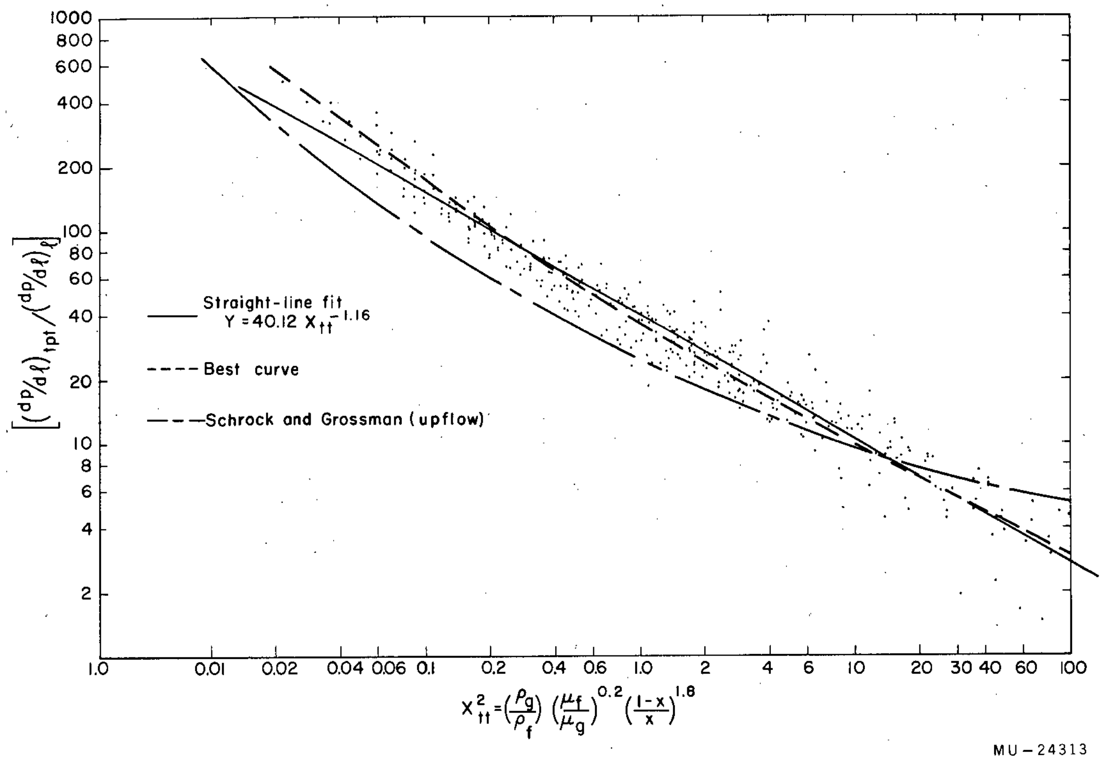

Fig. 37. Correlation of forced-convection-boiling total pressure drop using the Martinelli parameter X_{tt}. The data presented are from Runs 100.0 to 172.0 .

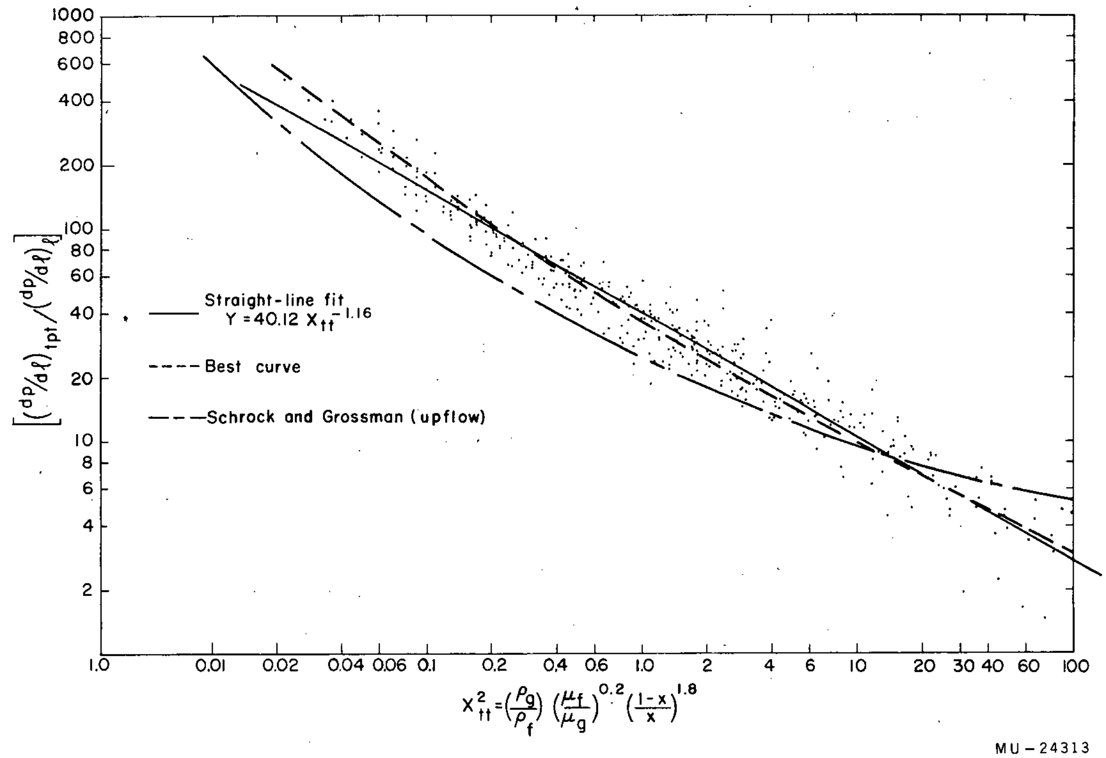

Fig. 37. Forced-convection boiling total pressure drop correlation using the Martinelli parameter X_{tt}.

is

$$\left(\frac{dp}{d\ell}\right)_{\ell} = \frac{0.3164\ [(1-x)G]^2}{2.144 g_c\ D_i\ \rho_{\ell}\ Re_{\ell}^{1/4}} . \qquad \text{(V-7)}$$

The least-squares straight line for the data presented in Fig. 37 is

$$\left[\left(\frac{dp}{d\ell}\right)_{tpt} \Big/ \left(\frac{dp}{d\ell}\right)_{\ell}\right] = 40.12\ X_{tt}^{-1.16} , \qquad \text{(V-8)}$$

although the best curve through the data is not a straight line. The largest scatter occurs for large values of X_{tt} (low vapor fractions). Lockhart and Martinelli also observed this effect. This could possibly be attributed to changes in the hydrodynamic flow pattern. Equation (V-8) is generally above the upflow data of Schrock and Grossman. A possible explanation lies in the fact that undoubtedly liquid holdup in the two systems would be different; the gravity field in the downflow system tends to accelerate the liquid phase (rather than decelerate it) causing substantially larger momentum losses. Hydrostatic-head contributions in the two systems are of opposite sign, but of such small magnitude as to be negligible. Figure 37 does not employ the conventional Lockhart-Martinelli coordinants but uses the square of these quantities. In view of this test of the data and the success of the Schrock-Grossman correlation, the validity of the total-pressure-drop correlation over a wider range of conditions seems justifiable. It is surprising that the Martinelli method should provide a correlation for total-boiling-pressure gradients, as there is no provision in this method for varying heat fluxes, for momentum changes, or hydrostatic-head contributions. However, the correlation has been tested over a moderate range of conditions and seems to provide good agreement.

2. Prediction and Correlation of Individual Pressure Losses

As discussed in the Introduction, the total pressure loss in forced-convection boiling is made up from three contributions: friction losses, acceleration losses (momentum changes), and hydrostatic head. A series of calculations were made to predict these individual loss terms by various methods, to combine them to obtain total pressure gradients, and to compare these values with the observed quantities. In these calculations, the pressure actually observed in the experiment was used to define the vapor fraction x and the physical properties of water.

Acceleration losses and hydrostatic-head contributions are dependent on the evaluation of the volumetric vapor fraction α. In these calculations, α was obtained by several methods:

a. The "bubble" flow theory of Bankoff[33] and the "momentum exchange" theory of Levy[34] were used.

b. The published correlations of α with X_{tt} by Lockhart and Martinelli and by Dengler were used. Neither of these correlations is based on a downflow system.

c. The volumetric vapor fraction α was also obtained by specification of the slip ratio ψ. If it is assumed that an average velocity can be assigned to each phase, the volumetric vapor fraction and the slip ratio are related by

$$\alpha = \frac{x}{\left[\psi \frac{\rho_g}{\rho_f}(1-x) + x\right]} .$$

Values of ψ used were 1.0 and 2.0. The value 1.0 was chosen because this represents the "homogeneous" flow model. If we assume the vapor phase can never have a smaller velocity than the liquid phase, the homogeneous flow model sets the upper limit on acceleration losses. The value 2.0 was chosen as a more probable value for the slip ratio. The compilation of slip-ratio data at Argonne National Laboratory shows that for a large range of vapor fraction and at high superficial liquid velocities (6 to 10 ft/sec), the value 2.0 is a good approximation. Many runs in this report are for superficial velocities in this range.

Once α is determined, the pressure gradients due to acceleration losses and hydrostatic head are obtained from

$$-\left(\frac{dp}{d\ell}\right)_a = \frac{G^2}{144g_c} \frac{d}{d\ell}\left[\frac{x^2}{\rho_g\alpha} + \frac{(1-x)^2}{\rho_f(1-\alpha)}\right] \tag{V-10}$$

and

$$-\left(\frac{dp}{d\ell}\right)_h = -\frac{g}{144g_c}\left[\rho_f(1-\alpha) + p_g\alpha\right] . \tag{V-11}$$

Equations (V-10) and V-11) are derived from elementary force and momentum balances. [Equation (V-10) is derived in Appendix D.]

Frictional pressure gradients were calculated by several methods: the theories of Bankoff and Levy,[35] the original correlation of Lockhart and Martinelli, and finally a modified friction factor method. For the Lockhart-Martinelli method, the friction-factor multiplier ϕ_ℓ^2 was obtained from

$$\ln \phi_{\ell} = 1.46664 - 0.51346\,(\ln X_{tt}) + 0.04879\,(\ln X_{tt})^2. \quad \text{(V-12)}$$

This equation was obtained from a least-squares fit of the original Lockhart-Martinelli data.

The modified friction-factor method consisted essentially of computing mean or effective density and viscosity values

$$\rho_m = \alpha\rho_g + (1-\alpha)\,\rho_f \quad \text{(V-13)}$$

and

$$\mu_m = \frac{1}{\dfrac{x}{\mu_g} + \dfrac{(1-x)}{\mu_f}} \quad . \quad \text{(V-14)}$$

Values of α were obtained by the methods described above. These mean quantities were then used in Eqs. (V-6) and (V-7).

The total pressure gradients calculated by combining the individual gradients were compared with the observed values obtained in both the first and second experimental stages of this report. The theories of Bankoff and Levy were reliable only for very low qualities (under 1%), and this reliability was not consistent. Admittedly, the theory of Bankoff had as its basis the bubble-flow model, where the liquid phase is continuous over the pipe cross section with vapor bubbles being dispersed throughout the flow channel. Bubble flow is stable only for relatively low flow rates and for a limited range of volumetric vapor fraction (less than 90%). In the present experiments, bubble flow, if obtained at all, was probably limited to the entrance regions of the test section and then only for lower flow rates. In the original papers of both Bankoff and Levy, the theories are compared favorably to experimental data. Most of the data used were for high pressures; the low pressures used in this experiment form a more stringent test of these theories.

The acceleration and hydrostatic-head gradients obtained with the correlations of Lockhart and Martinelli and of Dengler were combined with frictional gradients obtained by all of the above friction methods. In few cases was the comparison with the observed total gradients satisfactory; usually acceleration losses seemed to be too small. Slip ratios calculated from these correlations are usually much larger than 2.0.

With the specification ψ = 1.0 (the homogeneous-flow model), in many cases the accelerational gradient was larger than the total-pressure gradient. With the specification of ψ = 2.0 for the determination of acceleration and hydrostatic-head gradients, and with the use of the Lockhart-Martinelli friction correlation or the modified-friction-factor method, at least fair agreement with the observed gradients was usually obtained. In general, the two methods gave usually similar results, the Lockhart-Martinelli correlation being slightly more reliable. The methods were usually unreliable for qualities under 3%, where the observed gradients were less than 1.0 psi/ft. In these cases both methods gave gradients much larger than those observed.

Because of the unreliability of these methods at low qualities, the total-pressure-gradient correlation, Eq. (V-8) and Fig. 37, is recommended. It is interesting to note that above 3% quality, the two methods have slightly less scatter than the correlation. In this range of quality it seems reasonable to conclude that

a. The slip ratio is in the neighborhood of 2.0 for most of the runs in this report, and

b. For downflow forced-convection boiling there is a good degree of correlation of the frictional pressure gradient with the Martinelli parameter X_{tt}, i.e. the original Lockhart-Martinelli correlation.

D. Flow Pattern and Vaporization Mechanism

The flow pattern within the boiling test section could not be observed but there were sight glasses in both the inlet and outlet connecting piping. For low flow rates and low vapor fractions (1%), the flow pattern observed in the inlet sight glass is best described by the bubble-flow model. Bubbles were usually large and well-separated from each other. At higher velocities and qualities, a definite liquid-annulus-vapor-core flow pattern was noticed. The liquid vapor interface was usually wavy. At even higher velocities, the core was usually quite turbulent and consisted of a mixture of both liquid and vapor. The flow pattern observed at the outlet of connecting piping below the test section can best be described as a very turbulent mixture of liquid and vapor. Little variation from one run to another was observed. Illumination by a Strobe light provided little additional information. It should be noted that, in this experiment, flow rates that were so low that "slugging" occurred were usually avoided.

It is believed that the flow pattern within the boiling test sections was generally like that observed at the outlet sight glass. Liquid would certainly be continuous at the heat-transfer surface, or heat-transfer coefficients would not be as large as those observed. The inner core, including most of the cross-sectional area of the tube, was probably a very turbulent mixture of liquid and vapor. From the work predicting pressure gradients, it seems that the homogeneous flow pattern did not exist in the majority of runs, if at all. Instead it seems slip ratios were on the order of $\psi = 2.0$. This is not to say that there was actual physical slip between the two phases; rather, it is believed there was no slip at any vapor-liquid interface. As pointed out by Bankoff, there will be a velocity gradient across the tube (the velocity at the tube wall is zero), and if the vapor phase is more concentrated in the center of the tube, the slip ratios based on average velocities will be greater than 1.0. Large slip ratios (up to 5 and 6) as obtained in many upflow experiments probably would not occur in a downflow system because of the gravity acceleration of the liquid phase.

Along with this proposed flow pattern, it seems plausible that most of the vaporization occurred at existing vapor-liquid interfaces, not at the wall, the mechanism resembling evaporation or flashing rather than nucleate boiling. This proposed mechanism is in line with that given by Sachs and Long.[36] These authors visually observed forced-convection boiling in an annulus. An inner rod acted as the heat-transfer surface while the outer tube was transparent. They observed that nucleate boiling occurred only in a small zone near the tube entrance. This zone seemed to be independent of flow rate and heat flux. Downstream, no nucleation was observed, although vaporization continued. Since flow rates in their work were relatively small, but boiling numbers large,* it seems quite possible that the supression of nucleate boiling is a good deal easier than postulated by Dengler and others. If this is true, it is probable that very little nucleate boiling actually occurred in the present experiments. If nucleation did occur, it was most certainly limited to the region near the tube entrance, where the interaction with thermal entrance effects complicated the recognition of the nucleate boiling phenomena.

E. Application to Design

In the general case of forced-convection boiling in tubes (or conduits), design procedures must include both heat-transfer and pressure-drop calculations. Since these calculations are interdependent, a double trial-and-error, stepwise computation necessarily results. In the special case of a uniformly heated tube, where the heat flux is uniquely specified, the performance can be predicted by the pressure-drop calculation alone.† This involves a single trial-and-error computation involving the stepwise determination and integration of local pressure gradients.

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* The mass fluxes used by Sachs and Long were 4 to 22 lbm/sec ft^2. Heat fluxes up to 23,359 BTU/hr ft^2 were used. Boiling numbers, Bo, would be about 36×10^{-4}.

† This is also true for the case where the quality x is given as a function of conduit length. Here heat flux is implicitly specified.

Once this computation has been performed, the results may be used with heat-transfer correlations to predict tube-wall temperatures.

Noyes, Bergonzoli, and Gingrich have written a program to predict heat transfer, pressure drop, and volumetric vapor fraction for flow in a pipe.[37] One-phase forced convection, subcooled boiling, and two-phase forced-convection boiling were included in what the authors hoped was a general method of calculation. However, it is felt that the basic relations used in some cases were unsatisfactory and could be improved significantly. For instance, a correlation advanced by S. Levy for nucleate pool boiling was superimposed on the Dittus-Boelter relation for calculation of the heat-transfer coefficient. Also, a correlation for air-water flow by Chrisholm and Laird was used for the volumetric vapor fraction. Neither of these two methods seem to be satisfactory for the forced-convection net boiling of water. The comparison of the results from a sample calculation and the pressure-drop data of Jens and Lottes shows reasonable agreement for engineering purposes -- about $\pm$ 20%.

1. Design Computations

Using the two satisfactory pressure-drop methods discussed in Section C-2 (with the specification of $\psi = 2.0$) and the total pressure-drop correlation [Eq. (V-8)], an IBM 709 Fortran program was written to predict the performance of the uniformly heated test sections used in this report.

Basically, the computation scheme is as follows. The length of the boiling tube is divided into a number of equal length segments, $\Delta \ell$. Consider one of these small segments whose upstream location is ℓ. It is assumed that the pressure p_i and the quality x_i are known at the upstream end of the segment (denoted by i). The flow rate and heat flux are also known. At the downstream end of the segment (denoted by ii), a pressure p_{ii} is assumed. Using p_{ii} (a saturation pressure), the thermodynamic and physical properties of the working fluid are obtained at the location $\ell + \Delta \ell$. Then with the knowledge of the wall heat transfer, an energy balance [Eq. (IV-15)] is used to obtain the quality x_{ii}. With the use of x_i, x_{ii}, p_i, p_{ii}, and the properties at each end of the segment, the pressure-loss calculations are performed. For example, the pressure loss due to acceleration is obtained from rearragement of Eq. (V-10):

$$\Delta p_a = \frac{G^2}{144 g_c} \Delta \left[\frac{x^2}{\rho_g \alpha} + \frac{(1-x)^2}{\rho_f (1-\alpha)} \right], \qquad \text{(V-15)}$$

where the difference Δ is obtained by using x_i and x_{ii}, etc. The pressure losses due to hydrostatic head and friction are determined by

$$\Delta p_h = \frac{g}{144 g_c} \left[\rho_f (1-\alpha) + \rho_g \alpha \right] \Delta \ell \qquad \text{(V-16)}$$

and

$$\Delta p_{tpf} = \left[\left(\frac{dp}{d\ell} \right)_{tpf} \right] \Delta \ell, \qquad \text{(V-17)}$$

with the square-bracketed quantities being evaluated at the midpoint of the segment, and with the use of mean properties $x_m = \frac{x_i + x_{ii}}{2}$, etc. With the total-pressure-gradient correlation, Δp_T is also evaluated at the segment midpoint. After the pressure drop is evaluated, it is used in the relation

$$p_{ii} = p_i - \Delta p_T. \qquad \text{(V-18)}$$

This new value of p_{ii} is compared to the initially assumed value. If the agreement is not satisfactory, another value of p_{ii} is assumed and the calculation repeated. When the agreement does become satisfactory, the value of p_{ii} is then accepted for the pressure p_i of the next segment and the computation continues. The computation can be started at either end of the tube, but usually the conditions are more easily specified at the inlet.

In the actual computation, the pressure p_{ii} assumed at the start of the computation (for each segment) was that obtained from friction loss alone. The frictional gradient was evaluated at the point i. If the calculated value of p_{ii} was not satisfactorily close to the assumed value, it was then adopted as the assumed p_{ii} for the next iteration, etc. In this manner, starting at a low value of Δp, the "marching" computation was continued until agreement was obtained. Agreement within 0.001 psi, with a $\Delta \ell$ of 0.125 ft, was usually obtained within 20 iterations. Design calculations for six representative runs required some 15 to 20 min on the IBM 709.

2. Comparison of the Calculated and Observed Pressure Profiles

The marching-type iterative calculation described above is a relatively unsophisticated procedure which is extremely dependent upon the accuracy of the calculated gradients. As errors are cumulative in this procedure, even small inaccuracies in the gradients can cause large deviations from the observed results. In fact, the deviations may become so large that the results are completely unrealistic or the iterative procedure diverges. The stability of the calculation is also somewhat dependent on the increment size,

$\Delta\ell$, and the agreement that is desired between successive trials.

The comparisons of the calculated and observed pressure profiles were essentially in line with the comparisons of the calculated and observed total-pressure gradients (as discussed in Section C). The total-pressure-gradient correlation seems to be much more reliable than the two methods that predict individual losses. In fact these two latter methods gave diverging results in four of the six runs. In these calculations the two methods gave reasonable results for about 60% of the tube length, and then rapidly diverged and were terminated. The correlation calculation never gave unrealistic results or diverged, and it was considerably faster than either of the other two methods. The profiles obtained from the correlation were always within 17% of the observed profiles. Figures 38 and 39 show comparison of pressure profiles for two runs; Figures 40 and 41 show comparisons of calculated and observed inside-wall temperatures. These temperatures were obtained from the calculated pressure profiles using heat-transfer correlation No. 1. The large differences in the temperature profiles near the tube entrance are due to thermal-entrance effects; the divergence of these curves can serve as a definition for the thermal-entrance length.

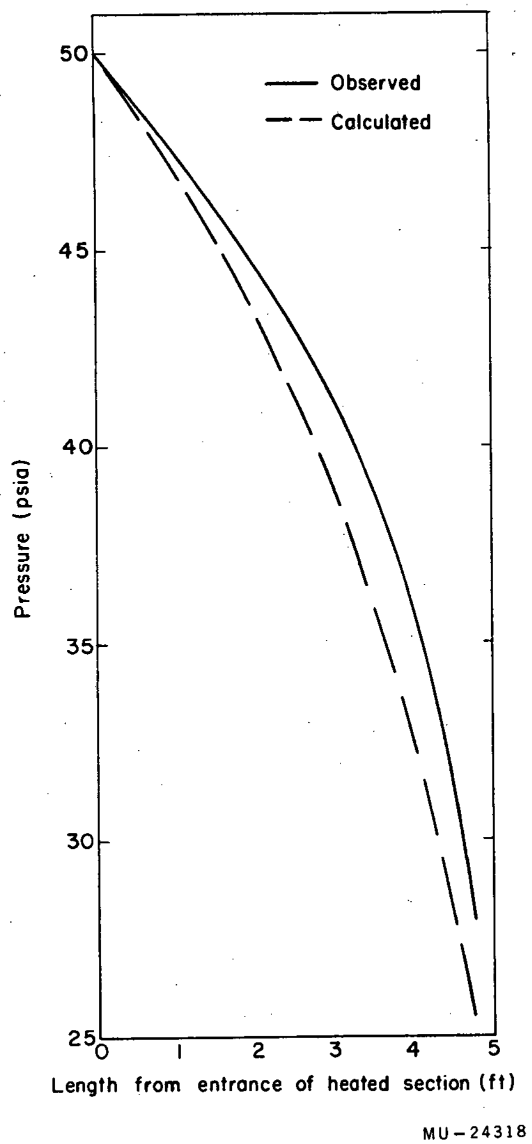

Fig. 38. Comparison of the calculated and observed pressure profiles for Run 161.0.

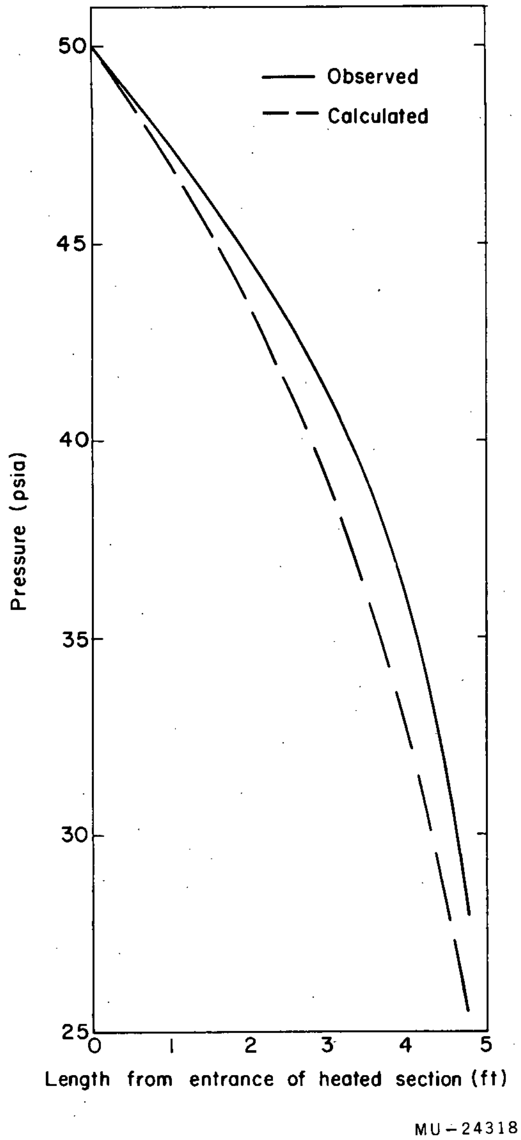

Fig. 38. Comparison of the calculated and observed pressure profiles for Run 161.0. The total-pressure-gradient correlation, Eq. (V-8), was used in this calculation.

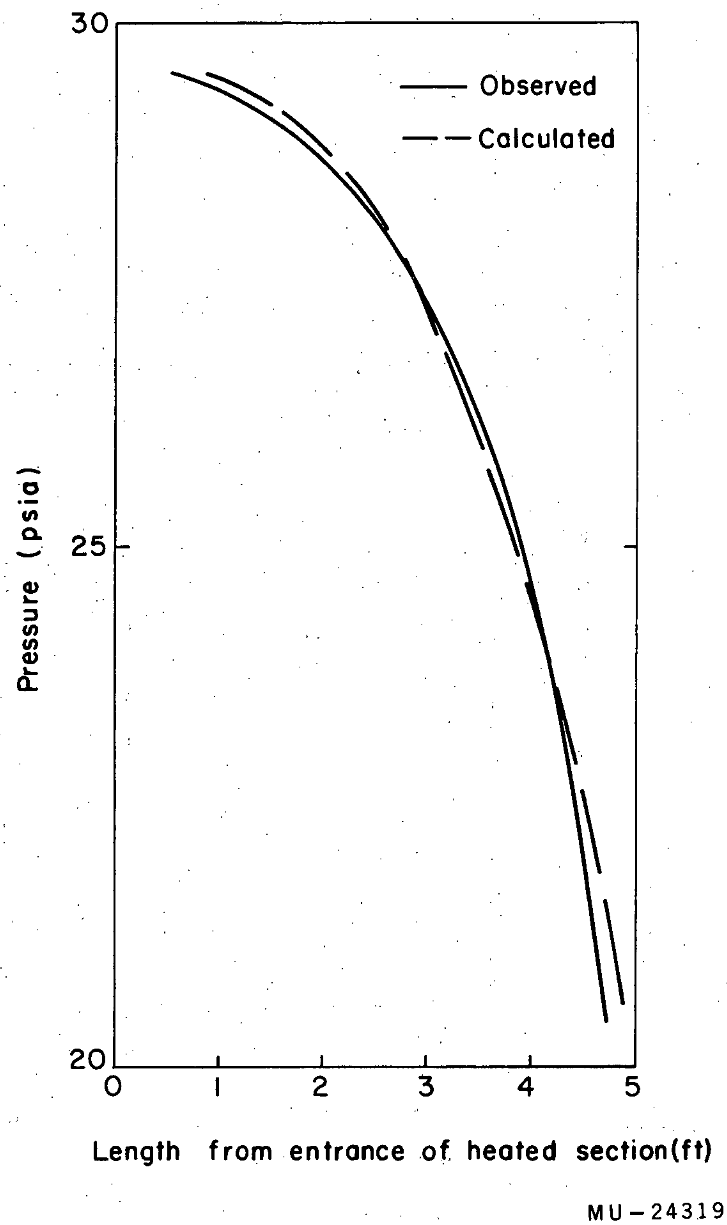

Fig. 39. Comparison of the calculated and observed pressure profiles for Run 159.0. The total pressure gradient correlation, Eq. (V-8) was used in this calculation.

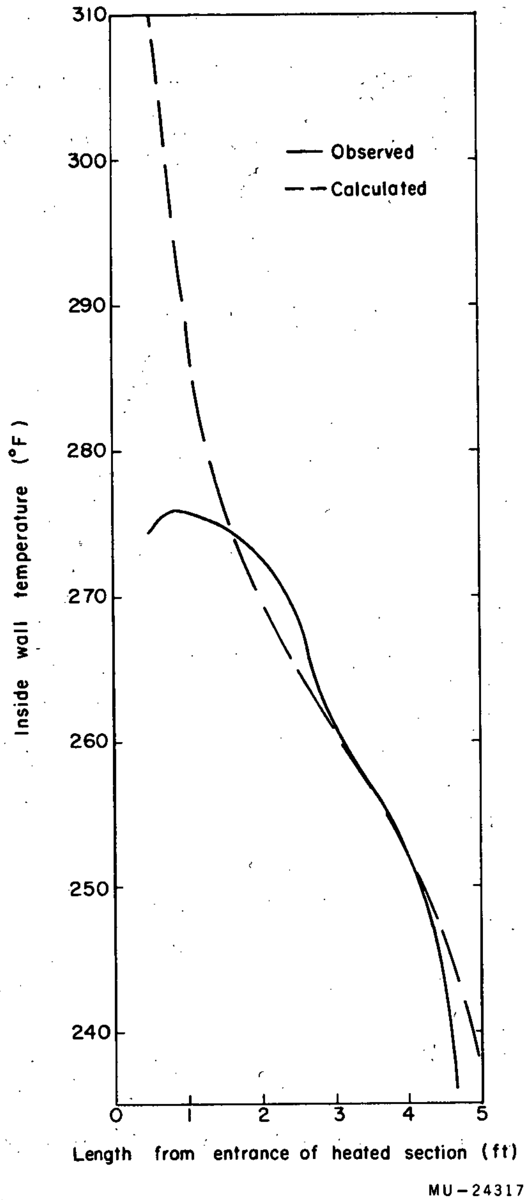

Fig. 40. Comparison of the calculated and observed inside-wall temperature profiles for Run 159.0. Pressures were obtained by use of the total-pressure-gradient correlation Eq. (V-8); temperatures were obtained by use of heat-transfer correlation No. 1. At $\ell = 0.50$, the quality is 0.14%. The inside-wall temperature of 309°F would give essentially the same coefficient as the Dittus-Boelter equation if it were not for the large thermal-entrance effects.

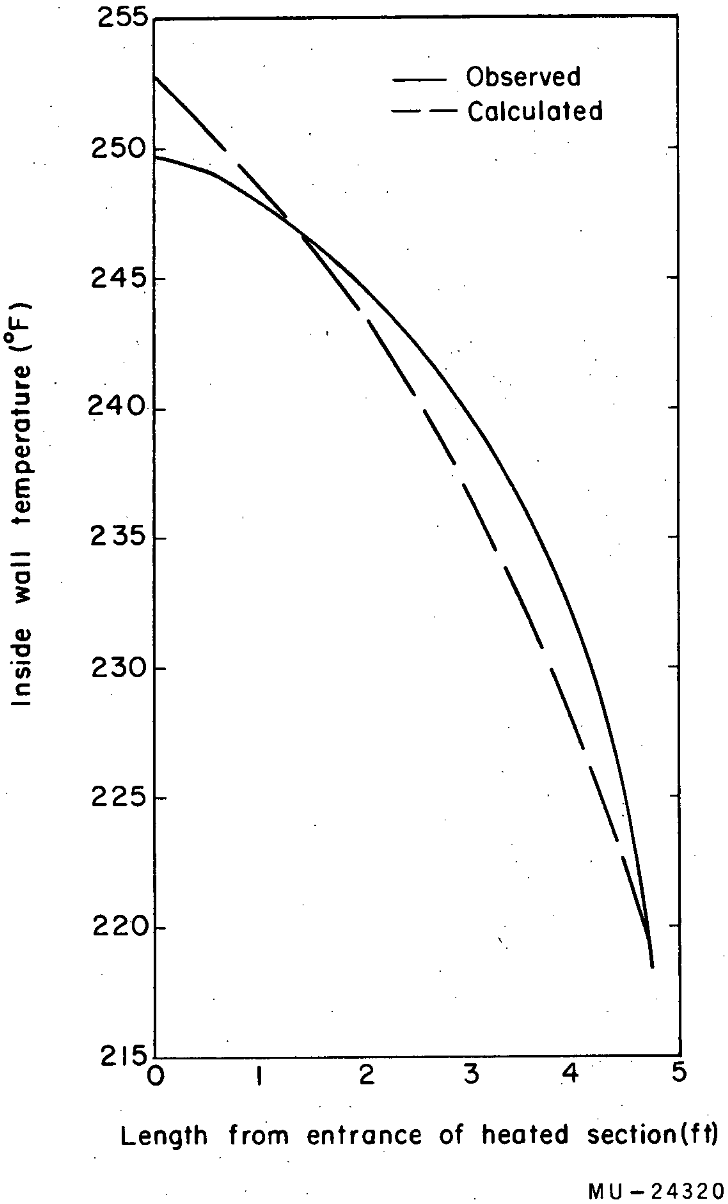

Fig. 41. Comparison of the calculated and observed inside-wall-temperature profiles for Run 172.0. Pressures were obtained by use of the total-pressure-gradient correlation Eq. (V-8); temperatures were obtained by use of heat-transfer correlation No. 1. The entrance quality was 4.64%.

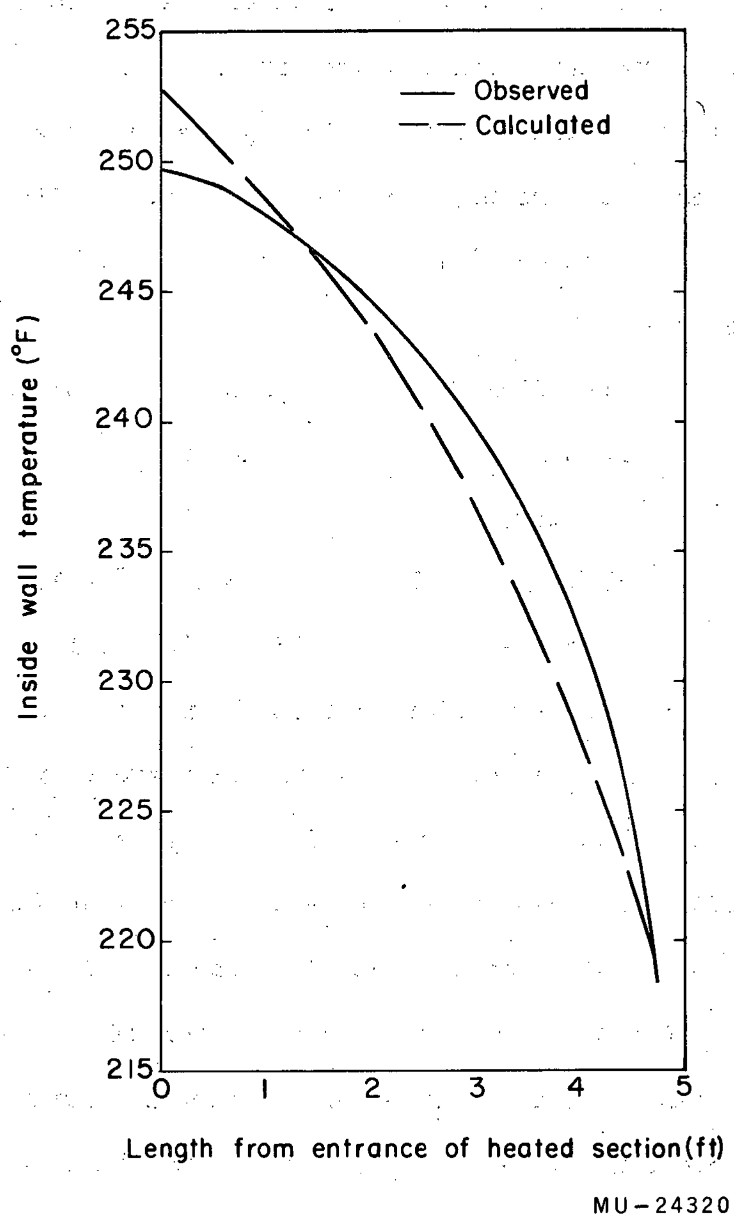

Fig. 41. Comparison of the calculated and observed inside-wall-temperature profiles for Run 172.0.

VI. CONCLUSIONS AND RECOMMENDATIONS

Local heat-transfer coefficients and local total-pressure gradients have been measured in the downflow forced-convection boiling of water in electrically heated tubes. The two test sections used were 0.719 and 0.472 in. i.d., with lengths of 5.67 and 4.69 ft, respectively. The range of variables covered in this work include:

Heat flux, q	13,800-88,000	BTU/hr ft^2
Mass flux, G	110-700	lbm/sec ft^2
Quality, x	0-19%	
Boiling No., Bo	$0.24 \times 10^{-4} - 1.9 \times 10^{-4}$	
Pressure	15.8 - 68.2 psia	

It has been observed that thermal-entrance regions associated with two-phase-boiling heat transfer are very important in both design and analytical work. Thermal-entrance regions were observed with both one-phase and two-phase heat transfer; in both cases, heat-transfer coefficients in these regions were very large.

New boiling heat-transfer correlations have been derived using a least-squares, multiple-regression subroutine on an IBM-709 data-processing system. These correlations have the skeleton

$$h_B \sim G^{0.6} q^{0.3} x^{0.4}.$$

The variations of the physical properties of water were not sufficient to accurately define their significance in the correlations. Consequently, these properties were used only in dimensionless groups which were arbitrarily selected. In order to improve and introduce some pressure dependence in correlations, a modified boiling number has been introduced:

$$Bo_m = Bo \cdot \frac{\rho_f}{\rho_g} .$$

Local, total, two-phase-boiling pressure gradients have been correlated with the Martinelli parameter, X_{tt}:

$$\frac{\left(\frac{dp}{d\ell}\right)_{tpt}}{\left(\frac{dp}{d\ell}\right)_{\ell}} = 40.12\ X_{tt}^{-1.16} .$$

This correlation has proved to be more reliable than several methods of calculation which predict individual pressure losses. These latter methods, however, have shown that homogeneous flow conditions (equal velocities) existed in very few experimental runs, if at all. Rather, slip ratios were on the order of 2.0. By use of the above correlation, a numerical procedure has been devised which gives reasonable design predictions.

On the basis of observations at the outlet of the test section, a general flow pattern and a heat-transfer mechanism are proposed. It is felt that liquid is continuous at the heat-transfer surface, while the bulk of the tube volume is occupied by a very turbulent mixture of vapor and liquid. It is believed that very little nucleate boiling occurs at the heat-transfer surface; rather, the vaporization mechanism is one of evaporation at existing vapor-liquid interfaces. This necessarily demands that the liquid at the tube wall be supersaturated, and that heat is transferred at the wall by a forced-convection mechanism.

To increase the generality of the correlations, several recommendations are made:

a. The ranges of flow rate, vapor fraction, and heat flux should be increased. Heat fluxes used in this experiment are quite low and should be increased by an order of magnitude. Flow rates have covered a reasonable range, but should be increased by at least a factor of two.

b. In order to determine the significance of the various physical properties of the working fluid, it is recommended that fluids other than water also be included in the experimental program. If the range of operating conditions for each fluid is sufficiently large, it is felt that results from the present digital-correlation program would be greatly improved.

c. In order to test the pressure dependence of the correlations, it is suggested that moderate-to high-pressure data from the literature also be included in the correlation program.

4. Both larger and smaller diameter tubes should be employed to ascertain the diameter dependence.

With the application to design, it is recommended that more reliable numerical procedures be devised. Even if correlations are improved, design calculations may not be entirely satisfactory if the numerical procedure is inaccurate or unstable. Also, it would be interesting to develop general calculation procedures for systems where the heat flux is not specified; e.g. a steam-heated test section.

It might be possible to gain an insight on flow pattern and heat-transfer mechanisms by an extended analysis of pressure fluctuations (or possibly temperature fluctuations). This would require cancellation of the fluctuations introduced by the feed pump.

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BIBLIOGRAPHY

1. A.H. Brown, M.E. Lazaar, T. Wasserman, and W.D. Ramage, Flash Heat, Food Packer, 32, 20(Jan. 1951).

2. R. Siegel and E.M. Sparrow, Turbulent Flow in a Circular Tube with Arbitrary Internal Heat Sources and Wall Heat Transfer. Trans. Am. Soc. Mech. Engrs., Series C, J. Heat Transfer 81,280 (1959).

3. Robert G. Deissler, Analysis of Turbulent Heat Transfer and Flow in Entrance Regions of Smooth Passages, National Advisory Committee for Aeronautics Rept. NACA 1210, 1955.

4. C.F. Staley and Merle Baker, Heat-Transfer Rate Between Heated Tubes and Boiling Refrigerant, J. Am. Soc. Heating, Refrigerating, and Air Conditioning Engrs. 1, 83(1959).

5. C.E. Dengler, Heat Transfer and Pressure Drop for Evaporation of Water in a Vertical Tube, Sc. D. Thesis, Massachusetts Institute of Technology, 1952.

6. C.E. Dengler and J.N. Addoms, Heat Transfer Mechanism for Vaporization of Water in Vertical Tubes, Chem. Engr. Progr. Symposium Ser. 52, No. 18, 95(1956).

7. F.W. Dittus and L.M.K. Boelter, Heat Transfer in Automobile Radiators of the Tubular Type, University of California Publication in Engineering 2, 443(1930).

8. R.W. Lockhart and R.C. Martinelli, Proposed Correlation of Data for Isothermal Two-Phase, Two-Component Flow in Pipes, Chem. Engr. Progr. 45, 39(1949).

9. J.F. Mumm, Heat Transfer to Boiling Water Forced Through a Uniformily Heated Tube, Argonne National Laboratory Rept. ANL-5276, November 1954.

10. W.F. Davidson, P.H. Hardie, C.G.R. Humphreys, A.A. Markson, and T. Ravese, Studies of Heat Transmission Through Boiler Tubing at Pressures from 500 to 3300 Pounds, Trans. Am. Soc. Mech. Engrs. 65, 553(1943).

11. V.E. Schrock and L.M. Grossman, Local Heat Transfer Coefficients and Pressure Drop in Forced Convection Boiling, University of California Institute of Engineering Research (Berkeley), Series No. 73308-UCX, Issue No. 1, September 30, 1957.

12. V.E. Schrock and L.M. Grossman, Forced Convection Boiling Studies, University of California Institute of Engineering Research (Berkeley), Series No. 73308-UCX 2182, Issue No. 2, November 1, 1959.

13. S.A. Guerrieri and R.D. Talty, A Study of Heat Transfer to Organic Liquids in Single-Tube, Natural Circulation, Vertical-Tube Boilers, Chem. Engr. Progr. Symposium Ser. 52, No. 18, 69 (1956).

14. M. Altman, R.H. Norris, and F.W. Staub, Local and Average Heat Transfer and Pressure Drop for Refrigerants Evaporating in Horizontal Tubes, Trans. Am. Soc. Mech. Engrs., Ser. C, J. Heat Transfer 82, 189(1960).

15. L.S. Sterman, V.G. Morozov, and S.A. Kovalev, Study of Heat Exchange During Boiling of Water and Ethyl Alcohol in Pipes, J. Eng. Phys. 2, 40(Oct. 1959); UCLRL Translation 694.

16. P.A. Lottes, M. Petrick, and J.F. Marchaterre, Lecture Notes on Heat Extraction from Boiling Water Power Reactors, Argonne National Laboratory Rept. ANL-6063, Oct. 1959.

17. R.C. Martinelli and D.B. Nelson, Prediction of Pressure Drop During Forced Circulation Boiling of Water, Trans. Am. Soc. Mech. Engrs. 70, 695(1948).

18. W.H. Jens and P.A. Lottes, Two-Phase Pressure Drop and Burnout Using Water Flowing in Round and Rectangular Channels, Argonne National Laboratory Rept. ANL-4915, Oct. 1, 1952.

19. D.H. Weiss, Pressure Drop in Two-Phase Flow, Argonne National Laboratory, Rept. ANL-4916, October 20, 1952.

20. V.E. Schrock and L.M. Grossman, Local Pressure Gradients in Forced-Convection Vaporization, Nuclear Sci. and Eng. 6, 245 (1959).

21. Robert L. Sani, Downflow Boiling and Nonboiling Heat Transfer in a Uniformly Heated Tube, Lawrence Radiation Laboratory Rept. UCRL-9023, Jan. 4, 1960.

22. A.J. Ter Linden, Der Zyklon als Tropfen Abscheider, (The Cyclone as a Drop Separator), Chem. Ing. Technik, 25, 328(1953).

23. D.I.J. Roderick and C.E. Hierons, The Development of a Gas Liquid Separator, British Chemical Engineering 2, (4), 180(1957).

24. Arthur Pollack and L.T. Work, The Separation of Liquid from Vapor Using Cyclones, Trans. Am. Soc. Mech. Engrs. 64, 31(1942).

25. C.J. Stairmand, The Design and Performance of Cyclone Separators, Trans. Inst. of Chem. Engrs. (London) 29, 356(1951).

26. H. Buchberg etal., Final Report on Studies in Boiling Heat Transfer. University of California at Los Angeles, COO-24, March 1951, p. I-F-21 and p. III-A-15.

27. Stainless Steel Handbook (Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., 1959.)

28. J.H. Keenan and F.G. Keyes, Thermodynamic Properties of Steam (John Wiley and Sons, Inc., New York, 1954).

29. P.A. Lottes, The Reactor Handbook, Volume 2, Section 1, Chapter 1.3, Physical and Thermodynamic Properties of Light and Heavy Water, AECD 3646, (U.S. Atomic Energy Commission, Washington, D.C. May 1955).

30. Tables of Thermal Properties of Gases, Circular 564, (U.S. Department of Commerce, National Bureau of Standards, Nov. 1, 1955).

31. Revised Steam Tables and Diagrams of the Japan Society of Mechanical Engineers, 2nd. Edition (1955).

32. E.N. Sieder and G.E. Tate, Heat Transfer and Pressure Drop of Liquids in Tubes, Ind. Eng. Chem. 28, 1429(1936).

33. S.G. Bankoff, A Variable Density Single-Fluid Model for Two-Phase Flow with Particular Reference to Steam-Water Flow., Trans. Am. Soc. Mech. Engrs., Series C, J. Heat Transfer 82, 265(1960).

34. S. Levy, Steam Slip--Theoretical Prediction From Momentum Model, Trans. Am. Soc. Mech. Engrs., Series C, J. Heat Transfer 82, 113(1960).

35. S. Levy, Theory of Pressure Drop and Heat Transfer for Annular Steady-State Two-Phase Two-Component Flow in Pipes, Proc. Second Midwestern Conference on Fluid Mechanics, 1952.

36. P. Sachs and R.A.K. Long, A Correlation for Heat Transfer in Stratified Two-Phase Flow with Vaporization, Intern. J. Heat and Mass Transfer 2, 222(1961).

37. R.C. Noyes, F. Bergonzoli, and J.E. Gingrich, Fugue-A Nondimensional Method for Digital Computer Calculation of Steady State Temperature, Pressure, and Void Fraction in Pipe Flow With or Without Boiling, Atomics International Rept. NAA-SR-5958, Aug. 1, 1959.

NOMENCLATURE

General

A_B	Cross-sectional flow area of the boiling tube	ft^2
A_h	Heat transfer area of the boiling tube	ft^2
A_1	Cross-sectional flow area of the pipe at station 1	ft^2
Bo	Boiling number $= \frac{q}{h_{fg} G \cdot 3600}$	dimensionless
Bo_m	Modified boiling number $= Bo \frac{\rho_f}{\rho_g}$	dimensionless
C_p	Specific heat at constant pressure	BTU/lbm °F
C_1	Constant defined in Eqs. (IV-6) and (IV-10).	
D	Diameter	ft
E	Voltage drop	volts
f	Blasius friction factor $= 0.3164\ Re_\ell^{-1/4}$	dimensionless
g	Acceleration of gravity = 32.153	ft/sec^2
g_c	Conversion factor in Newton's Law: = 32.1739 lb force $= \frac{g}{g_c}$ lb mass	$ft \cdot lbm/sec^2 lbf$
G	Mass flux	$lbm/sec\ ft^2$
h	Enthalpy, or	BTU/lbm
	Heat-transfer coefficient, or	$BTU/hr \cdot ft^2\ °F$
	Contribution to pressure loss due to hydrostatic head	psia
J	Joule's constant = 778.26	ft·lbf/BTU
k	Thermal conductivity	BTU/hr ft °F
ℓ	Distance from entrance of heated test section	ft

L	Total length of test section		ft
mv	Output voltage from the pressure transducer		mv
Nu	Nusselt number	$= \frac{h_B D_i}{k_\ell}$	dimensionless
p	Pressure		psia
Pr	Prandtl number	$= \frac{C_p \mu \cdot 3600}{k}$	dimensionless
Pw	Electric power expended in the heated test section		watts
q	Heat flux		$BTU/hr\ ft^2$
Q	Total heat input		BTU/hr
r	Radius		ft
R	Electrical resistance		ohm
Re	Reynolds number: $Re_T = \frac{D_i G}{\mu}$ $Re_\ell = \frac{D_i(1-x)G}{\mu_\ell}$		dimensionless
St	Stanton number	$= \frac{h_B}{C_p G \cdot 3600}$	dimensionless
T	Temperature		^oF
ΔT	Temperature difference	$\Delta T_B = T_i - T_B$ $\Delta T_w = T_o - T_i$	^oF
v	Velocity		ft/sec
V	Volume		ft^3
W	Flow rate		lbm/hr
x	Mass fraction vapor, quality		dimensionless
X_{tt}	Martinelli parameter	$= \left(\frac{\rho_g}{\rho_f}\right)^{0.5}\left(\frac{\mu_f}{\mu_g}\right)^{0.1}\left(\frac{1-x}{x}\right)^{0.9}$	dimensionless
z_1	Elevation difference between station 1 and the test-section inlet		ft

α	Volumetric vapor fraction, or	dimensionless
	Linear temperature coefficient of thermal conductivity	$^{o}F^{-1}$
γ	Linear temperature coefficient of electrical resistance	$^{o}F^{-1}$
ρ	Density	lbm/ft^3
μ	Viscosity	lbm/sec ft
ω	Power generation per unit volume in the test section	$BTU/hr\ ft^3$
ψ	Slip ratio $= \frac{v_g}{v_f}$	dimensionless
ϕ_ℓ	Lockhart-Martinelli friction-factor multiplier	dimensionless

Subscripts

a	Acceleration
avg	Average
b	Evaluation at bulk fluid properties
B	Boiling
f	Properties of saturated liquid
fg	Difference in a property between saturated vapor and saturated liquid
g	Properties of saturated vapor
h	Hydrostatic head
i	Inner wall, or inside
ℓ	Liquid property or Evaluation on the basis of local liquid flow rate
m	Mean, or Metal property
o	Outer wall, or Evaluation on the basis of the total flow rate, or Evaluation of a property at some base

T	Total
tpf	Two-phase friction-pressure loss
tpt	Two-phase total-pressure loss
w	Wall, or Evaluation at the inner-wall temperature
1	Evaluation at station 1 before the flashing valve

APPENDICES

A. Solution of the Conduction Equation for the Inside-Wall Temperature

Equation (V-1) can be rewritten

$$\frac{1}{r}\frac{d}{dr}\left[r\,k(T)\,\frac{dT}{dr}\right] = -\,\omega. \qquad \text{(A-1a)}$$

Boundary condition 1 (B.C.1.) is

$$r = r_o, \left(\frac{dT}{dr}\right) = 0 \qquad \text{(A-1b)}$$

and boundary condition 2 (B.C.2) is

$$r = r_o \text{ and } T = T_o, \text{ a constant.} \qquad \text{(A-1c)}$$

We can define a new variable ξ (T) by

$$\xi(T) \equiv \int_0^T k(T)\,dT, \qquad \text{(A-2)}$$

$$\frac{d\xi}{dT} = k,$$

and $$\frac{d\xi}{dr} = \frac{d\xi}{dT}\cdot\frac{dT}{dr} = k\,\frac{dT}{dr}\,. \qquad \text{(A-3)}$$

Substituting Eq. (A-3) into Eq. (A-1a), we have

$$\frac{1}{r}\frac{d}{dr}\left[r\,\frac{d\xi}{dr}\right] = -\,\omega \qquad \text{(A-4)}$$

Integrating Eq. (A-4), we obtain

$$\frac{r\,d\xi}{dr} = -\,\frac{\omega r^2}{2} + c_1. \qquad \text{(A-5)}$$

Using B.C.1 in Eq. (A-3) and noting that k is finite, we have at $r = r_o$

$$\frac{d\xi}{dr} = 0. \qquad \text{(A-6)}$$

Substituting Eq. (A-6) in Eq. (A-5) we have

$$c_1 = \frac{\omega r_o^2}{2}, \qquad \text{(A-7)}$$

and Eq. (A-5) becomes

$$r \frac{d\xi}{dr} = + \frac{\omega}{2} (r_o^2 - r^2). \tag{A-8}$$

Integrating again, we obtain

$$\xi = \frac{\omega}{2} (r_o^2 \ln r - \frac{r^2}{2}) + c_2. \tag{A-9}$$

Now by assigning the functional dependence of ξ, we may return to the original dependent variable. For the linear relation

$$k = k_o(1 + \alpha T),$$

Eq. (A-2) gives

$$\xi = k_o(T + \frac{\alpha T^2}{2}),$$

and Eq. (A-9) becomes

$$k_o(T + \frac{\alpha T^2}{2}) = \frac{\omega}{2} (r_o^2 \ln r - \frac{r^2}{2}) + c_2. \tag{A-10}$$

Finally using B.C.2, we have

$$c_2 = k_o(T_o + \frac{\alpha T_o^2}{2}) - \frac{\omega}{2} (r_o^2 \ln r_o - \frac{r_o^2}{2}) . \tag{A-11}$$

For the inner-wall temperature, substituting Eq. (A-11) into Eq. (A-10) gives

$$k_o(T_i + \frac{\alpha T_i^2}{2}) = \frac{\omega}{2} (r_o^2 \ln r_i - \frac{r_i^2}{2}) + k_o(T_o + \frac{\alpha T_o^2}{2}) - \frac{\omega}{2} (r_o^2 \ln r_o - \frac{r_o^2}{2}), \tag{A-12}$$

which readily reduces to

$$T_o - T_i = \frac{\omega}{2k_o} \left[r_o^2 \ln \frac{r_o}{r_i} - \frac{1}{2}(r_o^2 - r_i^2) \right] - \frac{\alpha}{2} (T_o^2 - T_i^2)$$

and

$$T_o - T_i = \frac{\omega}{2} \left[r_o^2 \ln \frac{r_o}{r_i} - \frac{1}{2} (r_o^2 - r_i^2) \right] \frac{1}{k_o \left[1 + \frac{\alpha}{2}(T_o + T_i) \right]} .$$

If $k(T)$ is assumed constant at k_{avg} in Eq. (A-1a), the solution is readily obtained by integration:

$$T_o - T_i = \frac{\omega}{2}\left[r_o^2 \ln\frac{r_o}{r_i} - \frac{1}{2}(r_o^2 - r_i^2)\right]\frac{1}{k_{avg}} .$$

B. <u>Pressure Measurement Using the Pressure Transducer</u>

The pressure transducer calibration equation is in general

$$\text{psia} = a\,(\text{mv}) + b \qquad \text{(B-1)}$$

Consider the situation where the transducer diaphragm is in contact with the atmosphere. It "sees" the pressure $(\text{psia})_{atm}$ and its output voltage is (mv_a) :

$$(\text{psia})_{atm} - a(\text{mv}_a) + b \qquad \text{(B-2)}$$

Now, consider the case where the transducer is mounted at its manifold and one line is open to a pressure tap at the test section. This connecting line is completely filled with liquid, but the test section is empty and is open to the atmosphere. The pressure at the test section is $(\text{psia})_{atm}$ but the transducer "sees" the pressure $(\text{psia})_o$. The transducer output is (mv_o):

$$(\text{psia})_o = (\text{psia})_{atm} + h = a(\text{mv}_o) + b, \qquad \text{(B-3)}$$

where h is the contribution of the hydrostatic head of liquid in the connecting line. Thirdly, consider the situation during a boiling run with the connecting line still filled. The pressure in the test section is $(\text{psia})_R$, but the transducer sees $(\text{psia})_t$. The total transducer output is (mv_R):

$$(\text{psia})_t = (\text{psia})_R + h = a(\text{mv}_R) + b. \qquad \text{(B-4)}$$

Here h can be obtained from Eqs. (B-2) and (B-3),

$$h = a\,(\text{mv}_o - \text{mv}_a), \qquad \text{(B-5)}$$

and should be a constant if the transducer operates in accord with its calibration and if the connecting tubing is always filled (this also assumes constant liquid density). Thus the quantity ($mv_o - mv_a$) should be constant for all runs. Substituting Eq. (B-5) in Eq. (B-4), we have

$$(psia)_R = a\left[mv_R - (mv_o - mv_a)\right] + b. \qquad \text{(B-6)}$$

Values of ($mv_o - mv_a$) can be obtained in two ways. First, they may be measured directly, as in the second case above, Eq.(B-3). However, when this was actually done it was difficult to keep liquid in the connecting lines from draining into the test section. Also there was always the possibility of drift of the transducer supply voltage. The second and more reliable method was to measure the elevation difference ($\Delta \ell$) between a pressure tap and the transducer. ($mv_o - mv_a$) was then calculated from

$$(mv_o - mv_a) = \frac{\Delta \ell \cdot \rho}{144 \cdot a} , \qquad \text{(B-7)}$$

where $\Delta \ell$ is in feet, ρ is the density of water in lbm/ft^3, and a comes from the calibration equation in psia/mv.

Where drainage from the connecting line was not appreciable, results of the two methods were in good agreement.

C. Derivation of the Energy Balance

If we write input terms on the left and output terms on the right, the steady-state energy balance is (the units of each quantity are BTU per pound-mass of flowing fluid)

$$h_1 + \frac{v_1^2}{2g_cJ} + \frac{Q}{W}\frac{\ell}{L} = xh_g + (1-x)\,h_f + x\,\frac{v_g^2}{2g_cJ} + (1-x)\,\frac{v_g^2}{2g_cJ} - \frac{(\ell + z_1)}{J}\,\frac{g}{g_c}$$

The reference point is at station 1, the flashing valve, and z_1 is the elevation difference between station 1 and the test-section entrance (the test section is below station 1). Simple rearrangement gives the form of Eq. (V-15).

The velocity at station 1 is easily obtained from

$$v_1 = \frac{W}{3600\ \rho_1 A_1} ,$$

where A_1 is the cross-section area of the piping at station 1 (in ft^2) and ρ_1 is the liquid density (in lbm/ft^3). Similar equations may be written for the saturated vapor and liquid velocities in the test section:

$$v_g = \frac{xW}{3600\ \rho_g A_g}$$

$$v_f = \frac{(1-x)W}{3600\ \rho_f A_g} ,$$

where A_g and A_f are the areas of the tube filled with vapor and liquid, respectively. Noting $A_g + A_f = A_B$ or $A_g = A_B - A_f$, where A_B is the total cross-sectional area of the boiling test section, and introducing the "slip ratio", we have

$$\psi \equiv \frac{v_g}{v_f} ,$$

$$\psi v_f = v_g = \frac{xW}{3600\rho_g (A_B - A_f)}, \text{ or}$$

$$v_f = \frac{xW}{\psi 3600\ \rho_g (A_B - A_f)} .$$

Now equating the two expressions for v_f and solving for A_f, we obtain

$$A_f = \frac{(1-x)\ \psi\ \rho_g A_B}{\left[(1-x)\ \psi\ \rho_g + \rho_f\right]} .$$

Substituting this into the original velocity expressions, we have

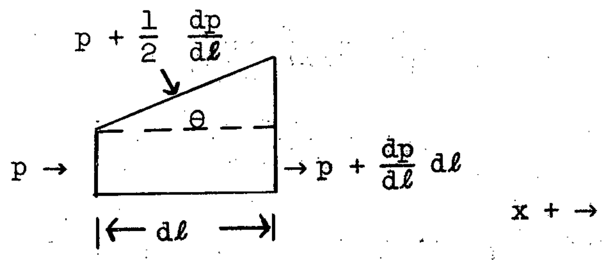
$$v_g = \frac{W\,[(1-x)\,\psi\,\rho_g + x\,\rho_f\,]}{3600\,A_B\,\rho_g\rho_f}$$

and
$$v_f = \frac{v_g}{\psi}\ .$$

With ψ arbitarily prescribed, these velocity expressions along with the energy balance equation form a complete system of algebraic equations.

D. Force-Momentum Balance Used to Calculate Acceleration-Pressure Losses

Consider the fluid element:



If we neglect friction and body forces, the net force in the positive x direction is

$$F_x = pA - \left(p + \frac{dp}{d\ell}\,d\ell\right)\left(A + \frac{dA}{d\ell}\,d\ell\right) + \left(p + \frac{1}{2}\,\frac{dp}{d\ell}\,d\ell\right)\left(d\ell\,\cos\theta\right)\left(\sin\theta\right)\ .$$

For small angles

$$\theta = \sin\theta = \tan\theta = \frac{dA}{d\ell} \qquad \text{and} \qquad \cos\theta = 1$$

we can write

$$F_x = pA - pA - p\,\frac{dA}{d\ell}\,d\ell - \frac{dp}{d\ell}\,d\ell\,A - \frac{dp}{d\ell}\,\frac{dA}{d\ell}(d\ell)^2 + p\,d\ell\,\frac{dA}{d\ell}$$
$$+ \frac{1}{2}\,\frac{dp}{d\ell}\,\frac{dA}{d\ell}(d\ell)^2.$$

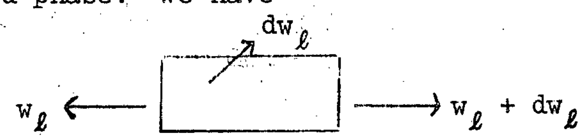
Dropping second-order terms and cancelling, we have

$$F_x = -A\,\frac{dp}{d\ell}\,d\ell.$$

This pressure gradient is that due to acceleration, and the area is that of the boiling tube:

$$F_x = -A_B \left(\frac{dp}{d\ell}\right)_a \; d\ell$$

The change in the momentum rate for the liquid phase may be calculated as follows. It is assumed that the dw_ℓ (lbm/sec) are vaporized within the element. Thus the momentum connected with dw_ℓ is lost from the liquid phase. We have



$$\text{Change in momentum rate}_\ell = \frac{1}{g_c}\left[\left(w_\ell + dw_\ell\right)\left(v_\ell + dv_\ell\right) - w_\ell v_\ell - dw_\ell\left(v_\ell + \frac{1}{2}\,dv_\ell\right)\right]$$

$$= \frac{1}{g_c}\, w_\ell dv_\ell .$$

Similarly for the gas phase, we have

$$\text{Change in momentum rate}_g = \frac{1}{g_c}\left[\left(w_g + dw_g\right)\left(v_g + dv_g\right) - w_g v_g + v_\ell dw_\ell\right]$$

$$= \frac{1}{g_c}\left[\, d(w_g v_g) + v_\ell dw_\ell \,\right] .$$

Equating F_x with the sum of the momentum rate changes (Newton's Law), we have

$$-A_B\left(\frac{dp}{d\ell}\right)_a d\ell = \frac{1}{g_c}\left[w_\ell dv_\ell + d(w_g v_g) + v_\ell dw_\ell\right] = \frac{1}{g_c}\, d\left[v_g w_g + v_\ell w_\ell\right] .$$

which for $w_\ell = \rho_\ell v_\ell A_\ell$ and $w_g = \rho_g v_g A_g$ becomes

$$-A_B\left(\frac{dp}{d\ell}\right)_a d\ell = \frac{1}{g_c}\, d\left[A_g \rho_g v_g^2 + A_\ell \rho_\ell v_\ell^2\right] .$$

Noting that A_B is a constant so that it may be included within the differential operator, and that the volumetric vapor fraction is defined by

$$\alpha = \frac{A_g}{A_B} \qquad \text{and } (1-\alpha) = \frac{A_\ell}{A_B} ,$$

and, from material balances using the total mass flux, G (a constant),

$$v_g = \frac{Gx}{\rho_g \alpha} \qquad \text{and } v_\ell = \frac{G(1-x)}{\rho_\ell (1-\alpha)}$$

we can write

$$\left(\frac{dp}{d\ell}\right)_a = \frac{G^2}{144 g_c} \frac{d}{d\ell} \left[\frac{x^2}{\rho_g \alpha} + \frac{(1-x)^2}{\rho_\ell (1-\alpha)} \right] ,$$

where 144 is the conversion factor to psia/ft.

Appendix E. Data-Reduction Program

The IBM-709 Fortran data-reduction program is listed in the following pages. Variables are given names to symbolize the actual mathematical notation. The final "A" on the thermodynamic properties denotes the array name; i.e. the method of storing the tabled quantities. A partial list of variable names follows; the mathematical symbols are those given in the Nomenclature.

Variable Name	Definition
T, TB	saturation boiling temperature (^oF)
P, PSIA	saturation pressure (psia)
HF, HG	h_f, h_g
RHOF, RHOG	ρ_f, ρ_g
FMUF, FMUG	μ_f, μ_g
FKL, FKG	k_ℓ, k_g
PRL, PRNOLQ, PRNOGS	Pr_ℓ, Pr_g
MATERL	designation of the working substance
NOTUBE	test section number
POS	ℓ
AHL	A_h/L

Variable Name	Definition
TOTI, TITB	T_o-T_i, T_i-T_b
VF, VG	v_f, v_g
HB, HL, HO	h_B, h_ℓ, h_o
RENOL	Re_ℓ
FNUB	Nu_B
FNUBRE	$Nu_B/(Re_\ell^{.8} Pr_\ell^{.33})$
STNTNO	St
BONO,BONOM	Bo, Bo_m
DPDLL	$(dp/d\ell)_\ell$
DPDLTP	$(dp/dl)_{tpt}$
ALPHA2	α, volumetric vapor fraction
PSI	ψ, slip ratio

```
DRIII
C     FORCED CONVECTION BOILING   DATA REDUCTION III  ROGER M.WRIGHT
C     PRIMARY DATA REDUCTION AND TABULATED PRINTOUT
C     FCONV BOIL   4601-80       NOVEMBER 8, 1960
C     REVISED JANUARY 3, 1961
C     REVISED FEBRUARY 3, 1961 TO ENABLE PROCESSING OF DATA FROM ANY OF
C       5 TEST SECTIONS DURING THE SAME COMPUTER RUN
C     REVISED JULY 13, 1961   ADDITIONS AND FORMAT IMPROVEMENTS
      DIMENSION  T(48),P(48),HFA(48),HGA(48),RHOFA(48),RHOGA(48),
     1          FMUFA(48),FMUGA(48),FKLA(48),FKGA(48),PRLA(48),PRGA(48),
     2          TCONST(40)
      DIMENSION  ARRAY1(456), ARRAY2(456)
C     READ IN TABULATED THERMODYNAMIC DATA, THE FOLLOWING FOR WATER
      READ INPUT TAPE 2,1,(T(I),I=1,48)
    1 FORMAT (8X,16F4.0)
      READ INPUT TAPE 2,2,(P(I),I=1,48)
    2 FORMAT (8X,8F7.3,8X)
      READ INPUT TAPE 2,3,(HFA(I),I=1,48)
    3 FORMAT (8X,8F7.2,8X)
      READ INPUT TAPE 2,4,(HGA(I),I=1,48)
    4 FORMAT (8X,8F7.1,8X)
      READ INPUT TAPE 2,5,(RHOFA(I),I=1,48)
    5 FORMAT (8X,8F7.3,8X)
      READ INPUT TAPE 2,6,(RHOGA(I),I=1,48)
    6 FORMAT (8X,8F7.5,8X)
      READ INPUT TAPE 2,7,(FMUFA(I),I=1,48)
    7 FORMAT (8X,8E8.4,8X)
      READ INPUT TAPE 2,8,(FMUGA(I),I=1,48)
    8 FORMAT (8X,8E8.4,8X)
      READ INPUT TAPE 2,9,(FKLA(I),I=1,48)
    9 FORMAT (8X,12F5.4,4X)
      READ INPUT TAPE 2,6,(FKGA(I),I=1,48)
      READ INPUT TAPE 2,10,(PRLA(I),I=1,48)
      READ INPUT TAPE 2,10,(PRGA(I),I=1,48)
   10 FORMAT (8X,12F5.3,4X)
C     READ IN TEST SECTION CONSTANTS, IN THE FORM OF AN ARRAY TCONST
      READ INPUT TAPE 2,15, (TCONST (I),I=1,40)
   15 FORMAT (3X,F9.7,5X,E13.8,8X,E13.8,5X,F9.8/3X,E13.8,4X,F9.7,9X,E8.2
     1,10X,F9.8)
      K       = 0
      L       = 0
      RUNNOO  = 0.0
C     READ IN DATA,ONE CARD FROM MONITOR INPUT TAPE NO. 2 (BCD)
   20 READ INPUT TAPE 2,21,RUNNO,MATERL,NOTUBE,T1,PW,W,POS,TO,PSIA,
     1                  DPDLTP
   21 FORMAT (4X,F5.1,I1,I2,3X,F6.2,3X,F6.0,2X,F5.0,2X,F4.2,3X,F6.2,2X,F
     17.3,6X,F5.3)
      IF (RUNNO - 990.)  30, 30, 80
C     MAIN CALCULATION  FROM DATA REDUCTION III STARTS AT STATEMENT 30
C     SELECT TEST SECTION CONSTANTS
   30 DO 31 I=1,5
      IF (NOTUBE-I) 31,32,31
   31 CONTINUE
   32 IP=8*(I-1)
      AH     =TCONST (IP+1)
      AB     =TCONST (IP+2)
```

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```
      CONST1=TCONST (IP+3)
      AHL   =TCONST (IP+4)
      A1    =TCONST (IP+5)
      Z1    =TCONST (IP+6)
      ALPHA =TCONST (IP+7)
      DI    =TCONST (IP+8)
C     TABLE SEARCH FOR THERMODYNAMIC PROPERTIES AND LINEAR INTERPOLATION
   40 DO 41 I=1,48
      IF (PSIA-P(I)) 42,42,41
   41 CONTINUE
   42 TB=T(I-1)+((T(I)-T(I-1))*(PSIA-P(I-1)))/(P(I)-P(I-1))
      HF=HFA(I-1)+((HFA(I)-HFA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      HG=HGA(I-1)+((HGA(I)-HGA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      RHOF=RHOFA(I-1)+((RHOFA(I)-RHOFA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      RHOG=RHOGA(I-1)+((RHOGA(I)-RHOGA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      FMUF=FMUFA(I-1)+((FMUFA(I)-FMUFA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      FMUG=FMUGA(I-1)+((FMUGA(I)-FMUGA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      FKL=FKLA(I-1)+((FKLA(I)-FKLA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      FKG=FKGA(I-1)+((FKGA(I)-FKGA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      PRNOLQ=PRLA(I-1)+((PRLA(I)-PRLA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      PRNOGS=PRGA(I-1)+((PRGA(I)-PRGA(I-1))*(TB-T(I-1)))/(T(I)-T(I-1))
      CPL    = PRNOLQ * FKL / (FMUF*3600.)
C     INSIDE WALL TEMPERATURE, CONSTANT PROPERTIES EVALUATED AT AVERAGE
C     WALL TEMP. BY ITERATION PROCEDURE
      TOTI=CONST1*PW/(1.+ALPHA*TO)
   50 TEFF=TO-TOTI/2.
      TOTIO=TOTI
      TOTI=CONST1*PW/(1.+ALPHA*TEFF)
      IF (ABSF (TOTI-TOTIO)-0.0001) 51,51,50
   51 TI=TO-TOTI
      TITB=TI-TB
C     HEAT FLUX AND HEAT TRANSFER COEFFICIENT
      Q=(3.41304/AH)*PW
      HB=Q/TITB
      G=W/(3600.*AB)
C     ENERGY BALANCE
C     TABLE SEARCH FOR H1 AND RHO1
   52 DO 53 I=1,48
      IF (T1-T(I)) 54,54,53
   53 CONTINUE
   54 H1=HFA(I-1)+((HFA(I)-HFA(I-1))*(T1-T(I-1)))/(T(I)-T(I-1))
      RHO1=RHOFA(I-1)+((RHOFA(I)-RHOFA(I-1))*(T1-T(I-1)))/(T(I)-T(I-1))
      V1= W/(3600.*A1*RHO1)
      CALC1= (H1-HF+(V1*V1*1.996832E-5)+(Q*AHL*POS/W)
     1+((POS+Z1)*1.2840939E-3))/(HG-HF)
      X=CALC1
      PSI    = 2.0
      DO 55 I=1,5
      VG=(W*(((1.-X)*PSI*RHOG)+(X*RHOF)))/(3600.*AB*RHOG*RHOF)
      VF=VG/PSI
      CALC2=(X*VG*VG*1.996832E-5+(1.-X)*VF*VF*1.996832E-5)/(HG-HF)
      X=CALC1-CALC2
   55 CONTINUE
      VG=(W*(((1.-X)*PSI*RHOG)+(X*RHOF)))/(3600.*AB*RHOG*RHOF)
      VF=VG/PSI
      XTT= ((RHOG/RHOF)**0.5)*((FMUF/FMUG)**0.1)*(((1.-X)/X)**0.9)
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```
      XTTSQ=XTT*XTT
      RENOL=(1.-X)*G*DI/FMUF
   56 IF (NOTUBE - 1) 60,60,61
   60 HL     = (0.023*FKL/DI) * (RENOL**0.8) * (PRNOLQ**0.4)
      GO TO 62
   61 HL     = (0.022*FKL/DI) * (RENOL**0.8) * (PRNOLQ**0.4)
   62 HBHL   = HB/HL
      HBHO=((1.0-X)**0.8)*HBHL
      FNUB=HB*DI/FKL
      FNUBRE=FNUB/((RENOL**0.8)*(PRNOLQ**0.333333))
      STNTNO = HB / (CPL * G * 3600.)
      BONO= Q/((HG-HF)*G*3600.)
      BONOM= BONO*RHOF/RHOG
      DPDLL= (.34146E-4*(((1.0-X)*G)**2.))/(DI*RHOF*(RENOL**0.25))
      DPDLQ= DPDLTP/DPDLL
      DPDL2R = SQRTF(DPDLQ)
      ALPHA2 = X/((PSI * (1.-X) /(RHOF/RHOG)) + X)
      PW     = PW/1000.
      QT1    = (RENOL**.106)*(BONOM**.296)*(PRNOLQ**.4) / (XTT**.457)
      QT2    = (RENOL**.455)*(Q     **.289)*(PRNOLQ**.4)*(X**.379)
      QT3    = (BONOM**.282)*(X     **.391)*(PRNOLQ**.4) /(RENOL**.035)
      QT4    = (RENOL**.934)*(BONOM**.281)*(PRNOLQ**.4) / (XTT**.459)
      QT5    = (BONO **.186)*(X     **.362)*(PRNOLQ**.4) / (RENOL**.258)
      QT6    = (RENOL**.783)*(BONOM**.268)*(PRNOLQ**.4)*(X**.382)
      QT7    = (BONOM + 0.28625/(XTT**.581))
      QT8    = (BONO  + 3.524E-4/(XTT**.667))
      QT9    = (BONO  + 3.424E-4/(XTT**.581))
      QT10   = (BONO  + 1.5  E-4/(XTT**.667))
      IF (RUNNO-RUNNOO) 70,79,70
   70 IF (RUNNOO)        80,71,80
C     HEADINGS FOR 1ST PAGE PRINTOUT
   71 WRITE OUTPUT TAPE 3, 72
   72 FORMAT (1H1,46X, 25HFORCED CONVECTION BOILING  )
      IF (MATERL-1) 75, 73, 75
   73 WRITE OUTPUT TAPE 3, 74, RUNNO, NOTUBE
   74 FORMAT (1H0,7HRUN NO.,F5.1,4X,5HWATER,9X,16HTEST SECTION NO.,I2)
      GO TO 77
   75 WRITE OUTPUT TAPE 3, 76, RUNNO, NOTUBE
   76 FORMAT (1H0,7HRUN NO.,F5.1,4X,9HN-BUTANOL,5X, 16HTEST SECTION NO.,
     1I2)
      GO TO 77
   77 WRITE OUTPUT TAPE 3, 78, W, G, PW, Q, RENOL, T1, V1
   78 FORMAT (1H0,12HFLOW RATE,W=,F5.0,1X,6HLBS/HR,2X,16HMASS VELOCITY,G
     1=F6.1,1X,20HLBS/SEC.SQFT  POWER=,F6.2,1X,23HKILOWATTS  HEAT FLUX,Q
     2=F7.0,1X,11HBTU/HR.SQFT/1H0,13HREYNOLDS NO.=,F8.0,5X,25HTEMPERATUR
     3E BEFORE FLASH=,F6.1,1X,1HF,4X,22HVELOCITY BEFORE FLASH=,F5.1,1X,
     46HFT/SEC/
     5120HOL,FT  PSIA   TO    TI  TO-TI   TB  TI-TB  HBOIL  HLIQ  HB/HL
     6HB/HO   X     XTT   NUB  STANTN  BO E4 BOMOD  NUB/RE PRNOL )
      RUNNOO = RUNNO
C     SET UP RESULTS IN ARRAY1 FOR 1ST PAGE PRINTOUT
   79 ARRAY1 (K+1) = POS
      ARRAY1 (K+2) = PSIA
      ARRAY1 (K+3) = TO
      ARRAY1 (K+4) = TI
      ARRAY1 (K+5) = TOTI
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      DRIII
          ARRAY1 (K+6) = TB
          ARRAY1 (K+7) = TITB
          ARRAY1 (K+8) = HB
          ARRAY1 (K+9) = HL
          ARRAY1 (K+10)= HBHL
          ARRAY1 (K+11)= HBHO
          ARRAY1 (K+12)= X
          ARRAY1 (K+13)= XTT
          ARRAY1 (K+14)= FNUB
          ARRAY1 (K+15)= STNTNO
          ARRAY1 (K+16)= BONO * 10000.
          ARRAY1 (K+17)= BONOM
          ARRAY1 (K+18)= FNUBRE
          ARRAY1 (K+19)= PRNOLQ
C         SET UP RESULTS IN ARRAY2 FOR 2ND PAGE PRINTOUT
          ARRAY2 (L+1) = POS
          ARRAY2 (L+2) = DPDLL
          ARRAY2 (L+3) = DPDLTP
          ARRAY2 (L+4) = DPDLQ
          ARRAY2 (L+5) = VF
          ARRAY2 (L+6) = ALPHA2
          ARRAY2 (L+7) = QT1
          ARRAY2 (L+8) = QT2
          ARRAY2 (L+9) = QT3
          ARRAY2 (L+10)= QT4
          ARRAY2 (L+11)= QT5
          ARRAY2 (L+12)= QT6
          ARRAY2 (L+13)= QT7
          ARRAY2 (L+14)= QT8  * 10000.
          ARRAY2 (L+15)= QT9  * 10000.
          ARRAY2 (L+16)= QT10 * 10000.
          ARRAY2 (L+17)= XTTSQ
          ARRAY2 (L+18)= DPDL2R
          K      = K + 19
          L      = L + 18
          GO TO 20
       80 N1     = K
          N2     = L
          WRITE OUTPUT TAPE 3, 81, (ARRAY1(K),K=1,N1)
       81 FORMAT (1H0,F4.2,F6.2,1X,F5.1,1X,F5.1,1X,F5.2,1X,F5.1,1X,F5.2,1X,
         1         F6.0,1X,F6.0,1X,F5.2,1X,F5.2,1X,F5.4,1X,F6.3,F6.0,1X,F6.5,
         2         1X,F6.3,1X,F6.4,1X,F6.4,1X,F5.2 )
          WRITE OUTPUT TAPE 3, 82, RUNNOO, (ARRAY2(L),L=1,N2)
       82 FORMAT (1H1/1H0,7HRUN NO.,F5.1/1H0/1H0/120H0L,FT DP/DLL DP/DLTP TP
         1/LIQ VELOC ALPHA   Q1      Q2     Q3      Q4       Q5       Q6     Q7      Q
         28 E4  Q9 E4  Q10E4 XTTSQ TPLQRT /
         3(1H0,F4.2,F7.4,F7.3,1X,F7.2,1X,F5.1,1X,F5.4,F7.3,F6.0,F7.4,F7.0,
         4 1X,F6.5,F7.0,F6.3,F7.3,F7.3,F7.3,F6.2,F7.2 ))
          K      = 0
          L      = 0
          IF (RUNNO - 990.) 71,71,1000
     1000 CALL EXIT
C         THE LAST DATA CARD MUST BE A DUMMY CARD PUNCHED WITH VALID DATA,
C         BUT WITH A FICTICIOUS RUN NUMBER=999.9101
          END(0,1,0,1,0,0,1,1,0,0,0,0,0,0,0)
```

Appendix F. Forced-Convection Boiling Data

The following pages are the tabulated reduced data of all boiling runs. All units are those used in the Nomenclature. The Reynolds number given in the table heading is Re_{ℓ} for the first data point. Symbols not self-explanatory are:

Symbol	Definition
BO E4	$Bo \cdot 10^{+4}$
BOMOD	Bo_m
NUB/RE	$\frac{Nu_B}{Re_{\ell}^{0.8} Pr_{\ell}^{1/3}}$
DPDLL	$\left(\frac{dp}{d\ell}\right)_{\ell}$ (psia/ft)
DPDLTP	$\left(\frac{dp}{d\ell}\right)_{tpt}$ (psia/ft)
TP/LIQ	$\left(\frac{dp}{d\ell}\right)_{tpt} / \left(\frac{dp}{d\ell}\right)_{\ell}$
VELOC	Liquid velocity calculated on the basis of the slip ratio, ψ=2.0 (ft/sec)
ALPHA	α, the volumetric vapor fraction based on ψ=2.0

The quantities Q1, Q2 ---are defined by:

Quantity	Definition
Q 1	$Re_{\ell}^{0.106}\ Bo_{m}^{0.296}\ X_{tt}^{-0.457}\ Pr_{\ell}^{0.4}$
Q 2	$Re_{\ell}^{0.455}\ q^{0.289}\ x^{0.379}\ Pr_{\ell}^{0.4}$
Q 3	$Re_{\ell}^{-0.035}\ Bo_{m}^{0.282}\ x^{0.391}\ Pr_{\ell}^{0.4}$
Q 4	$Re_{\ell}^{0.934}\ Bo_{m}^{0.281}\ X_{tt}^{-0.459}\ Pr_{\ell}^{0.4}$
Q 5	$Re_{\ell}^{-0.258}\ Bo^{0.186}\ x^{0.362}\ Pr_{\ell}^{0.4}$
Q 6	$Re_{\ell}^{0.783}\ Bo_{m}^{0.268}\ x^{0.382}\ Pr_{\ell}^{0.4}$
Q 7	$Bo_{m} + 0.28625\ \bar{X}_{tt}^{0.581}$
Q 8	$Bo + 3.524 \cdot 10^{-4}\ X_{tt}^{-2/3}$
Q 9	$Bo + 3.424 \cdot 10^{-4}\ X_{tt}^{-0.581}$
Q 10	$Bo + 1.5 \cdot 10^{-4}\ X_{tt}^{-2/3}$

FORCED CONVECTION BOILING

RUN NO. 3.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1658. LBS/HR MASS VELOCITY,G= 163.2 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 52452. TEMPERATURE BEFORE FLASH= 223.8 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	16.50	222.3	221.4	0.93	217.9	3.55	3887.	1119.	3.47	3.46	.0062	3.470	590.	.00656	0.243	0.0349	0.0828	1.71	0.0166	0.	0.	14.9	.8173	0.822	398.	0.0450	6977.	.00165	358.	0.174	1.780	1.905	0.897
0.50	16.46	223.5	222.5	0.93	217.7	4.80	2879.	1118.	2.57	2.56	.0071	3.050	437.	.00485	0.243	0.0350	0.0614	1.71	0.0166	0.	0.	16.7	.8379	0.873	420.	0.0476	7399.	.00174	378.	0.185	1.918	2.035	0.956
1.00	16.42	223.7	222.8	0.93	217.6	5.17	2670.	1117.	2.39	2.38	.0081	2.723	405.	.00450	0.243	0.0351	0.0570	1.71	0.0165	0.	0.	18.6	.8544	0.920	440.	0.0500	7789.	.00182	396.	0.195	2.050	2.157	1.012
1.50	16.37	223.7	222.8	0.93	217.5	5.34	2585.	1116.	2.32	2.30	.0090	2.457	393.	.00436	0.243	0.0352	0.0552	1.71	0.0165	0.	0.	20.6	.8682	0.965	459.	0.0523	8160.	.00190	414.	0.205	2.178	2.274	1.067
2.00	16.33	223.7	222.8	0.93	217.3	5.48	2519.	1114.	2.26	2.24	.0100	2.240	383.	.00425	0.243	0.0353	0.0539	1.71	0.0165	0.	0.	22.5	.8797	1.007	476.	0.0545	8509.	.00197	430.	0.214	2.301	2.387	1.119
2.50	16.28	223.7	222.8	0.93	217.2	5.61	2463.	1113.	2.21	2.19	.0110	2.055	374.	.00416	0.243	0.0354	0.0527	1.71	0.0164	0.	0.	24.5	.8896	1.049	493.	0.0566	8846.	.00204	445.	0.224	2.423	2.496	1.171
3.00	16.23	223.6	222.7	0.93	217.0	5.69	2426.	1112.	2.18	2.16	.0119	1.900	368.	.00409	0.243	0.0355	0.0520	1.71	0.0164	0.	0.	26.5	.8980	1.088	509.	0.0585	9166.	.00210	459.	0.233	2.540	2.601	1.221
3.50	16.17	223.4	222.5	0.93	216.8	5.68	2432.	1110.	2.19	2.17	.0129	1.762	369.	.00410	0.243	0.0356	0.0522	1.71	0.0164	0.	0.	28.6	.9055	1.127	524.	0.0605	9482.	.00216	474.	0.242	2.658	2.707	1.271
4.00	16.09	223.0	222.1	0.93	216.6	5.51	2505.	1109.	2.26	2.23	.0140	1.638	380.	.00423	0.243	0.0357	0.0539	1.72	0.0164	0.	0.	30.8	.9125	1.167	540.	0.0625	9802.	.00223	488.	0.251	2.779	2.814	1.323
4.50	16.00	222.4	221.5	0.93	216.3	5.16	2677.	1107.	2.42	2.39	.0151	1.523	407.	.00452	0.243	0.0359	0.0577	1.72	0.0163	0.	0.	33.2	.9189	1.209	555.	0.0645	10130.	.00229	502.	0.260	2.905	2.925	1.376
5.00	15.86	221.5	220.6	0.93	215.9	4.72	2926.	1105.	2.65	2.61	.0163	1.411	444.	.00494	0.243	0.0362	0.0632	1.72	0.0163	0.	0.	36.0	.9253	1.256	572.	0.0668	10491.	.00237	518.	0.271	3.044	3.047	1.435
5.50	15.77	220.5	219.5	0.93	215.6	3.96	3492.	1103.	3.17	3.12	.0175	1.325	530.	.00590	0.243	0.0364	0.0755	1.72	0.0163	0.	0.	38.4	.9301	1.294	586.	0.0686	10792.	.00242	531.	0.279	3.164	3.151	1.486

FORCED CONVECTION BOILING

RUN NO. 4.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1675. LBS/HR MASS VELOCITY,G= 164.8 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 54077. TEMPERATURE BEFORE FLASH= 233.1 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	18.07	226.5	225.6	0.93	222.6	2.99	4619.	1137.	4.06	4.03	.0110	2.142	701.	.00770	0.242	0.0318	0.0967	1.66	0.0167	0.242	14.52	22.6	.8800	0.990	497.	0.0543	8639.	.00199	442.	0.216	2.362	2.441	1.144
0.50	17.94	227.3	226.4	0.93	222.2	4.15	3326.	1135.	2.93	2.90	.0122	1.943	505.	.00554	0.242	0.0320	0.0698	1.67	0.0166	0.	0.	25.1	.8913	1.038	517.	0.0567	9031.	.00207	460.	0.227	2.504	2.569	1.205
1.00	17.81	227.3	226.4	0.93	221.8	4.57	3024.	1133.	2.67	2.64	.0134	1.780	459.	.00504	0.241	0.0322	0.0635	1.67	0.0166	0.248	14.93	27.5	.9006	1.083	535.	0.0590	9398.	.00215	476.	0.237	2.640	2.691	1.262
1.50	17.69	227.1	226.2	0.93	221.5	4.70	2939.	1131.	2.60	2.57	.0146	1.643	446.	.00490	0.241	0.0324	0.0619	1.68	0.0166	0.	0.	29.8	.9086	1.126	552.	0.0611	9746.	.00222	492.	0.247	2.771	2.807	1.318
2.00	17.56	226.8	225.9	0.93	221.1	4.75	2906.	1129.	2.58	2.54	.0158	1.525	441.	.00484	0.241	0.0326	0.0613	1.68	0.0165	0.255	15.41	32.2	.9155	1.168	568.	0.0632	10084.	.00229	507.	0.257	2.901	2.921	1.373
2.50	17.43	226.5	225.5	0.93	220.7	4.82	2866.	1127.	2.54	2.51	.0170	1.422	435.	.00478	0.241	0.0329	0.0606	1.68	0.0165	0.	0.	34.7	.9216	1.209	584.	0.0652	10410.	.00235	521.	0.266	3.028	3.032	1.427
3.00	17.30	226.1	225.2	0.93	220.3	4.84	2856.	1125.	2.54	2.50	.0182	1.331	433.	.00476	0.241	0.0331	0.0605	1.69	0.0165	0.267	16.19	37.2	.9270	1.249	599.	0.0672	10729.	.00241	535.	0.276	3.154	3.141	1.481
3.50	17.17	225.6	224.7	0.93	219.9	4.76	2905.	1122.	2.59	2.55	.0194	1.251	441.	.00484	0.241	0.0333	0.0616	1.69	0.0165	0.	0.	39.7	.9317	1.289	613.	0.0691	11037.	.00248	548.	0.285	3.277	3.248	1.533
4.00	17.03	225.0	224.0	0.93	219.5	4.53	3052.	1120.	2.73	2.68	.0206	1.178	463.	.00509	0.241	0.0336	0.0649	1.69	0.0164	0.289	17.59	42.3	.9361	1.328	627.	0.0710	11341.	.00254	562.	0.294	3.401	3.355	1.586
4.50	16.88	224.2	223.2	0.93	219.0	4.19	3296.	1118.	2.95	2.90	.0219	1.109	500.	.00550	0.241	0.0339	0.0703	1.70	0.0164	0.	0.	45.2	.9402	1.369	641.	0.0730	11653.	.00260	575.	0.303	3.530	3.465	1.641
5.00	16.71	223.2	222.3	0.93	218.5	3.78	3658.	1115.	3.28	3.22	.0232	1.045	555.	.00610	0.241	0.0342	0.0782	1.70	0.0164	0.366	22.36	48.2	.9441	1.411	655.	0.0750	11974.	.00266	588.	0.313	3.663	3.579	1.698
5.50	16.48	222.0	221.1	0.93	217.8	3.30	4186.	1111.	3.77	3.69	.0247	0.980	636.	.00699	0.241	0.0346	0.0898	1.71	0.0163	0.	0.	51.8	.9480	1.460	670.	0.0772	12330.	.00273	603.	0.324	3.812	3.705	1.761

FORCED CONVECTION BOILING

RUN NO. 5.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1670. LBS/HR MASS VELOCITY,G= 164.3 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 54561. TEMPERATURE BEFORE FLASH= 238.0 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	18.98	228.7	227.8	0.93	225.2	2.66	5190.	1138.	4.56	4.51	.0135	1.822	787.	.00869	0.243	0.0305	0.1084	1.64	0.0165	0.225	13.67	26.1	.8956	1.047	535.	0.0577	9214.	.00213	472.	0.233	2.605	2.659	1.248
0.50	18.86	229.3	228.4	0.93	224.8	3.54	3902.	1136.	3.43	3.39	.0146	1.686	592.	.00653	0.243	0.0307	0.0816	1.64	0.0164	0.240	14.60	28.2	.9036	1.088	552.	0.0597	9544.	.00220	487.	0.242	2.730	2.771	1.302
1.00	16.73	229.3	228.4	0.93	224.5	3.93	3518.	1134.	3.10	3.06	.0158	1.566	533.	.00589	0.243	0.0309	0.0737	1.65	0.0164	0.262	15.97	30.5	.9108	1.128	568.	0.0617	9870.	.00226	502.	0.251	2.856	2.881	1.355
1.50	18.59	228.9	228.0	0.93	224.1	3.91	3532.	1132.	3.12	3.08	.0170	1.459	536.	.00591	0.243	0.0311	0.0742	1.65	0.0164	0.283	17.28	32.8	.9172	1.168	584.	0.0637	10193.	.00233	516.	0.261	2.982	2.992	1.408
2.00	18.43	228.5	227.6	0.93	223.6	3.98	3470.	1130.	3.07	3.03	.0183	1.360	526.	.00580	0.243	0.0313	0.0730	1.65	0.0163	0.308	18.84	35.3	.9233	1.210	600.	0.0658	10525.	.00239	531.	0.271	3.113	3.107	1.464
2.50	18.27	228.1	227.2	0.93	223.2	4.03	3429.	1128.	3.04	2.99	.0196	1.273	520.	.00574	0.242	0.0316	0.0724	1.66	0.0163	0.339	20.77	37.9	.9286	1.251	615.	0.0678	10847.	.00246	545.	0.280	3.243	3.219	1.520
3.00	18.10	227.7	226.8	0.93	222.7	4.08	3383.	1125.	3.01	2.96	.0209	1.194	513.	.00566	0.242	0.0318	0.0715	1.66	0.0163	0.370	22.72	40.6	.9334	1.292	630.	0.0698	11168.	.00252	559.	0.290	3.374	3.332	1.575
3.50	17.90	227.1	226.2	0.93	222.1	4.07	3392.	1122.	3.02	2.97	.0223	1.120	515.	.00567	0.242	0.0322	0.0719	1.67	0.0163	0.407	25.04	43.5	.9380	1.335	645.	0.0719	11500.	.00259	573.	0.300	3.510	3.449	1.633
4.00	17.69	226.3	225.4	0.93	221.5	3.93	3515.	1120.	3.14	3.08	.0237	1.051	533.	.00588	0.242	0.0325	0.0747	1.68	0.0162	0.452	27.86	46.7	.9423	1.381	660.	0.0741	11839.	.00266	587.	0.311	3.651	3.569	1.693
4.50	17.44	225.3	224.4	0.93	220.7	3.68	3755.	1116.	3.36	3.30	.0253	0.985	570.	.00628	0.242	0.0329	0.0801	1.68	0.0162	0.520	32.12	50.1	.9464	1.429	676.	0.0763	12198.	.00273	602.	0.322	3.801	3.696	1.757
5.00	17.13	224.1	223.2	0.93	219.8	3.32	4164.	1112.	3.74	3.66	.0270	0.920	632.	.00696	0.242	0.0335	0.0891	1.69	0.0162	0.635	39.31	54.2	.9505	1.484	692.	0.0789	12594.	.00280	618.	0.334	3.968	3.836	1.828
5.40	16.82	222.9	222.0	0.93	218.9	3.16	4375.	1108.	3.95	3.86	.0287	0.864	664.	.00732	0.242	0.0341	0.0941	1.70	0.0161	0.825	51.19	58.3	.9541	1.536	707.	0.0813	12966.	.00287	633.	0.346	4.128	3.970	1.896

FORCED CONVECTION BOILING

RUN NO. 5.1 WATER TEST SECTION NO. 1

FLOW RATE,W=1661. LBS/HR MASS VELOCITY,G= 163.5 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 54185. TEMPERATURE BEFORE FLASH= 238.9 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	18.95	228.7	227.8	0.93	225.1	2.74	5035.	1132.	4.45	4.40	.0145	1.702	763.	.00847	0.244	0.0307	0.1057	1.64	0.0163	0.230	14.13	27.8	.9025	1.082	549.	0.0595	9465.	.00219	484.	0.241	2.716	2.758	1.296
0.50	18.38	229.6	228.7	0.93	224.9	3.79	3649.	1131.	3.23	3.19	.0155	1.598	553.	.00614	0.244	0.0308	0.0767	1.64	0.0163	0.252	15.50	29.6	.9086	1.115	563.	0.0612	9739.	.00225	496.	0.249	2.822	2.852	1.341
1.00	18.74	229.4	228.5	0.93	224.5	3.95	3498.	1129.	3.10	3.06	.0167	1.487	530.	.00588	0.244	0.0310	0.0737	1.64	0.0162	0.276	17.01	31.9	.9153	1.155	579.	0.0632	10063.	.00232	511.	0.258	2.949	2.963	1.395
1.50	18.61	229.0	228.1	0.93	224.1	3.96	3492.	1127.	3.10	3.05	.0179	1.392	530.	.00587	0.244	0.0312	0.0737	1.65	0.0162	0.302	18.64	34.2	.9210	1.193	594.	0.0651	10367.	.00238	524.	0.267	3.070	3.069	1.447
2.00	18.44	228.6	227.7	0.93	223.7	4.06	3401.	1124.	3.02	2.98	.0192	1.300	516.	.00572	0.244	0.0315	0.0719	1.65	0.0162	0.330	20.41	36.8	.9267	1.236	609.	0.0672	10698.	.00244	539.	0.277	3.203	3.184	1.503
2.50	16.27	228.2	227.3	0.93	223.2	4.13	3346.	1122.	2.98	2.93	.0205	1.218	508.	.00563	0.244	0.0317	0.0710	1.66	0.0161	0.362	22.43	39.4	.9318	1.277	625.	0.0692	11020.	.00251	553.	0.287	3.334	3.298	1.559
3.00	18.07	227.8	226.8	0.93	222.6	4.25	3253.	1119.	2.91	2.86	.0219	1.141	493.	.00547	0.244	0.0321	0.0692	1.66	0.0161	0.403	25.02	42.3	.9365	1.321	640.	0.0713	11353.	.00258	567.	0.297	3.471	3.415	1.618
3.50	17.85	227.2	226.2	0.93	221.9	4.29	3218.	1116.	2.88	2.83	.0234	1.068	488.	.00541	0.244	0.0324	0.0686	1.67	0.0161	0.451	28.06	45.5	.9411	1.367	655.	0.0735	11702.	.00265	582.	0.308	3.616	3.539	1.679
4.00	17.58	226.3	225.4	0.93	221.1	4.27	3235.	1113.	2.91	2.85	.0250	0.998	491.	.00544	0.243	0.0329	0.0692	1.68	0.0160	0.507	31.61	49.1	.9455	1.418	672.	0.0759	12077.	.00272	598.	0.320	3.773	3.672	1.746
4.50	17.33	225.4	224.4	0.93	220.4	4.00	3453.	1110.	3.11	3.05	.0266	0.938	524.	.00580	0.243	0.0333	0.0741	1.69	0.0160	0.575	35.93	52.6	.9492	1.466	686.	0.0782	12425.	.00279	612.	0.330	3.921	3.797	1.809
5.00	17.03	224.0	223.1	0.93	219.5	3.60	3832.	1106.	3.47	3.39	.0283	0.878	582.	.00644	0.243	0.0339	0.0826	1.69	0.0160	0.	0.	56.7	.9531	1.520	702.	0.0807	12813.	.00286	628.	0.343	4.087	3.937	1.880
5.55	16.82	222.7	221.8	0.93	218.9	2.94	4695.	1102.	4.26	4.16	.0299	0.831	713.	.00790	0.243	0.0342	0.1015	1.70	0.0159	0.	0.	60.3	.9559	1.565	716.	0.0827	13134.	.00292	641.	0.353	4.229	4.055	1.940

FORCED CONVECTION BOILING

RUN NO. 8.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1676. LBS/HR MASS VELOCITY,G= 164.9 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 54925. TEMPERATURE BEFORE FLASH= 244.4 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	19.52	231.1	230.2	0.93	226.6	3.58	3857.	1140.	3.38	3.33	.0187	1.369	585.	.00643	0.242	0.0296	0.0803	1.62	0.0164	0.148	9.03	34.4	.9208	1.180	605.	0.0647	10445.	.00238	531.	0.268	3.100	3.095	1.459
0.25	19.47	231.6	230.6	0.93	226.5	4.13	3348.	1140.	2.94	2.89	.0192	1.333	508.	.00559	0.242	0.0296	0.0698	1.62	0.0154	0.	0.	35.3	.9230	1.195	612.	0.0655	10571.	.00241	537.	0.272	3.152	3.140	1.481
0.50	19.43	231.7	230.8	0.93	226.4	4.43	3119.	1139.	2.74	2.70	.0197	1.299	473.	.00520	0.242	0.0297	0.0651	1.63	0.0164	0.185	11.30	36.3	.9251	1.210	618.	0.0663	10695.	.00243	542.	0.276	3.202	3.184	1.502
1.00	19.33	231.5	230.6	0.93	226.1	4.43	3116.	1137.	2.74	2.69	.0208	1.233	472.	.00520	0.242	0.0299	0.0651	1.63	0.0163	0.233	14.26	38.3	.9291	1.241	630.	0.0678	10947.	.00248	554.	0.283	3.306	3.273	1.546
1.50	19.20	231.0	230.0	0.93	225.8	4.27	3236.	1135.	2.85	2.80	.0220	1.169	491.	.00540	0.242	0.0300	0.0677	1.63	0.0163	0.302	18.52	40.6	.9331	1.275	643.	0.0695	11214.	.00254	565.	0.291	3.417	3.369	1.594
2.00	19.03	230.4	229.5	0.93	225.3	4.22	3277.	1133.	2.89	2.84	.0233	1.105	497.	.00546	0.242	0.0303	0.0688	1.64	0.0163	0.367	22.54	43.1	.9372	1.312	657.	0.0713	11505.	.00260	578.	0.300	3.538	3.473	1.645
2.50	18.33	229.9	229.0	0.93	224.7	4.20	3287.	1130.	2.91	2.85	.0246	1.044	498.	.00548	0.242	0.0306	0.0691	1.64	0.0162	0.427	26.28	45.9	.9411	1.352	671.	0.0732	11811.	.00266	591.	0.310	3.667	3.582	1.700
3.00	18.56	229.3	228.4	0.93	224.1	4.31	3206.	1127.	2.85	2.79	.0262	0.982	486.	.00534	0.242	0.0310	0.0677	1.65	0.0162	0.478	29.48	49.1	.9451	1.397	685.	0.0753	12146.	.00272	605.	0.320	3.808	3.702	1.760
3.50	18.22	228.7	227.7	0.93	223.3	4.41	3134.	1124.	2.79	2.73	.0277	0.925	475.	.00522	0.242	0.0314	0.0663	1.66	0.0162	0.527	32.57	52.5	.9487	1.443	700.	0.0775	12484.	.00279	619.	0.331	3.953	3.824	1.821
4.00	18.06	227.9	227.0	0.93	222.5	4.45	3104.	1120.	2.77	2.71	.0293	0.873	471.	.00517	0.241	0.0318	0.0659	1.66	0.0161	0.568	35.18	56.1	.9521	1.489	714.	0.0797	12823.	.00286	633.	0.342	4.100	3.947	1.884
4.50	17.76	227.0	226.0	0.93	221.7	4.37	3164.	1117.	2.83	2.76	.0310	0.822	480.	.00527	0.241	0.0323	0.0675	1.67	0.0161	0.612	37.99	60.1	.9554	1.540	729.	0.0820	13182.	.00292	647.	0.353	4.256	4.077	1.950
5.00	17.42	225.7	224.8	0.93	220.7	4.10	3372.	1112.	3.03	2.95	.0328	0.774	512.	.00561	0.241	0.0329	0.0722	1.68	0.0161	0.645	40.13	64.5	.9585	1.594	744.	0.0845	13565.	.00300	662.	0.365	4.423	4.216	2.021
5.50	17.10	223.6	222.7	0.93	219.7	2.99	4625.	1108.	4.17	4.06	.0346	0.731	702.	.00770	0.241	0.0334	0.0994	1.69	0.0160	0.677	42.22	69.0	.9613	1.647	758.	0.0868	13930.	.00307	677.	0.377	4.585	4.349	2.090

FORCED CONVECTION BOILING

RUN NO. 9.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1664. LBS/HR MASS VELOCITY,G= 163.8 LBS/SEC.SQFT POWER= 4.26 KILOWATTS HEAT FLUX,Q= 13623. BTU/HR.SQFT

REYNOLDS NO.= 55197. TEMPERATURE BEFORE FLASH= 249.3 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.53	232.6	231.7	0.91	229.3	2.41	5652.	1138.	4.96	4.88	.0211	1.253	856.	.00950	0.241	0.0280	0.1178	1.60	0.0161	0.343	21.33	36.5	.9260	1.202	629.	0.0664	10697.	.00247	547.	0.279	3.272	3.244	1.531
0.25	20.44	233.2	232.3	0.91	229.1	3.17	4294.	1137.	3.78	3.71	.0217	1.217	651.	.00722	0.241	0.0282	0.0896	1.60	0.0161	0.	0.	37.7	.9284	1.220	636.	0.0673	10842.	.00250	553.	0.284	3.332	3.296	1.557
0.50	20.36	233.4	232.5	0.91	228.9	3.60	3785.	1136.	3.33	3.27	.0223	1.184	574.	.00636	0.241	0.0283	0.0791	1.60	0.0160	0.	0.	38.8	.9305	1.237	642.	0.0682	10978.	.00252	559.	0.288	3.389	3.345	1.581
1.00	20.17	233.0	232.1	0.91	228.4	3.68	3703.	1134.	3.27	3.20	.0236	1.119	561.	.00622	0.241	0.0285	0.0775	1.61	0.0160	0.400	24.97	41.2	.9347	1.274	656.	0.0699	11265.	.00258	572.	0.297	3.511	3.449	1.633
1.50	19.96	232.4	231.5	0.91	227.8	3.61	3774.	1131.	3.34	3.27	.0250	1.057	572.	.00634	0.241	0.0288	0.0792	1.61	0.0160	0.	0.	43.9	.9387	1.312	669.	0.0718	11561.	.00264	585.	0.306	3.636	3.556	1.686
2.00	19.73	231.8	230.9	0.91	227.2	3.68	3702.	1128.	3.28	3.21	.0264	0.998	561.	.00622	0.241	0.0291	0.0779	1.62	0.0160	0.474	29.71	46.7	.9426	1.352	683.	0.0737	11866.	.00270	598.	0.316	3.768	3.668	1.742
2.50	19.46	231.2	230.3	0.91	226.5	3.77	3609.	1125.	3.21	3.14	.0279	0.943	547.	.00606	0.240	0.0294	0.0762	1.62	0.0159	0.	0.	49.8	.9462	1.394	697.	0.0758	12179.	.00277	611.	0.326	3.904	3.782	1.800
3.00	19.20	230.6	229.7	0.91	225.8	3.90	3491.	1122.	3.11	3.04	.0295	0.891	529.	.00586	0.240	0.0298	0.0740	1.63	0.0159	0.575	36.19	53.1	.9497	1.439	711.	0.0779	12507.	.00283	624.	0.336	4.047	3.903	1.861
3.50	18.90	229.9	229.0	0.92	224.9	4.01	3394.	1118.	3.04	2.96	.0312	0.841	515.	.00570	0.240	0.0303	0.0722	1.64	0.0159	0.	0.	56.7	.9530	1.485	726.	0.0800	12842.	.00290	638.	0.347	4.195	4.026	1.924
4.00	18.57	229.0	228.1	0.92	224.0	4.05	3365.	1114.	3.02	2.94	.0329	0.794	510.	.00565	0.240	0.0308	0.0718	1.65	0.0158	0.676	42.73	60.7	.9561	1.535	740.	0.0823	13192.	.00297	652.	0.358	4.350	4.155	1.990
4.50	18.22	227.8	226.9	0.92	223.0	3.89	3505.	1110.	3.16	3.07	.0347	0.749	532.	.00588	0.240	0.0313	0.0751	1.66	0.0158	0.	0.	65.0	.9591	1.587	754.	0.0847	13558.	.00304	666.	0.370	4.515	4.291	2.060
5.00	17.85	226.2	225.3	0.92	221.9	3.36	4060.	1106.	3.67	3.56	.0366	0.706	616.	.00681	0.240	0.0319	0.0874	1.67	0.0157	0.790	50.18	69.6	.9620	1.642	769.	0.0872	13934.	.00311	681.	0.382	4.685	4.431	2.132
5.50	17.43	224.5	223.5	0.92	220.7	2.83	4813.	1101.	4.37	4.24	.0386	0.664	730.	.00807	0.240	0.0326	0.1041	1.68	0.0157	0.	0.	74.9	.9648	1.703	784.	0.0899	14341.	.00319	696.	0.396	4.869	4.582	2.210

FORCED CONVECTION BOILING

RUN NO. 10.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1670. LBS/HR MASS VELOCITY,G= 164.3 LBS/SEC.SQFT POWER= 4.30 KILOWATTS HEAT FLUX,Q= 13751. BTU/HR.SQFT

REYNOLDS NO.= 56101. TEMPERATURE BEFORE FLASH= 258.0 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	21.93	236.0	235.1	0.92	232.9	2.20	6250.	1145.	5.46	5.34	.0265	1.044	947.	.01046	0.243	0.0265	0.1293	1.57	0.0160	0.418	26.16	42.8	.9370	1.278	688.	0.0710	11544.	.00266	592.	0.306	3.668	3.583	1.701
0.25	21.85	236.5	235.5	0.92	232.7	2.86	4803.	1144.	4.20	4.11	.0272	1.018	727.	.00804	0.243	0.0266	0.0995	1.57	0.0160	0.439	27.51	44.0	.9387	1.295	694.	0.0718	11675.	.00268	597.	0.310	3.725	3.631	1.725
0.50	21.73	236.6	235.7	0.92	232.4	3.27	4203.	1143.	3.68	3.60	.0279	0.992	637.	.00704	0.243	0.0268	0.0872	1.57	0.0159	0.458	28.73	45.3	.9405	1.312	701.	0.0726	11812.	.00271	603.	0.314	3.785	3.682	1.750
1.00	21.50	236.0	235.1	0.92	231.8	3.24	4246.	1140.	3.72	3.64	.0293	0.944	643.	.00711	0.243	0.0270	0.0883	1.58	0.0159	0.502	31.55	47.8	.9438	1.347	713.	0.0743	12085.	.00276	615.	0.323	3.904	3.783	1.801
1.50	21.24	235.3	234.4	0.92	231.2	3.20	4295.	1137.	3.78	3.68	.0308	0.896	651.	.00719	0.243	0.0273	0.0896	1.58	0.0159	0.548	34.52	50.7	.9471	1.386	726.	0.0762	12377.	.00282	627.	0.332	4.034	3.892	1.856
2.00	20.95	234.6	233.6	0.92	230.4	3.21	4279.	1134.	3.77	3.68	.0323	0.851	648.	.00717	0.242	0.0277	0.0895	1.59	0.0158	0.601	37.94	53.8	.9502	1.425	739.	0.0781	12672.	.00288	639.	0.342	4.166	4.003	1.913
2.50	20.63	233.8	232.9	0.92	229.6	3.28	4191.	1130.	3.71	3.61	.0340	0.807	635.	.00702	0.242	0.0281	0.0880	1.60	0.0158	0.658	41.63	57.2	.9532	1.468	753.	0.0801	12990.	.00294	652.	0.352	4.309	4.122	1.973
3.00	20.23	233.0	232.1	0.92	228.7	3.39	4060.	1126.	3.60	3.50	.0357	0.764	615.	.00680	0.242	0.0285	0.0856	1.60	0.0158	0.722	45.79	60.9	.9562	1.514	766.	0.0822	13322.	.00301	666.	0.363	4.459	4.246	2.037
3.50	19.91	232.1	231.2	0.92	227.7	3.47	3958.	1122.	3.53	3.42	.0375	0.724	600.	.00663	0.242	0.0290	0.0837	1.61	0.0157	0.793	50.41	64.8	.9589	1.562	780.	0.0844	13658.	.00307	679.	0.374	4.612	4.372	2.102
4.00	19.51	230.9	230.0	0.92	226.6	3.40	4040.	1118.	3.61	3.50	.0394	0.685	612.	.00676	0.242	0.0296	0.0859	1.62	0.0157	0.871	55.51	69.3	.9617	1.614	794.	0.0868	14020.	.00314	693.	0.386	4.778	4.508	2.173
4.50	19.07	229.5	228.6	0.92	225.4	3.19	4316.	1113.	3.88	3.75	.0415	0.647	654.	.00722	0.242	0.0302	0.0922	1.64	0.0157	0.956	61.08	74.2	.9643	1.670	808.	0.0893	14397.	.00322	707.	0.399	4.953	4.651	2.247
5.00	18.58	228.0	227.1	0.92	224.1	3.01	4565.	1108.	4.12	3.98	.0436	0.610	692.	.00764	0.241	0.0309	0.0980	1.65	0.0156	1.048	67.13	79.8	.9669	1.733	823.	0.0921	14811.	.00329	723.	0.413	5.144	4.806	2.328
5.50	18.02	226.0	225.1	0.93	222.4	2.66	5176.	1101.	4.70	4.53	.0460	0.572	785.	.00865	0.241	0.0318	0.1118	1.67	0.0156	1.152	74.01	86.4	.9695	1.804	839.	0.0952	15269.	.00338	740.	0.428	5.358	4.979	2.419

FORCED CONVECTION BOILING

RUN NO. 11.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1670. LBS/HR MASS VELOCITY,G= 164.3 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 56638. TEMPERATURE BEFORE FLASH= 268.2 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	23.44	239.6	238.7	0.92	236.5	2.20	6288.	1147.	5.48	5.33	.0337	0.861	952.	.01052	0.245	0.0251	0.1298	1.54	0.0157	0.587	37.32	50.6	.9470	1.365	753.	0.0762	12443.	.00287	639.	0.337	4.138	3.979	1.902
0.25	23.29	239.9	239.0	0.92	236.2	2.81	4917.	1145.	4.29	4.17	.0344	0.841	745.	.00823	0.245	0.0252	0.1017	1.55	0.0157	0.600	38.19	52.0	.9484	1.383	759.	0.0770	12579.	.00290	645.	0.342	4.200	4.031	1.928
0.50	23.13	240.0	239.1	0.92	235.8	3.29	4203.	1144.	3.67	3.57	.0352	0.821	636.	.00703	0.245	0.0254	0.0870	1.55	0.0157	0.615	39.19	53.4	.9499	1.402	765.	0.0779	12721.	.00293	651.	0.346	4.265	4.085	1.956
1.00	22.82	239.4	238.5	0.92	235.0	3.44	4018.	1140.	3.52	3.42	.0368	0.783	608.	.00672	0.244	0.0257	0.0834	1.55	0.0157	0.651	41.58	56.4	.9526	1.439	777.	0.0797	12999.	.00298	662.	0.356	4.393	4.191	2.010
1.50	22.48	238.5	237.6	0.92	234.2	3.34	4133.	1137.	3.64	3.52	.0385	0.746	626.	.00692	0.244	0.0261	0.0861	1.56	0.0156	0.692	44.30	59.6	.9553	1.478	789.	0.0815	13289.	.00304	674.	0.365	4.527	4.302	2.067
2.00	22.13	237.6	236.7	0.92	233.4	3.33	4148.	1133.	3.66	3.54	.0402	0.712	628.	.00695	0.244	0.0264	0.0867	1.57	0.0156	0.742	47.62	63.0	.9577	1.518	801.	0.0834	13582.	.00310	686.	0.375	4.663	4.414	2.125
2.50	21.76	236.7	235.8	0.93	232.5	3.31	4178.	1130.	3.70	3.57	.0419	0.680	633.	.00700	0.244	0.0269	0.0877	1.57	0.0155	0.801	51.53	66.5	.9601	1.559	813.	0.0853	13883.	.00315	698.	0.385	4.804	4.530	2.185
3.00	21.34	235.7	234.8	0.93	231.4	3.35	4124.	1126.	3.66	3.54	.0438	0.646	625.	.00691	0.244	0.0273	0.0869	1.58	0.0155	0.870	56.12	70.6	.9625	1.606	826.	0.0874	14210.	.00322	710.	0.396	4.958	4.656	2.251
3.50	20.87	234.6	233.7	0.93	230.2	3.49	3957.	1121.	3.53	3.40	.0458	0.613	599.	.00663	0.244	0.0279	0.0838	1.59	0.0155	0.947	61.25	75.3	.9649	1.658	839.	0.0898	14565.	.00328	724.	0.408	5.127	4.793	2.322
4.00	20.38	233.4	232.5	0.93	228.9	3.53	3909.	1116.	3.50	3.37	.0479	0.582	592.	.00655	0.243	0.0285	0.0831	1.60	0.0154	1.031	66.87	80.3	.9672	1.712	852.	0.0922	14931.	.00335	737.	0.421	5.301	4.934	2.396
4.50	19.86	232.0	231.0	0.93	227.6	3.46	3992.	1110.	3.60	3.45	.0501	0.551	605.	.00669	0.243	0.0292	0.0854	1.61	0.0154	1.123	73.04	85.8	.9694	1.771	866.	0.0948	15316.	.00343	752.	0.434	5.485	5.082	2.474
5.00	19.28	230.2	229.3	0.93	226.0	3.29	4199.	1104.	3.80	3.64	.0525	0.521	637.	.00703	0.243	0.0300	0.0904	1.63	0.0153	1.221	79.64	92.2	.9716	1.838	880.	0.0977	15740.	.00351	767.	0.448	5.690	5.246	2.561
5.50	18.65	227.5	226.6	0.93	224.3	2.32	5966.	1098.	5.44	5.19	.0550	0.491	905.	.00998	0.243	0.0310	0.1292	1.65	0.0153	1.322	86.49	99.5	.9738	1.911	895.	0.1008	16197.	.00359	783.	0.464	5.910	5.422	2.655

FORCED CONVECTION BOILING

RUN NO. 12.0 WATER TEST SECTION NO. 1

FLOW RATE.W=1664. LBS/HR MASS VELOCITY.G= 163.8 LBS/SEC.SQFT POWER= 4.38 KILOWATTS HEAT FLUX.Q= 14007. BTU/HR.SQFT

REYNOLDS NO.= 56816. TEMPERATURE BEFORE FLASH= 284.8 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	25.36	244.6	243.6	0.93	240.8	2.79	5014.	1141.	4.39	4.23	.0470	0.653	759.	.00841	0.250	0.0237	0.1039	1.51	0.0152	0.642	42.21	64.5	.9590	1.512	852.	0.0847	13840.	.00322	711.	0.390	4.932	4.635	2.243
0.25	25.20	244.7	243.8	0.93	240.5	3.32	4221.	1140.	3.70	3.56	.0477	0.641	639.	.00708	0.250	0.0239	0.0876	1.52	0.0152	0.674	44.37	65.9	.9599	1.528	856.	0.0855	13957.	.00325	716.	0.394	4.989	4.682	2.267
0.50	25.02	244.6	243.7	0.93	240.1	3.56	3939.	1138.	3.46	3.33	.0485	0.629	596.	.00660	0.250	0.0240	0.0819	1.52	0.0152	0.704	46.40	67.4	.9609	1.546	862.	0.0863	14082.	.00327	721.	0.399	5.050	4.731	2.293
1.00	24.55	243.6	242.7	0.93	239.3	3.40	4119.	1135.	3.63	3.48	.0502	0.605	623.	.00691	0.249	0.0244	0.0859	1.52	0.0151	0.767	50.68	70.5	.9627	1.580	872.	0.0879	14332.	.00332	731.	0.407	5.174	4.832	2.346
1.50	24.25	242.6	241.7	0.94	238.4	3.33	4211.	1131.	3.72	3.57	.0520	0.581	637.	.00706	0.249	0.0247	0.0881	1.53	0.0151	0.833	55.18	74.0	.9645	1.619	882.	0.0897	14602.	.00337	741.	0.417	5.309	4.941	2.403
2.00	23.82	241.6	240.7	0.94	237.4	3.29	4261.	1127.	3.78	3.62	.0538	0.558	645.	.00715	0.249	0.0251	0.0895	1.54	0.0151	0.905	60.11	77.8	.9663	1.659	893.	0.0915	14881.	.00343	752.	0.427	5.448	5.053	2.462
2.50	23.34	240.5	239.6	0.94	236.3	3.30	4241.	1122.	3.78	3.61	.0557	0.535	642.	.00712	0.249	0.0256	0.0895	1.55	0.0150	0.978	65.14	82.0	.9681	1.704	904.	0.0935	15183.	.00349	763.	0.437	5.598	5.174	2.526
3.00	22.83	239.4	238.4	0.94	235.1	3.37	4155.	1117.	3.72	3.55	.0578	0.512	629.	.00698	0.249	0.0261	0.0881	1.55	0.0150	1.055	70.47	86.6	.9699	1.751	915.	0.0956	15503.	.00355	775.	0.449	5.758	5.302	2.594
3.50	22.23	238.1	237.2	0.94	233.7	3.45	4055.	1112.	3.65	3.47	.0600	0.489	614.	.00681	0.248	0.0267	0.0864	1.56	0.0149	1.132	75.84	91.7	.9717	1.803	926.	0.0979	15844.	.00361	787.	0.461	5.930	5.439	2.667
4.00	21.70	236.6	235.7	0.94	232.3	3.38	4145.	1107.	3.74	3.56	.0622	0.466	628.	.00697	0.248	0.0274	0.0888	1.57	0.0149	1.211	81.39	97.3	.9734	1.858	938.	0.1002	16203.	.00367	800.	0.473	6.109	5.581	2.743
4.50	21.07	234.9	233.9	0.94	230.7	3.21	4360.	1101.	3.96	3.75	.0646	0.444	660.	.00733	0.248	0.0282	0.0939	1.59	0.0148	1.292	87.11	103.8	.9751	1.920	950.	0.1029	16592.	.00375	813.	0.487	6.306	5.737	2.827
5.00	20.41	232.8	231.8	0.94	229.0	2.81	4977.	1095.	4.55	4.30	.0671	0.422	754.	.00837	0.248	0.0290	0.1079	1.60	0.0148	1.376	93.07	110.9	.9768	1.987	962.	0.1057	17001.	.00382	827.	0.502	6.515	5.901	2.915
5.50	19.70	230.2	229.3	0.94	227.1	2.15	6529.	1088.	6.00	5.67	.0698	0.400	990.	.01097	0.247	0.0300	0.1426	1.62	0.0147	1.463	99.29	118.9	.9785	2.062	975.	0.1089	17446.	.00391	842.	0.517	6.741	6.079	3.012

FORCED CONVECTION BOILING

RUN NO. 13.0 WATER TEST SECTION NO. 1

FLOW RATE.W=1655. LBS/HR MASS VELOCITY.G= 162.9 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX.Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 56969. TEMPERATURE BEFORE FLASH= 295.9 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	27.07	247.5	246.6	0.92	244.5	2.14	6467.	1136.	5.69	5.44	.0552	0.577	979.	.01090	0.248	0.0221	0.1344	1.49	0.0148	1.010	68.20	70.6	.9630	1.558	897.	0.0879	14305.	.00339	739.	0.416	5.333	4.960	2.413
0.25	26.82	247.6	246.7	0.92	244.0	2.69	5127.	1134.	4.52	4.32	.0561	0.566	776.	.00864	0.248	0.0223	0.1068	1.49	0.0148	1.018	68.84	72.4	.9640	1.577	902.	0.0888	14441.	.00342	744.	0.421	5.401	5.016	2.442
0.50	26.56	247.4	246.5	0.92	243.4	3.05	4523.	1132.	4.00	3.81	.0571	0.554	684.	.00763	0.248	0.0225	0.0944	1.50	0.0148	1.027	69.55	74.2	.9649	1.598	907.	0.0897	14583.	.00344	750.	0.426	5.474	5.074	2.472
1.00	26.05	246.9	246.0	0.92	242.3	3.70	3732.	1128.	3.31	3.15	.0590	0.532	565.	.00629	0.248	0.0230	0.0782	1.50	0.0147	1.044	70.91	78.0	.9667	1.638	918.	0.0916	14865.	.00350	760.	0.436	5.617	5.189	2.533
1.50	25.52	245.2	244.3	0.92	241.2	3.11	4439.	1124.	3.95	3.76	.0610	0.511	672.	.00748	0.248	0.0234	0.0934	1.51	0.0147	1.063	72.42	82.0	.9684	1.681	928.	0.0935	15156.	.00355	771.	0.446	5.765	5.307	2.596
2.00	24.99	244.0	243.1	0.92	240.0	3.08	4481.	1119.	4.00	3.60	.0630	0.491	678.	.00755	0.247	0.0239	0.0947	1.52	0.0146	1.085	74.15	86.2	.9701	1.724	938.	0.0954	15449.	.00361	782.	0.457	5.914	5.426	2.659
2.50	24.44	242.8	241.9	0.92	238.8	3.11	4449.	1114.	3.99	3.78	.0651	0.471	673.	.00750	0.247	0.0244	0.0945	1.53	0.0146	1.112	76.22	90.8	.9716	1.770	948.	0.0975	15749.	.00367	793.	0.468	6.071	5.551	2.726
3.00	23.89	241.5	240.6	0.92	237.5	3.07	4499.	1109.	4.06	3.84	.0671	0.452	681.	.00759	0.247	0.0249	0.0960	1.54	0.0145	1.145	78.71	95.6	.9731	1.817	958.	0.0995	16052.	.00373	803.	0.479	6.230	5.677	2.794
3.50	23.32	240.1	239.2	0.92	236.2	2.96	4665.	1104.	4.22	3.99	.0693	0.434	706.	.00788	0.247	0.0254	0.1000	1.55	0.0145	1.187	81.85	100.7	.9746	1.866	968.	0.1016	16366.	.00378	814.	0.490	6.395	5.807	2.864
4.00	22.72	238.5	237.6	0.92	234.8	2.81	4916.	1099.	4.47	4.22	.0715	0.416	744.	.00830	0.247	0.0260	0.1060	1.56	0.0145	1.243	85.98	106.4	.9760	1.919	979.	0.1039	16700.	.00385	826.	0.502	6.571	5.946	2.939
4.50	22.07	236.9	236.0	0.93	233.2	2.77	4995.	1093.	4.57	4.30	.0739	0.398	757.	.00844	0.246	0.0268	0.1083	1.57	0.0144	1.335	92.65	112.8	.9774	1.978	989.	0.1064	17063.	.00391	838.	0.516	6.762	6.095	3.020
5.00	21.36	235.1	234.2	0.93	231.5	2.73	5064.	1087.	4.66	4.37	.0764	0.380	767.	.00856	0.246	0.0276	0.1105	1.58	0.0144	1.480	103.07	120.1	.9789	2.044	1000.	0.1091	17461.	.00398	851.	0.530	6.971	6.258	3.108
5.50	20.55	232.1	231.2	0.93	229.4	1.80	7694.	1079.	7.13	6.67	.0793	0.360	1166.	.01300	0.246	0.0286	0.1691	1.60	0.0143	1.751	122.38	128.9	.9804	2.122	1012.	0.1124	17915.	.00407	866.	0.547	7.212	6.445	3.211

FORCED CONVECTION BOILING

RUN NO. 14.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1668. LBS/HR MASS VELOCITY,G= 164.1 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 53093. TEMPERATURE BEFORE FLASH= 226.6 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	16.97	223.5	222.6	0.93	219.3	3.24	4266.	1128.	3.78	3.76	.0076	2.923	648.	.00714	0.242	0.0338	0.0901	1.70	0.0167	0.128	7.67	17.3	.8423	0.880	431.	0.0482	7547.	.00176	387.	0.187	1.965	2.078	0.976
0.25	16.94	224.4	223.5	0.93	219.2	4.24	3262.	1127.	2.89	2.88	.0081	2.755	495.	.00546	0.242	0.0339	0.0690	1.70	0.0167	0.132	7.91	18.3	.8510	0.904	442.	0.0494	7752.	.00181	396.	0.193	2.035	2.142	1.005
0.50	16.90	224.8	223.8	0.93	219.1	4.70	2937.	1126.	2.61	2.59	.0086	2.602	446.	.00492	0.242	0.0339	0.0621	1.70	0.0167	0.137	8.22	19.3	.8589	0.929	452.	0.0507	7956.	.00185	406.	0.198	2.104	2.206	1.035
1.00	16.84	225.0	224.0	0.93	218.9	5.13	2691.	1125.	2.39	2.37	.0096	2.346	409.	.00451	0.242	0.0341	0.0570	1.70	0.0166	0.146	8.77	21.4	.8725	0.975	471.	0.0530	8339.	.00193	423.	0.208	2.238	2.328	1.091
1.50	16.77	225.0	224.1	0.93	218.7	5.38	2566.	1123.	2.28	2.27	.0107	2.134	390.	.00430	0.242	0.0342	0.0544	1.70	0.0166	0.156	9.39	23.5	.8840	1.019	490.	0.0553	8705.	.00200	440.	0.218	2.368	2.446	1.147
2.00	16.69	224.9	223.9	0.93	218.5	5.49	2515.	1121.	2.24	2.22	.0117	1.955	382.	.00421	0.242	0.0344	0.0534	1.70	0.0166	0.166	10.01	25.6	.8938	1.063	507.	0.0574	9058.	.00207	456.	0.228	2.496	2.562	1.201
2.50	16.60	224.7	223.7	0.93	218.2	5.57	2481.	1120.	2.22	2.19	.0128	1.798	377.	.00416	0.242	0.0345	0.0528	1.70	0.0166	0.178	10.75	27.9	.9025	1.106	524.	0.0596	9406.	.00214	472.	0.238	2.624	2.677	1.256
3.00	16.51	224.4	223.5	0.93	217.9	5.59	2471.	1118.	2.21	2.19	.0139	1.663	375.	.00414	0.242	0.0347	0.0527	1.71	0.0165	0.191	11.56	30.2	.9101	1.148	541.	0.0617	9745.	.00221	487.	0.248	2.752	2.790	1.310
3.50	16.40	224.0	223.1	0.93	217.6	5.49	2516.	1116.	2.25	2.23	.0151	1.544	382.	.00422	0.242	0.0349	0.0537	1.71	0.0165	0.206	12.49	32.6	.9169	1.190	557.	0.0637	10080.	.00228	502.	0.257	2.880	2.902	1.365
4.00	16.29	223.4	222.5	0.93	217.2	5.27	2620.	1114.	2.35	2.32	.0162	1.439	398.	.00439	0.242	0.0351	0.0561	1.71	0.0165	0.225	13.66	35.1	.9229	1.232	572.	0.0658	10408.	.00234	516.	0.267	3.007	3.014	1.419
4.50	16.17	222.8	221.8	0.93	216.8	4.99	2771.	1112.	2.49	2.46	.0174	1.343	421.	.00465	0.242	0.0354	0.0594	1.71	0.0164	0.251	15.27	37.7	.9284	1.274	587.	0.0678	10738.	.00241	530.	0.277	3.136	3.126	1.474
5.00	16.05	221.9	221.0	0.93	216.4	4.57	3020.	1109.	2.72	2.68	.0187	1.256	459.	.00507	0.242	0.0357	0.0649	1.72	0.0164	0.287	17.49	40.5	.9334	1.318	602.	0.0699	11071.	.00247	545.	0.286	3.269	3.241	1.530
5.50	15.88	221.0	220.0	0.93	215.9	4.12	3355.	1107.	3.03	2.98	.0200	1.175	510.	.00563	0.242	0.0360	0.0723	1.72	0.0164	0.343	20.94	43.5	.9382	1.363	617.	0.0720	11413.	.00254	559.	0.297	3.406	3.359	1.589

FORCED CONVECTION BOILING

RUN NO. 15.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1722. LBS/HR MASS VELOCITY,G= 169.5 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 58819. TEMPERATURE BEFORE FLASH= 277.6 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	24.75	242.3	241.4	0.92	239.5	1.93	7168.	1176.	6.09	5.90	.0406	0.740	1085.	.01162	0.238	0.0231	0.1442	1.52	0.0164	0.800	48.92	59.4	.9537	1.426	818.	0.0796	13431.	.00301	688.	0.364	4.544	4.315	2.071
0.25	24.53	242.7	241.8	0.92	239.0	2.83	4882.	1174.	4.16	4.02	.0415	0.722	739.	.00791	0.238	0.0233	0.0984	1.53	0.0163	0.812	49.72	61.1	.9551	1.447	824.	0.0806	13586.	.00304	695.	0.369	4.615	4.374	2.101
0.50	24.33	242.6	241.7	0.92	238.5	3.14	4405.	1172.	3.76	3.63	.0424	0.706	667.	.00714	0.238	0.0235	0.0889	1.53	0.0163	0.825	50.58	62.8	.9563	1.466	830.	0.0815	13731.	.00307	700.	0.374	4.683	4.429	2.130
1.00	23.91	241.7	240.8	0.92	237.6	3.23	4271.	1168.	3.66	3.53	.0442	0.674	647.	.00693	0.237	0.0239	0.0866	1.54	0.0163	0.849	52.18	66.4	.9587	1.506	842.	0.0833	14029.	.00313	712.	0.384	4.822	4.543	2.189
1.50	23.48	240.8	239.9	0.92	236.6	3.33	4153.	1164.	3.57	3.44	.0460	0.644	629.	.00674	0.237	0.0243	0.0845	1.54	0.0162	0.877	54.04	70.1	.9610	1.547	854.	0.0852	14330.	.00318	724.	0.394	4.963	4.659	2.249
2.00	23.04	239.9	239.0	0.92	235.6	3.40	4069.	1159.	3.51	3.37	.0478	0.615	616.	.00660	0.237	0.0247	0.0831	1.55	0.0162	0.905	55.91	74.0	.9632	1.589	865.	0.0871	14638.	.00324	736.	0.404	5.108	4.777	2.311
2.50	22.58	238.9	237.9	0.92	234.5	3.48	3970.	1155.	3.44	3.30	.0497	0.588	601.	.00644	0.237	0.0252	0.0814	1.56	0.0161	0.937	58.04	78.3	.9653	1.634	877.	0.0891	14958.	.00330	748.	0.415	5.261	4.900	2.375
3.00	22.12	237.8	236.9	0.92	233.3	3.51	3931.	1150.	3.42	3.27	.0516	0.562	595.	.00638	0.237	0.0257	0.0810	1.57	0.0161	0.972	60.37	82.7	.9672	1.680	889.	0.0912	15278.	.00335	760.	0.426	5.413	5.023	2.440
3.50	21.66	236.6	235.7	0.93	232.2	3.47	3982.	1146.	3.47	3.33	.0535	0.538	603.	.00647	0.237	0.0262	0.0824	1.57	0.0161	1.012	63.03	87.3	.9690	1.726	900.	0.0932	15599.	.00341	771.	0.437	5.567	5.146	2.505
4.00	21.13	235.2	234.3	0.93	230.9	3.45	4003.	1141.	3.51	3.35	.0557	0.512	606.	.00650	0.236	0.0268	0.0832	1.59	0.0160	1.064	66.46	92.7	.9709	1.779	912.	0.0955	15959.	.00348	784.	0.449	5.741	5.286	2.579
4.50	20.56	233.6	232.7	0.93	229.4	3.27	4224.	1135.	3.72	3.55	.0579	0.487	640.	.00686	0.236	0.0274	0.0883	1.60	0.0160	1.129	70.72	98.8	.9728	1.838	925.	0.0980	16342.	.00355	798.	0.462	5.927	5.434	2.659
5.00	20.00	231.6	230.7	0.93	228.0	2.77	4994.	1129.	4.42	4.21	.0601	0.464	757.	.00811	0.236	0.0281	0.1050	1.61	0.0159	1.203	75.58	105.0	.9745	1.897	937.	0.1006	16725.	.00362	811.	0.475	6.113	5.582	2.737
5.50	19.36	228.7	227.8	0.93	226.2	1.62	8529.	1122.	7.60	7.22	.0627	0.440	1293.	.01384	0.236	0.0290	0.1805	1.63	0.0159	1.287	81.10	112.6	.9763	1.967	950.	0.1036	17161.	.00370	826.	0.490	6.327	5.751	2.828

FORCED CONVECTION BOILING

RUN NO. 16.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1657. LBS/HR MASS VELOCITY,G= 163.1 LBS/SEC.SQFT POWER= 15.60 KILOWATTS HEAT FLUX,Q= 49888. BTU/HR.SQFT

REYNOLDS NO.= 59201. TEMPERATURE BEFORE FLASH= 300.1 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	30.75	262.0	258.7	3.30	251.7	6.95	7174.	1160.	6.18	5.92	.0523	0.643	1085.	.01198	0.900	0.0710	0.1458	1.45	0.0148	0.843	56.80	59.9	.9561	2.079	1282.	0.1181	19366.	.00414	1009.	0.441	5.631	5.325	2.914
0.25	30.54	262.9	259.6	3.30	251.3	8.31	6005.	1157.	5.19	4.96	.0542	0.620	908.	.01004	0.900	0.0715	0.1224	1.45	0.0148	0.878	59.35	62.3	.9579	2.119	1297.	0.1201	19670.	.00420	1022.	0.449	5.749	5.421	2.964
0.50	30.31	263.2	259.9	3.30	250.9	9.00	5544.	1153.	4.81	4.59	.0561	0.597	838.	.00928	0.899	0.0720	0.1133	1.45	0.0147	0.914	61.99	64.9	.9597	2.160	1313.	0.1221	19978.	.00426	1034.	0.458	5.870	5.519	3.015
1.00	29.84	262.5	259.2	3.30	250.0	9.20	5424.	1147.	4.73	4.50	.0600	0.556	820.	.00909	0.899	0.0730	0.1115	1.46	0.0146	0.995	67.93	70.2	.9629	2.241	1343.	0.1260	20584.	.00438	1060.	0.476	6.112	5.714	3.118
1.50	29.31	261.2	257.9	3.30	249.0	8.96	5566.	1140.	4.88	4.63	.0641	0.518	842.	.00935	0.898	0.0742	0.1152	1.46	0.0145	1.086	74.64	76.0	.9659	2.326	1373.	0.1300	21200.	.00449	1084.	0.494	6.361	5.914	3.223
2.00	28.72	260.1	256.8	3.31	247.8	8.93	5586.	1132.	4.94	4.66	.0682	0.484	845.	.00941	0.897	0.0756	0.1164	1.47	0.0144	1.185	82.01	82.2	.9686	2.415	1401.	0.1342	21830.	.00461	1109.	0.512	6.619	6.120	3.333
2.50	28.05	258.9	255.6	3.31	246.5	9.03	5526.	1125.	4.91	4.62	.0725	0.451	836.	.00930	0.897	0.0772	0.1159	1.47	0.0143	1.297	90.41	89.0	.9711	2.511	1430.	0.1386	22496.	.00474	1135.	0.532	6.888	6.333	3.447
3.00	27.40	257.5	254.2	3.31	245.2	9.03	5527.	1118.	4.94	4.64	.0769	0.422	836.	.00931	0.896	0.0790	0.1167	1.48	0.0142	1.417	99.49	96.3	.9735	2.611	1459.	0.1432	23173.	.00487	1161.	0.552	7.164	6.550	3.564
3.50	26.68	255.9	252.6	3.31	243.7	8.95	5572.	1110.	5.02	4.69	.0813	0.394	843.	.00938	0.895	0.0810	0.1185	1.49	0.0141	1.553	109.85	104.2	.9756	2.716	1487.	0.1478	23866.	.00500	1186.	0.572	7.448	6.773	3.684
4.00	25.90	253.7	250.4	3.32	242.0	8.36	5968.	1103.	5.41	5.04	.0859	0.369	903.	.01005	0.894	0.0832	0.1279	1.51	0.0140	1.706	121.63	113.0	.9777	2.829	1514.	0.1528	24594.	.00513	1212.	0.594	7.750	7.008	3.812
4.50	25.30	250.9	247.6	3.32	240.1	7.56	6596.	1094.	6.03	5.59	.0908	0.344	998.	.01111	0.893	0.0860	0.1426	1.52	0.0139	1.883	135.36	123.2	.9796	2.956	1541.	0.1582	25389.	.00527	1239.	0.618	8.077	7.261	3.951
5.00	23.96	248.1	244.7	3.32	237.7	7.05	7078.	1083.	6.53	6.03	.0960	0.319	1072.	.01193	0.891	0.0895	0.1546	1.54	0.0138	2.090	151.50	135.3	.9816	3.102	1569.	0.1643	26257.	.00542	1268.	0.645	8.443	7.542	4.106
5.50	22.92	245.2	241.9	3.33	235.0	6.85	7280.	1072.	6.79	6.23	.1015	0.295	1102.	.01228	0.889	0.0936	0.1608	1.55	0.0137	2.323	169.86	149.4	.9834	3.266	1597.	0.1710	27202.	.00559	1298.	0.675	8.841	7.846	4.274

FORCED CONVECTION BOILING

RUN NO. 17.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1663. LBS/HR MASS VELOCITY,G= 163.7 LBS/SEC.SQFT POWER= 15.60 KILOWATTS HEAT FLUX,Q= 49888. BTU/HR.SQFT

REYNOLDS NO.= 56413. TEMPERATURE BEFORE FLASH= 232.3 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.79	244.0	240.7	3.33	230.0	10.66	4680.	1157.	4.05	4.04	.0024	8.990	709.	.00787	0.883	0.1015	0.0960	1.59	0.0166	0.040	2.41	6.6	.5823	0.716	406.	0.0409	6335.	.00143	343.	0.181	1.698	1.839	1.230
0.25	20.79	247.7	244.4	3.33	230.0	14.43	3458.	1155.	2.99	2.98	.0039	5.833	524.	.00582	0.883	0.1016	0.0710	1.59	0.0165	0.	0.	8.9	.6927	0.872	487.	0.0493	7716.	.00170	412.	0.204	1.970	2.112	1.346
0.50	20.77	249.7	246.4	3.32	230.0	16.47	3029.	1154.	2.62	2.61	.0054	4.337	459.	.00509	0.883	0.1016	0.0623	1.59	0.0165	0.	0.	11.3	.7582	0.998	551.	0.0561	8829.	.00191	466.	0.224	2.208	2.343	1.447
1.00	20.75	251.1	247.8	3.32	229.9	17.89	2789.	1151.	2.42	2.41	.0084	2.904	423.	.00469	0.883	0.1017	0.0575	1.59	0.0164	0.076	4.63	16.1	.8304	1.199	650.	0.0667	10585.	.00224	550.	0.256	2.614	2.726	1.620
1.50	20.70	251.0	247.7	3.32	229.8	17.92	2785.	1148.	2.43	2.40	.0115	2.186	422.	.00468	0.883	0.1020	0.0576	1.60	0.0163	0.133	8.14	21.0	.8705	1.366	731.	0.0754	12027.	.00251	619.	0.284	2.975	3.057	1.773
2.00	20.61	250.6	247.3	3.32	229.5	17.80	2803.	1144.	2.45	2.42	.0147	1.746	425.	.00471	0.883	0.1024	0.0581	1.60	0.0162	0.200	12.31	26.2	.8963	1.516	800.	0.0831	13300.	.00275	678.	0.309	3.313	3.360	1.917
2.50	20.50	249.8	246.5	3.32	229.2	17.26	2890.	1141.	2.53	2.50	.0179	1.452	438.	.00486	0.883	0.1029	0.0601	1.60	0.0162	0.285	17.64	31.5	.9141	1.652	862.	0.0900	14439.	.00296	730.	0.333	3.631	3.640	2.052
3.00	20.31	248.2	244.9	3.32	228.8	16.14	3092.	1136.	2.72	2.67	.0214	1.231	468.	.00520	0.882	0.1038	0.0646	1.60	0.0161	0.385	23.97	37.3	.9278	1.787	920.	0.0967	15544.	.00316	780.	0.358	3.951	3.918	2.189
3.50	20.06	245.7	242.4	3.33	228.2	14.26	3499.	1131.	3.09	3.03	.0249	1.063	530.	.00589	0.882	0.1049	0.0734	1.61	0.0160	0.500	31.31	43.5	.9382	1.918	973.	0.1032	16592.	.00336	826.	0.381	4.266	4.187	2.322
4.00	19.81	242.9	239.6	3.33	227.4	12.13	4112.	1126.	3.65	3.57	.0286	0.930	623.	.00691	0.882	0.1062	0.0867	1.62	0.0159	0.630	39.69	50.1	.9466	2.048	1023.	0.1095	17604.	.00354	870.	0.405	4.580	4.453	2.456
4.50	19.46	240.6	237.3	3.34	226.5	10.84	4603.	1120.	4.11	4.00	.0325	0.819	698.	.00774	0.881	0.1080	0.0976	1.63	0.0158	0.770	48.81	57.5	.9537	2.183	1072.	0.1160	18625.	.00373	913.	0.429	4.906	4.725	2.594
5.00	19.04	238.4	235.1	3.34	225.3	9.79	5098.	1113.	4.58	4.44	.0366	0.726	773.	.00857	0.880	0.1102	0.1088	1.64	0.0157	0.905	57.73	65.7	.9596	2.325	1119.	0.1226	19653.	.00391	955.	0.455	5.242	5.003	2.737
5.50	18.55	235.2	231.9	3.35	224.0	7.93	6295.	1106.	5.69	5.50	.0409	0.647	955.	.01057	0.880	0.1129	0.1353	1.65	0.0156	1.030	66.13	74.8	.9647	2.473	1164.	0.1294	20696.	.00410	996.	0.481	5.589	5.287	2.884

FORCED CONVECTION BOILING

RUN NO. 18.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1662. LBS/HR MASS VELOCITY,G= 163.6 LBS/SEC.SQFT POWER= 15.50 KILOWATTS HEAT FLUX,Q= 49569. BTU/HR.SQFT

REYNOLDS NO.= 57254. TEMPERATURE BEFORE FLASH= 242.9 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	22.58	248.3	245.0	3.30	234.5	10.53	4708.	1161.	4.05	4.03	.0089	2.863	713.	.00792	0.881	0.0936	0.0961	1.56	0.0163	0.095	5.82	15.8	.8271	1.170	664.	0.0659	10522.	.00226	554.	0.249	2.628	2.739	1.624
0.25	22.56	251.5	248.2	3.30	234.4	13.79	3593.	1159.	3.10	3.07	.0105	2.478	544.	.00604	0.881	0.0937	0.0734	1.56	0.0163	0.129	7.92	18.1	.8489	1.250	704.	0.0702	11228.	.00239	588.	0.263	2.804	2.902	1.700
0.50	22.52	252.0	248.7	3.30	234.3	14.39	3444.	1158.	2.97	2.95	.0120	2.180	522.	.00579	0.881	0.0938	0.0705	1.56	0.0162	0.160	9.85	20.4	.8664	1.326	742.	0.0742	11893.	.00252	620.	0.276	2.976	3.058	1.773
1.00	22.42	251.8	248.5	3.30	234.1	14.42	3437.	1154.	2.98	2.94	.0152	1.757	521.	.00578	0.881	0.0942	0.0706	1.56	0.0162	0.228	14.11	25.2	.8919	1.465	810.	0.0814	13097.	.00274	677.	0.300	3.300	3.348	1.910
1.50	22.29	251.4	248.1	3.30	233.8	14.34	3457.	1150.	3.01	2.96	.0185	1.467	524.	.00582	0.880	0.0947	0.0712	1.56	0.0161	0.295	18.36	30.1	.9100	1.593	870.	0.0881	14194.	.00295	728.	0.324	3.609	3.621	2.042
2.00	22.14	250.8	247.5	3.30	233.4	14.09	3518.	1146.	3.07	3.01	.0218	1.256	533.	.00592	0.880	0.0953	0.0727	1.57	0.0160	0.370	23.16	35.2	.9234	1.714	925.	0.0942	15206.	.00314	774.	0.346	3.906	3.879	2.168
2.50	21.94	249.9	246.6	3.30	232.9	13.72	3614.	1142.	3.16	3.10	.0252	1.094	547.	.00608	0.880	0.0961	0.0750	1.57	0.0159	0.450	28.34	40.7	.9339	1.831	976.	0.1001	16171.	.00332	817.	0.368	4.200	4.130	2.293
3.00	21.69	248.8	245.5	3.30	232.3	13.16	3767.	1137.	3.31	3.24	.0288	0.963	571.	.00634	0.879	0.0971	0.0785	1.57	0.0158	0.543	34.40	46.5	.9424	1.947	1024.	0.1058	17107.	.00349	858.	0.390	4.493	4.379	2.418
3.50	21.37	246.9	243.6	3.31	231.5	12.07	4106.	1132.	3.63	3.53	.0325	0.855	622.	.00691	0.879	0.0984	0.0860	1.58	0.0157	0.662	42.19	52.7	.9494	2.065	1070.	0.1115	18028.	.00366	898.	0.412	4.790	4.628	2.544
4.00	21.03	244.8	241.5	3.31	230.6	10.83	4576.	1126.	4.06	3.94	.0363	0.765	693.	.00770	0.878	0.0999	0.0964	1.59	0.0156	0.803	51.50	59.6	.9554	2.186	1115.	0.1173	18943.	.00382	937.	0.434	5.093	4.880	2.672
4.50	20.58	242.9	239.6	3.31	229.5	10.13	4893.	1120.	4.37	4.23	.0404	0.685	741.	.00823	0.878	0.1019	0.1037	1.60	0.0155	0.953	61.51	67.3	.9607	2.315	1158.	0.1234	19890.	.00399	976.	0.458	5.412	5.142	2.808
5.00	20.03	241.0	237.6	3.31	228.0	9.60	5163.	1112.	4.64	4.47	.0448	0.615	782.	.00869	0.877	0.1045	0.1102	1.61	0.0154	1.118	72.65	76.1	.9654	2.454	1201.	0.1298	20881.	.00417	1015.	0.484	5.750	5.418	2.951
5.50	19.44	236.5	233.2	3.32	226.4	6.76	7335.	1104.	6.64	6.38	.0493	0.554	1112.	.01234	0.876	0.1074	0.1579	1.63	0.0153	1.305	85.38	85.8	.9695	2.602	1243.	0.1364	21881.	.00435	1054.	0.511	6.101	5.701	3.100

FORCED CONVECTION BOILING

RUN NO. 20.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1669. LBS/HR MASS VELOCITY,G= 164.2 LBS/SEC.SQFT POWER= 0.47 KILOWATTS HEAT FLUX,Q= 1503. BTU/HR.SQFT

REYNOLDS NO.= 53752. TEMPERATURE BEFORE FLASH= 241.1 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	18.38	224.3	224.2	0.10	223.5	0.70	2145.	1129.	1.90	1.87	.0184	1.348	325.	.00359	0.026	0.0034	0.0452	1.66	0.0163	0.	0.	35.6	.9240	0.630	317.	0.0354	5664.	.00159	294.	0.244	2.914	2.905	1.256
0.25	18.29	224.3	224.2	0.10	223.2	0.94	1594.	1128.	1.41	1.39	.0188	1.324	242.	.00267	0.026	0.0034	0.0336	1.66	0.0163	0.	0.	36.4	.9256	0.637	319.	0.0357	5712.	.00160	296.	0.247	2.949	2.935	1.270
0.50	18.21	224.2	224.1	0.10	223.0	1.12	1342.	1127.	1.19	1.17	.0191	1.302	204.	.00225	0.026	0.0034	0.0283	1.66	0.0163	0.	0.	37.1	.9270	0.643	321.	0.0360	5758.	.00161	298.	0.249	2.982	2.964	1.284
1.00	18.03	223.7	223.6	0.10	222.5	1.14	1324.	1125.	1.18	1.16	.0197	1.258	201.	.00222	0.026	0.0035	0.0280	1.67	0.0163	0.	0.	38.5	.9298	0.655	325.	0.0366	5852.	.00164	302.	0.254	3.050	3.023	1.313
1.50	17.84	223.2	223.1	0.10	221.9	1.14	1313.	1123.	1.17	1.15	.0203	1.216	199.	.00220	0.026	0.0035	0.0278	1.67	0.0163	0.	0.	40.1	.9326	0.668	328.	0.0372	5948.	.00166	306.	0.259	3.120	3.083	1.343
2.00	17.66	222.6	222.5	0.10	221.4	1.10	1372.	1121.	1.22	1.20	.0210	1.177	208.	.00229	0.026	0.0035	0.0291	1.68	0.0163	0.	0.	41.6	.9351	0.681	332.	0.0378	6042.	.00168	310.	0.264	3.188	3.142	1.372
2.50	17.47	222.0	221.9	0.10	220.8	1.10	1366.	1119.	1.22	1.20	.0216	1.138	207.	.00228	0.026	0.0036	0.0291	1.68	0.0163	0.	0.	43.2	.9376	0.694	336.	0.0384	6138.	.00170	314.	0.269	3.259	3.202	1.402
3.00	17.26	221.5	221.4	0.10	220.2	1.15	1309.	1117.	1.17	1.15	.0223	1.100	199.	.00219	0.026	0.0036	0.0279	1.69	0.0163	0.	0.	45.0	.9401	0.708	340.	0.0391	6241.	.00173	318.	0.275	3.334	3.267	1.434
3.50	17.04	220.9	220.8	0.10	219.6	1.21	1245.	1115.	1.12	1.10	.0231	1.060	189.	.00208	0.026	0.0037	0.0266	1.69	0.0163	0.	0.	47.0	.9427	0.723	344.	0.0398	6352.	.00175	323.	0.280	3.417	3.337	1.469
4.00	16.82	220.2	220.1	0.10	218.9	1.23	1224.	1112.	1.10	1.08	.0239	1.021	186.	.00205	0.026	0.0037	0.0262	1.70	0.0162	0.	0.	49.1	.9453	0.739	348.	0.0405	6466.	.00178	327.	0.287	3.502	3.410	1.506
4.50	16.58	219.4	219.3	0.10	218.1	1.15	1308.	1109.	1.18	1.16	.0248	0.983	199.	.00219	0.026	0.0038	0.0281	1.70	0.0162	0.	0.	51.3	.9477	0.755	353.	0.0413	6583.	.00181	332.	0.293	3.591	3.485	1.544
5.00	16.32	218.4	218.3	0.10	217.3	1.02	1468.	1106.	1.33	1.30	.0257	0.943	223.	.00246	0.026	0.0038	0.0316	1.71	0.0162	0.	0.	53.9	.9503	0.774	357.	0.0421	6714.	.00184	337.	0.300	3.691	3.569	1.586
5.50	16.04	217.4	217.3	0.10	216.4	0.91	1659.	1103.	1.50	1.47	.0267	0.904	252.	.00278	0.026	0.0039	0.0359	1.72	0.0162	0.	0.	56.7	.9528	0.793	362.	0.0430	6852.	.00187	342.	0.307	3.795	3.657	1.631

FORCED CONVECTION BOILING

RUN NO. 21.0 WATER TEST SECTION NO. 1

FLOW RATE.W=1667. LBS/HR MASS VELOCITY.G= 164.0 LBS/SEC.SQFT POWER= 0.47 KILOWATTS HEAT FLUX.Q= 1503. BTU/HR.SQFT

REYNOLDS NO.= 54665. TEMPERATURE BEFORE FLASH= 252.8 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.05	229.1	229.0	0.10	228.1	0.93	1614.	1132.	1.43	1.40	.0260	1.020	245.	.00271	0.027	0.0032	0.0338	1.61	0.0160	0.	0.	45.5	.9409	0.693	360.	0.0391	6323.	.00178	329.	0.286	3.504	3.411	1.507
0.25	19.95	229.0	228.9	0.10	227.8	1.09	1379.	1131.	1.22	1.19	.0264	1.007	209.	.00231	0.027	0.0032	0.0289	1.61	0.0160	0.	0.	46.2	.9418	0.698	361.	0.0394	6364.	.00179	330.	0.288	3.535	3.438	1.520
0.50	19.83	228.9	228.8	0.10	227.5	1.30	1160.	1130.	1.03	1.00	.0267	0.991	176.	.00195	0.027	0.0032	0.0244	1.61	0.0160	0.	0.	47.0	.9429	0.705	363.	0.0397	6411.	.00180	332.	0.291	3.571	3.468	1.535
1.00	19.59	228.3	228.2	0.10	226.8	1.33	1127.	1128.	1.00	0.98	.0275	0.960	171.	.00189	0.026	0.0032	0.0237	1.62	0.0160	0.	0.	48.8	.9451	0.718	367.	0.0403	6508.	.00182	336.	0.296	3.647	3.532	1.567
1.50	19.33	227.6	227.5	0.10	226.1	1.37	1100.	1125.	0.98	0.96	.0283	0.929	167.	.00185	0.026	0.0033	0.0232	1.63	0.0160	0.	0.	50.8	.9473	0.733	371.	0.0410	6612.	.00185	341.	0.302	3.727	3.600	1.602
2.00	19.05	226.9	226.8	0.10	225.4	1.40	1071.	1123.	0.95	0.93	.0292	0.898	162.	.00180	0.026	0.0033	0.0227	1.64	0.0160	0.	0.	53.0	.9495	0.748	375.	0.0417	6724.	.00187	345.	0.308	3.814	3.672	1.639
2.50	18.76	226.1	226.0	0.10	224.6	1.46	1028.	1120.	0.92	0.90	.0301	0.866	156.	.00172	0.026	0.0034	0.0218	1.64	0.0159	0.	0.	55.3	.9517	0.765	379.	0.0425	6841.	.00190	350.	0.315	3.905	3.748	1.677
3.00	18.45	225.4	225.3	0.10	223.7	1.59	945.	1117.	0.85	0.82	.0311	0.835	143.	.00158	0.026	0.0034	0.0201	1.65	0.0159	0.	0.	57.9	.9539	0.783	384.	0.0433	6965.	.00193	354.	0.321	4.002	3.829	1.718
3.50	18.13	224.6	224.5	0.10	222.8	1.75	857.	1113.	0.77	0.75	.0321	0.803	130.	.00143	0.026	0.0035	0.0183	1.66	0.0159	0.	0.	60.7	.9561	0.802	388.	0.0442	7095.	.00196	360.	0.329	4.104	3.915	1.762
4.00	17.81	223.8	223.7	0.10	221.8	1.88	800.	1110.	0.72	0.70	.0331	0.774	121.	.00134	0.026	0.0035	0.0172	1.67	0.0159	0.	0.	63.5	.9581	0.821	393.	0.0451	7225.	.00199	365.	0.336	4.208	4.000	1.806
4.50	17.46	222.8	222.7	0.10	220.9	1.87	803.	1107.	0.73	0.71	.0342	0.745	122.	.00135	0.026	0.0036	0.0173	1.68	0.0159	0.	0.	66.6	.9601	0.841	397.	0.0460	7360.	.00202	370.	0.343	4.314	4.088	1.851
5.00	17.13	221.7	221.6	0.10	219.8	1.75	857.	1103.	0.78	0.76	.0353	0.717	130.	.00144	0.026	0.0037	0.0185	1.69	0.0159	0.	0.	70.0	.9621	0.862	402.	0.0469	7503.	.00205	375.	0.351	4.428	4.182	1.900
5.50	16.78	220.1	220.0	0.10	218.8	1.27	1186.	1099.	1.08	1.05	.0365	0.689	180.	.00199	0.026	0.0037	0.0257	1.70	0.0158	0.	0.	73.5	.9640	0.884	406.	0.0479	7647.	.00208	380.	0.359	4.545	4.279	1.950

FORCED CONVECTION BOILING

RUN NO. 22.0 WATER TEST SECTION NO. 1

FLOW RATE.W=1664. LBS/HR MASS VELOCITY.G= 163.8 LBS/SEC.SQFT POWER= 0.47 KILOWATTS HEAT FLUX.Q= 1503. BTU/HR.SQFT

REYNOLDS NO.= 55976. TEMPERATURE BEFORE FLASH= 277.6 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	23.61	237.3	237.2	0.10	236.9	0.30	4975.	1135.	4.38	4.23	.0433	0.683	753.	.00835	0.027	0.0027	0.1037	1.54	0.0154	0.747	48.65	63.6	.9584	0.785	433.	0.0449	7328.	.00209	384.	0.360	4.571	4.300	1.961
0.25	23.42	237.2	237.1	0.10	236.5	0.67	2228.	1134.	1.97	1.90	.0438	0.674	337.	.00374	0.027	0.0027	0.0465	1.54	0.0153	0.758	49.39	64.7	.9591	0.792	435.	0.0452	7378.	.00210	386.	0.363	4.613	4.334	1.979
0.50	23.23	237.0	236.9	0.10	236.0	0.87	1728.	1132.	1.53	1.47	.0443	0.664	262.	.00290	0.027	0.0028	0.0361	1.55	0.0153	0.772	50.33	65.9	.9599	0.799	437.	0.0456	7431.	.00211	388.	0.366	4.658	4.371	1.998
1.00	22.83	236.0	235.9	0.10	235.1	0.75	2007.	1129.	1.78	1.71	.0453	0.645	304.	.00337	0.027	0.0028	0.0421	1.55	0.0153	0.802	52.35	68.4	.9614	0.815	440.	0.0463	7536.	.00214	392.	0.372	4.748	4.444	2.036
1.50	22.44	234.8	234.7	0.10	234.1	0.63	2375.	1126.	2.11	2.03	.0464	0.626	360.	.00399	0.027	0.0029	0.0500	1.56	0.0153	0.841	54.97	71.2	.9630	0.831	444.	0.0470	7651.	.00216	396.	0.379	4.845	4.524	2.078
2.00	22.01	233.7	233.6	0.10	233.1	0.57	2659.	1123.	2.37	2.28	.0475	0.606	403.	.00447	0.027	0.0029	0.0561	1.57	0.0153	0.883	57.79	74.1	.9645	0.849	448.	0.0478	7772.	.00219	401.	0.386	4.948	4.607	2.122
2.50	21.56	232.6	232.5	0.10	232.0	0.57	2650.	1119.	2.37	2.28	.0487	0.587	401.	.00445	0.027	0.0030	0.0561	1.58	0.0153	0.927	60.75	77.3	.9660	0.868	451.	0.0486	7900.	.00222	405.	0.393	5.057	4.695	2.168
3.00	21.06	231.6	231.5	0.10	230.7	0.74	2045.	1115.	1.83	1.76	.0501	0.566	310.	.00344	0.027	0.0030	0.0435	1.59	0.0152	0.978	64.19	81.0	.9677	0.889	456.	0.0496	8039.	.00225	410.	0.401	5.178	4.792	2.219
3.50	20.58	230.4	230.3	0.10	229.5	0.88	1699.	1110.	1.53	1.47	.0515	0.546	257.	.00286	0.027	0.0031	0.0363	1.60	0.0152	1.040	68.36	85.0	.9692	0.911	460.	0.0506	8186.	.00228	416.	0.410	5.305	4.895	2.273
4.00	20.04	229.2	229.1	0.10	228.1	1.04	1449.	1106.	1.31	1.25	.0530	0.525	220.	.00244	0.027	0.0032	0.0311	1.61	0.0152	1.123	73.93	89.5	.9708	0.936	464.	0.0517	8347.	.00232	421.	0.419	5.443	5.006	2.332
4.50	19.44	227.8	227.7	0.10	226.4	1.30	1158.	1100.	1.05	1.01	.0547	0.502	176.	.00195	0.027	0.0033	0.0250	1.63	0.0152	1.250	82.42	95.0	.9726	0.966	470.	0.0530	8531.	.00236	428.	0.430	5.604	5.135	2.401
5.00	18.78	226.1	226.0	0.10	224.6	1.42	1060.	1094.	0.97	0.93	.0566	0.479	161.	.00178	0.026	0.0034	0.0230	1.64	0.0151	1.414	93.40	101.3	.9744	1.000	475.	0.0545	8738.	.00241	435.	0.442	5.785	5.278	2.478
5.50	18.02	223.9	223.8	0.10	222.4	1.34	1125.	1086.	1.04	0.99	.0588	0.453	171.	.00189	0.026	0.0035	0.0247	1.67	0.0151	1.589	105.18	109.2	.9763	1.041	482.	0.0562	8985.	.00246	443.	0.457	6.001	5.450	2.570

FORCED CONVECTION BOILING

RUN NO. 23.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1660. LBS/HR MASS VELOCITY,G= 163.4 LBS/SEC.SQFT POWER= 9.72 KILOWATTS HEAT FLUX,Q= 31084. BTU/HR.SQFT

REYNOLDS NO.= 57842. TEMPERATURE BEFORE FLASH= 279.4 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	26.53	249.9	247.8	2.07	243.4	4.47	6954.	1153.	6.03	5.85	.0386	0.802	1052.	.01169	0.556	0.0506	0.1425	1.50	0.0154	0.602	39.20	51.3	.9481	1.718	999.	0.0967	15773.	.00345	816.	0.376	4.640	4.449	2.295
0.25	26.39	250.7	248.7	2.07	243.1	5.62	5529.	1151.	4.80	4.65	.0398	0.777	837.	.00929	0.556	0.0509	0.1135	1.50	0.0153	0.676	44.11	53.1	.9499	1.747	1010.	0.0981	15997.	.00350	826.	0.382	4.728	4.522	2.332
0.50	26.23	250.9	248.8	2.07	242.7	6.12	5082.	1149.	4.42	4.28	.0411	0.752	769.	.00854	0.556	0.0512	0.1045	1.50	0.0153	0.735	48.06	55.0	.9517	1.776	1021.	0.0995	16229.	.00354	835.	0.389	4.819	4.597	2.371
1.00	25.86	250.2	248.2	2.07	241.9	6.26	4963.	1144.	4.34	4.18	.0438	0.704	751.	.00834	0.556	0.0518	0.1025	1.51	0.0152	0.842	55.30	59.1	.9552	1.839	1045.	0.1025	16711.	.00364	856.	0.403	5.009	4.754	2.451
1.50	25.42	249.1	247.0	2.07	241.0	6.06	5130.	1140.	4.50	4.33	.0466	0.659	776.	.00862	0.556	0.0527	0.1064	1.51	0.0152	0.937	61.82	63.7	.9586	1.907	1068.	0.1058	17220.	.00373	877.	0.417	5.211	4.919	2.537
2.00	24.95	248.1	246.0	2.07	240.0	6.07	5119.	1135.	4.51	4.33	.0495	0.617	775.	.00860	0.555	0.0536	0.1067	1.52	0.0151	1.027	68.08	68.6	.9617	1.977	1091.	0.1090	17735.	.00383	898.	0.432	5.417	5.087	2.625
2.50	24.41	247.1	245.0	2.07	238.7	6.30	4931.	1129.	4.37	4.18	.0526	0.577	746.	.00829	0.555	0.0547	0.1033	1.53	0.0150	1.102	73.41	74.2	.9647	2.053	1114.	0.1126	18280.	.00393	919.	0.449	5.640	5.267	2.719
3.00	23.85	246.1	244.0	2.07	237.5	6.54	4754.	1123.	4.23	4.04	.0557	0.541	720.	.00800	0.554	0.0558	0.1002	1.54	0.0149	1.173	78.51	80.1	.9674	2.131	1136.	0.1161	18823.	.00403	940.	0.465	5.864	5.448	2.814
3.50	23.25	244.6	242.6	2.07	236.1	6.49	4789.	1117.	4.29	4.09	.0589	0.506	725.	.00806	0.554	0.0572	0.1016	1.55	0.0149	1.247	83.88	86.6	.9700	2.215	1159.	0.1199	19395.	.00414	962.	0.482	6.101	5.638	2.915
4.00	22.60	243.0	240.9	2.08	234.5	6.42	4842.	1110.	4.36	4.14	.0623	0.474	733.	.00815	0.553	0.0587	0.1034	1.56	0.0148	1.323	89.46	93.8	.9724	2.304	1181.	0.1239	19993.	.00424	984.	0.500	6.352	5.837	3.021
4.50	21.91	241.1	239.0	2.08	232.8	6.21	5005.	1103.	4.54	4.30	.0658	0.443	758.	.00843	0.552	0.0604	0.1076	1.57	0.0147	1.410	95.85	101.7	.9747	2.400	1203.	0.1280	20614.	.00435	1006.	0.520	6.614	6.044	3.132
5.00	21.13	238.8	236.7	2.08	231.0	5.70	5455.	1095.	4.98	4.70	.0695	0.415	826.	.00919	0.552	0.0623	0.1182	1.58	0.0146	1.500	102.52	110.6	.9768	2.503	1225.	0.1324	21263.	.00447	1029.	0.540	6.890	6.261	3.250
5.50	20.40	234.5	232.4	2.08	229.0	3.43	9075.	1087.	8.35	7.86	.0733	0.387	1375.	.01529	0.551	0.0645	0.1982	1.60	0.0146	1.596	109.67	120.5	.9789	2.616	1247.	0.1372	21948.	.00459	1052.	0.561	7.184	6.491	3.374

FORCED CONVECTION BOILING

RUN NO. 24.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1664. LBS/HR MASS VELOCITY,G= 163.8 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 58299. TEMPERATURE BEFORE FLASH= 296.5 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	28.64	254.0	252.0	2.09	247.7	4.28	7356.	1151.	6.39	6.12	.0526	0.620	1113.	.01233	0.564	0.0476	0.1508	1.47	0.0150	0.875	58.38	64.4	.9591	1.885	1122.	0.1063	17435.	.00383	901.	0.426	5.412	5.084	2.627
0.25	28.42	255.0	252.9	2.09	247.2	5.68	5544.	1148.	4.83	4.62	.0540	0.603	839.	.00930	0.563	0.0480	0.1139	1.47	0.0150	0.902	60.32	66.5	.9604	1.914	1132.	0.1077	17655.	.00388	910.	0.432	5.504	5.159	2.666
0.50	28.20	255.1	253.0	2.09	246.8	6.22	5057.	1146.	4.41	4.22	.0553	0.586	765.	.00848	0.563	0.0483	0.1041	1.47	0.0149	0.932	62.46	68.6	.9617	1.944	1142.	0.1091	17873.	.00392	919.	0.439	5.596	5.234	2.706
1.00	27.72	254.1	252.0	2.09	245.8	6.20	5079.	1141.	4.45	4.24	.0582	0.554	768.	.00852	0.563	0.0491	0.1051	1.48	0.0149	1.000	67.33	73.2	.9642	2.005	1162.	0.1121	18322.	.00401	937.	0.452	5.787	5.387	2.786
1.50	27.20	253.8	251.8	2.09	244.8	7.00	4494.	1136.	3.96	3.76	.0612	0.524	680.	.00754	0.562	0.0500	0.0934	1.49	0.0148	1.067	72.18	78.0	.9666	2.070	1182.	0.1151	18785.	.00409	956.	0.467	5.984	5.546	2.870
2.00	26.66	251.7	249.6	2.09	243.6	5.97	5274.	1131.	4.66	4.42	.0642	0.496	798.	.00884	0.562	0.0509	0.1102	1.49	0.0147	1.140	77.50	83.2	.9688	2.137	1202.	0.1181	19255.	.00418	974.	0.481	6.186	5.707	2.956
2.50	26.03	250.6	248.5	2.09	242.3	6.19	5082.	1125.	4.52	4.27	.0674	0.468	769.	.00852	0.562	0.0520	0.1068	1.50	0.0146	1.220	83.37	89.2	.9710	2.212	1222.	0.1215	19770.	.00428	993.	0.497	6.408	5.883	3.050
3.00	25.39	249.3	247.2	2.10	240.9	6.28	5012.	1119.	4.48	4.23	.0706	0.442	759.	.00840	0.561	0.0533	0.1059	1.51	0.0146	1.305	89.66	95.5	.9730	2.289	1242.	0.1250	20290.	.00437	1012.	0.513	6.632	6.060	3.145
3.50	24.72	247.8	245.7	2.10	239.4	6.27	5018.	1112.	4.51	4.24	.0740	0.418	759.	.00841	0.560	0.0546	0.1067	1.52	0.0145	1.395	96.36	102.3	.9749	2.370	1261.	0.1285	20823.	.00447	1031.	0.530	6.865	6.244	3.244
4.00	24.00	245.8	243.7	2.10	237.8	5.94	5295.	1105.	4.79	4.49	.0774	0.394	802.	.00888	0.560	0.0561	0.1134	1.54	0.0144	1.495	103.82	110.0	.9768	2.458	1280.	0.1323	21379.	.00457	1051.	0.548	7.113	6.438	3.349
4.50	23.23	243.9	241.8	2.10	236.0	5.80	5426.	1097.	4.94	4.62	.0810	0.372	822.	.00911	0.559	0.0578	0.1171	1.55	0.0143	1.602	111.86	118.4	.9785	2.552	1299.	0.1363	21967.	.00468	1071.	0.566	7.374	6.641	3.460
5.00	22.36	241.4	239.3	2.10	234.0	5.30	5942.	1089.	5.46	5.08	.0849	0.350	900.	.00998	0.558	0.0598	0.1293	1.56	0.0142	1.717	120.60	128.2	.9803	2.659	1319.	0.1408	22611.	.00479	1092.	0.587	7.662	6.864	3.582
5.50	21.48	237.0	234.9	2.11	231.8	3.12	10096.	1081.	9.34	8.67	.0888	0.328	1529.	.01697	0.557	0.0621	0.2215	1.58	0.0142	1.842	130.15	139.2	.9819	2.774	1338.	0.1455	23297.	.00490	1114.	0.609	7.968	7.099	3.712

FORCED CONVECTION BOILING

RUN NO. 25.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1668. LBS/HR MASS VELOCITY,G= 164.1 LBS/SEC.SQFT POWER= 9.90 KILOWATTS HEAT FLUX,Q= 31660. BTU/HR.SQFT

REYNOLDS NO.= 56633. TEMPERATURE BEFORE FLASH= 249.5 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	22.06	241.2	239.1	2.12	233.2	5.89	5376.	1153.	4.66	4.60	.0174	1.545	814.	.00901	0.560	0.0609	0.1105	1.57	0.0162	0.250	15.43	28.8	.9056	1.367	748.	0.0759	12276.	.00265	633.	0.283	3.196	3.219	1.682
0.25	21.99	242.4	240.3	2.12	233.0	7.31	4331.	1152.	3.76	3.70	.0185	1.458	656.	.00726	0.560	0.0610	0.0891	1.57	0.0162	0.278	17.19	30.6	.9111	1.405	766.	0.0779	12600.	.00271	648.	0.291	3.300	3.310	1.726
0.50	21.92	243.0	240.9	2.11	232.9	8.03	3943.	1151.	3.43	3.37	.0196	1.380	597.	.00661	0.560	0.0612	0.0812	1.57	0.0161	0.307	19.02	32.3	.9160	1.442	782.	0.0798	12913.	.00277	662.	0.299	3.402	3.399	1.770
1.00	21.77	243.2	241.1	2.11	232.5	8.59	3684.	1148.	3.21	3.15	.0218	1.245	558.	.00618	0.560	0.0616	0.0761	1.57	0.0161	0.367	22.82	35.9	.9246	1.514	814.	0.0835	13519.	.00289	690.	0.314	3.604	3.574	1.855
1.50	21.60	242.6	240.5	2.11	232.1	8.41	3767.	1145.	3.29	3.23	.0241	1.132	571.	.00632	0.560	0.0620	0.0780	1.58	0.0160	0.432	26.96	39.7	.9319	1.586	845.	0.0870	14107.	.00300	716.	0.328	3.804	3.745	1.940
2.00	21.38	241.9	239.8	2.12	231.5	8.29	3821.	1141.	3.35	3.28	.0265	1.031	579.	.00641	0.559	0.0626	0.0794	1.58	0.0160	0.502	31.45	43.8	.9385	1.661	875.	0.0908	14709.	.00312	742.	0.344	4.013	3.923	2.029
2.50	21.08	241.2	239.1	2.12	230.7	8.32	3805.	1136.	3.35	3.27	.0292	0.938	576.	.00638	0.559	0.0635	0.0794	1.59	0.0159	0.576	36.24	48.5	.9447	1.742	906.	0.0947	15346.	.00324	770.	0.361	4.237	4.113	2.125
3.00	20.76	240.4	238.3	2.12	229.9	8.33	3799.	1132.	3.36	3.27	.0319	0.858	576.	.00637	0.559	0.0643	0.0796	1.59	0.0158	0.655	41.38	53.5	.9500	1.824	936.	0.0987	15972.	.00335	796.	0.377	4.462	4.302	2.220
3.50	20.39	239.4	237.3	2.12	229.0	8.32	3806.	1127.	3.38	3.28	.0347	0.786	577.	.00638	0.558	0.0654	0.0802	1.60	0.0158	0.739	46.89	58.9	.9547	1.910	965.	0.1027	16613.	.00347	823.	0.395	4.696	4.496	2.319
4.00	20.00	238.0	235.9	2.12	228.0	7.97	3970.	1122.	3.54	3.43	.0376	0.724	602.	.00666	0.558	0.0666	0.0840	1.61	0.0157	0.826	52.64	64.7	.9589	1.997	993.	0.1068	17249.	.00359	849.	0.412	4.931	4.690	2.419
4.50	19.57	236.2	234.1	2.12	226.8	7.32	4324.	1116.	3.87	3.75	.0407	0.666	655.	.00725	0.558	0.0680	0.0920	1.62	0.0156	0.915	58.57	71.1	.9627	2.090	1021.	0.1110	17904.	.00371	875.	0.430	5.178	4.893	2.524
5.00	19.08	234.2	232.1	2.12	225.4	6.64	4766.	1110.	4.29	4.14	.0439	0.613	723.	.00799	0.557	0.0696	0.1021	1.64	0.0156	1.005	64.63	78.3	.9663	2.190	1049.	0.1156	18590.	.00384	902.	0.450	5.439	5.105	2.635
5.50	18.53	231.1	229.0	2.13	224.1	4.95	6400.	1103.	5.80	5.58	.0471	0.567	971.	.01072	0.557	0.0713	0.1379	1.65	0.0155	1.100	71.06	85.8	.9694	2.291	1075.	0.1201	19269.	.00396	928.	0.469	5.700	5.316	2.746

FORCED CONVECTION BOILING

RUN NO. 26.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1684. LBS/HR MASS VELOCITY,G= 165.7 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 54786. TEMPERATURE BEFORE FLASH= 226.5 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	18.11	233.1	231.0	2.11	222.7	8.30	3789.	1148.	3.30	3.29	.0040	5.378	575.	.00628	0.547	0.0719	0.0785	1.66	0.0170	0.036	2.11	10.1	.7247	0.829	432.	0.0459	7206.	.00160	377.	0.180	1.695	1.836	1.036
0.25	18.09	234.2	232.1	2.11	222.7	9.46	3327.	1147.	2.90	2.89	.0049	4.436	505.	.00552	0.547	0.0719	0.0690	1.66	0.0170	0.052	3.06	11.8	.7653	0.905	468.	0.0499	7865.	.00173	408.	0.192	1.852	1.988	1.103
0.50	18.08	235.1	233.0	2.11	222.6	10.38	3031.	1146.	2.64	2.63	.0059	3.777	460.	.00503	0.547	0.0720	0.0629	1.66	0.0170	0.067	3.95	13.6	.7960	0.974	500.	0.0535	8461.	.00185	437.	0.204	2.000	2.129	1.166
1.00	18.04	236.2	234.1	2.11	222.5	11.59	2714.	1144.	2.37	2.36	.0078	2.916	412.	.00450	0.547	0.0721	0.0564	1.67	0.0169	0.097	5.73	17.1	.8388	1.097	557.	0.0599	9512.	.00205	486.	0.226	2.273	2.386	1.282
1.50	17.99	236.2	234.1	2.11	222.3	11.73	2682.	1142.	2.35	2.33	.0098	2.372	407.	.00445	0.547	0.0723	0.0559	1.67	0.0169	0.132	7.83	20.8	.8677	1.207	606.	0.0655	10442.	.00223	529.	0.246	2.528	2.620	1.390
2.00	17.92	236.1	234.0	2.11	222.1	11.84	2657.	1140.	2.33	2.31	.0119	1.994	403.	.00441	0.547	0.0726	0.0555	1.67	0.0168	0.167	9.94	24.6	.8885	1.308	650.	0.0707	11291.	.00239	568.	0.264	2.771	2.840	1.494
2.50	17.82	235.9	233.8	2.11	221.9	11.94	2636.	1137.	2.32	2.29	.0140	1.714	400.	.00437	0.547	0.0730	0.0552	1.67	0.0167	0.208	12.42	28.7	.9043	1.404	691.	0.0755	12087.	.00254	605.	0.282	3.007	3.051	1.594
3.00	17.70	235.5	233.4	2.11	221.5	11.90	2644.	1134.	2.33	2.30	.0162	1.497	401.	.00438	0.547	0.0734	0.0555	1.67	0.0167	0.254	15.22	32.9	.9168	1.497	729.	0.0801	12845.	.00268	638.	0.300	3.239	3.255	1.693
3.50	17.55	234.6	232.5	2.11	221.1	11.44	2751.	1131.	2.43	2.40	.0184	1.323	417.	.00456	0.547	0.0740	0.0579	1.68	0.0166	0.303	18.23	37.4	.9269	1.588	765.	0.0846	13578.	.00281	671.	0.317	3.471	3.457	1.791
4.00	17.38	233.1	231.0	2.11	220.6	10.39	3029.	1128.	2.69	2.64	.0207	1.181	460.	.00502	0.547	0.0746	0.0640	1.68	0.0166	0.357	21.55	42.1	.9353	1.679	800.	0.0890	14292.	.00295	702.	0.335	3.701	3.656	1.889
4.50	17.19	231.5	229.3	2.11	220.0	9.33	3373.	1124.	3.00	2.95	.0231	1.063	512.	.00559	0.546	0.0754	0.0715	1.69	0.0165	0.415	25.15	47.1	.9423	1.768	833.	0.0933	14986.	.00307	732.	0.352	3.931	3.852	1.987
5.00	16.97	229.7	227.6	2.11	219.3	8.30	3794.	1120.	3.39	3.32	.0256	0.961	576.	.00629	0.546	0.0763	0.0807	1.69	0.0164	0.476	28.96	52.5	.9484	1.859	864.	0.0976	15676.	.00320	761.	0.369	4.165	4.051	2.087
5.50	16.72	227.2	225.1	2.12	218.5	6.50	4839.	1115.	4.34	4.24	.0283	0.872	735.	.00803	0.546	0.0774	0.1034	1.70	0.0164	0.541	33.05	58.3	.9537	1.952	895.	0.1019	16371.	.00332	789.	0.387	4.406	4.253	2.189

FORCED CONVECTION BOILING

RUN NO. 27.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1670. LBS/HR MASS VELOCITY,G= 164.3 LBS/SEC.SQFT POWER= 9.78 KILOWATTS HEAT FLUX,Q= 31276. BTU/HR.SQFT

REYNOLDS NO.= 57571. TEMPERATURE BEFORE FLASH= 264.4 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	24.35	245.5	243.4	2.09	238.6	4.83	6480.	1158.	5.60	5.47	.0275	1.058	981.	.01083	0.555	0.0548	0.1324	1.53	0.0159	0.520	32.74	40.4	.9332	1.563	886.	0.0873	14266.	.00308	736.	0.332	3.949	3.868	1.999
0.25	24.22	246.6	244.5	2.09	238.3	6.24	5008.	1156.	4.33	4.23	.0287	1.014	758.	.00837	0.555	0.0551	0.1025	1.53	0.0159	0.542	34.19	42.3	.9362	1.597	900.	0.0890	14541.	.00314	748.	0.339	4.047	3.952	2.041
0.50	24.08	247.0	244.9	2.08	238.0	6.97	4484.	1154.	3.89	3.79	.0300	0.972	679.	.00750	0.554	0.0554	0.0920	1.53	0.0158	0.567	35.84	44.3	.9391	1.631	914.	0.0907	14818.	.00319	760.	0.346	4.147	4.036	2.084
1.00	23.80	246.6	244.6	2.09	237.3	7.23	4324.	1150.	3.76	3.66	.0325	0.897	655.	.00723	0.554	0.0560	0.0890	1.54	0.0158	0.619	39.29	48.2	.9443	1.698	941.	0.0940	15354.	.00329	784.	0.361	4.343	4.201	2.167
1.50	23.49	245.9	243.8	2.09	236.6	7.15	4374.	1146.	3.82	3.71	.0350	0.831	662.	.00732	0.554	0.0567	0.0904	1.54	0.0157	0.676	43.08	52.4	.9489	1.766	967.	0.0974	15890.	.00339	807.	0.375	4.542	4.368	2.251
2.00	23.16	245.0	242.9	2.09	235.9	7.05	4435.	1142.	3.89	3.77	.0377	0.772	672.	.00742	0.554	0.0574	0.0920	1.55	0.0156	0.736	47.11	56.9	.9530	1.835	992.	0.1007	16423.	.00349	829.	0.390	4.743	4.534	2.337
2.50	22.78	244.2	242.1	2.09	234.9	7.15	4373.	1137.	3.85	3.72	.0404	0.717	662.	.00732	0.553	0.0583	0.0911	1.56	0.0156	0.803	51.62	61.8	.9569	1.908	1018.	0.1042	16977.	.00360	852.	0.406	4.955	4.709	2.427
3.00	22.33	243.4	241.3	2.09	233.8	7.42	4214.	1132.	3.72	3.59	.0434	0.665	638.	.00705	0.553	0.0594	0.0882	1.56	0.0155	0.880	56.83	67.3	.9606	1.988	1043.	0.1079	17562.	.00370	876.	0.422	5.180	4.894	2.522
3.50	21.85	242.0	240.0	2.09	232.7	7.27	4300.	1126.	3.82	3.68	.0464	0.618	651.	.00720	0.552	0.0606	0.0905	1.57	0.0154	0.962	62.42	73.2	.9639	2.070	1068.	0.1116	18154.	.00381	899.	0.439	5.410	5.081	2.620
4.00	21.35	240.4	238.4	2.09	231.4	6.92	4521.	1120.	4.04	3.88	.0495	0.575	685.	.00757	0.552	0.0619	0.0957	1.58	0.0153	1.055	68.77	79.5	.9669	2.155	1093.	0.1155	18751.	.00392	922.	0.456	5.646	5.272	2.720
4.50	20.79	238.8	236.7	2.09	230.0	6.70	4667.	1114.	4.19	4.01	.0528	0.535	707.	.00782	0.551	0.0634	0.0994	1.59	0.0153	1.155	75.66	86.7	.9697	2.248	1118.	0.1197	19381.	.00404	946.	0.475	5.899	5.475	2.826
5.00	20.18	236.7	234.6	2.10	228.4	6.20	5043.	1107.	4.56	4.35	.0562	0.498	764.	.00845	0.551	0.0652	0.1082	1.61	0.0152	1.268	83.47	94.6	.9724	2.348	1142.	0.1241	20040.	.00415	971.	0.495	6.164	5.687	2.940
5.50	19.48	233.3	231.2	2.10	226.5	4.67	6696.	1099.	6.09	5.80	.0599	0.461	1015.	.01121	0.550	0.0673	0.1448	1.62	0.0151	1.540	101.90	103.9	.9750	2.463	1168.	0.1290	20762.	.00428	996.	0.516	6.458	5.920	3.065

FORCED CONVECTION BOILING

RUN NO. 29.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1676. LBS/HR MASS VELOCITY,G= 164.9 LBS/SEC.SQFT POWER= 9.90 KILOWATTS HEAT FLUX,Q= 31660. BTU/HR.SQFT

REYNOLDS NO.= 58727. TEMPERATURE BEFORE FLASH= 297.2 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	28.72	254.2	252.1	2.10	247.8	4.25	7444.	1157.	6.43	6.16	.0531	0.614	1126.	.01239	0.563	0.0475	0.1518	1.47	0.0152	0.960	63.33	65.4	.9594	1.891	1132.	0.1066	17606.	.00384	909.	0.427	5.441	5.108	2.640
0.25	28.46	254.7	252.6	2.10	247.4	5.21	6076.	1155.	5.26	5.03	.0546	0.597	919.	.01011	0.563	0.0478	0.1242	1.47	0.0151	0.968	64.00	67.6	.9608	1.922	1142.	0.1081	17835.	.00388	919.	0.434	5.537	5.186	2.680
0.50	28.24	254.7	252.6	2.10	246.9	5.73	5527.	1152.	4.80	4.58	.0560	0.580	836.	.00920	0.563	0.0482	0.1132	1.47	0.0151	0.987	65.41	69.8	.9621	1.953	1153.	0.1095	18062.	.00393	928.	0.441	5.632	5.263	2.720
1.00	27.75	253.8	251.7	2.10	245.9	5.82	5438.	1147.	4.74	4.52	.0589	0.548	823.	.00905	0.562	0.0490	0.1119	1.48	0.0150	1.022	68.04	74.5	.9646	2.015	1173.	0.1125	18516.	.00401	946.	0.455	5.824	5.417	2.802
1.50	27.24	252.7	250.6	2.10	244.8	5.78	5481.	1142.	4.80	4.56	.0618	0.519	829.	.00912	0.562	0.0498	0.1133	1.49	0.0149	1.069	71.51	79.3	.9669	2.079	1193.	0.1154	18974.	.00410	964.	0.469	6.019	5.573	2.885
2.00	26.69	251.6	249.5	2.11	243.7	5.82	5441.	1137.	4.79	4.54	.0648	0.491	823.	.00906	0.561	0.0508	0.1131	1.49	0.0149	1.127	75.75	84.6	.9691	2.146	1212.	0.1185	19448.	.00419	982.	0.483	6.221	5.735	2.971
2.50	26.12	250.5	248.4	2.11	242.5	5.91	5361.	1131.	4.74	4.48	.0679	0.465	811.	.00893	0.561	0.0518	0.1120	1.50	0.0148	1.195	80.74	90.3	.9711	2.217	1232.	0.1217	19934.	.00428	1001.	0.498	6.431	5.901	3.060
3.00	25.51	249.3	247.2	2.11	241.2	6.03	5253.	1125.	4.67	4.40	.0711	0.440	795.	.00874	0.560	0.0530	0.1104	1.51	0.0147	1.270	86.26	96.4	.9731	2.291	1251.	0.1250	20439.	.00437	1019.	0.514	6.649	6.074	3.152
3.50	24.86	247.9	245.8	2.11	239.8	6.01	5269.	1119.	4.71	4.43	.0744	0.417	797.	.00877	0.560	0.0542	0.1114	1.52	0.0146	1.357	92.66	103.1	.9750	2.370	1270.	0.1285	20963.	.00447	1038.	0.530	6.877	6.253	3.249
4.00	24.15	245.9	243.8	2.11	238.1	5.64	5615.	1112.	5.05	4.73	.0778	0.394	850.	.00935	0.559	0.0557	0.1195	1.53	0.0146	1.460	100.22	110.7	.9768	2.456	1289.	0.1322	21514.	.00457	1057.	0.548	7.122	6.445	3.353
4.50	23.39	243.6	241.5	2.11	236.4	5.14	6158.	1104.	5.58	5.21	.0814	0.372	932.	.01026	0.559	0.0574	0.1320	1.55	0.0145	1.587	109.54	119.0	.9785	2.549	1308.	0.1361	22095.	.00467	1077.	0.566	7.380	6.645	3.462
5.00	22.56	241.1	238.9	2.12	234.4	4.54	6979.	1096.	6.37	5.93	.0852	0.350	1057.	.01164	0.558	0.0593	0.1508	1.56	0.0144	1.747	121.28	128.6	.9802	2.652	1327.	0.1405	22726.	.00478	1098.	0.586	7.661	6.863	3.581
5.50	21.58	237.1	235.0	2.12	232.0	2.95	10739.	1087.	9.88	9.17	.0893	0.327	1627.	.01792	0.557	0.0618	0.2342	1.58	0.0143	2.095	146.34	140.3	.9820	2.775	1347.	0.1454	23457.	.00490	1121.	0.610	7.982	7.111	3.718

FORCED CONVECTION BOILING

RUN NO. 30.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1673. LBS/HR MASS VELOCITY,G= 164.6 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 56074. TEMPERATURE BEFORE FLASH= 240.8 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DF/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.51	237.7	235.6	2.11	229.5	6.07	5187.	1152.	4.50	4.46	.0119	2.119	786.	.00867	0.554	0.0642	0.1068	1.60	0.0165	0.150	9.09	21.8	.8746	1.210	649.	0.0670	10761.	.00233	555.	0.249	2.689	2.767	1.463
0.25	20.59	239.3	237.2	2.11	229.5	7.71	4081.	1151.	3.55	3.51	.0129	1.968	618.	.00682	0.554	0.0643	0.0841	1.60	0.0165	0.172	10.44	23.5	.8834	1.252	669.	0.0692	11125.	.00240	572.	0.257	2.797	2.864	1.509
0.50	20.54	239.8	237.7	2.10	229.4	8.35	3767.	1150.	3.28	3.24	.0139	1.833	571.	.00630	0.554	0.0644	0.0777	1.60	0.0164	0.196	11.92	25.2	.8914	1.294	688.	0.0714	11485.	.00247	589.	0.266	2.906	2.961	1.555
1.00	20.44	240.2	238.1	2.10	229.1	9.06	3472.	1147.	3.03	2.99	.0160	1.606	526.	.00581	0.553	0.0647	0.0718	1.60	0.0164	0.245	14.96	28.7	.9050	1.376	726.	0.0756	12185.	.00260	621.	0.282	3.122	3.153	1.647
1.50	20.30	240.0	237.9	2.10	228.7	9.14	3442.	1145.	3.01	2.96	.0182	1.423	522.	.00575	0.553	0.0651	0.0714	1.60	0.0163	0.302	18.50	32.5	.9162	1.458	761.	0.0797	12864.	.00273	652.	0.298	3.338	3.343	1.739
2.00	20.13	239.4	237.3	2.11	228.3	9.03	3485.	1141.	3.05	3.00	.0205	1.272	528.	.00583	0.553	0.0656	0.0725	1.61	0.0163	0.363	22.32	36.5	.9256	1.539	795.	0.0838	13530.	.00286	682.	0.315	3.555	3.531	1.831
2.50	19.92	238.7	236.6	2.11	227.8	8.89	3538.	1138.	3.11	3.05	.0229	1.143	536.	.00591	0.553	0.0662	0.0738	1.61	0.0162	0.432	26.67	40.8	.9336	1.621	828.	0.0878	14190.	.00298	711.	0.331	3.776	3.720	1.925
3.00	19.69	237.9	235.8	2.11	227.1	8.74	3602.	1134.	3.18	3.11	.0254	1.034	546.	.00602	0.553	0.0670	0.0754	1.62	0.0161	0.508	31.48	45.4	.9405	1.705	860.	0.0919	14845.	.00311	740.	0.348	3.999	3.911	2.020
3.50	19.40	236.9	234.8	2.11	226.3	8.44	3730.	1129.	3.30	3.23	.0281	0.938	565.	.00623	0.552	0.0679	0.0785	1.63	0.0161	0.591	36.77	50.5	.9467	1.792	892.	0.0961	15512.	.00323	768.	0.365	4.231	4.107	2.118
4.00	19.07	235.6	233.5	2.11	225.4	8.06	3902.	1124.	3.47	3.39	.0309	0.853	592.	.00652	0.552	0.0690	0.0825	1.64	0.0160	0.682	42.60	56.0	.9521	1.883	923.	0.1004	16193.	.00336	797.	0.383	4.472	4.309	2.220
4.50	18.72	234.1	232.0	2.11	224.4	7.59	4145.	1119.	3.70	3.60	.0337	0.780	628.	.00692	0.552	0.0702	0.0880	1.65	0.0159	0.783	49.12	61.9	.9568	1.974	953.	0.1047	16861.	.00348	824.	0.401	4.712	4.508	2.323
5.00	18.32	232.2	230.1	2.11	223.3	6.81	4618.	1114.	4.15	4.02	.0366	0.714	700.	.00771	0.551	0.0716	0.0966	1.66	0.0159	0.	0.	68.4	.9611	2.071	982.	0.1091	17550.	.00361	852.	0.420	4.964	4.716	2.430
5.50	17.91	230.0	227.9	2.11	222.1	5.76	5465.	1108.	4.93	4.77	.0397	0.656	829.	.00912	0.551	0.0731	0.1174	1.67	0.0158	0.	0.	75.4	.9648	2.170	1011.	0.1136	18237.	.00373	879.	0.439	5.219	4.925	2.538

FORCED CONVECTION BOILING

RUN NO. 31.0 WATER TEST SECTION NO. 1

FLOW RATE,W=2151. LBS/HR MASS VELOCITY,G= 211.7 LBS/SEC.SQFT POWER= 9.68 KILOWATTS HEAT FLUX,Q= 30956. BTU/HR.SQFT

REYNOLDS NO.= 73944. TEMPERATURE BEFORE FLASH= 243.9 F VELOCITY BEFORE FLASH= 2.7 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	22.51	242.9	240.8	2.07	234.3	6.53	4743.	1425.	3.33	3.30	.0102	2.539	718.	.00616	0.425	0.0453	0.0789	1.56	0.0256	0.188	7.35	22.9	.8455	1.025	684.	0.0561	11518.	.00193	586.	0.212	2.318	2.417	1.231
0.25	22.46	243.8	241.7	2.07	234.2	7.53	4112.	1424.	2.89	2.86	.0110	2.361	623.	.00534	0.425	0.0454	0.0684	1.56	0.0256	0.215	8.41	24.5	.8559	1.060	705.	0.0579	11903.	.00199	604.	0.219	2.412	2.503	1.271
0.50	22.40	244.4	242.4	2.07	234.0	8.32	3720.	1422.	2.61	2.59	.0119	2.205	563.	.00483	0.425	0.0455	0.0620	1.56	0.0255	0.244	9.56	26.2	.8652	1.095	724.	0.0596	12277.	.00205	621.	0.226	2.505	2.588	1.310
0.75	22.34	244.7	242.7	2.07	233.9	8.79	3522.	1421.	2.48	2.45	.0127	2.066	533.	.00458	0.425	0.0456	0.0587	1.56	0.0255	0.272	10.67	27.9	.8735	1.129	744.	0.0613	12643.	.00210	638.	0.233	2.597	2.671	1.349
1.00	22.27	244.9	242.8	2.07	233.7	9.13	3391.	1419.	2.39	2.36	.0136	1.938	513.	.00441	0.425	0.0457	0.0566	1.56	0.0254	0.302	11.87	29.7	.8813	1.163	763.	0.0631	13012.	.00216	655.	0.241	2.691	2.756	1.389
1.50	22.10	244.4	242.4	2.07	233.3	9.06	3417.	1416.	2.41	2.38	.0154	1.722	518.	.00444	0.425	0.0461	0.0572	1.57	0.0254	0.363	14.31	33.4	.8948	1.231	799.	0.0665	13728.	.00226	687.	0.255	2.878	2.922	1.469
2.00	21.90	243.8	241.8	2.07	232.8	8.95	3460.	1413.	2.45	2.42	.0174	1.539	524.	.00450	0.425	0.0464	0.0581	1.57	0.0253	0.428	16.92	37.4	.9063	1.299	835.	0.0698	14442.	.00236	718.	0.269	3.067	3.090	1.550
2.50	21.66	243.1	241.0	2.07	232.2	8.81	3515.	1409.	2.50	2.46	.0194	1.385	532.	.00457	0.424	0.0469	0.0592	1.57	0.0252	0.496	19.67	41.7	.9162	1.368	869.	0.0732	15150.	.00246	749.	0.284	3.260	3.258	1.631
3.00	21.40	242.3	240.3	2.07	231.6	8.69	3561.	1404.	2.54	2.49	.0215	1.254	539.	.00463	0.424	0.0474	0.0601	1.58	0.0251	0.568	22.60	46.3	.9247	1.438	903.	0.0765	15848.	.00256	779.	0.298	3.454	3.426	1.714
3.50	21.10	241.3	239.3	2.07	230.8	8.47	3657.	1399.	2.61	2.56	.0237	1.139	554.	.00476	0.424	0.0481	0.0620	1.59	0.0251	0.647	25.83	51.4	.9322	1.510	936.	0.0800	16555.	.00266	809.	0.314	3.655	3.599	1.799
4.00	20.75	239.9	237.8	2.07	229.9	7.94	3900.	1394.	2.80	2.74	.0260	1.036	591.	.00507	0.424	0.0488	0.0664	1.59	0.0250	0.740	29.64	56.9	.9390	1.585	968.	0.0835	17281.	.00277	839.	0.329	3.865	3.778	1.888
4.50	20.36	238.4	236.3	2.07	228.9	7.40	4183.	1388.	3.01	2.94	.0285	0.946	634.	.00544	0.423	0.0497	0.0715	1.60	0.0249	0.844	33.93	63.0	.9450	1.663	1001.	0.0871	18018.	.00287	869.	0.345	4.081	3.960	1.980
5.00	19.91	236.6	234.5	2.07	227.7	6.80	4550.	1382.	3.29	3.21	.0311	0.864	690.	.00592	0.423	0.0507	0.0782	1.61	0.0248	0.966	38.97	69.7	.9505	1.747	1033.	0.0909	18784.	.00298	899.	0.362	4.308	4.151	2.077
5.50	19.38	233.5	231.4	2.08	226.3	5.17	5991.	1374.	4.36	4.24	.0339	0.786	908.	.00779	0.423	0.0520	0.1036	1.63	0.0247	1.123	45.48	77.8	.9558	1.843	1067.	0.0952	19624.	.00309	932.	0.381	4.562	4.362	2.185

FORCED CONVECTION BOILING

RUN NO. 32.0 . WATER TEST SECTION NO. 1

FLOW RATE,W=2142. LBS/HR MASS VELOCITY,G= 210.8 LBS/SEC.SQFT POWER= 9.90 KILOWATTS HEAT FLUX,Q= 31663. BTU/HR.SQFT

REYNOLDS NO.= 76625. TEMPERATURE BEFORE FLASH= 267.7 F VELOCITY BEFORE FLASH= 2.8 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	27.56	251.5	249.4	2.11	245.7	3.70	8552.	1437.	5.95	5.84	.0236	1.291	1294.	.01114	0.440	0.0384	0.1405	1.48	0.0246	0.375	15.23	40.3	.9134	1.307	943.	0.0727	15192.	.00256	779.	0.285	3.413	3.392	1.705
0.25	27.56	253.3	251.2	2.10	245.5	5.73	5529.	1436.	3.85	3.78	.0245	1.243	836.	.00720	0.440	0.0386	0.0909	1.48	0.0246	0.457	18.60	41.9	.9168	1.332	956.	0.0740	15452.	.00260	791.	0.291	3.489	3.458	1.738
0.50	27.44	253.7	251.6	2.10	245.2	6.35	4985.	1434.	3.48	3.41	.0255	1.196	754.	.00649	0.440	0.0387	0.0821	1.48	0.0245	0.540	22.01	43.7	.9201	1.357	970.	0.0752	15720.	.00264	803.	0.297	3.568	3.526	1.771
1.00	27.13	253.2	251.1	2.10	244.6	6.45	4909.	1430.	3.43	3.36	.0276	1.105	743.	.00639	0.440	0.0391	0.0811	1.49	0.0245	0.683	27.93	47.4	.9267	1.412	999.	0.0780	16289.	.00272	827.	0.309	3.737	3.671	1.843
1.50	26.75	252.3	250.2	2.11	243.8	6.41	4939.	1425.	3.47	3.38	.0299	1.020	747.	.00643	0.439	0.0397	0.0819	1.49	0.0244	0.814	33.40	51.7	.9329	1.472	1028.	0.0808	16889.	.00281	853.	0.323	3.916	3.823	1.919
2.00	26.31	251.5	249.4	2.11	242.9	6.48	4889.	1419.	3.44	3.35	.0323	0.942	740.	.00637	0.439	0.0403	0.0814	1.50	0.0243	0.930	38.31	56.4	.9387	1.535	1058.	0.0839	17518.	.00290	880.	0.337	4.108	3.985	2.001
2.50	25.82	250.6	248.5	2.11	241.8	6.66	4754.	1414.	3.36	3.27	.0349	0.870	719.	.00619	0.439	0.0410	0.0795	1.51	0.0242	1.033	42.73	61.6	.9441	1.602	1087.	0.0870	18164.	.00299	906.	0.351	4.306	4.151	2.085
3.00	25.28	249.7	247.6	2.11	240.7	6.92	4574.	1407.	3.25	3.15	.0375	0.805	692.	.00596	0.438	0.0418	0.0768	1.52	0.0241	1.130	46.94	67.3	.9490	1.672	1116.	0.0903	18829.	.00309	933.	0.367	4.512	4.323	2.172
3.50	24.69	248.6	246.5	2.11	239.4	7.13	4442.	1400.	3.17	3.07	.0403	0.744	672.	.00579	0.438	0.0427	0.0750	1.52	0.0240	1.223	51.02	73.6	.9535	1.746	1145.	0.0937	19516.	.00318	960.	0.383	4.729	4.502	2.264
4.00	24.04	247.0	244.8	2.11	237.9	6.97	4543.	1393.	3.26	3.15	.0433	0.688	688.	.00592	0.438	0.0438	0.0772	1.53	0.0239	1.325	55.51	80.6	.9577	1.826	1174.	0.0973	20234.	.00328	988.	0.399	4.959	4.692	2.362
4.50	23.35	245.0	242.9	2.11	236.3	6.61	4788.	1384.	3.46	3.33	.0464	0.637	725.	.00624	0.437	0.0450	0.0819	1.55	0.0238	1.440	60.59	88.3	.9616	1.910	1202.	0.1010	20971.	.00338	1015.	0.417	5.197	4.886	2.463
5.00	22.58	242.6	240.5	2.12	234.5	6.02	5260.	1375.	3.82	3.67	.0497	0.588	797.	.00686	0.437	0.0464	0.0906	1.56	0.0237	1.567	66.25	97.3	.9652	2.004	1231.	0.1051	21769.	.00349	1045.	0.436	5.458	5.098	2.574
5.50	21.77	238.6	236.5	2.12	232.5	4.04	7840.	1366.	5.74	5.49	.0531	0.543	1187.	.01024	0.436	0.0480	0.1361	1.57	0.0235	1.710	72.65	107.2	.9686	2.103	1259.	0.1093	22598.	.00360	1074.	0.456	5.730	5.317	2.689

FORCED CONVECTION BOILING

RUN NO. 33.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1122. LBS/HR MASS VELOCITY,G= 110.4 LBS/SEC.SQFT POWER= 9.85 KILOWATTS HEAT FLUX,Q= 31503. BTU/HR.SQFT

REYNOLDS NO.= 36738. TEMPERATURE BEFORE FLASH= 268.1 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	21.00	238.6	236.5	2.11	230.5	6.00	5247.	820.	6.40	6.19	.0397	0.703	795.	.01308	0.827	0.0942	0.1518	1.59	0.0078	0.315	40.42	43.9	.9593	2.141	845.	0.1212	13374.	.00433	700.	0.446	5.287	5.031	2.725
0.25	20.92	239.8	237.7	2.11	230.3	7.33	4297.	819.	5.25	5.08	.0413	0.676	651.	.01071	0.827	0.0945	0.1245	1.59	0.0078	0.342	44.01	45.7	.9610	2.182	857.	0.1233	13597.	.00439	710.	0.454	5.402	5.125	2.774
0.50	20.83	240.0	237.9	2.11	230.1	7.79	4046.	817.	4.95	4.78	.0429	0.651	613.	.01009	0.827	0.0949	0.1175	1.59	0.0077	0.370	47.74	47.6	.9626	2.223	868.	0.1253	13819.	.00446	719.	0.462	5.519	5.220	2.824
1.00	20.64	239.5	237.4	2.11	229.6	7.83	4022.	814.	4.94	4.76	.0462	0.605	609.	.01003	0.826	0.0957	0.1172	1.60	0.0077	0.427	55.40	51.5	.9656	2.305	891.	0.1295	14260.	.00459	739.	0.479	5.752	5.410	2.923
1.50	20.40	238.8	236.7	2.11	229.0	7.70	4091.	811.	5.05	4.85	.0496	0.563	620.	.01020	0.826	0.0967	0.1198	1.60	0.0077	0.483	63.03	55.7	.9683	2.391	914.	0.1337	14709.	.00472	758.	0.496	5.994	5.605	3.026
2.00	20.12	238.0	235.9	2.11	228.3	7.61	4140.	807.	5.13	4.91	.0530	0.525	627.	.01032	0.826	0.0979	0.1218	1.61	0.0076	0.542	71.14	60.2	.9708	2.480	936.	0.1380	15162.	.00486	777.	0.514	6.241	5.804	3.131
2.50	19.82	237.2	235.1	2.11	227.5	7.63	4130.	803.	5.14	4.91	.0566	0.490	626.	.01029	0.825	0.0993	0.1221	1.62	0.0076	0.602	79.48	65.1	.9731	2.572	957.	0.1424	15620.	.00499	796.	0.532	6.495	6.006	3.238
3.00	19.49	236.4	234.3	2.11	226.6	7.71	4085.	799.	5.11	4.87	.0603	0.458	619.	.01018	0.825	0.1009	0.1215	1.62	0.0075	0.663	88.05	70.2	.9751	2.668	979.	0.1470	16080.	.00513	815.	0.551	6.754	6.212	3.349
3.50	19.14	235.3	233.2	2.11	225.6	7.58	4158.	795.	5.23	4.96	.0639	0.430	630.	.01036	0.824	0.1026	0.1243	1.63	0.0075	0.727	97.12	75.6	.9770	2.766	999.	0.1515	16539.	.00527	833.	0.570	7.016	6.418	3.460
4.00	18.76	234.0	231.9	2.11	224.6	7.36	4280.	790.	5.42	5.12	.0677	0.403	649.	.01066	0.824	0.1046	0.1288	1.64	0.0074	0.796	106.99	81.5	.9788	2.869	1019.	0.1563	17011.	.00540	852.	0.590	7.287	6.631	3.575
4.50	18.34	232.6	230.5	2.11	223.4	7.09	4441.	786.	5.65	5.33	.0716	0.378	674.	.01105	0.823	0.1067	0.1345	1.66	0.0074	0.870	117.67	87.9	.9804	2.977	1039.	0.1612	17494.	.00554	870.	0.611	7.568	6.850	3.694
5.00	17.89	230.7	228.6	2.12	222.1	6.57	4795.	781.	6.14	5.77	.0757	0.354	727.	.01193	0.822	0.1092	0.1462	1.67	0.0073	0.956	130.12	94.9	.9819	3.093	1058.	0.1663	17995.	.00569	889.	0.632	7.863	7.079	3.819
5.50	17.37	227.2	225.1	2.12	220.5	4.59	6858.	775.	8.85	8.28	.0799	0.332	1041.	.01706	0.821	0.1122	0.2107	1.68	0.0073	1.078	147.70	102.8	.9834	3.220	1078.	0.1719	18532.	.00584	908.	0.656	8.178	7.322	3.953

FORCED CONVECTION BOILING

RUN NO. 34.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1126. LBS/HR MASS VELOCITY,G= 110.8 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 36813. TEMPERATURE BEFORE FLASH= 303.2 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	23.66	244.7	242.6	2.10	237.0	5.61	5611.	812.	6.91	6.52	.0707	0.428	849.	.01392	0.827	0.0840	0.1636	1.54	0.0074	0.718	97.46	69.0	.9748	2.565	1039.	0.1452	16089.	.00526	837.	0.553	7.031	6.431	3.468
0.25	23.43	244.9	242.9	2.10	236.6	6.25	5035.	810.	6.22	5.85	.0725	0.417	762.	.01249	0.827	0.0846	0.1472	1.54	0.0073	0.743	101.16	71.2	.9756	2.603	1047.	0.1471	16280.	.00532	844.	0.561	7.146	6.522	3.517
0.50	23.29	244.9	242.8	2.10	236.2	6.63	4744.	808.	5.87	5.52	.0743	0.405	718.	.01177	0.826	0.0852	0.1390	1.55	0.0073	0.768	104.89	73.5	.9764	2.643	1056.	0.1490	16472.	.00538	852.	0.569	7.263	6.613	3.566
1.00	22.90	244.1	242.0	2.10	235.2	6.74	4670.	804.	5.81	5.44	.0780	0.384	707.	.01159	0.826	0.0866	0.1376	1.55	0.0073	0.816	112.14	78.2	.9779	2.725	1073.	0.1528	16860.	.00549	867.	0.586	7.501	6.799	3.667
1.50	22.49	243.0	240.9	2.10	234.2	6.68	4710.	800.	5.89	5.50	.0817	0.364	713.	.01169	0.825	0.0880	0.1396	1.56	0.0072	0.862	119.22	83.2	.9794	2.809	1090.	0.1566	17251.	.00561	882.	0.603	7.744	6.988	3.770
2.00	22.05	241.9	239.8	2.10	233.2	6.65	4735.	795.	5.95	5.54	.0855	0.345	717.	.01176	0.825	0.0896	0.1411	1.57	0.0072	0.903	125.70	88.6	.9807	2.896	1107.	0.1606	17652.	.00572	897.	0.621	7.994	7.181	3.876
2.50	21.57	240.8	238.7	2.10	232.0	6.70	4699.	791.	5.94	5.51	.0894	0.327	712.	.01167	0.824	0.0914	0.1409	1.58	0.0071	0.947	132.70	94.4	.9820	2.988	1123.	0.1647	18066.	.00584	912.	0.640	8.253	7.380	3.986
3.00	21.08	239.6	237.5	2.10	230.7	6.79	4634.	786.	5.90	5.45	.0933	0.310	702.	.01151	0.823	0.0934	0.1399	1.59	0.0071	0.977	137.80	100.6	.9832	3.086	1139.	0.1691	18485.	.00597	928.	0.659	8.522	7.586	4.100
3.50	20.58	238.4	236.3	2.11	229.5	6.80	4628.	781.	5.93	5.46	.0973	0.294	701.	.01150	0.822	0.0955	0.1407	1.60	0.0070	0.998	141.70	107.1	.9843	3.187	1154.	0.1735	18907.	.00609	943.	0.678	8.794	7.794	4.215
4.00	20.01	236.7	234.6	2.11	228.0	6.59	4776.	776.	6.16	5.65	.1015	0.279	724.	.01186	0.822	0.0980	0.1462	1.61	0.0070	1.010	144.38	114.5	.9854	3.297	1170.	0.1783	19362.	.00622	958.	0.699	9.086	8.015	4.339
4.50	19.44	234.5	232.4	2.11	226.4	6.02	5228.	770.	6.79	6.21	.1057	0.264	793.	.01298	0.821	0.1007	0.1613	1.63	0.0069	1.015	146.07	122.5	.9864	3.415	1185.	0.1833	19821.	.00636	974.	0.721	9.386	8.243	4.467
5.00	18.85	232.1	230.0	2.11	224.8	5.17	6082.	764.	7.96	7.25	.1099	0.250	922.	.01509	0.820	0.1036	0.1892	1.64	0.0069	1.017	147.36	131.0	.9873	3.538	1200.	0.1885	20295.	.00650	989.	0.744	9.697	8.476	4.598
5.50	18.23	229.2	227.1	2.12	223.0	4.09	7696.	758.	10.15	9.21	.1143	0.237	1167.	.01909	0.819	0.1069	0.2415	1.66	0.0069	1.020	148.82	140.4	.9883	3.670	1215.	0.1940	20790.	.00664	1005.	0.767	10.023	8.720	4.737

FORCED CONVECTION BOILING

RUN NO. 35.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1127. LBS/HR MASS VELOCITY,G= 110.9 LBS/SEC.SQFT POWER= 9.78 KILOWATTS HEAT FLUX,Q= 31276. BTU/HR.SQFT

REYNOLDS NO.= 37007. TEMPERATURE BEFORE FLASH= 288.5 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	22.75	242.5	240.4	2.09	234.9	5.54	5643.	818.	6.90	6.58	.0571	0.517	855.	.01399	0.820	0.0865	0.1633	1.56	0.0076	0.547	72.15	58.1	.9696	2.384	962.	0.1352	15010.	.00488	783.	0.506	6.292	5.843	3.149
0.25	22.51	243.0	240.9	2.09	234.5	6.39	4892.	817.	5.99	5.71	.0588	0.501	741.	.01213	0.820	0.0870	0.1419	1.56	0.0076	0.580	76.73	60.2	.9707	2.423	972.	0.1371	15210.	.00493	792.	0.515	6.406	5.934	3.197
0.50	22.47	243.1	241.0	2.09	234.2	6.82	4584.	815.	5.63	5.35	.0605	0.486	694.	.01137	0.819	0.0875	0.1333	1.56	0.0075	0.616	81.73	62.2	.9717	2.461	982.	0.1389	15406.	.00499	800.	0.523	6.519	6.024	3.245
1.00	22.17	242.5	240.4	2.09	233.5	6.97	4488.	811.	5.53	5.25	.0640	0.458	680.	.01113	0.819	0.0886	0.1311	1.57	0.0075	0.683	91.16	66.5	.9736	2.539	1001.	0.1427	15802.	.00511	816.	0.539	6.749	6.206	3.343
1.50	21.82	241.6	239.5	2.09	232.6	6.90	4535.	807.	5.62	5.31	.0675	0.432	687.	.01125	0.819	0.0899	0.1332	1.57	0.0074	0.750	100.71	71.1	.9755	2.622	1019.	0.1466	16212.	.00523	833.	0.556	6.988	6.395	3.445
2.00	21.43	240.6	238.5	2.09	231.6	6.88	4545.	803.	5.66	5.33	.0712	0.407	688.	.01128	0.818	0.0914	0.1342	1.58	0.0074	0.813	109.85	76.1	.9772	2.710	1028.	0.1507	16634.	.00535	849.	0.574	7.237	6.590	3.550
2.50	21.00	239.6	237.6	2.09	230.5	7.02	4455.	799.	5.58	5.24	.0750	0.383	675.	.01106	0.817	0.0931	0.1323	1.59	0.0074	0.872	118.56	81.6	.9788	2.804	1056.	0.1551	17068.	.00548	866.	0.593	7.497	6.794	3.660
3.00	20.53	238.6	236.5	2.09	229.3	7.15	4374.	794.	5.51	5.16	.0789	0.361	663.	.01085	0.817	0.0951	0.1307	1.60	0.0073	0.926	126.71	87.5	.9803	2.904	1075.	0.1596	17517.	.00561	883.	0.612	7.767	7.003	3.775
3.50	20.04	237.3	235.2	2.09	228.1	7.14	4378.	789.	5.55	5.18	.0829	0.341	663.	.01087	0.816	0.0972	0.1317	1.61	0.0073	0.974	134.14	93.9	.9818	3.007	1092.	0.1642	17972.	.00574	900.	0.632	8.043	7.217	3.892
4.00	19.49	235.8	233.7	2.10	226.6	7.13	4389.	783.	5.60	5.21	.0871	0.321	665.	.01089	0.815	0.0997	0.1331	1.62	0.0072	1.018	141.12	101.1	.9832	3.122	1110.	0.1693	18457.	.00589	917.	0.654	8.341	7.446	4.018
4.50	18.95	234.1	232.0	2.10	225.1	6.88	4543.	778.	5.84	5.41	.0912	0.302	689.	.01126	0.814	0.1024	0.1388	1.64	0.0072	1.057	147.48	108.6	.9844	3.239	1127.	0.1744	18939.	.00603	934.	0.676	8.639	7.674	4.145
5.00	18.40	231.9	229.8	2.10	223.5	6.26	4998.	773.	6.47	5.57	.0954	0.286	758.	.01239	0.814	0.1052	0.1539	1.65	0.0071	1.088	152.81	116.6	.9855	3.360	1144.	0.1796	19428.	.00617	951.	0.698	8.944	7.906	4.274
5.50	17.87	227.6	225.5	2.10	222.0	3.55	8809.	767.	11.48	10.56	.0996	0.270	1337.	.02182	0.813	0.1081	0.2733	1.67	0.0071	0.	0.	124.9	.9866	3.482	1160.	0.1848	19908.	.00631	967.	0.720	9.250	8.138	4.404

FORCED CONVECTION BOILING

RUN NO. 36.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1124. LBS/HR MASS VELOCITY,G= 110.6 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 36862. TEMPERATURE BEFORE FLASH= 274.4 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	21.53	239.9	237.8	2.10	231.9	5.92	5315.	820.	6.48	6.25	.0450	0.632	805.	.01323	0.825	0.0918	0.1537	1.58	0.0077	0.443	57.29	48.5	.9633	2.225	884.	0.1260	13946.	.00451	729.	0.466	5.613	5.297	2.863
0.25	21.42	240.5	238.4	2.10	231.6	6.77	4645.	818.	5.68	5.46	.0467	0.609	704.	.01156	0.825	0.0922	0.1346	1.58	0.0077	0.462	59.92	50.4	.9648	2.266	896.	0.1280	14166.	.00457	738.	0.474	5.731	5.393	2.913
0.50	21.30	241.1	239.0	2.10	231.3	7.67	4102.	817.	5.02	4.83	.0484	0.588	621.	.01021	0.825	0.0927	0.1191	1.58	0.0077	0.483	62.82	52.4	.9662	2.308	907.	0.1301	14385.	.00464	748.	0.483	5.849	5.488	2.963
1.00	21.05	240.6	238.5	2.10	230.7	7.81	4031.	813.	4.96	4.75	.0518	0.548	611.	.01003	0.825	0.0937	0.1176	1.59	0.0076	0.527	68.93	56.6	.9688	2.391	929.	0.1342	14821.	.00477	767.	0.500	6.087	5.680	3.065
1.50	20.79	239.8	237.7	2.10	230.0	7.72	4077.	810.	5.04	4.81	.0552	0.513	618.	.01014	0.824	0.0948	0.1195	1.59	0.0076	0.572	75.25	60.9	.9711	2.476	950.	0.1383	15251.	.00490	785.	0.517	6.326	5.872	3.166
2.00	20.43	239.0	236.9	2.11	229.2	7.71	4079.	806.	5.06	4.82	.0587	0.480	618.	.01015	0.824	0.0961	0.1201	1.60	0.0076	0.621	82.18	65.6	.9733	2.564	971.	0.1426	15690.	.00503	803.	0.534	6.572	6.068	3.271
2.50	20.16	238.2	236.1	2.11	228.4	7.77	4049.	802.	5.05	4.80	.0623	0.451	614.	.01007	0.823	0.0975	0.1198	1.61	0.0075	0.673	89.60	70.5	.9752	2.653	991.	0.1468	16129.	.00516	821.	0.552	6.821	6.265	3.376
3.00	19.81	237.4	235.3	2.11	227.4	7.82	4025.	798.	5.05	4.78	.0660	0.423	610.	.01001	0.823	0.0991	0.1198	1.62	0.0075	0.733	98.17	75.7	.9770	2.747	1011.	0.1512	16572.	.00529	838.	0.571	7.078	6.467	3.485
3.50	19.43	236.2	234.1	2.11	226.4	7.68	4095.	793.	5.16	4.87	.0697	0.398	621.	.01018	0.822	0.1009	0.1226	1.63	0.0074	0.800	107.79	81.3	.9787	2.845	1030.	0.1557	17021.	.00542	856.	0.590	7.341	6.673	3.597
4.00	19.01	234.7	232.6	2.11	225.2	7.31	4306.	789.	5.46	5.14	.0736	0.374	653.	.01071	0.822	0.1030	0.1298	1.64	0.0074	0.872	118.22	87.5	.9803	2.950	1049.	0.1605	17491.	.00556	874.	0.610	7.617	6.888	3.714
4.50	18.56	232.9	230.8	2.11	224.0	6.78	4641.	784.	5.92	5.55	.0776	0.351	704.	.01153	0.821	0.1053	0.1408	1.65	0.0073	0.957	130.57	94.2	.9818	3.060	1068.	0.1654	17970.	.00570	892.	0.631	7.900	7.107	3.834
5.00	18.05	231.0	228.9	2.11	222.5	6.42	4905.	778.	6.30	5.89	.0817	0.330	744.	.01218	0.820	0.1080	0.1499	1.66	0.0073	1.057	145.15	101.7	.9832	3.181	1087.	0.1707	18480.	.00584	910.	0.653	8.206	7.343	3.964
5.50	17.48	227.5	225.4	2.12	220.9	4.51	6977.	773.	9.03	8.40	.0861	0.309	1059.	.01732	0.819	0.1112	0.2150	1.68	0.0072	1.190	164.52	110.1	.9846	3.313	1106.	0.1764	19022.	.00600	929.	0.677	8.530	7.591	4.101

FORCED CONVECTION BOILING

RUN NO. 37.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1129. LBS/HR MASS VELOCITY,G= 111.1 LBS/SEC.SQFT POWER= 9.83 KILOWATTS HEAT FLUX,Q= 31439. BTU/HR.SQFT

REYNOLDS NO.= 36792. TEMPERATURE BEFORE FLASH= 257.5 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	19.96	236.9	234.8	2.11	227.9	6.93	4537.	825.	5.50	5.36	.0312	0.861	688.	.01124	0.819	0.0978	0.1305	1.61	0.0080	0.275	34.30	36.6	.9506	1.984	775.	0.1121	12394.	.00398	649.	0.410	4.712	4.553	2.476
0.25	19.91	238.0	235.9	2.10	227.7	8.22	3824.	824.	4.64	4.52	.0328	0.822	579.	.00947	0.819	0.0981	0.1102	1.61	0.0080	0.291	36.39	38.5	.9530	2.029	789.	0.1144	12650.	.00405	660.	0.419	4.835	4.656	2.528
0.50	19.84	238.7	236.6	2.10	227.5	9.10	3455.	822.	4.20	4.09	.0343	0.785	524.	.00856	0.818	0.0984	0.0998	1.61	0.0080	0.308	38.61	40.4	.9553	2.074	802.	0.1167	12902.	.00413	672.	0.428	4.958	4.758	2.581
0.75	19.76	238.8	236.7	2.10	227.3	9.45	3328.	821.	4.05	3.94	.0359	0.752	504.	.00824	0.818	0.0988	0.0963	1.62	0.0080	0.327	41.11	42.3	.9574	2.119	816.	0.1190	13150.	.00420	683.	0.437	5.081	4.860	2.633
1.00	19.67	238.7	236.6	2.10	227.1	9.50	3308.	819.	4.04	3.92	.0375	0.720	501.	.00819	0.818	0.0992	0.0959	1.62	0.0079	0.347	43.74	44.3	.9594	2.165	829.	0.1213	13398.	.00427	694.	0.446	5.206	4.962	2.686
1.50	19.48	237.9	235.8	2.10	226.5	9.23	3406.	816.	4.17	4.04	.0408	0.663	516.	.00843	0.818	0.1001	0.0991	1.62	0.0079	0.388	49.17	48.4	.9630	2.254	854.	0.1258	13881.	.00442	715.	0.463	5.451	5.164	2.790
2.00	19.28	237.1	235.0	2.11	226.0	8.97	3504.	813.	4.31	4.16	.0441	0.614	531.	.00868	0.818	0.1011	0.1024	1.63	0.0078	0.435	55.43	52.7	.9661	2.344	878.	0.1302	14356.	.00456	736.	0.481	5.697	5.364	2.895
2.50	19.05	236.3	234.2	2.11	225.4	8.88	3540.	810.	4.37	4.21	.0474	0.570	537.	.00876	0.817	0.1022	0.1039	1.64	0.0078	0.487	62.40	57.2	.9689	2.435	901.	0.1347	14827.	.00469	756.	0.499	5.946	5.565	3.000
3.00	18.80	235.6	233.5	2.11	224.7	8.85	3554.	806.	4.41	4.23	.0508	0.530	539.	.00879	0.817	0.1035	0.1048	1.64	0.0078	0.543	69.97	61.9	.9714	2.528	923.	0.1391	15295.	.00483	776.	0.517	6.196	5.766	3.107
3.50	18.52	234.7	232.6	2.11	223.9	8.68	3622.	802.	4.52	4.32	.0543	0.495	549.	.00896	0.816	0.1049	0.1074	1.65	0.0077	0.606	78.53	66.9	.9736	2.623	945.	0.1437	15766.	.00497	795.	0.536	6.452	5.970	3.215
4.00	18.20	233.3	231.2	2.11	223.0	8.19	3838.	798.	4.81	4.58	.0580	0.461	582.	.00949	0.816	0.1066	0.1144	1.66	0.0077	0.675	87.99	72.4	.9757	2.724	967.	0.1484	16250.	.00511	815.	0.555	6.719	6.183	3.329
4.50	17.82	231.7	229.6	2.11	221.9	7.69	4086.	794.	5.15	4.89	.0618	0.430	620.	.01010	0.815	0.1087	0.1225	1.67	0.0076	0.754	98.89	78.5	.9777	2.833	989.	0.1534	16756.	.00525	835.	0.576	7.000	6.404	3.448
5.00	17.43	230.0	227.8	2.11	220.7	7.14	4406.	789.	5.58	5.29	.0656	0.402	669.	.01089	0.815	0.1110	0.1330	1.68	0.0076	0.845	111.50	85.0	.9795	2.945	1010.	0.1585	17266.	.00540	854.	0.597	7.287	6.629	3.569
5.50	16.93	227.5	225.4	2.12	219.4	6.03	5217.	784.	6.66	6.28	.0697	0.375	792.	.01290	0.814	0.1137	0.1586	1.69	0.0075	0.945	125.50	92.3	.9812	3.067	1030.	0.1639	17802.	.00555	874.	0.620	7.592	6.867	3.699

FORCED CONVECTION BOILING

RUN NO. 38.0 WATER TEST SECTION NO. 1

FLOW RATE.W=1140. LBS/HR MASS VELOCITY.G= 112.2 LBS/SEC.SQFT POWER= 9.83 KILOWATTS HEAT FLUX.Q= 31439. BTU/HR.SQFT

REYNOLDS NO.= 36836. TEMPERATURE BEFORE FLASH= 245.5 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	18.81	234.3	232.2	2.11	224.7	7.50	4189.	832.	5.03	4.95	.0218	1.166	635.	.01027	0.809	0.1024	0.1197	1.64	0.0083	0.168	20.19	27.9	.9339	1.765	683.	0.0995	11026.	.00351	578.	0.364	3.990	3.941	2.163
0.25	18.77	235.6	233.5	2.11	224.6	8.93	3521.	831.	4.24	4.16	.0233	1.097	534.	.00863	0.809	0.1026	0.1008	1.64	0.0083	0.174	20.97	29.7	.9381	1.817	699.	0.1022	11328.	.00360	592.	0.374	4.122	4.054	2.219
0.50	18.72	236.6	234.5	2.11	224.5	10.03	3133.	830.	3.78	3.70	.0248	1.035	475.	.00768	0.809	0.1029	0.0898	1.65	0.0083	0.181	21.87	31.6	.9417	1.867	715.	0.1048	11618.	.00369	606.	0.383	4.252	4.164	2.274
0.75	18.68	237.0	234.9	2.11	224.3	10.60	2967.	828.	3.58	3.51	.0263	0.981	450.	.00727	0.809	0.1031	0.0852	1.65	0.0083	0.190	23.01	33.4	.9450	1.915	731.	0.1073	11898.	.00377	619.	0.393	4.379	4.272	2.329
1.00	18.63	237.0	234.9	2.11	224.2	10.69	2940.	827.	3.55	3.48	.0278	0.931	446.	.00720	0.809	0.1034	0.0845	1.65	0.0082	0.201	24.40	35.3	.9480	1.963	746.	0.1098	12173.	.00385	631.	0.402	4.505	4.378	2.382
1.50	18.52	236.5	234.4	2.11	223.9	10.48	3001.	825.	3.64	3.55	.0307	0.844	455.	.00735	0.809	0.1039	0.0865	1.65	0.0082	0.233	28.44	39.1	.9532	2.056	774.	0.1145	12702.	.00400	656.	0.420	4.754	4.586	2.488
2.00	18.40	235.8	233.7	2.11	223.5	10.16	3094.	822.	3.76	3.66	.0338	0.771	469.	.00758	0.808	0.1046	0.0895	1.65	0.0082	0.284	34.84	43.0	.9577	2.148	801.	0.1192	13216.	.00415	679.	0.438	5.001	4.792	2.593
2.50	18.24	235.1	233.0	2.11	223.1	9.89	3180.	819.	3.88	3.77	.0370	0.706	482.	.00779	0.808	0.1054	0.0924	1.66	0.0081	0.360	44.40	47.2	.9616	2.242	827.	0.1239	13728.	.00430	701.	0.456	5.253	4.999	2.700
3.00	18.03	234.2	232.1	2.11	222.5	9.64	3262.	815.	4.00	3.67	.0403	0.648	495.	.00799	0.808	0.1065	0.0952	1.67	0.0081	0.447	55.43	51.8	.9651	2.340	853.	0.1287	14250.	.00445	724.	0.475	5.513	5.212	2.810
3.50	17.79	233.2	231.1	2.11	221.8	9.33	3370.	812.	4.15	4.01	.0437	0.597	511.	.00825	0.807	0.1078	0.0988	1.67	0.0080	0.502	62.60	56.7	.9683	2.441	878.	0.1336	14769.	.00459	746.	0.494	5.777	5.426	2.923
4.00	17.53	232.0	229.8	2.11	221.0	8.85	3554.	808.	4.40	4.23	.0471	0.552	539.	.00870	0.807	0.1093	0.1047	1.68	0.0080	0.547	68.59	61.9	.9710	2.542	903.	0.1384	15283.	.00474	768.	0.513	6.042	5.640	3.035
4.50	17.24	230.5	228.4	2.11	220.2	8.25	3811.	804.	4.74	4.54	.0507	0.512	578.	.00933	0.807	0.1110	0.1128	1.69	0.0079	0.586	73.90	67.4	.9735	2.647	926.	0.1433	15800.	.00488	789.	0.533	6.313	5.857	3.150
5.00	16.93	229.0	226.9	2.11	219.2	7.68	4092.	800.	5.12	4.89	.0543	0.476	621.	.01002	0.806	0.1129	0.1219	1.70	0.0079	0.619	78.53	73.3	.9757	2.753	949.	0.1483	16317.	.00503	810.	0.554	6.590	6.078	3.268
5.50	16.62	226.6	224.5	2.12	218.3	6.20	5071.	796.	6.37	6.08	.0579	0.444	770.	.01243	0.806	0.1148	0.1519	1.70	0.0078	0.	0.	79.4	.9777	2.859	970.	0.1531	16818.	.00517	829.	0.574	6.865	6.295	3.385

FORCED CONVECTION BOILING

RUN NO. 39.0 WATER TEST SECTION NO. 1

FLOW RATE.W=1129. LBS/HR MASS VELOCITY.G= 111.1 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX.Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 36229. TEMPERATURE BEFORE FLASH= 236.1 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	17.92	231.8	229.7	2.11	222.1	7.57	4159.	826.	5.04	4.98	.0146	1.649	631.	.01029	0.816	0.1083	0.1199	1.67	0.0083	0.070	8.43	19.9	.9077	1.539	586.	0.0870	9465.	.00308	500.	0.322	3.341	3.377	1.891
0.25	17.90	234.0	231.9	2.11	222.1	9.82	3206.	825.	3.89	3.84	.0160	1.514	486.	.00793	0.816	0.1084	0.0925	1.67	0.0083	0.081	9.78	21.7	.9154	1.600	606.	0.0903	9831.	.00318	517.	0.333	3.488	3.507	1.954
0.50	17.83	235.0	232.9	2.11	222.0	10.87	2895.	824.	3.51	3.46	.0175	1.400	439.	.00716	0.816	0.1085	0.0836	1.67	0.0083	0.093	11.25	23.5	.9220	1.659	626.	0.0934	10179.	.00328	534.	0.344	3.632	3.633	2.015
0.75	17.85	235.5	233.4	2.11	221.9	11.44	2750.	823.	3.34	3.29	.0189	1.301	417.	.00680	0.816	0.1086	0.0796	1.67	0.0082	0.108	13.10	25.3	.9277	1.716	644.	0.0964	10513.	.00338	550.	0.354	3.773	3.755	2.075
1.00	17.82	235.7	233.6	2.11	221.9	11.73	2683.	821.	3.27	3.21	.0203	1.215	407.	.00664	0.816	0.1088	0.0777	1.67	0.0082	0.124	15.08	27.1	.9326	1.771	662.	0.0992	10835.	.00348	565.	0.364	3.910	3.873	2.133
1.50	17.76	235.6	233.5	2.11	221.7	11.83	2660.	819.	3.25	3.19	.0233	1.073	404.	.00658	0.816	0.1092	0.0773	1.67	0.0082	0.160	19.55	30.8	.9409	1.877	696.	0.1047	11445.	.00365	594.	0.384	4.178	4.103	2.247
2.00	17.67	235.2	233.1	2.11	221.4	11.66	2698.	817.	3.30	3.23	.0262	0.958	409.	.00667	0.816	0.1096	0.0786	1.68	0.0081	0.201	24.69	34.7	.9477	1.980	727.	0.1100	12029.	.00382	621.	0.403	4.442	4.326	2.359
2.50	17.56	234.5	232.4	2.11	221.1	11.28	2790.	814.	3.43	3.35	.0293	0.863	423.	.00690	0.816	0.1103	0.0816	1.68	0.0081	0.247	30.50	38.7	.9533	2.081	757.	0.1152	12595.	.00399	646.	0.422	4.705	4.547	2.471
3.00	17.42	233.6	231.5	2.11	220.7	10.78	2919.	811.	3.60	3.50	.0324	0.782	443.	.00721	0.815	0.1111	0.0857	1.68	0.0031	0.297	36.87	43.0	.9581	2.182	786.	0.1202	13148.	.00415	671.	0.441	4.968	4.765	2.583
3.50	17.25	232.5	230.3	2.11	220.2	10.16	3097.	808.	3.83	3.72	.0356	0.713	470.	.00765	0.815	0.1121	0.0913	1.69	0.0080	0.351	43.80	47.5	.9621	2.283	813.	0.1252	13690.	.00430	695.	0.461	5.231	4.983	2.695
4.00	17.14	231.1	229.0	2.11	219.9	9.14	3441.	806.	4.27	4.14	.0387	0.659	522.	.00851	0.815	0.1128	0.1018	1.69	0.0080	0.410	51.44	51.6	.9653	2.372	837.	0.1296	14163.	.00444	716.	0.478	5.470	5.178	2.796
4.50	16.82	229.6	227.5	2.11	218.9	8.65	3639.	801.	4.54	4.39	.0424	0.599	552.	.00900	0.814	0.1148	0.1082	1.70	0.0079	0.472	59.57	57.4	.9689	2.492	865.	0.1353	14767.	.00461	741.	0.500	5.773	5.425	2.925
5.00	16.57	227.8	225.7	2.12	218.1	7.60	4140.	797.	5.19	5.00	.0459	0.553	629.	.01025	0.814	0.1164	0.1238	1.70	0.0079	0.531	67.40	62.9	.9717	2.598	889.	0.1404	15301.	.00476	763.	0.520	6.049	5.647	3.042
5.50	16.30	225.6	223.5	2.12	217.2	6.24	5044.	793.	6.36	6.11	.0494	0.511	766.	.01250	0.814	0.1182	0.1516	1.71	0.0078	0.590	75.33	68.6	.9742	2.706	913.	0.1454	15828.	.00490	784.	0.541	6.327	5.870	3.160

FORCED CONVECTION BOILING

RUN NO. 40.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1126. LBS/HR MASS VELOCITY,G= 110.8 LBS/SEC.SQFT POWER= 14.40 KILOWATTS HEAT FLUX,Q= 46051. BTU/HR.SQFT

REYNOLDS NO.= 37538. TEMPERATURE BEFORE FLASH= 295.7 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	24.47	250.2	247.1	3.07	238.9	8.27	5566.	822.	6.77	6.44	.0608	0.503	843.	.01380	1.211	0.1192	0.1602	1.53	0.0075	0.622	82.98	57.8	.9695	2.639	1101.	0.1505	16734.	.00530	877.	0.546	6.785	6.316	3.584
0.25	24.31	250.8	247.8	3.06	238.5	9.27	4968.	820.	6.06	5.75	.0632	0.483	752.	.01232	1.211	0.1199	0.1434	1.53	0.0075	0.650	87.08	60.3	.9709	2.693	1116.	0.1531	17015.	.00539	890.	0.557	6.934	6.435	3.647
0.50	24.15	251.0	247.9	3.06	238.1	9.81	4697.	817.	5.75	5.44	.0655	0.465	711.	.01164	1.211	0.1206	0.1360	1.53	0.0074	0.680	91.48	62.9	.9722	2.747	1130.	0.1558	17290.	.00547	901.	0.567	7.083	6.553	3.710
1.00	23.80	250.5	247.4	3.07	237.3	10.10	4558.	813.	5.61	5.29	.0704	0.431	690.	.01130	1.210	0.1223	0.1328	1.54	0.0074	0.740	100.40	68.3	.9745	2.855	1158.	0.1610	17840.	.00563	924.	0.589	7.385	6.791	3.838
1.50	23.43	249.4	246.3	3.07	236.5	9.82	4691.	808.	5.81	5.45	.0752	0.401	710.	.01164	1.209	0.1240	0.1375	1.54	0.0073	0.810	110.84	73.9	.9766	2.965	1184.	0.1663	18382.	.00579	946.	0.610	7.687	7.028	3.967
2.00	23.02	248.2	245.1	3.07	235.5	9.60	4798.	803.	5.98	5.59	.0802	0.374	727.	.01191	1.209	0.1261	0.1415	1.55	0.0072	0.880	121.48	80.0	.9785	3.079	1210.	0.1717	18929.	.00595	968.	0.633	7.998	7.270	4.098
2.50	22.55	247.0	243.9	3.07	234.4	9.52	4839.	797.	6.07	5.65	.0854	0.349	733.	.01201	1.208	0.1285	0.1438	1.56	0.0072	0.955	133.02	86.6	.9803	3.200	1235.	0.1773	19492.	.00612	990.	0.656	8.322	7.521	4.236
3.00	22.06	245.8	242.7	3.07	233.2	9.52	4836.	792.	6.11	5.66	.0905	0.326	732.	.01201	1.207	0.1311	0.1448	1.57	0.0071	1.037	145.76	93.6	.9818	3.323	1259.	0.1829	20054.	.00628	1011.	0.680	8.650	7.774	4.375
3.50	21.51	244.3	241.2	3.07	231.9	9.37	4913.	786.	6.25	5.77	.0958	0.305	744.	.01221	1.206	0.1342	0.1482	1.58	0.0070	1.120	158.89	101.3	.9833	3.456	1283.	0.1888	20638.	.00645	1033.	0.705	8.993	8.037	4.520
4.00	20.93	242.2	239.1	3.08	230.4	8.74	5272.	780.	6.76	6.21	.1013	0.285	799.	.01310	1.204	0.1376	0.1604	1.59	0.0070	1.215	173.97	109.7	.9847	3.596	1306.	0.1950	21229.	.00662	1054.	0.731	9.349	8.308	4.671
4.50	20.32	240.1	237.0	3.08	228.8	8.27	5571.	773.	7.21	6.58	.1068	0.267	844.	.01384	1.203	0.1414	0.1710	1.60	0.0069	1.325	191.52	118.7	.9860	3.744	1328.	0.2014	21832.	.00680	1075.	0.759	9.716	8.585	4.827
5.00	19.61	237.7	234.6	3.08	226.9	7.75	5943.	766.	7.76	7.05	.1126	0.249	901.	.01476	1.202	0.1461	0.1843	1.62	0.0069	1.462	213.37	129.3	.9872	3.912	1351.	0.2085	22489.	.00699	1096.	0.789	10.116	8.886	4.996
5.50	18.82	233.6	230.5	3.09	224.7	5.79	7955.	758.	10.49	9.49	.1186	0.232	1206.	.01974	1.200	0.1518	0.2495	1.64	0.0068	1.644	242.29	141.4	.9884	4.101	1373.	0.2164	23197.	.00719	1119.	0.821	10.548	9.209	5.179

FORCED CONVECTION BOILING

RUN NO. 41.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1125. LBS/HR MASS VELOCITY,G= 110.7 LBS/SEC.SQFT POWER= 14.40 KILOWATTS HEAT FLUX,Q= 46051. BTU/HR.SQFT

REYNOLDS NO.= 37552. TEMPERATURE BEFORE FLASH= 279.1 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	23.16	247.2	244.2	3.07	235.9	8.32	5536.	826.	6.70	6.45	.0460	0.639	838.	.01375	1.210	0.1255	0.1586	1.55	0.0077	0.420	54.49	46.4	.9616	2.415	996.	0.1377	15297.	.00482	805.	0.497	5.959	5.650	3.232
0.25	23.06	248.8	245.7	3.07	235.6	10.07	4572.	825.	5.54	5.33	.0483	0.610	692.	.01136	1.210	0.1260	0.1313	1.55	0.0077	0.450	58.61	48.8	.9635	2.471	1013.	0.1405	15605.	.00491	818.	0.508	6.111	5.774	3.296
0.50	22.94	249.1	246.0	3.07	235.3	10.70	4302.	822.	5.23	5.02	.0506	0.582	651.	.01069	1.210	0.1266	0.1239	1.55	0.0076	0.479	62.64	51.3	.9654	2.528	1030.	0.1434	15915.	.00500	832.	0.519	6.265	5.899	3.362
1.00	22.70	248.5	245.4	3.07	234.7	10.65	4322.	818.	5.28	5.05	.0552	0.533	655.	.01074	1.209	0.1278	0.1251	1.56	0.0076	0.543	71.59	56.3	.9686	2.639	1062.	0.1490	16513.	.00518	858.	0.540	6.569	6.143	3.491
1.50	22.42	247.5	244.5	3.07	234.1	10.41	4423.	814.	5.43	5.17	.0599	0.490	670.	.01099	1.209	0.1293	0.1288	1.56	0.0075	0.612	81.36	61.6	.9715	2.752	1093.	0.1546	17104.	.00535	884.	0.562	6.876	6.388	3.621
2.00	22.09	246.6	243.5	3.07	233.3	10.22	4506.	809.	5.57	5.28	.0647	0.452	682.	.01120	1.208	0.1311	0.1320	1.57	0.0075	0.690	92.50	67.3	.9741	2.869	1123.	0.1602	17698.	.00552	909.	0.585	7.190	6.637	3.754
2.50	21.72	245.6	242.5	3.07	232.4	10.12	4552.	804.	5.66	5.34	.0696	0.418	689.	.01132	1.207	0.1331	0.1342	1.57	0.0074	0.782	105.73	73.4	.9763	2.989	1151.	0.1659	18291.	.00569	933.	0.608	7.509	6.888	3.890
3.00	21.29	244.5	241.4	3.07	231.3	10.14	4541.	799.	5.68	5.34	.0747	0.387	688.	.01129	1.206	0.1356	0.1348	1.58	0.0073	0.894	121.94	80.1	.9784	3.116	1179.	0.1719	18897.	.00587	957.	0.632	7.841	7.148	4.031
3.50	20.82	243.2	240.2	3.08	230.1	10.08	4568.	793.	5.76	5.39	.0799	0.359	692.	.01136	1.205	0.1384	0.1366	1.59	0.0073	1.025	141.04	87.3	.9803	3.250	1206.	0.1780	19509.	.00605	981.	0.657	8.183	7.414	4.175
4.00	20.28	241.4	238.3	3.08	228.7	9.61	4792.	787.	6.09	5.67	.0853	0.333	726.	.01191	1.204	0.1418	0.1445	1.60	0.0072	1.127	156.49	95.3	.9821	3.393	1232.	0.1845	20146.	.00623	1005.	0.684	8.542	7.690	4.327
4.50	19.69	239.1	236.1	3.08	227.1	8.96	5139.	781.	6.58	6.10	.0908	0.309	779.	.01277	1.203	0.1457	0.1563	1.62	0.0071	1.195	167.46	104.2	.9837	3.547	1258.	0.1913	20804.	.00642	1028.	0.712	8.917	7.978	4.486
5.00	19.07	236.6	233.5	3.09	225.4	8.09	5694.	774.	7.36	6.78	.0965	0.287	863.	.01414	1.201	0.1501	0.1749	1.64	0.0071	1.240	175.38	113.8	.9852	3.711	1283.	0.1985	21474.	.00661	1052.	0.741	9.306	8.274	4.651
5.50	18.46	232.3	229.3	3.09	223.7	5.54	8311.	767.	10.83	9.94	.1021	0.267	1260.	.02063	1.200	0.1547	0.2576	1.65	0.0070	1.268	181.01	124.0	.9865	3.877	1307.	0.2056	22138.	.00680	1075.	0.771	9.696	8.570	4.816

FORCED CONVECTION BOILING

RUN NO. 42.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1129. LBS/HR MASS VELOCITY,G= 111.1 LBS/SEC.SQFT POWER= 14.40 KILOWATTS HEAT FLUX,Q= 46051. BTU/HR.SQFT

REYNOLDS NO.= 37626. TEMPERATURE BEFORE FLASH= 270.8 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	22.39	246.5	243.4	3.07	234.0	9.41	4892.	830.	5.89	5.71	.0391	0.734	741.	.01211	1.204	0.1290	0.1396	1.56	0.0079	0.435	55.30	41.0	.9561	2.293	940.	0.1306	14540.	.00455	765.	0.471	5.534	5.301	3.047
0.25	22.29	247.8	244.8	3.07	233.8	11.03	4176.	829.	5.04	4.87	.0413	0.695	632.	.01034	1.204	0.1295	0.1194	1.56	0.0078	0.446	56.92	43.5	.9587	2.354	959.	0.1337	14884.	.00465	781.	0.483	5.694	5.432	3.115
0.50	22.17	248.4	245.4	3.07	233.5	11.92	3863.	826.	4.67	4.51	.0436	0.659	585.	.00957	1.204	0.1302	0.1108	1.57	0.0078	0.457	58.56	46.0	.9610	2.416	978.	0.1369	15229.	.00475	796.	0.495	5.856	5.565	3.184
1.00	21.95	248.0	244.9	3.07	232.9	12.01	3834.	822.	4.66	4.48	.0482	0.598	581.	.00950	1.203	0.1314	0.1105	1.57	0.0077	0.485	62.65	51.1	.9651	2.534	1013.	0.1428	15878.	.00494	825.	0.517	6.170	5.820	3.317
1.50	21.69	247.1	244.1	3.07	232.3	11.76	3916.	818.	4.79	4.58	.0528	0.545	593.	.00970	1.203	0.1328	0.1135	1.57	0.0077	0.520	67.71	56.4	.9685	2.652	1047.	0.1487	16512.	.00512	853.	0.540	6.485	6.074	3.451
2.00	21.43	246.2	243.1	3.07	231.6	11.46	4018.	814.	4.94	4.71	.0575	0.500	609.	.00995	1.202	0.1343	0.1171	1.58	0.0076	0.565	74.17	61.9	.9715	2.769	1078.	0.1544	17123.	.00530	879.	0.562	6.797	6.323	3.583
2.50	21.13	245.1	242.1	3.07	230.9	11.18	4118.	809.	5.09	4.83	.0623	0.460	624.	.01020	1.202	0.1361	0.1207	1.59	0.0076	0.624	82.59	67.7	.9741	2.889	1109.	0.1602	17728.	.00547	904.	0.585	7.113	6.575	3.718
3.00	20.79	244.0	241.0	3.07	230.0	10.98	4194.	804.	5.21	4.93	.0671	0.425	635.	.01039	1.201	0.1381	0.1237	1.59	0.0075	0.700	93.43	74.0	.9764	3.012	1138.	0.1661	18332.	.00565	929.	0.609	7.435	6.828	3.854
3.50	20.42	242.8	239.7	3.08	229.0	10.65	4323.	799.	5.41	5.10	.0721	0.394	655.	.01071	1.200	0.1404	0.1284	1.60	0.0074	0.797	107.28	80.6	.9785	3.137	1166.	0.1720	18934.	.00582	953.	0.632	7.761	7.084	3.993
4.00	19.97	241.2	238.1	3.08	227.9	10.26	4490.	794.	5.66	5.30	.0772	0.365	680.	.01112	1.199	0.1433	0.1343	1.61	0.0074	0.923	125.33	88.0	.9804	3.274	1193.	0.1782	19563.	.00600	978.	0.658	8.105	7.351	4.139
4.50	19.48	239.3	236.3	3.08	226.5	9.74	4729.	788.	6.00	5.60	.0825	0.338	717.	.01171	1.198	0.1467	0.1426	1.62	0.0073	1.084	148.49	96.1	.9822	3.419	1220.	0.1848	20202.	.00619	1002.	0.684	8.463	7.628	4.290
5.00	18.91	236.6	233.5	3.09	225.0	8.55	5388.	781.	6.90	6.41	.0880	0.313	817.	.01334	1.197	0.1508	0.1640	1.64	0.0072	1.278	176.65	105.2	.9838	3.578	1247.	0.1918	20879.	.00638	1026.	0.713	8.842	7.919	4.451
5.50	18.22	233.0	229.9	3.09	223.0	6.89	6681.	774.	8.63	7.98	.0938	0.289	1013.	.01653	1.195	0.1560	0.2054	1.66	0.0072	1.473	205.53	116.0	.9854	3.760	1274.	0.1997	21623.	.00659	1052.	0.745	9.261	8.238	4.628

FORCED CONVECTION BOILING

RUN NO. 43.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1137. LBS/HR MASS VELOCITY,G= 111.9 LBS/SEC.SQFT POWER= 14.40 KILOWATTS HEAT FLUX,Q= 46051. BTU/HR.SQFT

REYNOLDS NO.= 37736. TEMPERATURE BEFORE FLASH= 252.5 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.78	242.7	239.7	3.08	230.0	9.70	4746.	839.	5.66	5.55	.0238	1.126	719.	.01168	1.192	0.1372	0.1343	1.59	0.0082	0.080	9.74	27.6	.9334	1.937	786.	0.1103	12288.	.00382	650.	0.404	4.447	4.388	2.578
0.25	20.75	244.2	241.2	3.07	229.9	11.24	4098.	837.	4.89	4.79	.0258	1.044	621.	.01008	1.192	0.1373	0.1161	1.59	0.0082	0.117	14.30	29.9	.9385	2.006	811.	0.1140	12702.	.00394	670.	0.417	4.617	4.532	2.650
0.50	20.73	245.2	242.1	3.07	229.8	12.29	3748.	836.	4.49	4.39	.0279	0.971	568.	.00922	1.192	0.1375	0.1064	1.59	0.0082	0.153	18.77	32.1	.9430	2.073	834.	0.1175	13104.	.00406	689.	0.429	4.785	4.675	2.722
0.75	20.69	246.0	243.0	3.07	229.7	13.24	3478.	834.	4.17	4.07	.0300	0.908	527.	.00856	1.192	0.1377	0.0989	1.60	0.0081	0.190	23.39	34.5	.9470	2.140	856.	0.1210	13495.	.00417	707.	0.441	4.952	4.815	2.792
1.00	20.64	246.5	243.4	3.07	229.6	13.82	3332.	832.	4.00	3.90	.0321	0.851	505.	.00820	1.192	0.1380	0.0950	1.60	0.0081	0.230	28.42	36.9	.9505	2.205	878.	0.1244	13875.	.00428	725.	0.452	5.117	4.953	2.863
1.50	20.51	245.6	242.5	3.07	229.3	13.22	3483.	829.	4.20	4.08	.0364	0.754	528.	.00857	1.192	0.1388	0.0997	1.60	0.0080	0.310	38.59	41.8	.9566	2.334	919.	0.1310	14612.	.00449	759.	0.476	5.444	5.225	3.002
2.00	20.32	244.3	241.2	3.07	228.8	12.44	3702.	825.	4.49	4.34	.0409	0.674	561.	.00911	1.191	0.1400	0.1065	1.60	0.0080	0.397	49.81	47.0	.9616	2.463	958.	0.1376	15333.	.00469	791.	0.500	5.774	5.496	3.142
2.50	20.09	243.0	240.0	3.08	228.2	11.77	3912.	821.	4.77	4.59	.0455	0.607	593.	.00962	1.191	0.1415	0.1132	1.61	0.0079	0.490	61.96	52.7	.9659	2.593	995.	0.1440	16041.	.00489	822.	0.524	6.106	5.766	3.283
3.00	19.78	241.7	238.7	3.08	227.4	11.30	4076.	816.	5.00	4.79	.0503	0.548	618.	.01002	1.190	0.1436	0.1186	1.62	0.0078	0.590	75.21	58.9	.9696	2.731	1031.	0.1508	16759.	.00510	853.	0.549	6.451	6.045	3.430
3.50	19.44	240.3	237.2	3.08	226.4	10.79	4268.	811.	5.26	5.03	.0552	0.498	647.	.01049	1.190	0.1459	0.1251	1.63	0.0078	0.707	90.86	65.4	.9728	2.871	1065.	0.1575	17463.	.00530	882.	0.575	6.798	6.322	3.577
4.00	19.05	238.7	235.7	3.08	225.4	10.32	4464.	805.	5.54	5.27	.0602	0.454	677.	.01097	1.189	0.1487	0.1317	1.64	0.0077	0.816	105.74	72.6	.9756	3.016	1098.	0.1643	18169.	.00550	911.	0.601	7.154	6.604	3.728
4.50	18.61	237.1	234.0	3.08	224.1	9.89	4656.	800.	5.82	5.52	.0653	0.416	706.	.01144	1.188	0.1520	0.1385	1.65	0.0077	0.908	118.66	80.3	.9781	3.167	1130.	0.1713	18883.	.00569	939.	0.629	7.518	6.891	3.882
5.00	18.13	235.0	231.9	3.09	222.8	9.16	5029.	794.	6.34	5.98	.0706	0.381	763.	.01235	1.187	0.1557	0.1508	1.66	0.0076	0.989	130.37	88.8	.9803	3.325	1161.	0.1785	19605.	.00590	967.	0.657	7.896	7.186	4.042
5.50	17.60	231.8	228.7	3.09	221.2	7.50	6141.	787.	7.80	7.32	.0761	0.350	932.	.01507	1.185	0.1600	0.1857	1.68	0.0075	1.057	140.57	98.1	.9823	3.493	1190.	0.1860	20345.	.00610	995.	0.687	8.287	7.489	4.208

FORCED CONVECTION BOILING

RUN NO. 44.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1127. LBS/HR MASS VELOCITY,G= 110.9 LBS/SEC.SQFT POWER= 14.40 KILOWATTS HEAT FLUX,Q= 46051. BTU/HR.SQFT

REYNOLDS NO.= 37027. TEMPERATURE BEFORE FLASH= 238.4 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	19.31	239.9	236.9	3.08	226.1	10.80	4262.	833.	5.12	5.06	.0130	1.901	646.	.01057	1.200	0.1481	0.1216	1.63	0.0033	0.044	5.32	16.8	.8902	1.571	625.	0.0898	9787.	.00312	523.	0.345	3.495	3.557	2.177
0.25	19.30	244.1	241.0	3.07	226.0	14.96	3079.	832.	3.70	3.66	.0150	1.664	467.	.00764	1.200	0.1482	0.0880	1.63	0.0082	0.068	8.25	19.1	.9039	1.669	660.	0.0951	10386.	.00329	553.	0.361	3.709	3.747	2.268
0.50	19.23	245.4	242.4	3.07	226.0	16.38	2811.	830.	3.39	3.34	.0171	1.479	426.	.00697	1.200	0.1484	0.0805	1.63	0.0062	0.093	11.32	21.5	.9148	1.762	692.	0.1000	10944.	.00345	579.	0.376	3.914	3.928	2.355
0.75	19.25	245.8	242.7	3.07	225.9	16.83	2737.	829.	3.30	3.25	.0191	1.330	415.	.00679	1.200	0.1486	0.0785	1.63	0.0082	0.101	12.34	23.9	.9235	1.850	722.	0.1047	11468.	.00360	605.	0.391	4.113	4.101	2.440
1.00	19.22	246.3	243.2	3.07	225.8	17.41	2645.	827.	3.20	3.14	.0212	1.209	401.	.00656	1.200	0.1488	0.0760	1.63	0.0082	0.147	18.03	26.4	.9308	1.933	750.	0.1091	11962.	.00374	628.	0.405	4.305	4.267	2.521
1.50	19.13	245.9	242.8	3.07	225.6	17.22	2674.	824.	3.25	3.18	.0255	1.020	405.	.00663	1.199	0.1494	0.0772	1.63	0.0081	0.201	24.83	31.4	.9421	2.092	803.	0.1174	12886.	.00400	671.	0.432	4.677	4.584	2.680
2.00	19.02	244.9	241.8	3.07	225.3	16.58	2778.	820.	3.39	3.31	.0298	0.880	421.	.00689	1.199	0.1502	0.0805	1.64	0.0080	0.260	32.36	36.6	.9505	2.242	850.	0.1251	13740.	.00424	711.	0.459	5.036	4.887	2.833
2.50	18.87	243.6	240.5	3.08	224.9	15.63	2947.	816.	3.61	3.51	.0342	0.772	447.	.00731	1.199	0.1513	0.0858	1.64	0.0080	0.322	40.38	42.0	.9571	2.386	893.	0.1324	14547.	.00447	748.	0.484	5.388	5.180	2.982
3.00	18.69	241.9	238.8	3.08	224.4	14.42	3194.	813.	3.93	3.81	.0387	0.685	484.	.00792	1.198	0.1527	0.0935	1.65	0.0079	0.390	49.29	47.7	.9624	2.528	934.	0.1395	15318.	.00469	782.	0.509	5.736	5.466	3.130
3.50	18.47	239.9	236.8	3.08	223.8	13.08	3521.	808.	4.36	4.20	.0433	0.613	534.	.00873	1.198	0.1543	0.1036	1.65	0.0079	0.463	58.97	53.7	.9668	2.670	973.	0.1465	16068.	.00490	815.	0.535	6.084	5.749	3.278
4.00	18.22	237.9	234.8	3.08	223.0	11.74	3921.	804.	4.88	4.69	.0480	0.552	595.	.00972	1.197	0.1563	0.1160	1.66	0.0078	0.546	70.10	60.1	.9705	2.812	1009.	0.1534	16798.	.00511	846.	0.560	6.433	6.031	3.426
4.50	17.94	235.9	232.8	3.09	222.2	10.57	4355.	799.	5.45	5.22	.0528	0.501	661.	.01079	1.197	0.1586	0.1297	1.67	0.0077	0.645	83.48	66.9	.9736	2.956	1044.	0.1603	17515.	.00531	876.	0.586	6.784	6.312	3.575
5.00	17.50	233.8	230.7	3.09	221.2	9.50	4846.	794.	6.10	5.82	.0578	0.456	735.	.01200	1.196	0.1614	0.1453	1.68	0.0077	0.766	99.97	74.3	.9764	3.105	1078.	0.1673	18238.	.00552	905.	0.613	7.145	6.599	3.728
5.50	17.17	230.9	227.8	3.09	220.0	7.86	5862.	788.	7.44	7.06	.0630	0.415	890.	.01451	1.195	0.1651	0.1771	1.69	0.0076	0.927	122.02	82.7	.9789	3.268	1110.	0.1748	18997.	.00573	935.	0.642	7.527	6.900	3.890

FORCED CONVECTION BOILING

RUN NO. 45.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1125. LBS/HR MASS VELOCITY,G= 110.7 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 36125. TEMPERATURE BEFORE FLASH= 302.5 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	22.30	237.1	236.2	0.92	233.8	2.40	5761.	804.	7.16	6.74	.0732	0.403	873.	.01432	0.362	0.0390	0.1698	1.56	0.0073	0.712	97.01	75.2	.9770	2.108	827.	0.1193	13172.	.00462	684.	0.524	6.819	6.165	3.111
0.25	22.12	237.0	236.1	0.93	233.4	2.77	4983.	803.	6.21	5.84	.0742	0.397	755.	.01239	0.362	0.0393	0.1471	1.57	0.0073	0.725	98.95	76.8	.9775	2.130	831.	0.1203	13274.	.00465	688.	0.529	6.893	6.223	3.142
0.50	21.94	236.8	235.9	0.93	232.9	3.02	4574.	801.	5.71	5.36	.0753	0.390	693.	.01137	0.362	0.0396	0.1353	1.57	0.0073	0.739	101.02	78.5	.9780	2.153	835.	0.1214	13379.	.00468	692.	0.534	6.969	6.282	3.174
1.00	21.57	236.0	235.0	0.93	232.0	3.03	4564.	798.	5.72	5.36	.0774	0.377	691.	.01135	0.362	0.0402	0.1355	1.58	0.0073	0.767	105.20	81.9	.9790	2.199	843.	0.1234	13591.	.00474	699.	0.545	7.122	6.401	3.239
1.50	21.17	235.0	234.0	0.93	231.0	3.07	4503.	795.	5.66	5.30	.0796	0.363	682.	.01120	0.362	0.0409	0.1343	1.58	0.0073	0.794	109.27	85.6	.9799	2.250	851.	0.1257	13814.	.00481	708.	0.556	7.285	6.528	3.309
2.00	20.76	233.9	233.0	0.93	229.9	3.07	4493.	792.	5.67	5.30	.0818	0.350	681.	.01117	0.362	0.0416	0.1346	1.59	0.0072	0.821	113.37	89.6	.9809	2.303	858.	0.1281	14042.	.00488	716.	0.568	7.453	6.658	3.380
2.50	20.34	232.9	232.0	0.93	228.8	3.12	4431.	788.	5.62	5.24	.0841	0.338	671.	.01102	0.361	0.0424	0.1334	1.60	0.0072	0.849	117.63	93.7	.9818	2.357	866.	0.1305	14275.	.00495	724.	0.580	7.624	6.790	3.453
3.00	19.90	231.8	230.8	0.93	227.7	3.16	4371.	785.	5.57	5.18	.0864	0.326	662.	.01087	0.361	0.0433	0.1322	1.61	0.0072	0.876	121.79	98.2	.9827	2.415	874.	0.1330	14519.	.00502	732.	0.592	7.803	6.928	3.529
3.50	19.44	230.6	229.7	0.93	226.4	3.27	4223.	781.	5.41	5.02	.0889	0.314	640.	.01049	0.361	0.0442	0.1285	1.63	0.0072	0.904	126.12	103.2	.9836	2.478	882.	0.1358	14774.	.00510	741.	0.605	7.992	7.073	3.609
4.00	18.97	229.3	228.4	0.93	225.1	3.26	4244.	777.	5.46	5.06	.0913	0.302	643.	.01054	0.360	0.0452	0.1298	1.64	0.0071	0.931	130.33	108.3	.9844	2.543	890.	0.1386	15034.	.00518	750.	0.619	8.185	7.220	3.691
4.50	18.51	227.9	226.9	0.93	223.9	3.08	4488.	773.	5.81	5.37	.0937	0.291	681.	.01114	0.360	0.0463	0.1381	1.65	0.0071	0.958	134.58	113.8	.9852	2.610	898.	0.1414	15298.	.00526	759.	0.632	8.381	7.369	3.774
5.00	18.02	226.2	225.3	0.93	222.4	2.83	4887.	769.	6.36	5.86	.0963	0.280	741.	.01213	0.360	0.0475	0.1512	1.67	0.0071	0.986	139.01	119.7	.9860	2.682	905.	0.1444	15577.	.00534	768.	0.647	8.591	7.528	3.863
5.50	17.52	223.2	222.3	0.93	221.0	1.29	10673.	765.	13.96	12.84	.0989	0.270	1620.	.02648	0.359	0.0487	0.3323	1.68	0.0071	1.013	143.34	126.1	.9867	2.757	913.	0.1476	15866.	.00543	777.	0.662	8.806	7.692	3.955

FORCED CONVECTION BOILING

RUN NO. 46.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1122. LBS/HR MASS VELOCITY,G= 110.4 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 36125. TEMPERATURE BEFORE FLASH= 280.3 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.80	233.4	232.5	0.93	230.0	2.48	5567.	810.	6.87	6.58	.0532	0.531	843.	.01388	0.363	0.0417	0.1631	1.59	0.0076	0.510	67.06	58.7	.9700	1.910	739.	0.1082	11919.	.00415	621.	0.455	5.738	5.309	2.651
0.25	20.67	233.6	232.7	0.93	229.7	3.02	4579.	809.	5.66	5.42	.0542	0.521	694.	.01142	0.362	0.0419	0.1344	1.60	0.0076	0.532	70.06	60.0	.9707	1.932	743.	0.1092	12023.	.00418	625.	0.460	5.808	5.365	2.680
0.50	20.54	233.6	232.7	0.93	229.4	3.32	4159.	807.	5.15	4.92	.0551	0.511	630.	.01037	0.362	0.0422	0.1222	1.60	0.0076	0.554	73.06	61.4	.9714	1.953	748.	0.1102	12127.	.00421	630.	0.465	5.878	5.421	2.710
1.00	20.25	232.9	232.0	0.93	228.6	3.37	4100.	805.	5.09	4.86	.0571	0.491	621.	.01022	0.362	0.0427	0.1209	1.60	0.0076	0.596	78.83	64.3	.9727	1.998	757.	0.1123	12346.	.00428	638.	0.475	6.026	5.538	2.773
1.50	19.94	232.1	231.2	0.93	227.8	3.36	4110.	802.	5.12	4.88	.0591	0.472	623.	.01025	0.362	0.0433	0.1217	1.61	0.0075	0.634	84.12	67.5	.9741	2.046	766.	0.1145	12572.	.00435	647.	0.486	6.179	5.660	2.838
2.00	19.62	231.2	230.3	0.93	226.9	3.41	4054.	799.	5.07	4.82	.0612	0.453	614.	.01010	0.362	0.0440	0.1205	1.62	0.0075	0.668	88.90	70.8	.9754	2.096	775.	0.1169	12803.	.00442	656.	0.497	6.337	5.786	2.905
2.50	19.27	230.4	229.5	0.93	226.0	3.51	3932.	796.	4.94	4.69	.0633	0.435	596.	.00980	0.362	0.0447	0.1174	1.63	0.0075	0.696	92.91	74.4	.9766	2.149	785.	0.1193	13044.	.00449	665.	0.509	6.503	5.916	2.976
3.00	18.92	229.5	228.6	0.93	225.0	3.62	3820.	793.	4.82	4.57	.0655	0.418	579.	.00951	0.361	0.0455	0.1146	1.64	0.0075	0.720	96.41	78.3	.9778	2.204	794.	0.1218	13289.	.00457	675.	0.521	6.671	6.049	3.047
3.50	18.55	228.6	227.7	0.93	224.0	3.71	3722.	789.	4.72	4.46	.0677	0.401	564.	.00927	0.361	0.0463	0.1121	1.65	0.0074	0.741	99.54	82.3	.9790	2.262	803.	0.1244	13541.	.00464	684.	0.533	6.845	6.185	3.121
4.00	18.17	227.4	226.5	0.93	222.9	3.62	3817.	786.	4.86	4.58	.0700	0.385	579.	.00950	0.361	0.0472	0.1155	1.66	0.0074	0.760	102.43	86.7	.9801	2.322	812.	0.1271	13800.	.00472	693.	0.546	7.026	6.326	3.198
4.50	17.79	226.0	225.0	0.93	221.8	3.28	4215.	782.	5.39	5.07	.0723	0.369	639.	.01049	0.361	0.0482	0.1282	1.67	0.0074	0.775	104.79	91.2	.9811	2.383	821.	0.1298	14060.	.00480	703.	0.559	7.208	6.468	3.275
5.00	17.40	224.3	223.4	0.93	220.6	2.75	5033.	779.	6.46	6.07	.0746	0.355	764.	.01252	0.360	0.0491	0.1539	1.68	0.0074	0.788	106.90	96.0	.9821	2.447	830.	0.1325	14327.	.00488	712.	0.572	7.394	6.612	3.354
5.50	17.00	222.3	221.4	0.93	219.4	1.97	7022.	775.	9.06	8.50	.0770	0.341	1066.	.01747	0.360	0.0502	0.2158	1.69	0.0073	0.799	108.77	101.1	.9831	2.512	838.	0.1354	14600.	.00496	722.	0.585	7.588	6.762	3.437

FORCED CONVECTION BOILING

RUN NO. 47.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1120. LBS/HR MASS VELOCITY,G= 110.2 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 35902. TEMPERATURE BEFORE FLASH= 265.2 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	19.55	230.6	229.7	0.93	226.7	2.96	4668.	811.	5.75	5.56	.0406	0.668	708.	.01165	0.362	0.0442	0.1366	1.62	0.0078	0.342	43.94	47.7	.9627	1.763	669.	0.0997	10926.	.00379	570.	0.406	4.976	4.692	2.326
0.25	19.46	230.9	230.0	0.93	226.5	3.55	3895.	810.	4.81	4.65	.0414	0.653	590.	.00972	0.362	0.0444	0.1142	1.63	0.0078	0.365	46.96	48.8	.9636	1.783	675.	0.1007	11032.	.00383	575.	0.411	5.043	4.747	2.355
0.50	19.37	231.0	230.1	0.93	226.2	3.84	3595.	809.	4.44	4.29	.0423	0.640	545.	.00897	0.362	0.0446	0.1055	1.63	0.0078	0.387	49.86	50.0	.9645	1.803	679.	0.1017	11136.	.00386	579.	0.416	5.110	4.801	2.383
1.00	19.17	230.6	229.7	0.93	225.7	4.04	3418.	807.	4.23	4.08	.0440	0.613	518.	.00853	0.362	0.0450	0.1006	1.63	0.0077	0.432	55.80	52.5	.9663	1.846	689.	0.1037	11352.	.00393	588.	0.425	5.248	4.913	2.442
1.50	18.94	230.1	229.1	0.93	225.1	4.09	3376.	805.	4.19	4.04	.0459	0.586	512.	.00842	0.362	0.0455	0.0997	1.64	0.0077	0.473	61.27	55.2	.9680	1.892	700.	0.1059	11579.	.00400	598.	0.436	5.393	5.031	2.503
2.00	18.69	229.4	228.5	0.93	224.4	4.09	3380.	802.	4.21	4.05	.0478	0.561	513.	.00843	0.362	0.0461	0.1002	1.65	0.0077	0.511	66.38	58.1	.9697	1.939	710.	0.1082	11812.	.00407	607.	0.447	5.543	5.152	2.567
2.50	18.43	228.7	227.8	0.93	223.6	4.13	3344.	800.	4.18	4.01	.0497	0.537	507.	.00834	0.362	0.0467	0.0994	1.65	0.0077	0.545	71.00	61.2	.9712	1.988	720.	0.1105	12049.	.00414	617.	0.458	5.697	5.276	2.633
3.00	18.15	227.9	227.0	0.93	222.8	4.21	3283.	797.	4.12	3.95	.0517	0.514	498.	.00818	0.361	0.0474	0.0980	1.66	0.0077	0.574	75.00	64.5	.9728	2.040	730.	0.1130	12295.	.00422	627.	0.469	5.858	5.404	2.701
3.50	17.85	227.2	226.2	0.93	221.9	4.30	3210.	794.	4.04	3.87	.0538	0.491	487.	.00800	0.361	0.0481	0.0962	1.67	0.0076	0.595	77.98	68.0	.9743	2.095	740.	0.1155	12548.	.00429	637.	0.481	6.024	5.537	2.772
4.00	17.54	226.1	225.2	0.93	221.0	4.16	3319.	791.	4.20	4.01	.0559	0.470	504.	.00827	0.361	0.0489	0.0999	1.68	0.0076	0.620	81.50	71.7	.9757	2.150	750.	0.1180	12802.	.00437	647.	0.493	6.192	5.671	2.843
4.50	17.23	224.9	224.0	0.93	220.1	3.86	3578.	788.	4.54	4.33	.0580	0.450	543.	.00891	0.361	0.0497	0.1081	1.69	0.0076	0.639	84.26	75.6	.9770	2.207	760.	0.1206	13061.	.00445	657.	0.505	6.363	5.806	2.916
5.00	16.90	223.5	222.6	0.93	219.1	3.49	3959.	785.	5.05	4.80	.0602	0.430	601.	.00987	0.361	0.0506	0.1202	1.70	0.0076	0.656	86.78	79.8	.9782	2.267	769.	0.1233	13326.	.00452	666.	0.518	6.543	5.948	2.992
5.50	16.57	221.8	220.9	0.93	218.1	2.82	4906.	781.	6.28	5.97	.0625	0.412	745.	.01225	0.360	0.0515	0.1497	1.70	0.0075	0.670	88.93	84.2	.9794	2.327	779.	0.1259	13592.	.00460	676.	0.531	6.725	6.090	3.069

FORCED CONVECTION BOILING

RUN NO. 48.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1121. LBS/HR MASS VELOCITY,G= 110.3 LBS/SEC.SQFT POWER= 14.40 KILOWATTS HEAT FLUX,Q= 46051. BTU/HR.SQFT

REYNOLDS NO.= 37314. TEMPERATURE BEFORE FLASH= 302.3 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	24.32	250.8	247.8	3.06	239.9	7.88	5846.	817.	7.16	6.77	.0668	0.463	885.	.01455	1.218	0.1177	0.1693	1.52	0.0073	0.663	90.23	62.0	.9719	2.725	1136.	0.1554	17198.	.00549	901.	0.566	7.110	6.576	3.726
0.25	24.75	251.1	248.0	3.06	239.5	8.54	5395.	814.	6.63	6.26	.0693	0.446	817.	.01343	1.217	0.1185	0.1567	1.52	0.0073	0.691	94.45	64.6	.9731	2.778	1150.	0.1580	17466.	.00557	912.	0.576	7.258	6.693	3.789
0.50	24.57	251.2	248.1	3.06	239.1	9.05	5090.	812.	6.27	5.91	.0717	0.430	771.	.01267	1.217	0.1193	0.1483	1.53	0.0073	0.718	98.56	67.3	.9743	2.831	1164.	0.1606	17733.	.00566	924.	0.587	7.408	6.811	3.852
1.00	24.21	250.5	247.5	3.07	238.3	9.22	4996.	807.	6.19	5.81	.0766	0.400	756.	.01244	1.216	0.1209	0.1465	1.53	0.0072	0.776	107.44	72.7	.9763	2.937	1190.	0.1657	18256.	.00581	945.	0.608	7.705	7.043	3.978
1.50	23.80	249.4	246.4	3.07	237.3	9.04	5093.	802.	6.35	5.93	.0815	0.374	771.	.01269	1.216	0.1228	0.1503	1.54	0.0072	0.842	117.60	78.5	.9782	3.048	1215.	0.1709	18786.	.00597	966.	0.630	8.010	7.281	4.108
2.00	23.35	248.2	245.2	3.07	236.3	8.86	5199.	797.	6.53	6.07	.0866	0.349	787.	.01296	1.215	0.1250	0.1545	1.55	0.0071	0.915	128.93	84.7	.9799	3.162	1229.	0.1762	19322.	.00613	987.	0.652	8.323	7.524	4.240
2.50	22.37	247.0	244.0	3.07	235.2	8.80	5233.	791.	6.61	6.12	.0918	0.327	792.	.01304	1.214	0.1274	0.1566	1.55	0.0070	0.995	141.48	91.4	.9815	3.281	1263.	0.1817	19862.	.00629	1008.	0.676	8.644	7.771	4.376
3.00	22.33	245.8	242.8	3.07	233.8	8.91	5170.	785.	6.58	6.07	.0971	0.306	783.	.01289	1.213	0.1302	0.1560	1.56	0.0070	1.082	155.29	98.7	.9830	3.408	1286.	0.1874	20422.	.00645	1028.	0.700	8.979	8.028	4.519
3.50	21.75	244.4	241.3	3.07	232.4	8.87	5191.	779.	6.66	6.11	.1024	0.286	786.	.01295	1.211	0.1334	0.1579	1.57	0.0069	1.177	170.53	106.6	.9843	3.541	1309.	0.1933	20997.	.00662	1049.	0.725	9.326	8.292	4.666
4.00	21.13	242.5	239.5	3.08	230.9	8.58	5367.	773.	6.94	6.34	.1080	0.268	813.	.01339	1.210	0.1370	0.1647	1.59	0.0068	1.278	186.93	115.3	.9856	3.684	1331.	0.1995	21585.	.00679	1069.	0.752	9.688	8.566	4.819
4.50	20.47	240.3	237.2	3.08	229.2	8.08	5700.	766.	7.44	6.75	.1136	0.251	864.	.01422	1.209	0.1411	0.1765	1.60	0.0068	1.386	204.69	124.8	.9868	3.837	1352.	0.2061	22191.	.00697	1090.	0.780	10.065	8.850	4.979
5.00	19.76	237.8	234.7	3.08	227.3	7.42	6208.	759.	8.18	7.59	.1194	0.235	941.	.01549	1.207	0.1458	0.1942	1.62	0.0067	1.496	223.11	135.4	.9879	4.003	1373.	0.2131	22827.	.00715	1111.	0.810	10.463	9.147	5.147
5.50	18.98	232.5	229.4	3.09	225.2	4.25	10839.	751.	14.42	12.96	.1254	0.220	1643.	.02702	1.206	0.1513	0.3428	1.64	0.0066	1.611	242.64	147.5	.9890	4.189	1394.	0.2208	23508.	.00735	1132.	0.842	10.891	9.466	5.328

FORCED CONVECTION BOILING

RUN NO. 49.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1667. LBS/HR MASS VELOCITY,G= 164.0 LBS/SEC.SQFT POWER= 15.40 KILOWATTS HEAT FLUX,Q= 49249. BTU/HR.SQFT

REYNOLDS NO.= 59442. TEMPERATURE BEFORE FLASH= 290.3 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	29.58	261.2	258.0	3.26	249.5	8.49	5803.	1166.	4.98	4.80	.0440	0.744	878.	.00968	0.882	0.0722	0.1173	1.46	0.0153	0.218	14.29	52.9	.9496	1.960	1201.	0.1112	18307.	.00388	954.	0.412	5.172	4.946	2.708
0.25	29.52	262.1	258.9	3.26	249.4	9.50	5182.	1164.	4.45	4.29	.0455	0.719	784.	.00865	0.882	0.0724	0.1050	1.46	0.0152	0.290	19.06	54.8	.9514	1.992	1216.	0.1128	18571.	.00393	966.	0.419	5.271	5.028	2.750
0.50	29.44	262.6	259.3	3.26	249.2	10.11	4872.	1162.	4.19	4.03	.0472	0.695	737.	.00813	0.882	0.0725	0.0989	1.46	0.0152	0.364	24.00	56.8	.9532	2.025	1231.	0.1145	18840.	.00398	978.	0.426	5.373	5.111	2.793
1.00	29.22	261.7	258.4	3.26	248.8	9.63	5115.	1158.	4.42	4.24	.0505	0.649	774.	.00855	0.881	0.0730	0.1042	1.46	0.0151	0.525	34.82	61.0	.9566	2.093	1261.	0.1179	19388.	.00409	1002.	0.441	5.583	5.283	2.882
1.50	28.91	260.6	257.4	3.26	248.2	9.17	5370.	1152.	4.66	4.46	.0541	0.606	812.	.00898	0.881	0.0738	0.1099	1.46	0.0150	0.713	47.57	65.8	.9599	2.167	1291.	0.1215	19958.	.00420	1026.	0.457	5.804	5.462	2.976
2.00	28.52	259.4	256.2	3.26	247.4	8.75	5630.	1147.	4.91	4.68	.0578	0.565	852.	.00942	0.880	0.0747	0.1158	1.47	0.0149	0.925	62.11	71.0	.9630	2.246	1321.	0.1254	20559.	.00432	1051.	0.474	6.037	5.651	3.075
2.50	27.99	258.1	254.8	3.27	246.4	8.47	5813.	1140.	5.10	4.84	.0618	0.525	879.	.00973	0.880	0.0760	0.1203	1.48	0.0148	1.190	80.44	77.0	.9661	2.336	1352.	0.1296	21219.	.00444	1078.	0.492	6.293	5.856	3.184
3.00	27.33	256.5	253.3	3.27	245.0	8.26	5963.	1133.	5.26	4.98	.0661	0.487	902.	.00998	0.879	0.0777	0.1242	1.48	0.0147	1.475	100.41	83.9	.9690	2.437	1384.	0.1343	21931.	.00458	1106.	0.512	6.570	6.077	3.301
3.50	26.56	254.7	251.5	3.27	243.4	8.05	6116.	1126.	5.43	5.12	.0706	0.451	925.	.01024	0.878	0.0798	0.1284	1.50	0.0146	1.710	117.28	91.8	.9719	2.548	1415.	0.1393	22695.	.00471	1135.	0.534	6.867	6.313	3.427
4.00	25.57	252.6	249.4	3.28	241.5	7.87	6261.	1117.	5.61	5.26	.0754	0.417	948.	.01048	0.877	0.0824	0.1325	1.51	0.0145	1.880	129.98	101.0	.9746	2.673	1447.	0.1448	23524.	.00486	1165.	0.558	7.192	6.568	3.565
4.50	24.69	250.1	246.8	3.28	239.4	7.46	6604.	1107.	5.96	5.58	.0805	0.385	1000.	.01105	0.875	0.0854	0.1411	1.52	0.0143	2.075	144.65	111.4	.9771	2.809	1478.	0.1507	24402.	.00502	1196.	0.584	7.539	6.839	3.712
5.00	23.66	247.0	243.7	3.28	237.0	6.70	7345.	1097.	6.70	6.23	.0857	0.355	1112.	.01231	0.874	0.0888	0.1585	1.54	0.0142	0.	0.	123.2	.9794	2.956	1509.	0.1570	25308.	.00517	1227.	0.611	7.905	7.123	3.867
5.50	22.62	243.5	240.2	3.29	234.6	5.66	8704.	1086.	8.01	7.42	.0910	0.328	1318.	.01459	0.873	0.0926	0.1898	1.56	0.0141	0.	0.	136.1	.9815	3.110	1538.	0.1634	26236.	.00533	1257.	0.640	8.284	7.415	4.027

FORCED CONVECTION BOILING

RUN NO. 50.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1666. LBS/HR MASS VELOCITY,G= 163.9 LBS/SEC.SQFT POWER= 4.32 KILOWATTS HEAT FLUX,Q= 13815. BTU/HR.SQFT

REYNOLDS NO.= 57235. TEMPERATURE BEFORE FLASH= 295.6 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	26.87	247.1	246.2	0.92	244.1	2.09	6604.	1141.	5.79	5.53	.0553	0.574	999.	.01106	0.247	0.0222	0.1367	1.49	0.0150	0.865	57.73	71.7	.9633	1.563	900.	0.0880	14411.	.00339	743.	0.417	5.348	4.972	2.418
0.25	26.64	247.0	246.1	0.92	243.6	2.50	5522.	1139.	4.85	4.63	.0562	0.563	836.	.00925	0.246	0.0223	0.1145	1.49	0.0150	0.927	61.96	73.4	.9642	1.582	905.	0.0889	14542.	.00341	748.	0.422	5.414	5.026	2.446
0.50	26.42	246.8	245.9	0.92	243.1	2.76	5014.	1138.	4.41	4.21	.0571	0.553	759.	.00840	0.246	0.0225	0.1041	1.50	0.0149	0.972	65.05	75.0	.9651	1.600	910.	0.0897	14670.	.00344	753.	0.426	5.479	5.078	2.474
1.00	25.92	245.8	244.9	0.92	242.0	2.88	4795.	1133.	4.23	4.03	.0590	0.531	726.	.00803	0.246	0.0229	0.1000	1.51	0.0149	1.036	69.54	78.8	.9668	1.640	920.	0.0915	14949.	.00349	763.	0.436	5.620	5.191	2.534
1.50	25.39	244.7	243.8	0.92	240.9	2.90	4761.	1129.	4.22	4.01	.0609	0.510	720.	.00797	0.246	0.0234	0.0997	1.51	0.0149	1.087	73.19	82.9	.9686	1.683	931.	0.0935	15242.	.00355	774.	0.447	5.768	5.310	2.597
2.00	24.63	243.5	242.6	0.92	239.7	2.94	4707.	1124.	4.19	3.97	.0630	0.489	712.	.00788	0.246	0.0238	0.0990	1.52	0.0148	1.134	76.59	87.3	.9702	1.728	941.	0.0955	15549.	.00360	785.	0.458	5.924	5.434	2.663
2.50	24.25	242.3	241.4	0.92	238.4	3.00	4607.	1119.	4.12	3.90	.0651	0.469	697.	.00772	0.246	0.0244	0.0974	1.53	0.0148	1.177	79.73	92.2	.9719	1.777	952.	0.0976	15864.	.00366	797.	0.469	6.088	5.564	2.732
3.00	23.63	241.0	240.1	0.92	236.9	3.11	4437.	1114.	3.98	3.77	.0674	0.448	672.	.00744	0.245	0.0250	0.0943	1.54	0.0147	1.221	82.97	97.5	.9735	1.828	962.	0.0998	16199.	.00373	808.	0.481	6.262	5.701	2.806
3.50	23.02	239.6	238.6	0.92	235.5	3.12	4423.	1108.	3.99	3.77	.0696	0.430	670.	.00742	0.245	0.0256	0.0945	1.55	0.0147	1.262	86.02	103.1	.9750	1.881	973.	0.1021	16536.	.00379	820.	0.493	6.437	5.839	2.881
4.00	22.39	237.9	237.0	0.92	234.0	2.99	4620.	1103.	4.19	3.95	.0719	0.411	700.	.00775	0.245	0.0262	0.0993	1.56	0.0146	1.303	89.11	109.1	.9765	1.937	983.	0.1045	16889.	.00385	832.	0.506	6.622	5.984	2.959
4.50	21.73	235.9	235.0	0.93	232.4	2.61	5295.	1097.	4.83	4.54	.0743	0.393	802.	.00889	0.245	0.0270	0.1144	1.57	0.0146	1.357	93.11	115.8	.9779	1.997	994.	0.1070	17262.	.00392	844.	0.520	6.816	6.136	3.041
5.00	21.03	233.7	232.8	0.93	230.6	2.19	6313.	1090.	5.79	5.43	.0769	0.375	956.	.01060	0.244	0.0278	0.1373	1.59	0.0145	1.431	98.52	123.3	.9793	2.064	1005.	0.1098	17661.	.00399	857.	0.534	7.026	6.300	3.131
5.50	20.26	231.3	230.4	0.93	228.6	1.79	7704.	1083.	7.11	6.66	.0796	0.356	1167.	.01293	0.244	0.0287	0.1688	1.60	0.0145	1.590	109.85	132.0	.9808	2.140	1016.	0.1129	18103.	.00407	872.	0.550	7.259	6.481	3.230

FORCED CONVECTION BOILING

RUN NO. 51.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1129. LBS/HR MASS VELOCITY,G= 111.1 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 36980. TEMPERATURE BEFORE FLASH= 299.4 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	23.47	243.8	241.7	2.10	236.6	5.12	6144.	815.	7.54	7.13	.0671	0.449	930.	.01520	0.824	0.0844	0.1784	1.54	0.0075	0.620	83.16	66.2	.9735	2.516	1021.	0.1425	15841.	.00516	824.	0.540	6.834	6.275	3.382
0.25	23.31	244.1	242.0	2.10	236.2	5.79	5438.	814.	6.68	6.31	.0688	0.437	823.	.01346	0.824	0.0849	0.1583	1.55	0.0074	0.656	88.26	68.3	.9744	2.554	1030.	0.1443	16029.	.00521	832.	0.548	6.946	6.364	3.430
0.50	23.14	244.1	242.0	2.10	235.8	6.21	5070.	812.	6.25	5.89	.0706	0.425	768.	.01255	0.824	0.0855	0.1479	1.55	0.0074	0.693	93.52	70.4	.9752	2.592	1039.	0.1462	16220.	.00527	840.	0.556	7.061	6.454	3.479
1.00	22.78	243.2	241.1	2.10	234.9	6.18	5094.	808.	6.31	5.93	.0742	0.402	771.	.01261	0.823	0.0868	0.1494	1.56	0.0074	0.765	103.87	75.0	.9769	2.672	1056.	0.1499	16607.	.00539	855.	0.573	7.295	6.637	3.578
1.50	22.38	242.2	240.1	2.10	234.0	6.16	5111.	804.	6.36	5.96	.0779	0.380	774.	.01266	0.823	0.0882	0.1507	1.56	0.0073	0.832	113.68	80.0	.9784	2.756	1074.	0.1539	17005.	.00550	871.	0.590	7.538	6.827	3.681
2.00	21.94	241.2	239.1	2.10	232.9	6.21	5065.	799.	6.34	5.92	.0817	0.360	767.	.01255	0.822	0.0898	0.1502	1.57	0.0073	0.897	123.35	85.3	.9798	2.844	1091.	0.1579	17416.	.00562	886.	0.608	7.789	7.022	3.788
2.50	21.48	240.1	238.0	2.10	231.8	6.26	5027.	795.	6.33	5.89	.0855	0.341	761.	.01245	0.822	0.0916	0.1500	1.58	0.0072	0.957	132.46	91.0	.9812	2.936	1107.	0.1620	17833.	.00574	902.	0.627	8.047	7.221	3.897
3.00	20.98	239.0	236.9	2.11	230.5	6.37	4941.	790.	6.26	5.81	.0895	0.322	749.	.01224	0.821	0.0936	0.1484	1.59	0.0072	1.012	140.99	97.2	.9825	3.036	1124.	0.1665	18265.	.00587	918.	0.646	8.318	7.430	4.012
3.50	20.47	237.6	235.5	2.11	229.2	6.35	4954.	785.	6.31	5.84	.0935	0.305	751.	.01227	0.820	0.0957	0.1498	1.60	0.0071	1.063	149.08	103.8	.9837	3.138	1140.	0.1710	18701.	.00600	933.	0.666	8.594	7.641	4.129
4.00	19.92	236.0	233.9	2.11	227.7	6.13	5130.	779.	6.58	6.06	.0976	0.289	777.	.01271	0.819	0.0982	0.1563	1.61	0.0071	1.108	156.44	111.0	.9848	3.248	1156.	0.1758	19156.	.00613	949.	0.687	8.882	7.861	4.251
4.50	19.35	233.9	231.8	2.11	226.2	5.65	5574.	774.	7.20	6.61	.1018	0.274	845.	.01380	0.818	0.1008	0.1712	1.63	0.0070	1.148	163.17	118.9	.9859	3.365	1172.	0.1808	19624.	.00627	965.	0.709	9.184	8.089	4.379
5.00	18.77	231.5	229.4	2.11	224.6	4.83	6511.	768.	8.48	7.75	.1060	0.259	987.	.01611	0.818	0.1037	0.2015	1.64	0.0070	1.185	169.56	127.3	.9869	3.488	1188.	0.1860	20102.	.00640	981.	0.731	9.492	8.322	4.510
5.50	18.17	228.8	226.7	2.12	222.9	3.84	8188.	762.	10.74	9.78	.1104	0.245	1242.	.02025	0.817	0.1069	0.2556	1.66	0.0069	1.216	175.20	136.4	.9878	3.617	1203.	0.1914	20595.	.00655	997.	0.755	9.813	8.563	4.646

FORCED CONVECTION BOILING

RUN NO. 52.0 WATER TEST SECTION NO. 1

FLOW RATE.W= 519. LBS/HR MASS VELOCITY.G= 51.1 LBS/SEC.SQFT POWER= 9.83 KILOWATTS HEAT FLUX.Q= 31436. BTU/HR.SQFT

REYNOLDS NO.= 15635. TEMPERATURE BEFORE FLASH= 297.6 F VELOCITY BEFORE FLASH= 0.7 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	18.18	232.5	230.4	2.11	222.9	7.46	4217.	421.	10.02	9.38	.0789	0.343	640.	.02269	1.775	0.2321	0.2383	1.66	0.0019	0.243	128.37	45.0	.9825	3.611	755.	0.2144	10984.	.00811	604.	0.766	8.975	8.155	4.840
0.25	18.12	233.2	231.1	2.11	222.7	8.42	3735.	420.	8.90	8.31	.0820	0.329	567.	.02010	1.775	0.2329	0.2118	1.66	0.0019	0.261	138.68	47.0	.9832	3.681	765.	0.2180	11155.	.00824	611.	0.779	9.169	8.304	4.922
0.50	18.05	233.6	231.5	2.11	222.5	8.97	3504.	418.	8.38	7.80	.0852	0.317	532.	.01885	1.774	0.2337	0.1994	1.66	0.0019	0.279	149.12	48.9	.9840	3.750	775.	0.2216	11324.	.00837	619.	0.792	9.363	8.453	5.004
1.00	17.91	233.1	231.0	2.11	222.1	8.93	3521.	416.	8.47	7.85	.0915	0.294	534.	.01894	1.774	0.2354	0.2016	1.67	0.0018	0.315	170.34	52.8	.9853	3.888	794.	0.2287	11650.	.00862	633.	0.818	9.746	8.746	5.167
1.50	17.75	232.5	230.4	2.11	221.6	8.72	3603.	413.	8.73	8.04	.0979	0.274	547.	.01938	1.773	0.2374	0.2078	1.67	0.0018	0.349	190.98	56.9	.9864	4.026	812.	0.2357	11968.	.00886	647.	0.845	10.131	9.038	5.331
2.00	17.56	231.8	229.7	2.11	221.1	8.58	3662.	410.	8.93	8.18	.1043	0.256	556.	.01970	1.773	0.2396	0.2127	1.68	0.0018	0.383	212.12	61.2	.9875	4.166	829.	0.2427	12282.	.00910	660.	0.872	10.520	9.331	5.496
2.50	17.37	231.1	229.0	2.11	220.5	8.48	3706.	407.	9.10	8.29	.1107	0.240	562.	.01993	1.772	0.2421	0.2168	1.68	0.0018	0.414	232.09	65.6	.9884	4.306	845.	0.2496	12588.	.00934	673.	0.899	10.909	9.624	5.661
3.00	17.15	230.4	228.3	2.11	219.9	8.40	3742.	404.	9.26	8.38	.1173	0.225	568.	.02012	1.771	0.2450	0.2206	1.69	0.0018	0.443	251.41	70.2	.9892	4.451	861.	0.2565	12892.	.00957	685.	0.926	11.305	9.919	5.829
3.50	16.92	229.5	227.4	2.11	219.2	8.27	3803.	401.	9.49	8.53	.1238	0.211	577.	.02046	1.770	0.2481	0.2260	1.70	0.0017	0.470	270.09	75.0	.9900	4.596	875.	0.2634	13188.	.00980	697.	0.954	11.706	10.216	5.999
4.00	16.67	228.5	226.4	2.11	218.4	7.97	3946.	398.	9.92	8.87	.1305	0.199	599.	.02126	1.769	0.2514	0.2364	1.70	0.0017	0.495	288.06	80.1	.9907	4.743	889.	0.2703	13482.	.01003	708.	0.983	12.112	10.516	6.172
4.50	16.42	227.2	225.1	2.12	217.6	7.49	4198.	395.	10.64	9.46	.1371	0.188	637.	.02262	1.768	0.2551	0.2536	1.71	0.0017	0.516	304.13	85.3	.9913	4.893	903.	0.2772	13772.	.01026	719.	1.011	12.521	10.817	6.345
5.00	16.15	225.7	223.6	2.12	216.8	6.78	4638.	391.	11.85	10.47	.1438	0.177	704.	.02501	1.768	0.2590	0.2826	1.71	0.0017	0.535	319.42	90.8	.9919	5.046	915.	0.2842	14060.	.01048	729.	1.041	12.938	11.121	6.522
5.50	15.88	223.7	221.6	2.12	215.9	5.63	5583.	388.	14.39	12.63	.1504	0.168	848.	.03013	1.767	0.2631	0.3431	1.72	0.0017	0.553	334.47	96.5	.9925	5.200	927.	0.2911	14344.	.01070	739.	1.071	13.357	11.425	6.700

FORCED CONVECTION BOILING

RUN NO. 54.0 WATER TEST SECTION NO. 1

FLOW RATE.W=1656. LBS/HR MASS VELOCITY.G= 163.0 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX.Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 53845. TEMPERATURE BEFORE FLASH= 227.1 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	18.11	232.9	230.8	2.11	222.7	8.09	3889.	1132.	3.43	3.42	.0046	4.726	590.	.00656	0.557	0.0731	0.0817	1.66	0.0165	0.027	1.63	11.0	.7524	0.882	452.	0.0488	7559.	.00170	394.	0.189	1.807	1.946	1.089
0.25	18.10	234.8	232.7	2.11	222.7	10.07	3126.	1132.	2.76	2.75	.0056	3.986	474.	.00527	0.557	0.0731	0.0657	1.66	0.0165	0.032	1.94	12.7	.7860	0.953	485.	0.0526	8166.	.00182	423.	0.201	1.958	2.090	1.153
0.50	18.09	235.7	233.6	2.11	222.6	10.94	2875.	1131.	2.54	2.53	.0065	3.452	436.	.00485	0.557	0.0732	0.0605	1.66	0.0165	0.039	2.37	14.4	.8117	1.018	515.	0.0560	8715.	.00193	449.	0.213	2.099	2.224	1.213
1.00	18.07	236.7	234.6	2.11	222.6	11.99	2624.	1129.	2.32	2.31	.0084	2.728	398.	.00442	0.557	0.0733	0.0553	1.66	0.0164	0.059	3.60	17.9	.8485	1.134	568.	0.0620	9693.	.00212	496.	0.233	2.361	2.468	1.325
1.50	18.04	237.1	235.0	2.11	222.5	12.47	2524.	1127.	2.24	2.22	.0104	2.257	383.	.00426	0.557	0.0734	0.0533	1.67	0.0164	0.087	5.32	21.4	.8738	1.237	614.	0.0673	10558.	.00229	536.	0.252	2.604	2.690	1.428
2.00	17.99	237.1	235.0	2.11	222.3	12.70	2478.	1125.	2.20	2.18	.0124	1.920	376.	.00418	0.557	0.0736	0.0524	1.67	0.0163	0.123	7.55	25.1	.8924	1.333	656.	0.0721	11352.	.00244	572.	0.269	2.837	2.900	1.527
2.50	17.92	237.0	234.9	2.11	222.1	12.76	2467.	1122.	2.20	2.17	.0145	1.665	374.	.00416	0.556	0.0738	0.0523	1.67	0.0162	0.169	10.40	28.9	.9068	1.424	694.	0.0767	12102.	.00258	607.	0.287	3.065	3.103	1.624
3.00	17.82	236.5	234.4	2.11	221.9	12.54	2510.	1119.	2.24	2.21	.0166	1.464	381.	.00423	0.556	0.0742	0.0534	1.67	0.0162	0.226	13.96	33.0	.9184	1.513	731.	0.0812	12820.	.00272	639.	0.304	3.289	3.300	1.720
3.50	17.70	235.4	233.3	2.11	221.5	11.78	2671.	1117.	2.39	2.36	.0188	1.300	405.	.00450	0.556	0.0747	0.0569	1.68	0.0161	0.293	18.17	37.3	.9280	1.601	766.	0.0855	13520.	.00285	670.	0.320	3.514	3.496	1.815
4.00	17.53	233.9	231.8	2.11	221.0	10.81	2911.	1113.	2.61	2.57	.0212	1.163	442.	.00491	0.556	0.0753	0.0623	1.68	0.0161	0.370	23.03	41.9	.9361	1.690	800.	0.0899	14212.	.00298	700.	0.337	3.742	3.692	1.912
4.50	17.43	232.2	230.1	2.11	220.7	9.43	3339.	1111.	3.01	2.95	.0233	1.061	507.	.00563	0.556	0.0757	0.0716	1.68	0.0150	0.450	28.11	46.1	.9421	1.766	829.	0.0936	14806.	.00310	726.	0.352	3.944	3.864	1.998
5.00	17.09	230.1	228.0	2.11	219.7	8.33	3776.	1105.	3.42	3.34	.0262	0.945	573.	.00636	0.556	0.0771	0.0814	1.69	0.0159	0.511	32.06	52.4	.9492	1.875	865.	0.0987	15608.	.00324	759.	0.373	4.216	4.095	2.114
5.50	16.81	227.9	225.8	2.12	218.8	6.91	4555.	1100.	4.14	4.04	.0289	0.856	692.	.00768	0.555	0.0783	0.0986	1.70	0.0159	0.653	41.14	58.3	.9545	1.972	896.	0.1032	16314.	.00337	788.	0.392	4.464	4.303	2.219

FORCED CONVECTION BOILING

RUN NO. 55.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1651. LBS/HR MASS VELOCITY,G= 162.5 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 55906. TEMPERATURE BEFORE FLASH= 250.4 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	21.93	241.4	239.3	2.10	232.9	6.42	4904.	1142.	4.29	4.23	.0185	1.452	743.	.00831	0.562	0.0614	0.1018	1.57	0.0159	0.230	14.48	30.4	.9116	1.409	762.	0.0782	12524.	.00273	644.	0.292	3.311	3.320	1.732
0.25	21.88	242.8	240.7	2.10	232.8	7.99	3939.	1141.	3.45	3.40	.0196	1.378	597.	.00667	0.562	0.0616	0.0818	1.57	0.0159	0.255	16.08	32.1	.9163	1.444	778.	0.0800	12818.	.00279	658.	0.299	3.408	3.405	1.774
0.50	21.82	243.3	241.2	2.10	232.6	8.59	3665.	1140.	3.22	3.16	.0207	1.310	555.	.00621	0.562	0.0617	0.0762	1.57	0.0158	0.281	17.75	33.8	.9206	1.479	793.	0.0818	13111.	.00284	671.	0.306	3.506	3.490	1.815
0.75	21.75	243.4	241.3	2.10	232.4	8.86	3554.	1138.	3.12	3.07	.0218	1.246	538.	.00602	0.562	0.0619	0.0740	1.57	0.0158	0.309	19.56	35.6	.9246	1.515	809.	0.0836	13404.	.00290	685.	0.314	3.605	3.575	1.857
1.00	21.67	243.3	241.2	2.10	232.2	8.95	3516.	1137.	3.09	3.04	.0229	1.187	533.	.00596	0.562	0.0621	0.0733	1.57	0.0158	0.338	21.43	37.4	.9284	1.550	824.	0.0854	13697.	.00296	698.	0.321	3.705	3.661	1.900
1.50	21.46	242.8	240.7	2.10	231.8	8.89	3540.	1133.	3.12	3.06	.0253	1.081	536.	.00600	0.562	0.0626	0.0741	1.58	0.0157	0.403	25.65	41.2	.9353	1.623	854.	0.0890	14281.	.00307	724.	0.336	3.907	3.834	1.986
2.00	21.26	242.2	240.1	2.10	231.2	8.84	3561.	1130.	3.15	3.08	.0277	0.988	539.	.00603	0.562	0.0632	0.0748	1.58	0.0156	0.473	30.23	45.4	.9413	1.697	883.	0.0927	14867.	.00318	750.	0.352	4.115	4.010	2.074
2.50	21.00	241.4	239.3	2.10	230.5	8.72	3609.	1126.	3.21	3.13	.0303	0.905	547.	.00611	0.561	0.0639	0.0761	1.59	0.0156	0.551	35.36	49.9	.9468	1.774	912.	0.0964	15461.	.00330	775.	0.367	4.329	4.190	2.165
3.00	20.69	240.4	238.3	2.10	229.7	8.61	3656.	1121.	3.26	3.17	.0330	0.831	554.	.00619	0.561	0.0648	0.0774	1.60	0.0155	0.633	40.79	54.8	.9517	1.854	941.	0.1002	16065.	.00341	801.	0.384	4.550	4.375	2.259
3.50	20.34	239.3	237.2	2.11	228.8	8.32	3783.	1117.	3.39	3.29	.0358	0.764	573.	.00641	0.561	0.0658	0.0804	1.60	0.0155	0.722	46.72	60.1	.9561	1.937	969.	0.1042	16678.	.00352	826.	0.400	4.777	4.564	2.355
4.00	19.94	237.8	235.7	2.11	227.8	7.87	3998.	1111.	3.60	3.49	.0387	0.704	606.	.00677	0.560	0.0671	0.0854	1.61	0.0154	0.817	53.11	66.0	.9601	2.025	996.	0.1082	17310.	.00364	852.	0.418	5.014	4.759	2.456
4.50	19.49	236.2	234.1	2.11	226.6	7.50	4194.	1105.	3.79	3.67	.0418	0.648	636.	.00710	0.560	0.0685	0.0901	1.62	0.0153	0.913	59.61	72.5	.9639	2.120	1024.	0.1126	17969.	.00377	878.	0.437	5.266	4.965	2.563
5.00	19.00	234.5	232.4	2.11	225.2	7.18	4386.	1099.	3.99	3.85	.0450	0.598	665.	.00742	0.559	0.0701	0.0948	1.64	0.0152	1.014	66.51	79.7	.9673	2.220	1052.	0.1171	18645.	.00389	904.	0.456	5.526	5.177	2.674
5.50	18.48	231.8	229.7	2.11	223.8	5.94	5296.	1093.	4.85	4.66	.0483	0.552	803.	.00896	0.559	0.0720	0.1153	1.65	0.0152	1.118	73.68	87.5	.9703	2.325	1078.	0.1218	19333.	.00402	930.	0.476	5.795	5.393	2.787

FORCED CONVECTION BOILING

RUN NO. 56.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1639. LBS/HR MASS VELOCITY,G= 161.3 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 56671. TEMPERATURE BEFORE FLASH= 274.2 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	25.42	247.0	244.9	2.10	241.0	3.93	8004.	1139.	7.03	6.83	.0355	0.851	1211.	.01363	0.570	0.0540	0.1662	1.51	0.0151	0.590	39.01	48.6	.9458	1.709	966.	0.0957	15404.	.00340	795.	0.368	4.495	4.331	2.240
0.25	25.27	249.1	247.0	2.10	240.6	6.36	4951.	1137.	4.35	4.23	.0368	0.821	749.	.00843	0.569	0.0543	0.1030	1.52	0.0151	0.616	40.81	50.5	.9479	1.740	979.	0.0973	15652.	.00345	805.	0.375	4.590	4.410	2.281
0.50	25.12	249.6	247.5	2.10	240.3	7.18	4383.	1135.	3.86	3.74	.0380	0.793	663.	.00746	0.569	0.0546	0.0913	1.52	0.0151	0.643	42.69	52.4	.9499	1.772	991.	0.0988	15896.	.00349	816.	0.382	4.684	4.488	2.321
1.00	24.78	248.9	246.8	2.10	239.6	7.24	4349.	1131.	3.85	3.72	.0407	0.739	658.	.00740	0.569	0.0553	0.0910	1.52	0.0150	0.701	46.75	56.6	.9537	1.837	1015.	0.1020	16397.	.00359	837.	0.396	4.879	4.649	2.404
1.50	24.43	248.1	246.0	2.10	238.8	7.26	4332.	1126.	3.85	3.71	.0434	0.692	656.	.00738	0.569	0.0560	0.0910	1.53	0.0149	0.763	51.11	60.9	.9572	1.903	1038.	0.1052	16890.	.00369	858.	0.411	5.076	4.811	2.487
2.00	24.03	247.2	245.1	2.10	237.9	7.26	4337.	1121.	3.87	3.72	.0462	0.647	657.	.00739	0.568	0.0569	0.0915	1.54	0.0149	0.835	56.18	65.7	.9604	1.973	1062.	0.1085	17399.	.00379	879.	0.426	5.280	4.978	2.574
2.50	23.57	246.2	244.1	2.10	236.8	7.26	4337.	1116.	3.89	3.73	.0492	0.605	657.	.00739	0.568	0.0579	0.0920	1.54	0.0148	0.920	62.19	70.9	.9635	2.047	1085.	0.1120	17932.	.00389	900.	0.441	5.496	5.153	2.666
3.00	23.07	245.0	242.9	2.10	235.6	7.23	4354.	1110.	3.92	3.76	.0523	0.566	659.	.00742	0.567	0.0591	0.0929	1.55	0.0147	1.017	69.07	76.7	.9663	2.125	1108.	0.1156	18481.	.00399	922.	0.458	5.720	5.334	2.761
3.50	22.52	243.6	241.5	2.10	234.3	7.19	4377.	1104.	3.96	3.79	.0555	0.529	663.	.00747	0.567	0.0604	0.0939	1.56	0.0147	1.128	76.99	83.0	.9690	2.210	1131.	0.1194	19057.	.00410	944.	0.475	5.958	5.525	2.861
4.00	21.93	241.8	239.7	2.10	232.9	6.84	4602.	1098.	4.19	3.99	.0588	0.494	697.	.00785	0.566	0.0619	0.0993	1.57	0.0146	1.226	84.11	90.0	.9715	2.298	1154.	0.1233	19651.	.00420	966.	0.493	6.204	5.722	2.966
4.50	21.28	239.7	237.6	2.10	231.3	6.38	4936.	1091.	4.52	4.30	.0623	0.462	748.	.00842	0.566	0.0636	0.1073	1.58	0.0145	1.311	90.42	97.8	.9739	2.396	1177.	0.1276	20280.	.00432	989.	0.512	6.468	5.931	3.078
5.00	20.61	237.4	235.3	2.11	229.5	5.79	5434.	1084.	5.01	4.75	.0659	0.431	823.	.00927	0.565	0.0655	0.1190	1.60	0.0144	1.383	95.88	106.3	.9761	2.499	1200.	0.1320	20923.	.00444	1012.	0.532	6.741	6.147	3.194
5.50	19.39	234.4	232.3	2.11	227.7	4.66	6760.	1076.	6.28	5.93	.0696	0.403	1024.	.01153	0.564	0.0677	0.1492	1.61	0.0143	0.	0.	115.9	.9782	2.611	1222.	0.1368	21602.	.00456	1035.	0.553	7.030	6.373	3.316

FORCED CONVECTION BOILING

RUN NO. 57.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1672. LBS/HR MASS VELOCITY,G= 164.5 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 58451. TEMPERATURE BEFORE FLASH= 298.0 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	28.50	254.7	252.7	2.09	247.6	5.06	6219.	1153.	5.39	5.16	.0543	0.601	941.	.01038	0.561	0.0475	0.1272	1.47	0.0151	0.858	56.94	66.8	.9604	1.910	1137.	0.1076	17713.	.00387	914.	0.432	5.510	5.164	2.668
0.25	28.38	255.2	253.1	2.09	247.2	5.92	5318.	1151.	4.62	4.41	.0556	0.585	805.	.00887	0.561	0.0478	0.1090	1.47	0.0150	0.888	59.07	68.9	.9617	1.939	1147.	0.1089	17930.	.00391	922.	0.439	5.602	5.238	2.706
0.50	28.16	255.1	253.0	2.09	246.7	6.30	4992.	1149.	4.35	4.15	.0570	0.569	755.	.00833	0.561	0.0481	0.1026	1.47	0.0150	0.920	61.33	71.1	.9629	1.969	1157.	0.1103	18145.	.00396	931.	0.445	5.693	5.311	2.745
1.00	27.68	254.2	252.1	2.09	245.7	6.34	4965.	1144.	4.34	4.13	.0599	0.539	751.	.00829	0.560	0.0489	0.1025	1.48	0.0149	0.975	65.30	75.7	.9653	2.030	1176.	0.1132	18589.	.00404	949.	0.459	5.882	5.463	2.825
1.50	27.17	253.0	250.9	2.09	244.7	6.24	5041.	1139.	4.43	4.20	.0628	0.511	763.	.00841	0.560	0.0498	0.1046	1.49	0.0149	1.055	70.99	80.5	.9675	2.093	1196.	0.1161	19042.	.00413	967.	0.473	6.076	5.619	2.908
2.00	26.61	251.9	249.8	2.09	243.5	6.25	5031.	1133.	4.44	4.20	.0658	0.484	761.	.00840	0.559	0.0507	0.1049	1.50	0.0148	1.127	76.21	85.9	.9697	2.161	1215.	0.1192	19517.	.00422	985.	0.487	6.281	5.782	2.995
2.50	26.01	250.7	248.6	2.09	242.2	6.38	4929.	1127.	4.37	4.13	.0690	0.457	746.	.00822	0.559	0.0518	0.1033	1.50	0.0147	1.207	82.04	91.8	.9717	2.234	1235.	0.1225	20014.	.00431	1003.	0.503	6.496	5.952	3.086
3.00	25.38	249.5	247.4	2.10	240.9	6.49	4849.	1121.	4.32	4.07	.0722	0.433	734.	.00809	0.558	0.0530	0.1022	1.51	0.0146	1.290	88.15	98.1	.9737	2.310	1254.	0.1259	20524.	.00440	1022.	0.519	6.717	6.127	3.180
3.50	24.72	247.9	245.8	2.10	239.4	6.39	4923.	1115.	4.42	4.15	.0755	0.410	745.	.00822	0.558	0.0543	0.1044	1.52	0.0146	1.381	94.87	104.9	.9755	2.390	1273.	0.1294	21048.	.00450	1041.	0.535	6.948	6.308	3.278
4.00	24.02	245.9	243.8	2.10	237.8	5.94	5300.	1108.	4.78	4.49	.0789	0.387	802.	.00885	0.557	0.0558	0.1132	1.54	0.0145	1.478	102.07	112.5	.9772	2.475	1291.	0.1331	21591.	.00459	1060.	0.552	7.190	6.497	3.381
4.50	23.26	243.6	241.5	2.10	236.1	5.40	5827.	1100.	5.29	4.94	.0825	0.366	882.	.00974	0.556	0.0575	0.1254	1.55	0.0144	1.592	110.55	120.9	.9789	2.568	1310.	0.1370	22170.	.00470	1079.	0.571	7.448	6.698	3.490
5.00	22.42	241.1	239.0	2.10	234.1	4.93	6385.	1092.	5.85	5.44	.0863	0.344	967.	.01067	0.556	0.0594	0.1385	1.56	0.0143	1.728	120.69	130.7	.9806	2.673	1329.	0.1414	22805.	.00481	1100.	0.591	7.733	6.918	3.611
5.50	21.49	236.5	234.4	2.11	231.8	2.59	12148.	1083.	11.21	10.39	.0903	0.323	1840.	.02032	0.555	0.0618	0.2658	1.58	0.0142	1.918	134.77	142.1	.9822	2.791	1349.	0.1462	23505.	.00493	1123.	0.614	8.044	7.158	3.743

FORCED CONVECTION BOILING

RUN NO. 58.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1122. LBS/HR MASS VELOCITY,G= 110.4 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 35685. TEMPERATURE BEFORE FLASH= 227.8 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	16.99	231.2	229.1	2.11	219.4	9.73	3234.	821.	3.94	3.91	.0088	2.566	491.	.00805	0.820	0.1144	0.0939	1.69	0.0083	0.034	4.09	13.2	.8605	1.284	482.	0.0728	7784.	.00258	415.	0.280	2.699	2.800	1.620
0.25	16.99	232.9	230.8	2.11	219.4	11.45	2747.	820.	3.35	3.32	.0102	2.244	417.	.00684	0.820	0.1144	0.0799	1.69	0.0083	0.036	4.34	15.0	.8775	1.365	509.	0.0772	8267.	.00273	439.	0.293	2.875	2.960	1.695
0.50	16.98	234.0	231.9	2.11	219.4	12.58	2501.	819.	3.05	3.03	.0116	1.996	380.	.00622	0.820	0.1145	0.0728	1.69	0.0083	0.039	4.71	16.8	.8908	1.440	535.	0.0812	8713.	.00286	460.	0.306	3.042	3.112	1.766
0.75	16.97	234.8	232.7	2.11	219.3	13.38	2351.	818.	2.88	2.85	.0129	1.798	357.	.00585	0.820	0.1145	0.0685	1.70	0.0083	0.045	5.45	18.6	.9016	1.510	558.	0.0849	9128.	.00298	480.	0.318	3.202	3.254	1.834
1.00	16.96	235.4	233.3	2.11	219.3	13.97	2253.	817.	2.76	2.73	.0143	1.637	342.	.00561	0.820	0.1146	0.0657	1.70	0.0082	0.052	6.31	20.4	.9105	1.577	580.	0.0884	9519.	.00309	499.	0.330	3.356	3.391	1.900
1.25	16.95	235.8	233.7	2.11	219.3	14.43	2180.	816.	2.67	2.64	.0157	1.503	331.	.00543	0.820	0.1147	0.0637	1.70	0.0082	0.061	7.42	22.2	.9180	1.639	600.	0.0917	9887.	.00320	516.	0.341	3.505	3.522	1.963
1.50	16.93	236.0	233.9	2.11	219.2	14.66	2147.	815.	2.64	2.60	.0172	1.389	326.	.00534	0.820	0.1148	0.0628	1.70	0.0082	0.071	8.66	24.1	.9244	1.700	619.	0.0949	10239.	.00330	533.	0.351	3.650	3.649	2.025
2.00	16.89	235.7	233.6	2.11	219.1	14.52	2168.	812.	2.67	2.63	.0200	1.205	329.	.00540	0.820	0.1150	0.0636	1.70	0.0082	0.104	12.75	27.8	.9348	1.815	656.	0.1009	10903.	.00350	564.	0.372	3.932	3.892	2.144
2.50	16.84	235.1	233.0	2.11	218.9	14.12	2228.	810.	2.75	2.70	.0229	1.062	338.	.00555	0.820	0.1154	0.0655	1.70	0.0081	0.146	17.98	31.7	.9429	1.924	689.	0.1065	11526.	.00368	593.	0.392	4.206	4.126	2.261
3.00	16.76	234.4	232.3	2.11	218.7	13.58	2317.	808.	2.87	2.81	.0259	0.947	352.	.00577	0.819	0.1159	0.0684	1.70	0.0081	0.196	24.27	35.7	.9495	2.030	721.	0.1119	12118.	.00385	620.	0.411	4.474	4.354	2.375
3.50	16.56	233.3	231.2	2.11	218.4	12.81	2456.	805.	3.05	2.98	.0290	0.852	373.	.00612	0.819	0.1165	0.0727	1.70	0.0080	0.249	30.99	39.9	.9550	2.135	751.	0.1172	12694.	.00402	646.	0.431	4.742	4.578	2.489
4.00	16.52	231.9	229.8	2.11	217.9	11.83	2659.	802.	3.32	3.23	.0321	0.771	404.	.00663	0.819	0.1174	0.0790	1.71	0.0080	0.306	38.29	44.4	.9597	2.240	780.	0.1224	13259.	.00418	671.	0.450	5.011	4.802	2.603
4.50	16.37	230.1	228.0	2.11	217.5	10.58	2973.	799.	3.72	3.62	.0353	0.702	451.	.00741	0.819	0.1185	0.0887	1.71	0.0079	0.358	45.04	49.1	.9636	2.344	807.	0.1275	13809.	.00434	695.	0.470	5.279	5.023	2.717
5.00	16.19	227.9	225.8	2.12	216.9	8.94	3520.	796.	4.42	4.29	.0386	0.643	535.	.00878	0.818	0.1197	0.1055	1.71	0.0079	0.401	50.73	54.0	.9671	2.448	833.	0.1325	14349.	.00449	718.	0.490	5.549	5.243	2.832
5.50	15.98	225.4	223.3	2.12	216.3	7.05	4466.	792.	5.64	5.45	.0420	0.591	678.	.01115	0.818	0.1211	0.1345	1.72	0.0079	0.435	55.34	59.2	.9701	2.554	858.	0.1376	14886.	.00464	741.	0.510	5.821	5.464	2.948

FORCED CONVECTION BOILING

RUN NO. 51.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1127. LBS/HR MASS VELOCITY,G= 110.9 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 35751. TEMPERATURE BEFORE FLASH= 221.9 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	16.54	229.3	227.2	2.12	218.0	9.20	3421.	824.	4.15	4.14	.0041	5.061	519.	.00849	0.815	0.1168	0.0990	1.71	0.0085	0.	0.	7.3	.7460	0.949	362.	0.0545	5757.	.00196	313.	0.228	2.010	2.150	1.324
0.25	16.54	231.2	229.1	2.11	218.0	11.14	2826.	823.	3.43	3.42	.0055	3.899	429.	.00701	0.815	0.1168	0.0819	1.71	0.0084	0.	0.	9.1	.7970	1.070	404.	0.0610	6481.	.00218	349.	0.247	2.237	2.369	1.421
0.50	16.54	232.7	230.6	2.11	218.0	12.61	2495.	822.	3.04	3.02	.0068	3.185	379.	.00619	0.815	0.1168	0.0724	1.71	0.0084	0.012	1.42	10.9	.8309	1.173	439.	0.0666	7102.	.00236	380.	0.263	2.443	2.562	1.508
1.00	16.53	234.5	232.4	2.11	217.9	14.46	2176.	820.	2.65	2.63	.0096	2.342	330.	.00540	0.815	0.1169	0.0633	1.71	0.0084	0.025	2.98	14.6	.8737	1.350	499.	0.0760	8158.	.00267	431.	0.291	2.813	2.904	1.666
1.50	16.51	235.5	233.4	2.11	217.9	15.51	2029.	818.	2.48	2.46	.0123	1.858	308.	.00503	0.815	0.1170	0.0591	1.71	0.0083	0.041	4.91	18.3	.8995	1.500	548.	0.0840	9049.	.00293	474.	0.317	3.147	3.204	1.808
2.00	16.49	235.7	233.6	2.11	217.8	15.79	1992.	816.	2.44	2.41	.0151	1.541	303.	.00494	0.815	0.1171	0.0582	1.71	0.0083	0.061	7.35	22.0	.9169	1.635	592.	0.0910	9838.	.00316	512.	0.340	3.457	3.479	1.940
2.50	16.45	235.5	233.4	2.11	217.7	15.67	2009.	814.	2.47	2.43	.0180	1.315	305.	.00498	0.815	0.1174	0.0588	1.71	0.0083	0.087	10.53	25.8	.9294	1.758	631.	0.0975	10552.	.00337	545.	0.361	3.750	3.735	2.065
3.00	16.39	234.8	232.7	2.11	217.5	15.21	2069.	812.	2.55	2.51	.0209	1.144	314.	.00513	0.815	0.1178	0.0608	1.71	0.0082	0.119	14.47	29.8	.9390	1.875	667.	0.1035	11221.	.00356	576.	0.382	4.036	3.981	2.186
3.50	16.31	233.6	231.5	2.11	217.3	14.24	2210.	809.	2.73	2.68	.0238	1.010	336.	.00549	0.815	0.1183	0.0651	1.71	0.0082	0.159	19.44	33.9	.9466	1.988	700.	0.1092	11856.	.00374	605.	0.403	4.315	4.219	2.305
4.00	16.21	231.7	229.5	2.11	217.0	12.59	2500.	806.	3.10	3.03	.0269	0.902	380.	.00621	0.815	0.1190	0.0739	1.71	0.0081	0.207	25.44	38.3	.9528	2.098	732.	0.1147	12463.	.00392	633.	0.423	4.591	4.451	2.422
4.50	16.09	229.7	227.6	2.11	216.6	10.97	2868.	804.	3.57	3.48	.0300	0.813	436.	.00712	0.815	0.1198	0.0851	1.72	0.0081	0.263	32.49	42.7	.9578	2.204	761.	0.1201	13044.	.00408	659.	0.443	4.862	4.678	2.537
5.00	15.95	227.6	225.5	2.12	216.2	9.33	3372.	801.	4.21	4.10	.0331	0.738	512.	.00838	0.814	0.1208	0.1004	1.72	0.0081	0.325	40.36	47.4	.9621	2.310	789.	0.1252	13607.	.00424	683.	0.462	5.131	4.901	2.652
5.50	15.78	225.1	223.0	2.12	215.6	7.38	4265.	797.	5.35	5.19	.0364	0.672	648.	.01060	0.814	0.1220	0.1276	1.72	0.0080	0.386	48.20	52.4	.9659	2.418	816.	0.1305	14173.	.00440	708.	0.483	5.408	5.127	2.769

FORCED CONVECTION BOILING

RUN NO. 62.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1123. LBS/HR MASS VELOCITY,G= 110.5 LBS/SEC.SQFT POWER= 10.02 KILOWATTS HEAT FLUX,Q= 32044. BTU/HR.SQFT

REYNOLDS NO.= 35848. TEMPERATURE BEFORE FLASH= 230.2 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	17.32	231.5	229.3	2.15	220.4	8.96	3575.	822.	4.35	4.31	.0103	2.242	543.	.00888	0.835	0.1144	0.1036	1.69	0.0083	0.023	2.77	14.9	.8766	1.363	515.	0.0773	8300.	.00274	441.	0.293	2.891	2.977	1.710
0.25	17.31	233.3	231.2	2.15	220.4	10.81	2965.	821.	3.61	3.58	.0117	1.993	450.	.00737	0.835	0.1144	0.0860	1.69	0.0083	0.032	3.86	16.7	.8901	1.439	540.	0.0813	8750.	.00287	463.	0.306	3.059	3.128	1.782
0.50	17.30	234.4	232.2	2.15	220.3	11.90	2693.	820.	3.28	3.25	.0131	1.794	409.	.00669	0.835	0.1145	0.0782	1.69	0.0083	0.042	5.08	18.5	.9010	1.509	564.	0.0851	9170.	.00299	484.	0.318	3.221	3.272	1.850
1.00	17.27	235.5	233.3	2.15	220.3	13.08	2450.	818.	2.99	2.96	.0160	1.497	372.	.00609	0.835	0.1147	0.0713	1.69	0.0082	0.068	8.27	22.2	.9177	1.640	607.	0.0920	9941.	.00322	520.	0.341	3.527	3.543	1.981
1.50	17.23	236.0	233.9	2.15	220.1	13.76	2329.	816.	2.85	2.81	.0189	1.283	353.	.00579	0.834	0.1149	0.0680	1.69	0.0082	0.101	12.34	25.9	.9298	1.761	646.	0.0983	10642.	.00342	554.	0.363	3.819	3.797	2.105
1.75	17.21	236.1	234.0	2.15	220.1	13.90	2305.	815.	2.83	2.78	.0203	1.198	350.	.00573	0.834	0.1150	0.0674	1.69	0.0082	0.119	14.58	27.8	.9346	1.817	664.	0.1013	10969.	.00352	569.	0.373	3.958	3.917	2.164
2.00	17.18	236.0	233.9	2.15	220.0	13.90	2305.	814.	2.83	2.79	.0218	1.122	350.	.00573	0.834	0.1152	0.0675	1.69	0.0081	0.141	17.32	29.7	.9390	1.873	681.	0.1041	11289.	.00361	584.	0.383	4.097	4.036	2.223
2.50	17.10	235.5	233.4	2.15	219.7	13.66	2346.	811.	2.89	2.84	.0248	0.993	356.	.00583	0.834	0.1157	0.0689	1.69	0.0081	0.186	22.97	33.7	.9464	1.984	714.	0.1098	11915.	.00379	613.	0.403	4.376	4.273	2.342
3.00	16.99	234.5	232.4	2.15	219.4	13.00	2465.	808.	3.05	2.98	.0280	0.887	374.	.00613	0.834	0.1164	0.0727	1.69	0.0081	0.236	29.30	38.0	.9526	2.092	746.	0.1153	12516.	.00397	640.	0.423	4.651	4.505	2.459
3.50	16.85	233.2	231.0	2.15	219.0	12.06	2657.	805.	3.30	3.22	.0312	0.800	403.	.00661	0.834	0.1173	0.0786	1.70	0.0080	0.291	36.32	42.4	.9577	2.199	776.	0.1207	13098.	.00413	666.	0.443	4.925	4.733	2.575
4.00	16.70	231.5	229.3	2.15	218.5	10.85	2953.	802.	3.68	3.58	.0344	0.726	448.	.00735	0.834	0.1183	0.0877	1.70	0.0080	0.350	43.93	47.1	.9620	2.306	804.	0.1259	13665.	.00429	691.	0.463	5.199	4.959	2.692
4.50	16.51	229.7	227.5	2.15	217.9	9.64	3324.	799.	4.16	4.04	.0378	0.662	505.	.00827	0.833	0.1196	0.0992	1.71	0.0079	0.411	51.88	52.0	.9657	2.413	832.	0.1311	14224.	.00445	715.	0.483	5.474	5.185	2.809
5.00	16.29	227.9	225.8	2.16	217.2	8.53	3756.	795.	4.72	4.57	.0413	0.606	570.	.00936	0.833	0.1210	0.1126	1.71	0.0079	0.473	60.05	57.3	.9690	2.522	858.	0.1363	14780.	.00461	739.	0.504	5.754	5.413	2.927
5.50	16.06	225.5	223.3	2.16	216.5	6.84	4682.	791.	5.92	5.70	.0448	0.558	711.	.01167	0.833	0.1226	0.1411	1.72	0.0078	0.	0.	62.8	.9718	2.631	883.	0.1415	15325.	.00476	761.	0.524	6.033	5.638	3.046

FORCED CONVECTION BOILING

RUN NO. 63.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1115. LBS/HR MASS VELOCITY,G= 109.7 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 35986. TEMPERATURE BEFORE FLASH= 246.0 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	18.78	234.7	232.6	2.11	224.6	7.98	3944.	817.	4.83	4.74	.0225	1.135	598.	.00988	0.828	0.1050	0.1148	1.64	0.0080	0.132	16.51	28.1	.9358	1.796	683.	0.1015	11001.	.00359	578.	0.371	4.066	4.009	2.206
0.25	18.74	236.1	234.0	2.11	224.5	9.44	3335.	816.	4.09	4.01	.0239	1.070	506.	.00836	0.828	0.1052	0.0972	1.64	0.0080	0.	0.	29.8	.9397	1.847	699.	0.1041	11292.	.00367	591.	0.380	4.197	4.121	2.262
0.50	18.71	236.6	234.5	2.11	224.4	10.07	3124.	815.	3.84	3.76	.0254	1.011	474.	.00783	0.828	0.1054	0.0912	1.65	0.0080	0.170	21.37	31.6	.9432	1.896	715.	0.1067	11573.	.00376	605.	0.390	4.326	4.230	2.317
0.75	18.66	236.7	234.6	2.11	224.3	10.31	3052.	813.	3.75	3.67	.0269	0.957	463.	.00765	0.828	0.1056	0.0892	1.65	0.0079	0.	0.	33.5	.9464	1.946	730.	0.1092	11854.	.00384	618.	0.399	4.456	4.340	2.372
1.00	18.61	236.6	234.5	2.11	224.2	10.33	3045.	812.	3.75	3.66	.0284	0.909	462.	.00763	0.828	0.1059	0.0892	1.65	0.0079	0.213	26.92	35.3	.9493	1.993	745.	0.1117	12123.	.00392	630.	0.408	4.582	4.446	2.426
1.50	18.49	236.2	234.1	2.11	223.8	10.27	3063.	809.	3.78	3.69	.0316	0.824	465.	.00767	0.827	0.1065	0.0900	1.65	0.0079	0.260	33.03	39.2	.9545	2.090	774.	0.1166	12658.	.00408	654.	0.427	4.838	4.660	2.535
2.00	18.35	235.6	233.5	2.11	223.4	10.13	3106.	807.	3.85	3.74	.0347	0.751	471.	.00778	0.827	0.1072	0.0916	1.66	0.0078	0.312	39.85	43.3	.9589	2.185	801.	0.1214	13178.	.00423	678.	0.445	5.093	4.871	2.643
2.50	18.19	235.0	232.9	2.11	222.9	9.92	3172.	804.	3.95	3.83	.0380	0.688	481.	.00794	0.827	0.1081	0.0939	1.66	0.0078	0.370	47.52	47.5	.9627	2.281	827.	0.1262	13687.	.00438	700.	0.464	5.349	5.082	2.752
3.00	17.99	234.2	232.1	2.11	222.3	9.72	3236.	800.	4.04	3.91	.0413	0.633	491.	.00810	0.827	0.1092	0.0962	1.67	0.0077	0.433	55.92	52.0	.9661	2.379	853.	0.1311	14197.	.00453	723.	0.483	5.609	5.294	2.862
3.50	17.76	233.2	231.1	2.11	221.7	9.41	3343.	797.	4.20	4.04	.0447	0.584	507.	.00837	0.826	0.1105	0.0999	1.67	0.0077	0.500	64.93	56.9	.9691	2.479	877.	0.1359	14704.	.00468	744.	0.502	5.873	5.508	2.974
4.00	17.49	231.8	229.7	2.11	220.9	8.80	3576.	793.	4.51	4.33	.0483	0.540	543.	.00895	0.826	0.1121	0.1074	1.68	0.0077	0.562	73.41	62.1	.9718	2.583	901.	0.1409	15219.	.00483	766.	0.522	6.144	5.726	3.090
4.50	17.18	230.2	228.1	2.11	220.0	8.15	3859.	789.	4.89	4.69	.0519	0.500	586.	.00966	0.825	0.1140	0.1165	1.69	0.0076	0.590	77.52	67.7	.9742	2.692	925.	0.1460	15743.	.00498	787.	0.542	6.424	5.950	3.208
5.00	16.85	228.6	226.5	2.12	219.0	7.55	4168.	784.	5.31	5.08	.0557	0.463	633.	.01044	0.825	0.1160	0.1266	1.70	0.0076	0.616	81.43	73.8	.9765	2.803	948.	0.1511	16267.	.00513	808.	0.564	6.712	6.178	3.330
5.50	16.54	226.6	224.5	2.12	218.0	6.53	4817.	780.	6.17	5.88	.0594	0.432	731.	.01208	0.824	0.1180	0.1472	1.71	0.0075	0.664	88.31	79.9	.9784	2.911	969.	0.1560	16767.	.00527	827.	0.584	6.991	6.399	3.449

FORCED CONVECTION BOILING

RUN NO. 64.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1110. LBS/HR MASS VELOCITY,G= 109.2 LBS/SEC.SQFT POWER= 9.78 KILOWATTS HEAT FLUX,Q= 31276. BTU/HR.SQFT

REYNOLDS NO.= 36239. TEMPERATURE BEFORE FLASH= 263.0 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.47	236.7	234.7	2.09	229.2	5.48	5703.	813.	7.01	6.81	.0357	0.767	864.	.01437	0.829	0.0968	0.1664	1.60	0.0077	0.190	24.64	40.1	.9558	2.076	807.	0.1176	12815.	.00419	671.	0.431	5.034	4.823	2.619
0.25	20.42	238.9	236.8	2.09	229.0	7.81	4007.	812.	4.93	4.79	.0372	0.737	607.	.01010	0.829	0.0970	0.1171	1.60	0.0077	0.244	31.72	41.8	.9577	2.116	819.	0.1196	13036.	.00426	681.	0.439	5.147	4.916	2.667
0.50	20.35	239.3	237.2	2.09	228.9	8.35	3747.	811.	4.62	4.48	.0388	0.708	568.	.00944	0.829	0.0973	0.1097	1.60	0.0077	0.294	38.33	43.7	.9595	2.157	831.	0.1217	13263.	.00433	692.	0.447	5.264	5.012	2.717
1.00	20.19	238.9	236.8	2.09	228.4	8.36	3742.	808.	4.63	4.48	.0420	0.656	567.	.00943	0.829	0.0980	0.1100	1.61	0.0076	0.390	51.12	47.4	.9629	2.240	855.	0.1259	13712.	.00446	712.	0.464	5.498	5.204	2.816
1.50	19.97	238.3	236.2	2.09	227.9	8.36	3740.	805.	4.65	4.48	.0453	0.607	567.	.00942	0.828	0.0990	0.1104	1.61	0.0076	0.476	62.74	51.6	.9660	2.329	879.	0.1303	14177.	.00460	732.	0.482	5.744	5.404	2.921
2.00	19.71	237.5	235.5	2.09	227.2	8.29	3771.	801.	4.71	4.52	.0488	0.563	571.	.00950	0.828	0.1002	0.1118	1.62	0.0075	0.545	72.25	56.0	.9688	2.422	902.	0.1349	14648.	.00474	752.	0.500	5.998	5.609	3.029
2.50	19.42	236.7	234.6	2.10	226.4	8.22	3805.	797.	4.77	4.57	.0524	0.523	577.	.00958	0.828	0.1016	0.1134	1.63	0.0075	0.597	79.60	60.8	.9714	2.517	925.	0.1395	15121.	.00489	772.	0.519	6.256	5.816	3.138
3.00	19.11	235.8	233.7	2.10	225.5	8.16	3834.	793.	4.83	4.62	.0560	0.488	581.	.00965	0.827	0.1031	0.1149	1.63	0.0075	0.636	85.30	65.8	.9737	2.614	947.	0.1441	15591.	.00503	792.	0.538	6.517	6.024	3.249
3.50	18.78	234.7	232.6	2.10	224.6	7.95	3933.	789.	4.98	4.75	.0596	0.455	596.	.00990	0.827	0.1048	0.1185	1.64	0.0074	0.680	91.74	71.1	.9757	2.713	968.	0.1488	16060.	.00516	811.	0.557	6.781	6.234	3.361
4.00	18.42	233.5	231.4	2.10	223.6	7.77	4024.	785.	5.13	4.87	.0634	0.426	610.	.01013	0.826	0.1067	0.1220	1.65	0.0074	0.735	99.76	76.8	.9776	2.816	989.	0.1536	16538.	.00531	829.	0.577	7.053	6.448	3.477
4.50	18.03	232.0	229.9	2.10	222.5	7.47	4188.	780.	5.37	5.08	.0672	0.398	635.	.01054	0.825	0.1088	0.1277	1.67	0.0073	0.803	109.67	83.0	.9794	2.925	1009.	0.1585	17025.	.00545	848.	0.597	7.335	6.669	3.596
5.00	17.61	230.5	228.4	2.10	221.2	7.17	4361.	776.	5.62	5.30	.0712	0.373	662.	.01097	0.825	0.1112	0.1339	1.68	0.0073	0.880	120.94	89.7	.9810	3.039	1029.	0.1636	17523.	.00559	867.	0.619	7.625	6.895	3.719
5.50	17.15	228.8	226.7	2.10	219.9	6.85	4566.	770.	5.93	5.57	.0753	0.350	693.	.01148	0.824	0.1140	0.1412	1.69	0.0072	0.968	133.89	97.0	.9825	3.160	1049.	0.1690	18039.	.00574	886.	0.641	7.928	7.130	3.848

FORCED CONVECTION BOILING

RUN NO. 65.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1119. LBS/HR MASS VELOCITY,G= 110.1 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 36660. TEMPERATURE BEFORE FLASH= 273.0 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	21.37	239.9	237.8	2.10	231.5	6.30	4992.	817.	6.11	5.89	.0440	0.644	756.	.01248	0.829	0.0928	0.1449	1.58	0.0077	0.396	51.50	47.5	.9626	2.214	875.	0.1253	13808.	.00448	722.	0.463	5.556	5.251	2.841
0.25	21.27	240.6	238.5	2.10	231.2	7.22	4357.	815.	5.34	5.15	.0456	0.621	660.	.01089	0.829	0.0932	0.1267	1.58	0.0077	0.	0.	49.4	.9641	2.255	886.	0.1274	14027.	.00455	731.	0.471	5.672	5.346	2.890
0.50	21.17	240.7	238.6	2.10	231.0	7.62	4130.	814.	5.07	4.88	.0473	0.599	626.	.01032	0.828	0.0936	0.1203	1.58	0.0076	0.429	56.10	51.3	.9656	2.295	897.	0.1294	14242.	.00461	741.	0.479	5.788	5.440	2.940
1.00	20.94	240.3	238.2	2.10	230.4	7.81	4028.	811.	4.97	4.77	.0506	0.559	610.	.01007	0.828	0.0946	0.1179	1.59	0.0076	0.473	62.21	55.4	.9682	2.378	919.	0.1335	14675.	.00474	759.	0.496	6.024	5.630	3.040
1.50	20.65	239.6	237.5	2.11	229.7	7.76	4057.	807.	5.03	4.81	.0540	0.522	615.	.01014	0.828	0.0956	0.1193	1.60	0.0076	0.527	69.71	59.6	.9706	2.461	941.	0.1376	15104.	.00487	778.	0.513	6.262	5.821	3.141
2.00	20.41	238.8	236.7	2.11	229.0	7.68	4098.	803.	5.10	4.86	.0575	0.489	621.	.01024	0.827	0.0968	0.1211	1.60	0.0075	0.592	78.76	64.1	.9728	2.548	962.	0.1418	15536.	.00500	796.	0.530	6.504	6.014	3.244
2.50	20.09	237.9	235.8	2.11	228.2	7.65	4112.	800.	5.14	4.89	.0611	0.459	623.	.01026	0.827	0.0983	0.1221	1.61	0.0075	0.662	88.60	69.0	.9748	2.638	982.	0.1460	15978.	.00513	814.	0.549	6.755	6.213	3.350
3.00	19.73	237.0	234.9	2.11	227.2	7.63	4123.	795.	5.18	4.91	.0648	0.430	625.	.01030	0.826	0.0999	0.1231	1.62	0.0074	0.738	99.37	74.3	.9767	2.734	1002.	0.1505	16429.	.00526	832.	0.567	7.015	6.418	3.460
3.50	19.34	235.8	233.7	2.11	226.1	7.57	4154.	791.	5.25	4.96	.0686	0.403	630.	.01038	0.826	0.1018	0.1248	1.63	0.0074	0.813	110.14	80.0	.9785	2.835	1022.	0.1552	16894.	.00540	850.	0.587	7.285	6.630	3.575
4.00	18.91	234.4	232.3	2.11	225.0	7.29	4315.	786.	5.49	5.17	.0725	0.378	654.	.01078	0.825	0.1039	0.1305	1.64	0.0073	0.884	120.51	86.3	.9801	2.942	1042.	0.1601	17371.	.00554	868.	0.607	7.564	6.848	3.694
4.50	18.45	232.8	230.7	2.11	223.7	6.97	4515.	781.	5.78	5.42	.0765	0.355	685.	.01127	0.824	0.1063	0.1374	1.65	0.0073	0.945	129.64	93.0	.9816	3.054	1061.	0.1651	17860.	.00568	886.	0.629	7.853	7.072	3.816
5.00	17.96	230.9	228.7	2.11	222.3	6.49	4850.	776.	6.25	5.84	.0807	0.333	736.	.01210	0.824	0.1090	0.1488	1.67	0.0072	0.998	137.81	100.4	.9831	3.174	1080.	0.1704	18364.	.00583	905.	0.651	8.155	7.305	3.944
5.50	17.44	227.8	225.7	2.12	220.7	4.99	6303.	771.	8.18	7.62	.0849	0.313	957.	.01572	0.823	0.1120	0.1948	1.68	0.0072	0.104	14.46	108.4	.9844	3.300	1098.	0.1759	18885.	.00598	923.	0.674	8.468	7.545	4.077

FORCED CONVECTION BOILING

RUN NO. 66.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1128. LBS/HR MASS VELOCITY,G= 111.0 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 37023. TEMPERATURE BEFORE FLASH= 279.6 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	22.00	241.5	239.4	2.10	233.0	6.35	4958.	821.	6.04	5.80	.0494	0.584	751.	.01229	0.823	0.0897	0.1431	1.57	0.0077	0.440	57.06	52.2	.9659	2.286	916.	0.1295	14389.	.00465	751.	0.481	5.867	5.502	2.970
0.25	21.88	241.7	239.6	2.10	232.8	6.88	4576.	820.	5.58	5.35	.0511	0.565	693.	.01135	0.823	0.0901	0.1324	1.57	0.0077	0.	0.	54.1	.9672	2.325	926.	0.1314	14597.	.00471	760.	0.489	5.981	5.594	3.018
0.50	21.77	242.0	239.9	2.10	232.5	7.41	4249.	818.	5.20	4.97	.0527	0.547	644.	.01054	0.823	0.0905	0.1231	1.57	0.0077	0.486	63.38	56.1	.9684	2.364	937.	0.1333	14802.	.00477	769.	0.497	6.094	5.685	3.066
1.00	21.52	241.3	239.2	2.10	231.9	7.32	4300.	815.	5.28	5.04	.0561	0.513	651.	.01066	0.822	0.0915	0.1252	1.58	0.0076	0.542	71.09	60.1	.9706	2.443	957.	0.1372	15213.	.00489	786.	0.513	6.323	5.869	3.164
1.50	21.24	240.5	238.4	2.10	231.2	7.24	4347.	811.	5.36	5.10	.0595	0.482	658.	.01078	0.822	0.0926	0.1271	1.58	0.0076	0.605	79.82	64.5	.9727	2.525	977.	0.1412	15628.	.00501	804.	0.530	6.559	6.056	3.264
2.00	20.92	239.7	237.6	2.10	230.3	7.24	4344.	807.	5.38	5.11	.0631	0.452	658.	.01077	0.822	0.0939	0.1277	1.59	0.0075	0.677	89.85	69.2	.9747	2.611	997.	0.1453	16053.	.00514	821.	0.548	6.802	6.249	3.367
2.50	20.56	238.8	236.7	2.11	229.4	7.26	4334.	803.	5.40	5.11	.0668	0.425	657.	.01075	0.821	0.0954	0.1281	1.60	0.0075	0.753	100.54	74.3	.9765	2.702	1017.	0.1495	16488.	.00527	839.	0.566	7.054	6.448	3.474
3.00	20.17	237.7	235.6	2.11	228.4	7.22	4361.	799.	5.46	5.15	.0705	0.400	661.	.01081	0.820	0.0971	0.1296	1.61	0.0074	0.836	112.31	79.7	.9782	2.796	1036.	0.1539	16930.	.00539	856.	0.584	7.312	6.650	3.584
3.50	19.72	236.4	234.3	2.11	227.2	7.12	4420.	794.	5.57	5.23	.0744	0.376	670.	.01096	0.820	0.0991	0.1322	1.62	0.0074	0.915	123.70	85.8	.9798	2.899	1055.	0.1586	17395.	.00553	874.	0.604	7.586	6.864	3.700
4.00	19.24	234.9	232.8	2.11	225.9	6.93	4542.	789.	5.76	5.39	.0784	0.353	689.	.01126	0.819	0.1015	0.1368	1.63	0.0074	0.989	134.56	92.4	.9814	3.010	1074.	0.1636	17878.	.00567	892.	0.625	7.874	7.087	3.822
4.50	18.73	233.2	231.1	2.11	224.5	6.59	4772.	783.	6.09	5.69	.0825	0.332	724.	.01182	0.818	0.1040	0.1448	1.65	0.0073	0.104	14.24	99.6	.9828	3.125	1092.	0.1687	18372.	.00581	909.	0.647	8.169	7.314	3.947
5.00	18.19	231.1	229.0	2.11	222.9	6.08	5178.	778.	6.66	6.19	.0867	0.312	785.	.01282	0.817	0.1069	0.1584	1.66	0.0073	0.	0.	107.4	.9841	3.248	1111.	0.1740	18882.	.00596	928.	0.670	8.478	7.551	4.078
5.50	17.64	228.2	226.1	2.12	221.3	4.75	6626.	772.	8.58	7.95	.0910	0.294	1005.	.01640	0.817	0.1099	0.2043	1.68	0.0072	0.	0.	115.8	.9854	3.376	1128.	0.1795	19400.	.00611	945.	0.693	8.794	7.793	4.212

FORCED CONVECTION BOILING

RUN NO. 67.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1137. LBS/HR MASS VELOCITY,G= 111.9 LBS/SEC.SQFT POWER= 9.84 KILOWATTS HEAT FLUX,Q= 31468. BTU/HR.SQFT

REYNOLDS NO.= 37270. TEMPERATURE BEFORE FLASH= 294.5 F VELOCITY BEFORE FLASH= 1.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	23.11	243.7	241.6	2.10	235.7	5.86	5371.	822.	6.54	6.21	.0626	0.476	813.	.01320	0.818	0.0850	0.1548	1.55	0.0076	0.557	73.14	63.3	.9720	2.460	1000.	0.1392	15587.	.00502	811.	0.525	6.597	6.086	3.278
0.25	22.97	243.9	241.8	2.10	235.4	6.42	4903.	820.	5.98	5.67	.0643	0.463	742.	.01205	0.818	0.0855	0.1416	1.55	0.0076	0.	0.	65.3	.9729	2.497	1009.	0.1410	15776.	.00508	819.	0.533	6.708	6.174	3.325
0.50	22.82	243.9	241.8	2.10	235.0	6.76	4654.	818.	5.69	5.39	.0661	0.450	705.	.01144	0.818	0.0860	0.1347	1.55	0.0076	0.613	80.97	67.4	.9738	2.535	1018.	0.1429	15968.	.00514	827.	0.541	6.820	6.263	3.373
1.00	22.49	243.1	241.0	2.10	234.2	6.76	4654.	814.	5.72	5.40	.0696	0.425	705.	.01144	0.817	0.0872	0.1354	1.56	0.0075	0.682	90.63	71.8	.9755	2.614	1036.	0.1466	16358.	.00525	842.	0.558	7.051	6.444	3.470
1.50	22.13	242.2	240.1	2.10	233.4	6.78	4639.	810.	5.73	5.39	.0732	0.402	703.	.01141	0.817	0.0885	0.1357	1.57	0.0075	0.761	101.75	76.6	.9771	2.695	1054.	0.1504	16754.	.00537	858.	0.574	7.287	6.630	3.571
2.00	21.73	241.2	239.1	2.10	232.4	6.75	4661.	806.	5.78	5.42	.0768	0.380	706.	.01146	0.816	0.0900	0.1370	1.57	0.0074	0.814	109.52	81.7	.9787	2.781	1072.	0.1544	17163.	.00548	874.	0.592	7.532	6.821	3.675
2.50	21.29	240.2	238.1	2.10	231.3	6.79	4635.	802.	5.78	5.40	.0806	0.359	702.	.01140	0.816	0.0917	0.1371	1.58	0.0074	0.873	118.20	87.2	.9801	2.873	1089.	0.1585	17585.	.00560	890.	0.610	7.788	7.020	3.783
3.00	20.82	238.9	236.8	2.11	230.1	6.72	4682.	797.	5.88	5.47	.0846	0.340	709.	.01152	0.815	0.0936	0.1394	1.59	0.0073	0.943	128.50	93.2	.9815	2.970	1106.	0.1629	18018.	.00573	906.	0.629	8.054	7.225	3.896
3.50	20.31	237.5	235.4	2.11	228.8	6.60	4765.	792.	6.02	5.59	.0885	0.321	722.	.01172	0.814	0.0957	0.1428	1.60	0.0073	0.101	13.85	99.8	.9828	3.073	1123.	0.1675	18468.	.00586	922.	0.649	8.331	7.438	4.014
4.00	19.77	235.9	233.8	2.11	227.3	6.45	4882.	787.	6.21	5.74	.0926	0.304	740.	.01201	0.813	0.0982	0.1474	1.62	0.0072	0.110	15.19	106.9	.9840	3.183	1140.	0.1723	18932.	.00599	939.	0.670	8.619	7.659	4.136
4.50	19.22	234.2	232.1	2.11	225.8	6.24	5041.	781.	6.46	5.95	.0968	0.287	764.	.01239	0.813	0.1008	0.1534	1.63	0.0072	0.114	15.84	114.6	.9852	3.299	1157.	0.1773	19404.	.00613	955.	0.692	8.916	7.885	4.262
5.00	18.64	232.0	229.9	2.11	224.2	5.71	5511.	775.	7.11	6.53	.1010	0.271	836.	.01354	0.812	0.1037	0.1690	1.65	0.0071	0.117	16.37	123.0	.9863	3.422	1173.	0.1826	19895.	.00627	972.	0.715	9.225	8.119	4.393
5.50	18.06	228.4	226.3	2.12	222.5	3.78	8316.	769.	10.81	9.89	.1053	0.257	1262.	.02042	0.811	0.1067	0.2572	1.66	0.0071	0.120	16.90	131.9	.9873	3.549	1189.	0.1879	20390.	.00641	988.	0.738	9.542	8.357	4.527

FORCED CONVECTION BOILING

RUN NO.100.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1660. LBS/HR MASS VELOCITY,G= 163.4 LBS/SEC.SQFT POWER= 7.60 KILOWATTS HEAT FLUX,Q= 24321. BTU/HR.SQFT

REYNOLDS NO.= 55736. TEMPERATURE BEFORE FLASH= 241.5 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.77	233.6	232.0	1.63	229.9	2.02	12015.	1146.	10.49	10.38	.0123	2.062	1820.	.02024	0.431	0.0496	0.2488	1.59	0.0163	0.	0.	22.2	.8775	1.133	608.	0.0631	10071.	.00225	522.	0.238	2.606	2.680	1.357
0.25	20.66	235.8	234.2	1.63	229.7	4.54	5358.	1144.	4.68	4.63	.0133	1.914	812.	.00903	0.431	0.0499	0.1[illegible]1	1.60	0.0162	0.	0.	23.9	.8864	1.175	626.	0.0652	10419.	.00232	538.	0.246	2.717	2.779	1.404
0.50	20.57	236.7	235.1	1.63	229.4	5.69	4273.	1143.	3.74	3.70	.0143	1.792	647.	.00720	0.431	0.0501	0.0887	1.60	0.0162	0.	0.	25.5	.8937	1.212	643.	0.0671	10733.	.00238	553.	0.254	2.819	2.871	1.447
1.00	20.36	236.9	235.3	1.63	228.9	6.43	3780.	1140.	3.32	3.27	.0163	1.583	573.	.00637	0.431	0.0506	0.0787	1.60	0.0162	0.	0.	28.9	.9065	1.288	675.	0.0710	11356.	.00251	581.	0.270	3.025	3.053	1.535
1.50	20.14	236.6	234.9	1.63	228.3	6.62	3673.	1136.	3.23	3.18	.0183	1.415	557.	.00619	0.431	0.0511	0.0767	1.61	0.0161	0.	0.	32.5	.9170	1.360	705.	0.0746	11948.	.00262	608.	0.285	3.227	3.230	1.621
2.00	19.92	236.0	234.4	1.63	227.7	6.66	3650.	1133.	3.22	3.17	.0203	1.278	553.	.00615	0.431	0.0516	0.0765	1.61	0.0161	0.	0.	36.2	.9255	1.431	733.	0.0781	12511.	.00273	633.	0.300	3.423	3.400	1.704
2.50	19.68	235.3	233.7	1.63	227.1	6.59	3690.	1129.	3.27	3.21	.0224	1.160	559.	.00622	0.430	0.0522	0.0776	1.62	0.0160	0.	0.	40.1	.9329	1.501	760.	0.0816	13067.	.00284	657.	0.315	3.622	3.571	1.789
3.00	19.42	234.4	232.8	1.63	226.4	6.44	3775.	1126.	3.35	3.29	.0246	1.060	572.	.00636	0.430	0.0528	0.0797	1.63	0.0160	0.	0.	44.2	.9393	1.572	786.	0.0850	13615.	.00294	681.	0.330	3.821	3.741	1.873
3.50	19.15	233.4	231.8	1.63	225.6	6.14	3959.	1122.	3.53	3.45	.0268	0.973	600.	.00667	0.430	0.0535	0.0839	1.63	0.0159	0.535	33.64	48.5	.9448	1.643	811.	0.0884	14149.	.00305	703.	0.344	4.018	3.908	1.957
4.00	18.84	232.2	230.6	1.63	224.8	5.79	4199.	1117.	3.76	3.67	.0291	0.895	637.	.00707	0.430	0.0543	0.0893	1.64	0.0159	0.635	40.06	53.2	.9499	1.717	836.	0.0919	14697.	.00315	726.	0.360	4.223	4.081	2.045
4.50	18.50	230.8	229.2	1.63	223.8	5.38	4518.	1113.	4.06	3.96	.0315	0.825	685.	.00760	0.430	0.0553	0.0966	1.65	0.0158	0.720	45.58	58.2	.9544	1.793	860.	0.0955	15253.	.00326	749.	0.375	4.434	4.257	2.134
5.00	18.12	229.4	227.8	1.63	222.7	5.04	4825.	1108.	4.36	4.24	.0340	0.761	732.	.00812	0.429	0.0563	0.1036	1.66	0.0157	0.803	51.02	63.9	.9585	1.875	885.	0.0993	15833.	.00337	772.	0.392	4.658	4.443	2.229
5.50	17.71	227.9	226.2	1.64	221.5	4.72	5158.	1102.	4.68	4.54	.0367	0.702	783.	.00867	0.429	0.0575	0.1114	1.67	0.0157	0.	0.	70.1	.9623	1.961	909.	0.1032	16424.	.00348	796.	0.409	4.889	4.633	2.327

FORCED CONVECTION BOILING

RUN NO.100.1 WATER TEST SECTION NO. 1

FLOW RATE,W=1680. LBS/HR MASS VELOCITY,G= 165.3 LBS/SEC.SQFT POWER= 7.64 KILOWATTS HEAT FLUX,Q= 24429. BTU/HR.SQFT

REYNOLDS NO.= 56106. TEMPERATURE BEFORE FLASH= 241.2 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.41	234.8	233.2	1.64	229.0	4.15	5892.	1154.	5.11	5.05	.0128	1.967	893.	.00981	0.428	0.0501	0.1212	1.60	0.0166	0.	0.	23.7	.8839	1.164	622.	0.0645	10402.	.00229	536.	0.243	2.672	2.739	1.383
0.25	20.29	235.9	234.3	1.64	228.7	5.54	4407.	1152.	3.82	3.78	.0139	1.829	668.	.00734	0.428	0.0503	0.0908	1.60	0.0166	0.	0.	25.4	.8921	1.206	640.	0.0666	10750.	.00235	552.	0.252	2.783	2.838	1.430
0.50	20.18	236.7	235.1	1.64	228.4	6.69	3651.	1151.	3.17	3.13	.0149	1.710	553.	.00608	0.428	0.0506	0.0753	1.61	0.0165	0.	0.	27.2	.8994	1.246	657.	0.0686	11085.	.00242	567.	0.260	2.892	2.935	1.476
1.00	19.95	236.7	235.1	1.64	227.8	7.28	3355.	1147.	2.92	2.88	.0169	1.513	508.	.00559	0.427	0.0511	0.0694	1.61	0.0165	0.	0.	30.9	.9114	1.322	689.	0.0724	11718.	.00254	596.	0.276	3.101	3.119	1.565
1.50	19.61	236.4	234.7	1.64	226.9	7.86	3109.	1143.	2.72	2.68	.0193	1.330	471.	.00517	0.427	0.0520	0.0646	1.62	0.0164	0.	0.	35.4	.9230	1.412	724.	0.0768	12430.	.00268	627.	0.295	3.341	3.329	1.668
2.00	19.49	235.8	234.2	1.64	226.6	7.66	3191.	1140.	2.80	2.75	.0211	1.224	484.	.00531	0.427	0.0523	0.0665	1.62	0.0164	0.	0.	38.6	.9294	1.469	748.	0.0797	12899.	.00277	648.	0.307	3.507	3.472	1.738
2.50	19.25	235.1	233.5	1.64	225.9	7.60	3213.	1137.	2.83	2.77	.0232	1.115	487.	.00535	0.427	0.0529	0.0672	1.63	0.0163	0.	0.	42.6	.9363	1.540	774.	0.0831	13452.	.00287	672.	0.322	3.703	3.641	1.822
3.00	19.01	234.4	232.7	1.64	225.2	7.49	3262.	1133.	2.88	2.82	.0253	1.024	495.	.00543	0.427	0.0535	0.0684	1.64	0.0163	0.	0.	46.7	.9420	1.608	799.	0.0865	13982.	.00297	695.	0.336	3.895	3.804	1.903
3.50	18.75	233.5	231.9	1.64	224.5	7.33	3332.	1129.	2.95	2.89	.0274	0.944	505.	.00554	0.427	0.0542	0.0702	1.64	0.0162	0.490	30.17	51.1	.9471	1.678	823.	0.0898	14508.	.00307	717.	0.350	4.089	3.967	1.985
4.00	18.48	232.4	230.8	1.64	223.8	6.99	3497.	1125.	3.11	3.03	.0296	0.873	530.	.00581	0.426	0.0549	0.0739	1.65	0.0162	0.560	34.60	55.6	.9516	1.747	847.	0.0930	15027.	.00317	738.	0.365	4.283	4.130	2.068
4.50	18.18	231.2	229.6	1.64	222.9	6.71	3641.	1121.	3.25	3.17	.0319	0.809	552.	.00605	0.426	0.0557	0.0773	1.66	0.0151	0.630	39.05	60.6	.9557	1.820	870.	0.0964	15561.	.00327	760.	0.380	4.486	4.299	2.154
5.00	17.85	229.8	228.2	1.64	221.9	6.22	3927.	1116.	3.52	3.42	.0343	0.750	596.	.00653	0.426	0.0567	0.0837	1.67	0.0161	0.703	43.73	66.1	.9594	1.896	893.	0.0999	16104.	.00337	782.	0.395	4.695	4.472	2.243
5.50	17.48	228.1	226.5	1.64	220.9	5.65	4324.	1111.	3.89	3.79	.0368	0.696	656.	.00718	0.425	0.0578	0.0926	1.68	0.0160	0.775	48.38	72.0	.9629	1.977	916.	0.1036	16668.	.00347	804.	0.411	4.913	4.652	2.336

FORCED CONVECTION BOILING

RUN NO.101.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1675. LBS/HR MASS VELOCITY,G= 164.8 LBS/SEC.SQFT POWER= 7.59 KILOWATTS HEAT FLUX,Q= 24269. BTU/HR.SQFT

REYNOLDS NO.= 56822. TEMPERATURE BEFORE FLASH= 254.0 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	22.34	238.2	236.6	1.62	233.9	2.70	8983.	1155.	7.78	7.64	.0213	1.287	1360.	.01499	0.428	0.0459	0.1843	1.56	0.0162	0.	0.	34.5	.9212	1.366	749.	0.0759	12359.	.00271	636.	0.293	3.406	3.385	1.695
0.25	22.21	240.0	238.4	1.62	233.6	4.81	5050.	1153.	4.38	4.30	.0223	1.229	765.	.00843	0.428	0.0462	0.1037	1.57	0.0162	0.	0.	36.2	.9250	1.397	762.	0.0775	12618.	.00276	647.	0.300	3.498	3.464	1.735
0.50	22.08	240.6	239.0	1.62	233.2	5.73	4233.	1152.	3.68	3.61	.0234	1.175	641.	.00707	0.428	0.0464	0.0871	1.57	0.0161	0.	0.	38.0	.9286	1.429	775.	0.0791	12878.	.00281	659.	0.307	3.592	3.545	1.774
1.00	21.81	240.3	238.7	1.62	232.6	6.09	3986.	1148.	3.47	3.40	.0255	1.080	604.	.00666	0.427	0.0469	0.0823	1.57	0.0161	0.	0.	41.6	.9349	1.491	800.	0.0821	13382.	.00291	681.	0.321	3.775	3.702	1.852
1.50	21.51	239.8	238.2	1.62	231.9	6.32	3838.	1144.	3.35	3.28	.0277	0.995	581.	.00641	0.427	0.0475	0.0795	1.58	0.0160	0.	0.	45.5	.9406	1.556	824.	0.0853	13890.	.00300	703.	0.335	3.964	3.862	1.932
2.00	21.16	239.1	237.5	1.62	231.0	6.52	3720.	1140.	3.26	3.18	.0300	0.917	563.	.00621	0.427	0.0482	0.0774	1.58	0.0160	0.	0.	49.7	.9458	1.623	849.	0.0885	14407.	.00310	725.	0.349	4.159	4.027	2.016
2.50	20.93	238.3	236.7	1.62	230.1	6.58	3690.	1136.	3.25	3.16	.0323	0.849	559.	.00616	0.427	0.0490	0.0771	1.59	0.0159	0.	0.	54.2	.9504	1.691	872.	0.0917	14922.	.00320	746.	0.364	4.357	4.192	2.099
3.00	20.44	237.4	235.8	1.62	229.1	6.68	3632.	1131.	3.21	3.12	.0348	0.787	550.	.00607	0.426	0.0498	0.0762	1.60	0.0159	0.	0.	59.1	.9546	1.762	895.	0.0951	15451.	.00330	768.	0.379	4.562	4.362	2.187
3.50	20.01	236.3	234.7	1.63	228.0	6.74	3600.	1126.	3.20	3.10	.0373	0.730	546.	.00601	0.426	0.0508	0.0759	1.61	0.0158	0.695	43.95	64.4	.9585	1.837	918.	0.0986	15996.	.00340	790.	0.395	4.775	4.538	2.277
4.00	19.64	235.2	233.6	1.63	227.0	6.65	3647.	1121.	3.25	3.15	.0398	0.682	553.	.00609	0.426	0.0517	0.0773	1.62	0.0158	0.780	49.49	69.6	.9617	1.908	939.	0.1018	16494.	.00349	810.	0.409	4.975	4.703	2.362
4.50	19.21	234.0	232.4	1.63	225.8	6.58	3687.	1116.	3.30	3.19	.0424	0.636	559.	.00615	0.425	0.0528	0.0785	1.63	0.0157	0.873	55.59	75.5	.9648	1.985	961.	0.1053	17027.	.00359	830.	0.425	5.191	4.879	2.454
5.00	18.76	232.4	230.8	1.63	224.6	6.26	3874.	1110.	3.49	3.36	.0450	0.594	587.	.00646	0.425	0.0540	0.0830	1.64	0.0156	0.973	62.19	81.8	.9677	2.065	982.	0.1089	17566.	.00369	851.	0.441	5.410	5.057	2.547
5.50	18.25	230.0	228.4	1.63	223.1	5.27	4610.	1104.	4.18	4.01	.0479	0.554	699.	.00769	0.425	0.0553	0.0993	1.66	0.0156	1.081	69.36	89.0	.9704	2.154	1004.	0.1128	18149.	.00380	873.	0.459	5.649	5.250	2.649

FORCED CONVECTION BOILING

RUN NO.102.0 WATER TEST SECTION NO. 1

FLOW RATE.W=1675. LBS/HR MASS VELOCITY.G= 164.8 LBS/SEC.SQFT POWER= 7.67 KILOWATTS HEAT FLUX.Q= 24535. BTU/HR.SQFT

REYNOLDS NO.= 55546. TEMPERATURE BEFORE FLASH= 240.1 F VELOCITY BEFORE FLASH= 2.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	19.91	233.6	232.0	1.65	227.7	4.29	5712.	1148.	4.98	4.92	.0130	1.923	866.	.00954	0.431	0.0516	0.1182	1.61	0.0165	0.223	13.49	24.3	.8875	1.189	625.	0.0655	10531.	.00231	540.	0.247	2.709	2.772	1.400
0.25	19.85	235.6	234.0	1.64	227.6	6.40	3835.	1147.	3.34	3.31	.0139	1.810	581.	.00640	0.431	0.0517	0.0794	1.61	0.0165	0.234	14.18	25.9	.8942	1.223	640.	0.0673	10822.	.00237	554.	0.255	2.803	2.856	1.440
0.50	19.79	236.2	234.6	1.64	227.4	7.16	3426.	1146.	2.99	2.96	.0148	1.708	519.	.00572	0.430	0.0519	0.0710	1.62	0.0165	0.245	14.87	27.4	.9003	1.258	655.	0.0690	11108.	.00243	567.	0.262	2.896	2.939	1.480
1.00	19.66	235.9	234.3	1.64	227.0	7.26	3380.	1143.	2.96	2.92	.0166	1.533	512.	.00564	0.430	0.0522	0.0702	1.62	0.0164	0.270	16.43	30.6	.9108	1.324	684.	0.0724	11662.	.00253	592.	0.276	3.081	3.102	1.559
1.50	19.51	235.5	233.9	1.64	226.6	7.23	3394.	1140.	2.98	2.93	.0184	1.386	514.	.00566	0.430	0.0526	0.0707	1.62	0.0164	0.300	18.31	33.9	.9198	1.391	711.	0.0757	12203.	.00264	616.	0.289	3.265	3.263	1.637
2.00	19.35	234.9	233.3	1.64	226.2	7.10	3457.	1137.	3.04	2.99	.0203	1.263	524.	.00577	0.430	0.0530	0.0722	1.63	0.0163	0.335	20.51	37.4	.9274	1.455	737.	0.0789	12725.	.00274	640.	0.303	3.446	3.420	1.714
2.50	19.17	234.3	232.7	1.65	225.7	6.99	3508.	1134.	3.09	3.04	.0223	1.156	532.	.00585	0.430	0.0535	0.0735	1.63	0.0163	0.377	23.15	41.1	.9340	1.521	763.	0.0822	13243.	.00284	662.	0.317	3.630	3.578	1.792
3.00	18.97	233.6	232.0	1.65	225.1	6.84	3586.	1131.	3.17	3.11	.0243	1.063	544.	.00598	0.430	0.0540	0.0754	1.64	0.0162	0.428	26.36	44.9	.9398	1.586	787.	0.0853	13752.	.00294	684.	0.330	3.814	3.735	1.870
3.50	18.75	232.8	231.2	1.65	224.5	6.63	3698.	1127.	3.28	3.21	.0263	0.981	561.	.00617	0.430	0.0546	0.0780	1.64	0.0162	0.487	30.09	49.0	.9449	1.651	811.	0.0885	14258.	.00303	706.	0.344	3.999	3.892	1.949
4.00	18.50	231.9	230.3	1.65	223.8	6.40	3831.	1124.	3.41	3.33	.0284	0.908	581.	.00639	0.429	0.0552	0.0811	1.65	0.0161	0.560	34.71	53.3	.9495	1.719	834.	0.0917	14768.	.00313	727.	0.358	4.189	4.052	2.030
4.50	18.21	230.7	229.1	1.65	223.0	6.11	4012.	1120.	3.58	3.50	.0307	0.838	609.	.00669	0.429	0.0561	0.0853	1.66	0.0161	0.650	40.42	58.2	.9539	1.793	858.	0.0952	15309.	.00323	750.	0.373	4.393	4.222	2.116
5.00	17.87	229.4	227.7	1.65	222.0	5.73	4285.	1115.	3.84	3.74	.0332	0.775	650.	.00714	0.429	0.0570	0.0915	1.67	0.0160	0.765	47.74	63.7	.9580	1.871	882.	0.0988	15872.	.00333	772.	0.389	4.607	4.401	2.206
5.50	17.45	227.7	226.0	1.65	220.8	5.28	4647.	1109.	4.19	4.07	.0358	0.713	705.	.00774	0.429	0.0583	0.0997	1.68	0.0160	0.915	57.31	70.1	.9619	1.960	907.	0.1028	16488.	.00345	797.	0.407	4.844	4.595	2.308

FORCED CONVECTION BOILING

RUN NO.103.0 WATER TEST SECTION NO. 1

FLOW RATE.W=1670. LBS/HR MASS VELOCITY.G= 164.3 LBS/SEC.SQFT POWER= 7.64 KILOWATTS HEAT FLUX.Q= 24429. BTU/HR.SQFT

REYNOLDS NO.= 57970. TEMPERATURE BEFORE FLASH= 274.9 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	25.31	244.2	242.6	1.63	241.8	0.76	32186.	1158.	27.80	27.01	.0354	0.859	4871.	.05377	0.434	0.0406	0.6571	1.51	0.0156	0.870	55.68	48.7	.9449	1.565	905.	0.0880	14435.	.00320	747.	0.353	4.335	4.175	2.095
0.25	25.59	246.4	244.7	1.63	241.3	3.43	7131.	1156.	6.17	5.99	.0366	0.828	1079.	.01191	0.434	0.0409	0.1459	1.51	0.0156	0.873	55.98	50.7	.9471	1.596	916.	0.0895	14675.	.00325	757.	0.360	4.430	4.254	2.135
0.50	25.37	246.6	245.0	1.63	240.9	4.11	5947.	1153.	5.16	5.00	.0378	0.801	900.	.00993	0.434	0.0412	0.1219	1.51	0.0156	0.878	56.41	52.6	.9491	1.625	927.	0.0909	14901.	.00329	767.	0.367	4.521	4.330	2.173
1.00	24.93	246.1	244.4	1.63	239.9	4.53	5393.	1149.	4.69	4.54	.0402	0.750	816.	.00901	0.434	0.0419	0.1110	1.52	0.0155	0.892	57.53	56.7	.9529	1.684	947.	0.0938	15359.	.00338	786.	0.380	4.704	4.482	2.252
1.50	24.49	245.2	243.6	1.63	238.9	4.68	5216.	1144.	4.56	4.40	.0427	0.703	789.	.00872	0.433	0.0426	0.1078	1.53	0.0154	0.910	58.91	61.0	.9564	1.745	968.	0.0966	15809.	.00347	804.	0.394	4.890	4.635	2.330
2.00	24.03	244.1	242.5	1.63	237.9	4.61	5295.	1139.	4.65	4.48	.0452	0.661	802.	.00885	0.433	0.0433	0.1100	1.54	0.0154	0.936	60.83	65.5	.9595	1.806	987.	0.0995	16262.	.00355	823.	0.408	5.079	4.789	2.411
2.50	23.54	242.9	241.3	1.63	236.7	4.55	5368.	1134.	4.73	4.55	.0478	0.621	813.	.00898	0.433	0.0442	0.1121	1.54	0.0153	0.976	63.68	70.4	.9624	1.871	1007.	0.1025	16725.	.00364	841.	0.422	5.273	4.947	2.493
3.00	23.01	241.7	240.0	1.63	235.5	4.53	5393.	1129.	4.78	4.58	.0505	0.584	817.	.00902	0.432	0.0451	0.1132	1.55	0.0153	1.058	69.30	75.7	.9652	1.939	1026.	0.1056	17208.	.00373	860.	0.436	5.477	5.113	2.580
3.50	22.46	240.3	238.7	1.63	234.2	4.55	5367.	1123.	4.78	4.57	.0533	0.549	813.	.00898	0.432	0.0461	0.1132	1.56	0.0152	1.155	75.97	81.5	.9678	2.010	1045.	0.1088	17703.	.00382	879.	0.452	5.689	5.283	2.670
4.00	21.84	238.9	237.3	1.63	232.7	4.60	5306.	1117.	4.75	4.54	.0562	0.515	804.	.00889	0.431	0.0473	0.1126	1.57	0.0151	1.259	83.18	88.1	.9703	2.089	1065.	0.1123	18236.	.00391	898.	0.468	5.916	5.465	2.766
4.50	21.19	237.2	235.6	1.64	231.0	4.59	5326.	1110.	4.80	4.57	.0593	0.483	807.	.00892	0.431	0.0487	0.1138	1.58	0.0151	1.368	90.77	95.3	.9727	2.173	1084.	0.1160	18788.	.00401	918.	0.485	6.156	5.656	2.868
5.00	20.43	235.2	233.6	1.64	229.1	4.54	5375.	1102.	4.88	4.63	.0627	0.451	814.	.00900	0.430	0.0503	0.1157	1.60	0.0150	1.480	98.66	104.0	.9751	2.272	1105.	0.1202	19410.	.00412	940.	0.505	6.426	5.870	2.982
5.50	19.71	232.5	230.9	1.64	227.2	3.70	6603.	1094.	6.03	5.71	.0660	0.422	1001.	.01106	0.430	0.0520	0.1433	1.62	0.0149	1.595	106.80	113.0	.9771	2.370	1125.	0.1244	20016.	.00423	961.	0.524	6.692	6.080	3.095

FORCED CONVECTION BOILING

RUN NO.104.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1670. LBS/HR MASS VELOCITY,G= 164.3 LBS/SEC.SQFT POWER= 7.60 KILOWATTS HEAT FLUX,Q= 24301. BTU/HR.SQFT

REYNOLDS NO.= 58005. TEMPERATURE BEFORE FLASH= 302.3 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	28.47	251.6	250.0	1.62	247.3	2.67	9109.	1147.	7.94	7.57	.0592	0.552	1378.	.01522	0.434	0.0369	0.1874	1.47	0.0149	0.967	64.89	72.8	.9639	1.842	1087.	0.1037	17040.	.00382	878.	0.441	5.671	5.269	2.663
0.25	28.22	252.6	251.0	1.62	246.8	4.19	5805.	1144.	5.07	4.83	.0604	0.539	878.	.00970	0.433	0.0372	0.1197	1.47	0.0149	0.997	67.03	74.9	.9650	1.868	1095.	0.1049	17223.	.00385	885.	0.447	5.755	5.336	2.698
0.50	27.97	252.4	250.8	1.62	246.3	4.46	5444.	1142.	4.77	4.53	.0617	0.527	824.	.00910	0.433	0.0375	0.1125	1.48	0.0148	1.028	69.25	77.0	.9660	1.893	1103.	0.1061	17406.	.00389	892.	0.453	5.838	5.403	2.734
1.00	27.43	251.3	249.7	1.62	245.2	4.49	5413.	1137.	4.76	4.51	.0642	0.502	819.	.00904	0.433	0.0381	0.1124	1.48	0.0148	1.093	73.92	81.5	.9680	1.948	1118.	0.1086	17787.	.00396	907.	0.465	6.012	5.542	2.808
1.50	26.87	250.1	248.5	1.62	244.1	4.39	5542.	1132.	4.89	4.63	.0668	0.479	839.	.00926	0.433	0.0389	0.1156	1.49	0.0147	1.162	78.91	86.2	.9698	2.004	1133.	0.1111	18177.	.00404	921.	0.478	6.191	5.684	2.884
2.00	26.27	248.8	247.2	1.62	242.8	4.35	5586.	1127.	4.96	4.68	.0695	0.456	845.	.00933	0.432	0.0397	0.1171	1.50	0.0147	1.235	84.23	91.5	.9717	2.065	1149.	0.1139	18589.	.00411	937.	0.491	6.381	5.835	2.964
2.50	25.62	247.4	245.8	1.62	241.4	4.35	5588.	1121.	4.98	4.69	.0724	0.434	846.	.00934	0.432	0.0406	0.1178	1.51	0.0146	1.312	89.89	97.3	.9735	2.131	1164.	0.1168	19027.	.00419	952.	0.506	6.582	5.994	3.050
3.00	24.93	245.9	244.2	1.62	239.9	4.33	5614.	1115.	5.03	4.73	.0753	0.412	850.	.00938	0.431	0.0417	0.1191	1.52	0.0145	1.395	96.03	103.7	.9752	2.201	1180.	0.1198	19486.	.00428	969.	0.521	6.793	6.159	3.139
3.50	24.22	244.2	242.6	1.62	238.3	4.34	5602.	1109.	5.05	4.73	.0783	0.392	848.	.00936	0.431	0.0428	0.1196	1.53	0.0145	1.483	102.55	110.6	.9769	2.275	1195.	0.1230	19953.	.00436	985.	0.536	7.014	6.332	3.233
4.00	23.47	242.5	240.8	1.62	236.6	4.27	5692.	1102.	5.17	4.83	.0814	0.372	862.	.00952	0.430	0.0441	0.1223	1.54	0.0144	1.582	109.90	118.3	.9784	2.355	1210.	0.1264	20445.	.00445	1001.	0.553	7.247	6.513	3.332
4.50	22.56	240.5	238.9	1.62	234.6	4.21	5778.	1094.	5.28	4.92	.0847	0.352	875.	.00967	0.430	0.0455	0.1251	1.56	0.0143	1.687	117.77	127.0	.9800	2.443	1226.	0.1300	20979.	.00454	1019.	0.570	7.499	6.709	3.439
5.00	21.77	238.2	236.6	1.63	232.5	4.08	5954.	1086.	5.48	5.09	.0882	0.332	902.	.00997	0.429	0.0472	0.1300	1.57	0.0143	1.811	127.08	137.1	.9816	2.542	1241.	0.1341	21569.	.00464	1038.	0.590	7.777	6.923	3.557
5.50	20.82	235.2	233.6	1.63	230.1	3.50	6948.	1077.	6.45	5.97	.0920	0.313	1053.	.01164	0.428	0.0492	0.1531	1.59	0.0142	1.970	138.95	148.7	.9831	2.654	1258.	0.1386	22205.	.00476	1058.	0.612	8.080	7.156	3.685

FORCED CONVECTION BOILING

RUN NO.105.0 WATER TEST SECTION NO. 1

FLOW RATE,W=1675. LBS/HR MASS VELOCITY,G= 164.8 LBS/SEC.SQFT POWER= 7.64 KILOWATTS HEAT FLUX,Q= 24426. BTU/HR.SQFT

REYNOLDS NO.= 58094. TEMPERATURE BEFORE FLASH= 320.9 F VELOCITY BEFORE FLASH= 2.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	30.27	255.4	253.8	1.62	250.8	2.96	8266.	1144.	7.23	6.78	.0759	0.446	1250.	.01369	0.436	0.0349	0.1704	1.45	0.0145	1.378	95.17	87.9	.9705	1.990	1192.	0.1121	18453.	.00416	948.	0.492	6.474	5.909	3.006
0.25	29.92	256.2	254.6	1.62	250.2	4.48	5456.	1140.	4.79	4.49	.0773	0.436	825.	.00905	0.435	0.0353	0.1129	1.46	0.0144	1.388	96.07	90.4	.9714	2.018	1199.	0.1133	18636.	.00420	955.	0.499	6.567	5.982	3.045
0.50	29.57	255.8	254.2	1.62	249.5	4.75	5145.	1137.	4.53	4.24	.0787	0.426	778.	.00854	0.435	0.0357	0.1068	1.46	0.0144	1.398	96.97	93.0	.9722	2.046	1205.	0.1146	18820.	.00423	962.	0.506	6.660	6.056	3.085
1.00	28.37	254.6	252.9	1.62	248.1	4.81	5081.	1130.	4.50	4.20	.0815	0.407	769.	.00846	0.435	0.0365	0.1061	1.46	0.0144	1.422	99.06	98.3	.9738	2.103	1218.	0.1171	19189.	.00430	974.	0.519	6.848	6.203	3.165
1.50	28.15	253.2	251.6	1.62	246.7	4.94	4944.	1123.	4.40	4.10	.0844	0.389	748.	.00824	0.434	0.0373	0.1039	1.47	0.0143	1.449	101.39	104.1	.9754	2.165	1232.	0.1198	19591.	.00438	989.	0.532	7.045	6.357	3.248
2.00	27.43	251.8	250.2	1.62	245.2	5.00	4884.	1117.	4.37	4.06	.0873	0.372	739.	.00814	0.434	0.0382	0.1032	1.48	0.0142	1.482	104.16	110.1	.9768	2.229	1245.	0.1226	20001.	.00446	1003.	0.546	7.245	6.512	3.333
2.50	26.68	250.3	248.7	1.63	243.7	4.99	4894.	1111.	4.40	4.08	.0903	0.356	741.	.00815	0.433	0.0392	0.1040	1.49	0.0142	1.522	107.47	116.7	.9782	2.297	1259.	0.1255	20429.	.00453	1017.	0.561	7.453	6.674	3.421
3.00	25.90	248.7	247.1	1.63	242.0	5.07	4819.	1105.	4.36	4.03	.0933	0.340	729.	.00803	0.433	0.0403	0.1031	1.51	0.0141	1.577	111.91	123.9	.9796	2.371	1272.	0.1286	20881.	.00462	1032.	0.576	7.674	6.845	3.515
3.50	25.10	247.0	245.4	1.63	240.3	5.09	4799.	1098.	4.37	4.03	.0964	0.324	726.	.00799	0.432	0.0415	0.1033	1.52	0.0140	1.647	117.47	131.6	.9809	2.448	1285.	0.1318	21352.	.00470	1048.	0.592	7.903	7.020	3.612
4.00	24.25	245.1	243.5	1.63	238.4	5.11	4778.	1091.	4.38	4.03	.0997	0.309	723.	.00796	0.432	0.0428	0.1037	1.53	0.0140	1.743	124.94	140.4	.9821	2.532	1299.	0.1353	21846.	.00479	1063.	0.609	8.149	7.209	3.717
4.50	23.34	243.0	241.4	1.63	236.3	5.14	4754.	1083.	4.39	4.03	.1031	0.293	720.	.00793	0.431	0.0444	0.1040	1.55	0.0139	1.882	135.59	150.3	.9834	2.625	1313.	0.1391	22380.	.00488	1080.	0.628	8.414	7.412	3.829
5.00	22.36	240.5	238.9	1.63	233.9	4.94	4940.	1074.	4.60	4.20	.1068	0.278	748.	.00824	0.430	0.0462	0.1090	1.56	0.0138	2.082	150.82	161.8	.9846	2.729	1327.	0.1432	22969.	.00498	1097.	0.648	8.707	7.634	3.953
5.50	21.25	237.2	235.6	1.64	231.2	4.38	5574.	1064.	5.24	4.77	.1108	0.262	844.	.00931	0.430	0.0484	0.1242	1.58	0.0137	2.367	172.45	175.8	.9859	2.853	1341.	0.1481	23648.	.00510	1117.	0.672	9.042	7.887	4.095

FORCED CONVECTION BOILING

RUN NO.106.0 WATER TEST SECTION NO. 1

FLOW RATE,W=2720. LBS/HR MASS VELOCITY,G= 267.7 LBS/SEC.SQFT POWER= 14.00 KILOWATTS HEAT FLUX,Q= 44778. BTU/HR.SQFT

REYNOLDS NO.= 93247. TEMPERATURE BEFORE FLASH= 228.4 F VELOCITY BEFORE FLASH= 3.4 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
1.50	21.49	252.0	249.1	2.98	231.8	17.26	2595.	1723.	1.51	1.50	.0013	16.066	393.	.00267	0.485	0.0541	0.0357	1.58	0.0393	0.	0.	7.8	.4186	0.478	389.	0.0262	6475.	.00089	337.	0.111	1.038	1.167	0.721
2.00	21.48	252.2	249.2	2.98	231.8	17.44	2567.	1721.	1.49	1.49	.0030	7.611	389.	.00264	0.485	0.0541	0.0354	1.58	0.0392	0.065	1.66	11.9	.6229	0.673	532.	0.0362	9110.	.00120	461.	0.142	1.395	1.538	0.873
2.50	21.44	251.8	248.8	2.98	231.7	17.15	2611.	1718.	1.52	1.51	.0047	5.025	396.	.00269	0.485	0.0542	0.0360	1.58	0.0390	0.111	2.84	16.3	.7240	0.814	632.	0.0434	11007.	.00142	549.	0.166	1.686	1.825	0.996
3.00	21.37	251.2	248.3	2.98	231.5	16.77	2670.	1715.	1.56	1.55	.0065	3.737	404.	.00275	0.485	0.0543	0.0369	1.58	0.0369	0.176	4.52	20.8	.7850	0.933	714.	0.0493	12593.	.00160	621.	0.187	1.948	2.077	1.108
3.50	21.26	250.5	247.5	2.98	231.2	16.28	2751.	1711.	1.61	1.60	.0084	2.949	417.	.00283	0.485	0.0546	0.0381	1.58	0.0398	0.267	6.88	25.8	.8264	1.041	787.	0.0547	14022.	.00176	685.	0.207	2.198	2.312	1.214
4.00	21.10	249.3	246.4	2.98	230.8	15.57	2876.	1707.	1.68	1.67	.0104	2.409	436.	.00296	0.485	0.0550	0.0400	1.59	0.0387	0.407	10.52	31.2	.8568	1.145	854.	0.0598	15368.	.00191	745.	0.227	2.445	2.539	1.319
4.50	20.81	247.5	244.5	2.98	230.0	14.47	3095.	1701.	1.82	1.80	.0128	1.984	469.	.00318	0.485	0.0557	0.0432	1.59	0.0385	0.650	16.87	37.7	.8819	1.257	923.	0.0651	16787.	.00206	806.	0.248	2.716	2.784	1.434
5.00	20.36	243.9	241.0	2.99	228.9	12.06	3713.	1693.	2.19	2.17	.0156	1.641	563.	.00382	0.484	0.0568	0.0521	1.60	0.0384	1.110	28.92	45.8	.9030	1.381	993.	0.0710	18313.	.00222	870.	0.271	3.017	3.052	1.562
5.50	19.79	240.0	237.0	3.00	227.4	9.63	4650.	1683.	2.76	2.72	.0188	1.368	705.	.00478	0.484	0.0583	0.0656	1.62	0.0332	0.	0.	55.5	.9204	1.517	1063.	0.0772	19916.	.00239	935.	0.297	3.344	3.338	1.701

FORCED CONVECTION BOILING

RUN NO.107.0 WATER TEST SECTION NO. 1

FLOW RATE,W=2745. LBS/HR MASS VELOCITY,G= 270.1 LBS/SEC.SQFT POWER= 14.24 KILOWATTS HEAT FLUX,Q= 45539. BTU/HR.SQFT

REYNOLDS NO.= 99257. TEMPERATURE BEFORE FLASH= 247.3 F VELOCITY BEFORE FLASH= 3.5 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	26.68	255.9	252.9	3.02	243.7	9.18	4960.	1774.	2.80	2.79	.0038	6.636	750.	.00504	0.493	0.0446	0.0660	1.49	0.0394	0.273	6.93	12.5	.6349	0.667	594.	0.0371	9549.	.00127	498.	0.140	1.490	1.633	0.918
0.25	26.62	259.7	256.7	3.02	243.6	13.13	3469.	1772.	1.96	1.95	.0048	5.405	525.	.00353	0.493	0.0447	0.0462	1.50	0.0393	0.278	7.07	14.5	.6862	0.733	646.	0.0405	10485.	.00138	542.	0.152	1.637	1.778	0.980
0.50	26.55	261.4	258.4	3.02	243.4	14.98	3040.	1770.	1.72	1.71	.0058	4.562	460.	.00309	0.493	0.0448	0.0406	1.50	0.0393	0.290	7.38	16.6	.7255	0.793	693.	0.0436	11327.	.00148	582.	0.163	1.773	1.911	1.038
1.00	26.40	261.6	258.6	3.02	243.1	15.47	2943.	1767.	1.67	1.66	.0078	3.483	445.	.00299	0.493	0.0451	0.0394	1.50	0.0391	0.323	8.25	20.8	.7815	0.898	775.	0.0491	12806.	.00165	651.	0.184	2.026	2.151	1.145
1.50	26.24	261.2	258.2	3.02	242.7	15.45	2948.	1763.	1.67	1.66	.0098	2.820	446.	.00300	0.493	0.0453	0.0395	1.50	0.0390	0.367	9.41	25.1	.8194	0.991	844.	0.0538	14094.	.00179	710.	0.202	2.258	2.368	1.244
2.00	26.13	260.5	257.5	3.02	242.5	14.99	3037.	1759.	1.73	1.71	.0117	2.396	460.	.00309	0.493	0.0455	0.0408	1.50	0.0389	0.427	10.98	29.2	.8449	1.069	902.	0.0578	15168.	.00191	759.	0.218	2.460	2.554	1.330
2.50	25.83	259.5	256.5	3.02	241.9	14.63	3113.	1754.	1.78	1.76	.0140	2.020	471.	.00316	0.492	0.0460	0.0420	1.51	0.0387	0.502	12.96	34.4	.8687	1.160	965.	0.0623	16391.	.00205	814.	0.236	2.697	2.768	1.431
3.00	25.57	258.1	255.1	3.02	241.3	13.84	3291.	1749.	1.88	1.86	.0162	1.757	498.	.00335	0.492	0.0464	0.0445	1.51	0.0386	0.607	15.73	39.4	.8859	1.241	1019.	0.0662	17461.	.00217	861.	0.253	2.912	2.960	1.522
3.50	25.18	256.4	253.4	3.02	240.5	12.97	3510.	1742.	2.01	1.98	.0187	1.529	531.	.00357	0.492	0.0471	0.0476	1.52	0.0384	0.750	19.51	45.4	.9013	1.329	1075.	0.0705	18604.	.00229	910.	0.271	3.147	3.167	1.622
4.00	24.74	254.5	251.5	3.03	239.5	12.00	3796.	1735.	2.19	2.15	.0214	1.343	575.	.00386	0.492	0.0479	0.0517	1.52	0.0383	0.920	24.03	52.0	.9140	1.418	1129.	0.0747	19736.	.00241	958.	0.289	3.386	3.376	1.724
4.50	24.21	252.3	249.3	3.03	238.3	11.00	4138.	1727.	2.40	2.35	.0243	1.184	626.	.00421	0.491	0.0488	0.0567	1.53	0.0381	1.076	28.22	59.5	.9251	1.513	1182.	0.0792	20906.	.00254	1006.	0.308	3.640	3.595	1.831
5.00	23.61	249.8	246.8	3.03	236.9	9.87	4614.	1717.	2.69	2.63	.0273	1.050	699.	.00469	0.491	0.0500	0.0636	1.54	0.0380	1.242	32.72	67.9	.9346	1.612	1234.	0.0837	22093.	.00266	1053.	0.328	3.903	3.820	1.943
5.50	22.98	247.1	244.1	3.04	235.4	8.64	5272.	1708.	3.09	3.01	.0304	0.938	798.	.00537	0.490	0.0512	0.0731	1.55	0.0378	0.	0.	77.0	.9425	1.713	1283.	0.0882	23270.	.00278	1100.	0.348	4.169	4.045	2.056

FORCED CONVECTION BOILING

RUN NO.108.0 WATER TEST SECTION NO. 1

FLOW RATE,W=2800. LBS/HR MASS VELOCITY,G= 275.5 LBS/SEC.SQFT POWER= 14.10 KILOWATTS HEAT FLUX,Q= 45091. BTU/HR.SQFT

REYNOLDS NO.= 109577. TEMPERATURE BEFORE FLASH= 280.7 F VELOCITY BEFORE FLASH= 3.6 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	37.52	270.4	267.4	2.97	263.6	3.88	11636.	1855.	6.27	6.18	.0187	1.834	1760.	.01152	0.486	0.0315	0.1473	1.37	0.0392	1.001	25.55	33.2	.8606	1.057	1090.	0.0601	16552.	.00212	867.	0.233	2.837	2.892	1.486
0.25	37.37	272.9	269.9	2.97	263.1	6.78	6647.	1851.	3.59	3.53	.0199	1.724	1005.	.00658	0.485	0.0317	0.0843	1.37	0.0391	1.018	26.03	35.3	.8691	1.090	1116.	0.0618	17019.	.00217	888.	0.240	2.936	2.981	1.528
0.50	37.12	273.8	270.8	2.97	262.7	8.09	5573.	1848.	3.02	2.97	.0211	1.626	843.	.00552	0.485	0.0319	0.0709	1.37	0.0390	1.042	26.70	37.4	.8767	1.122	1141.	0.0634	17472.	.00222	909.	0.248	3.033	3.067	1.570
1.00	36.53	274.0	271.0	2.97	261.9	9.15	4930.	1840.	2.68	2.63	.0237	1.455	746.	.00489	0.485	0.0324	0.0630	1.38	0.0389	1.111	28.57	41.9	.8901	1.186	1189.	0.0667	18365.	.00232	949.	0.263	3.229	3.239	1.653
1.50	36.02	272.8	269.9	2.97	261.0	8.92	5054.	1833.	2.76	2.70	.0263	1.313	764.	.00501	0.485	0.0328	0.0648	1.38	0.0387	1.194	30.83	46.5	.9014	1.249	1234.	0.0698	19225.	.00242	987.	0.277	3.423	3.407	1.735
2.00	35.37	271.5	268.5	2.97	259.9	8.65	5214.	1824.	2.86	2.79	.0290	1.189	788.	.00517	0.484	0.0334	0.0672	1.39	0.0386	1.307	33.88	51.7	.9115	1.315	1279.	0.0731	20106.	.00252	1025.	0.292	3.625	3.581	1.821
2.50	34.63	270.1	267.1	2.97	258.6	8.51	5296.	1815.	2.92	2.84	.0319	1.076	801.	.00526	0.484	0.0340	0.0686	1.40	0.0384	1.444	37.61	57.5	.9207	1.385	1324.	0.0765	21029.	.00262	1064.	0.308	3.839	3.764	1.912
3.00	33.86	268.6	265.6	2.98	257.3	8.31	5426.	1806.	3.00	2.92	.0349	0.981	820.	.00539	0.483	0.0348	0.0707	1.41	0.0382	1.610	42.13	63.6	.9287	1.457	1368.	0.0799	21940.	.00272	1101.	0.324	4.054	3.947	2.003
3.50	32.98	266.9	264.0	2.98	255.8	8.18	5515.	1797.	3.07	2.98	.0381	0.893	834.	.00547	0.483	0.0356	0.0723	1.42	0.0380	1.780	46.80	70.6	.9360	1.534	1411.	0.0835	22899.	.00282	1140.	0.341	4.283	4.139	2.100
4.00	32.06	265.1	262.1	2.98	254.1	8.02	5623.	1788.	3.15	3.04	.0415	0.815	850.	.00557	0.482	0.0366	0.0741	1.43	0.0378	1.988	52.53	78.3	.9425	1.616	1455.	0.0873	23895.	.00293	1180.	0.359	4.520	4.337	2.201
4.50	31.01	263.1	260.1	2.98	252.2	7.86	5738.	1778.	3.23	3.11	.0450	0.743	868.	.00567	0.482	0.0377	0.0761	1.45	0.0377	2.215	58.83	87.1	.9486	1.706	1499.	0.0914	24962.	.00304	1221.	0.378	4.776	4.549	2.309
5.00	29.87	260.6	257.6	2.99	250.1	7.58	5952.	1762.	3.38	3.25	.0488	0.677	900.	.00590	0.481	0.0390	0.0797	1.46	0.0375	2.466	65.85	97.3	.9542	1.801	1540.	0.0956	26030.	.00315	1260.	0.398	5.052	4.775	2.426
5.50	28.57	257.1	254.1	2.99	247.5	6.57	6865.	1744.	3.94	3.77	.0530	0.614	1038.	.00684	0.480	0.0407	0.0929	1.47	0.0372	2.750	73.86	109.5	.9595	1.908	1582.	0.1002	27202.	.00326	1302.	0.421	5.357	5.024	2.556

FORCED CONVECTION BOILING

RUN NO.109.0 WATER TEST SECTION NO. 1

FLOW RATE,W=2740. LBS/HR MASS VELOCITY,G= 269.6 LBS/SEC.SQFT POWER= 14.20 KILOWATTS HEAT FLUX,Q= 45402. BTU/HR.SQFT

REYNOLDS NO.= 110213. TEMPERATURE BEFORE FLASH= 309.0 F VELOCITY BEFORE FLASH= 3.6 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	44.46	279.0	276.0	2.98	273.7	2.35	19316.	1829.	10.56	10.23	.0390	0.998	2924.	.01949	0.503	0.0278	0.2473	1.31	0.0361	0.	0.	54.5	.9182	1.322	1422.	0.0760	20865.	.00273	1096.	0.314	4.033	3.932	2.006
0.25	44.03	281.1	278.1	2.98	273.1	5.03	9032.	1825.	4.95	4.79	.0405	0.960	1367.	.00911	0.503	0.0281	0.1159	1.31	0.0360	0.	0.	56.9	.9217	1.350	1441.	0.0774	21240.	.00277	1112.	0.321	4.125	4.010	2.045
0.50	43.62	281.0	278.0	2.98	272.5	5.49	8266.	1821.	4.54	4.39	.0420	0.925	1251.	.00833	0.503	0.0283	0.1063	1.31	0.0359	0.	0.	59.2	.9250	1.377	1459.	0.0787	21600.	.00281	1127.	0.328	4.215	4.086	2.083
1.00	42.73	280.3	277.4	2.98	271.2	6.13	7408.	1813.	4.09	3.94	.0450	0.859	1121.	.00747	0.502	0.0289	0.0958	1.32	0.0358	0.	0.	64.2	.9311	1.435	1496.	0.0815	22337.	.00290	1158.	0.342	4.404	4.244	2.163
1.50	41.75	279.3	276.4	2.98	269.8	6.55	6928.	1803.	3.84	3.69	.0481	0.797	1048.	.00699	0.502	0.0295	0.0901	1.33	0.0356	0.	0.	69.8	.9369	1.496	1532.	0.0845	23098.	.00299	1189.	0.356	4.602	4.409	2.247
2.00	40.65	278.2	275.2	2.98	268.2	7.01	6475.	1793.	3.61	3.46	.0515	0.739	980.	.00653	0.501	0.0302	0.0847	1.34	0.0354	0.	0.	76.1	.9424	1.563	1568.	0.0876	23901.	.00308	1221.	0.372	4.814	4.584	2.337
2.50	39.36	276.9	273.9	2.99	266.2	7.70	5897.	1779.	3.31	3.17	.0552	0.682	892.	.00595	0.501	0.0311	0.0778	1.35	0.0352	0.	0.	83.6	.9478	1.639	1605.	0.0912	24770.	.00318	1255.	0.389	5.051	4.778	2.437

FORCED CONVECTION BOILING

RUN NO.110.0 WATER TEST SECTION NO. 1

FLOW RATE,W=3330. LBS/HR MASS VELOCITY,G= 327.7 LBS/SEC.SQFT POWER= 14.22 KILOWATTS HEAT FLUX,Q= 45478. BTU/HR.SQFT

REYNOLDS NO.= 125527. TEMPERATURE BEFORE FLASH= 251.3 F VELOCITY BEFORE FLASH= 4.3 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	30.70	263.4	260.4	3.01	251.7	8.73	5207.	2117.	2.46	2.46	.0003	62.797	787.	.00433	0.408	0.0323	0.0580	1.45	0.0553	0.055	0.99	4.8	.1548	0.220	260.	0.0129	3823.	.00048	215.	0.058	0.631	0.717	0.503
0.25	30.69	266.0	263.0	3.01	251.6	11.42	3984.	2115.	1.88	1.88	.0004	57.712	602.	.00331	0.408	0.0323	0.0444	1.45	0.0553	0.102	1.85	6.4	.1284	0.228	270.	0.0133	3971.	.00049	222.	0.059	0.644	0.733	0.508
0.50	30.66	267.9	264.9	3.00	251.6	13.29	3423.	2114.	1.62	1.62	.0011	21.669	518.	.00285	0.408	0.0323	0.0382	1.45	0.0552	0.150	2.72	8.0	.3044	0.357	407.	0.0204	6222.	.00073	337.	0.080	0.861	0.982	0.601
0.75	30.63	268.1	265.1	3.00	251.5	13.62	3338.	2112.	1.58	1.58	.0018	13.629	505.	.00278	0.408	0.0323	0.0373	1.45	0.0551	0.200	3.63	9.6	.4229	0.442	494.	0.0249	7693.	.00088	409.	0.095	1.025	1.159	0.671
1.00	30.59	268.1	265.1	3.00	251.4	13.71	3317.	2110.	1.57	1.57	.0026	9.936	502.	.00276	0.408	0.0324	0.0371	1.45	0.0551	0.252	4.58	11.4	.5102	0.511	564.	0.0286	8888.	.00100	468.	0.108	1.170	1.310	0.732
1.50	30.47	267.6	264.6	3.00	251.2	13.38	3399.	2106.	1.61	1.61	.0042	6.455	514.	.00283	0.408	0.0325	0.0380	1.45	0.0549	0.363	6.61	14.9	.6276	0.623	675.	0.0345	10820.	.00119	560.	0.129	1.424	1.567	0.840
2.00	30.29	266.3	263.3	3.00	250.9	12.46	3649.	2101.	1.74	1.73	.0060	4.710	552.	.00304	0.408	0.0327	0.0409	1.45	0.0548	0.485	8.86	18.8	.7057	0.720	768.	0.0396	12488.	.00134	639.	0.149	1.661	1.799	0.941
2.50	30.02	265.0	262.0	3.01	250.3	11.62	3914.	2095.	1.87	1.86	.0079	3.646	592.	.00326	0.408	0.0329	0.0441	1.45	0.0546	0.612	11.21	23.2	.7620	0.812	853.	0.0443	14029.	.00149	710.	0.168	1.895	2.023	1.041
3.00	29.65	263.5	260.5	3.01	249.6	10.88	4181.	2087.	2.00	1.99	.0100	2.922	632.	.00349	0.408	0.0333	0.0473	1.46	0.0544	0.761	13.98	28.2	.8046	0.901	931.	0.0488	15513.	.00163	777.	0.187	2.131	2.244	1.141
3.50	29.17	262.0	259.0	3.01	248.7	10.24	4439.	2078.	2.14	2.12	.0123	2.396	672.	.00371	0.407	0.0338	0.0504	1.46	0.0542	0.917	16.91	34.0	.8380	0.992	1007.	0.0533	16974.	.00176	842.	0.206	2.375	2.468	1.245
4.00	28.63	260.3	257.3	3.01	247.7	9.60	4739.	2068.	2.29	2.26	.0148	2.011	717.	.00397	0.407	0.0344	0.0541	1.47	0.0540	1.085	20.08	40.3	.8638	1.080	1077.	0.0576	18382.	.00189	903.	0.225	2.618	2.689	1.348
4.50	28.07	258.4	255.4	3.02	246.5	8.85	5139.	2059.	2.50	2.46	.0173	1.723	777.	.00431	0.407	0.0350	0.0589	1.47	0.0538	1.270	23.59	47.0	.8837	1.167	1142.	0.0617	19729.	.00201	961.	0.244	2.858	2.903	1.450
5.00	27.45	256.2	253.2	3.02	245.3	7.97	5709.	2050.	2.79	2.74	.0200	1.496	864.	.00478	0.406	0.0358	0.0658	1.48	0.0536	1.472	27.45	54.4	.8998	1.255	1204.	0.0659	21056.	.00212	1016.	0.262	3.100	3.116	1.553
5.50	26.70	253.6	250.5	3.02	243.7	6.81	6678.	2039.	3.27	3.21	.0230	1.302	1010.	.00559	0.406	0.0367	0.0774	1.49	0.0534	1.690	31.64	63.1	.9139	1.350	1266.	0.0702	22457.	.00224	1073.	0.282	3.361	3.343	1.664

FORCED CONVECTION BOILING

RUN NO.111.0 WATER TEST SECTION NO. 1

FLOW RATE,W=3270. LBS/HR MASS VELOCITY,G= 321.8 LBS/SEC.SQFT POWER= 14.05 KILOWATTS HEAT FLUX,Q= 44944. BTU/HR.SQFT

REYNOLDS NO.= 129609. TEMPERATURE BEFORE FLASH= 273.7 F VELOCITY BEFORE FLASH= 4.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	38.13	271.0	268.0	2.96	264.4	3.68	12216.	2118.	5.77	5.72	.0102	3.214	1848.	.01035	0.415	0.0266	0.1354	1.36	0.0521	0.659	12.64	23.4	.7670	0.790	932.	0.0448	14247.	.00158	747.	0.172	2.032	2.152	1.103
0.25	37.96	275.1	272.1	2.96	264.1	8.05	5586.	2115.	2.64	2.62	.0111	2.952	845.	.00473	0.415	0.0267	0.0620	1.37	0.0521	0.688	13.21	25.2	.7838	0.823	964.	0.0465	14806.	.00163	774.	0.179	2.127	2.240	1.143
0.50	37.76	275.7	272.8	2.96	263.8	8.98	5003.	2112.	2.37	2.35	.0121	2.724	757.	.00424	0.414	0.0268	0.0556	1.37	0.0520	0.722	13.89	27.1	.7989	0.855	996.	0.0482	15354.	.00169	799.	0.187	2.221	2.327	1.183
0.75	37.60	275.5	272.5	2.96	263.5	9.02	4980.	2109.	2.36	2.34	.0131	2.528	753.	.00422	0.414	0.0269	0.0555	1.37	0.0519	0.758	14.60	29.0	.8123	0.886	1025.	0.0498	15879.	.00174	824.	0.194	2.313	2.412	1.222
1.00	37.41	275.0	272.0	2.96	263.2	8.83	5089.	2106.	2.42	2.39	.0142	2.356	770.	.00431	0.414	0.0271	0.0568	1.37	0.0518	0.800	15.43	30.9	.8243	0.917	1054.	0.0514	16393.	.00179	848.	0.201	2.404	2.496	1.261
1.50	37.01	274.1	271.1	2.96	262.6	8.58	5239.	2099.	2.50	2.46	.0162	2.069	792.	.00444	0.414	0.0273	0.0586	1.37	0.0517	0.897	17.36	34.9	.8449	0.976	1109.	0.0544	17379.	.00188	893.	0.215	2.584	2.658	1.338
2.00	36.54	273.1	270.1	2.96	261.8	8.34	5390.	2092.	2.58	2.54	.0184	1.832	815.	.00457	0.414	0.0277	0.0605	1.38	0.0515	1.005	19.52	39.3	.8625	1.036	1162.	0.0575	18360.	.00198	937.	0.229	2.767	2.823	1.416
2.50	36.01	272.1	269.1	2.96	260.9	8.20	5483.	2084.	2.63	2.59	.0207	1.634	829.	.00465	0.414	0.0280	0.0618	1.38	0.0513	1.165	22.70	44.0	.8776	1.097	1213.	0.0605	19329.	.00207	980.	0.243	2.953	2.988	1.495
3.00	35.39	270.9	267.9	2.96	259.9	8.00	5616.	2075.	2.71	2.66	.0232	1.463	849.	.00477	0.413	0.0285	0.0636	1.39	0.0511	1.340	26.20	49.3	.8910	1.160	1263.	0.0636	20319.	.00216	1022.	0.258	3.147	3.158	1.577
3.50	34.65	269.6	266.7	2.97	258.7	8.02	5605.	2066.	2.71	2.66	.0259	1.309	848.	.00476	0.413	0.0290	0.0638	1.40	0.0509	1.545	30.34	55.4	.9033	1.230	1315.	0.0670	21378.	.00226	1067.	0.274	3.358	3.341	1.666
4.00	33.78	268.1	265.2	2.97	257.2	8.01	5613.	2055.	2.73	2.67	.0288	1.171	849.	.00477	0.412	0.0297	0.0643	1.41	0.0507	1.785	35.20	62.4	.9145	1.305	1367.	0.0705	22493.	.00236	1113.	0.291	3.583	3.536	1.762
4.50	32.75	266.2	263.2	2.97	255.4	7.85	5724.	2043.	2.80	2.73	.0321	1.046	866.	.00486	0.412	0.0306	0.0660	1.42	0.0505	2.085	41.32	70.6	.9248	1.388	1421.	0.0744	23706.	.00247	1162.	0.309	3.831	3.747	1.867
5.00	31.58	263.8	260.8	2.97	253.3	7.57	5940.	2031.	2.92	2.84	.0356	0.933	898.	.00503	0.411	0.0316	0.0689	1.44	0.0502	2.430	48.39	80.4	.9343	1.483	1477.	0.0787	25028.	.00259	1214.	0.330	4.102	3.976	1.982
5.50	30.32	260.9	257.9	2.98	250.9	7.00	6417.	2015.	3.18	3.08	.0394	0.834	970.	.00544	0.411	0.0328	0.0751	1.45	0.0500	2.800	56.05	91.6	.9426	1.583	1531.	0.0832	26372.	.00270	1265.	0.351	4.389	4.216	2.104

FORCED CONVECTION BOILING

RUN NO.112.0 WATER TEST SECTION NO. 1

FLOW RATE.W=3363. LBS/HR MASS VELOCITY.G= 330.9 LBS/SEC.SQFT POWER= 9.62 KILOWATTS HEAT FLUX.Q= 30752. BTU/HR.SQFT

REYNOLDS NO.= 127436. TEMPERATURE BEFORE FLASH= 258.3 F VELOCITY BEFORE FLASH= 4.3 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	31.92	259.9	257.9	2.04	253.9	3.99	7714.	2132.	3.62	3.60	.0048	5.864	1166.	.00636	0.274	0.0208	0.0852	1.43	0.0557	0.417	7.49	15.9	.6473	0.569	636.	0.0318	10134.	.00114	529.	0.123	1.357	1.499	0.735
0.25	31.82	262.1	260.1	2.04	253.7	6.37	4828.	2130.	2.27	2.26	.0054	5.219	730.	.00398	0.274	0.0209	0.0534	1.43	0.0556	0.450	8.09	17.3	.6765	0.600	667.	0.0335	10688.	.00120	555.	0.131	1.444	1.585	0.772
0.50	31.70	262.7	260.7	2.03	253.5	7.19	4278.	2129.	2.01	2.00	.0061	4.678	647.	.00353	0.274	0.0210	0.0474	1.44	0.0556	0.486	8.74	18.9	.7029	0.632	698.	0.0352	11238.	.00125	581.	0.138	1.533	1.671	0.810
0.75	31.53	262.7	260.7	2.03	253.3	7.42	4142.	2127.	1.95	1.94	.0068	4.241	626.	.00341	0.274	0.0210	0.0459	1.44	0.0555	0.523	9.42	20.4	.7255	0.662	726.	0.0367	11754.	.00130	605.	0.145	1.618	1.753	0.846
1.00	31.46	262.6	260.6	2.03	253.0	7.55	4072.	2125.	1.92	1.90	.0075	3.880	616.	.00335	0.274	0.0211	0.0452	1.44	0.0555	0.560	10.10	21.9	.7451	0.690	753.	0.0382	12242.	.00135	628.	0.151	1.700	1.831	0.881
1.50	31.16	262.2	260.1	2.04	252.5	7.64	4023.	2121.	1.90	1.88	.0090	3.278	608.	.00331	0.273	0.0213	0.0447	1.44	0.0553	0.641	11.58	25.4	.7798	0.748	806.	0.0411	13227.	.00144	673.	0.165	1.870	1.991	0.953
2.00	30.83	261.5	259.5	2.04	251.9	7.57	4064.	2116.	1.92	1.90	.0106	2.823	614.	.00334	0.273	0.0215	0.0453	1.45	0.0552	0.727	13.17	29.0	.8077	0.804	856.	0.0440	14165.	.00153	716.	0.178	2.037	2.147	1.024
2.50	30.45	260.7	258.7	2.04	251.2	7.51	4097.	2109.	1.94	1.92	.0122	2.454	620.	.00338	0.273	0.0218	0.0458	1.45	0.0551	0.822	14.92	33.0	.8316	0.861	903.	0.0468	15094.	.00162	757.	0.192	2.210	2.306	1.097
3.00	30.02	259.7	257.7	2.04	250.3	7.35	4185.	2101.	1.99	1.97	.0140	2.154	633.	.00345	0.273	0.0221	0.0470	1.45	0.0549	0.925	16.83	37.4	.8517	0.917	950.	0.0496	16012.	.00170	798.	0.205	2.385	2.465	1.172
3.50	29.52	258.8	256.8	2.04	249.4	7.40	4158.	2092.	1.99	1.96	.0159	1.902	629.	.00344	0.273	0.0224	0.0469	1.46	0.0548	1.037	18.92	42.4	.8693	0.976	995.	0.0524	16944.	.00179	838.	0.219	2.568	2.630	1.250
4.00	28.97	257.7	255.6	2.04	248.3	7.29	4219.	2082.	2.03	2.00	.0180	1.691	638.	.00350	0.273	0.0228	0.0478	1.46	0.0546	1.162	21.26	47.7	.8843	1.035	1039.	0.0552	17873.	.00187	877.	0.234	2.755	2.796	1.329
4.50	28.35	256.1	254.1	2.04	247.1	7.02	4383.	2073.	2.11	2.08	.0202	1.506	663.	.00364	0.272	0.0232	0.0499	1.47	0.0545	1.298	23.83	53.9	.8978	1.099	1084.	0.0583	18853.	.00196	918.	0.249	2.955	2.972	1.414
5.00	27.63	254.3	252.2	2.04	245.7	6.56	4691.	2063.	2.27	2.23	.0226	1.343	710.	.00389	0.272	0.0238	0.0537	1.48	0.0543	1.447	26.65	60.9	.9098	1.168	1129.	0.0615	19881.	.00205	960.	0.265	3.166	3.157	1.504
5.50	26.87	251.8	249.8	2.05	244.1	5.67	5426.	2053.	2.64	2.59	.0251	1.202	821.	.00450	0.272	0.0244	0.0624	1.49	0.0541	1.610	29.75	68.8	.9205	1.241	1174.	0.0648	20948.	.00214	1002.	0.282	3.390	3.349	1.599

FORCED CONVECTION BOILING

RUN NO.113.0 WATER TEST SECTION NO. 1

FLOW RATE.W=3390. LBS/HR MASS VELOCITY.G= 333.6 LBS/SEC.SQFT POWER= 9.69 KILOWATTS HEAT FLUX.Q= 31001. BTU/HR.SQFT

REYNOLDS NO.= 132588. TEMPERATURE BEFORE FLASH= 270.1 F VELOCITY BEFORE FLASH= 4.4 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	36.39	266.4	264.4	2.05	261.6	2.79	11093.	2168.	5.12	5.08	.0093	3.403	1678.	.00908	0.275	0.0185	0.1202	1.38	0.0558	0.814	14.60	23.5	.7595	0.696	823.	0.0393	12858.	.00142	671.	0.159	1.832	1.956	0.938
0.25	36.18	268.6	266.6	2.05	261.2	5.34	5809.	2165.	2.68	2.66	.0102	3.143	879.	.00476	0.275	0.0186	0.0631	1.38	0.0557	0.825	14.81	25.2	.7757	0.723	849.	0.0407	13333.	.00146	693.	0.166	1.917	2.036	0.974
0.50	35.98	268.9	266.8	2.05	260.9	5.93	5227.	2162.	2.42	2.40	.0110	2.924	790.	.00428	0.275	0.0187	0.0568	1.38	0.0556	0.842	15.14	26.8	.7898	0.749	874.	0.0420	13778.	.00151	714.	0.172	1.998	2.111	1.008
0.75	35.76	268.7	266.6	2.05	260.5	6.11	5076.	2159.	2.35	2.33	.0118	2.726	768.	.00416	0.275	0.0188	0.0553	1.39	0.0556	0.863	15.53	28.6	.8029	0.775	898.	0.0433	14225.	.00155	734.	0.179	2.080	2.187	1.043
1.00	35.53	268.4	266.4	2.05	260.2	6.21	4992.	2156.	2.32	2.29	.0127	2.550	755.	.00409	0.275	0.0189	0.0544	1.39	0.0555	0.886	15.97	30.4	.8148	0.801	922.	0.0447	14664.	.00159	754.	0.185	2.163	2.263	1.078
1.50	35.06	267.7	265.7	2.05	259.4	6.34	4893.	2149.	2.28	2.25	.0144	2.250	740.	.00401	0.275	0.0191	0.0535	1.39	0.0553	0.947	17.11	34.2	.8358	0.852	967.	0.0472	15526.	.00167	793.	0.198	2.327	2.412	1.148
2.00	34.56	266.9	264.9	2.05	258.5	6.36	4874.	2142.	2.27	2.25	.0163	2.005	737.	.00399	0.275	0.0194	0.0535	1.40	0.0552	1.028	18.63	38.2	.8535	0.902	1011.	0.0498	16367.	.00175	831.	0.210	2.491	2.560	1.218
2.50	34.02	265.9	263.9	2.05	257.6	6.27	4941.	2135.	2.31	2.28	.0181	1.799	747.	.00405	0.275	0.0197	0.0544	1.40	0.0550	1.130	20.53	42.6	.8687	0.953	1053.	0.0523	17198.	.00183	867.	0.223	2.656	2.708	1.288
3.00	33.43	264.8	262.8	2.05	256.6	6.18	5013.	2128.	2.36	2.32	.0201	1.623	758.	.00411	0.274	0.0200	0.0554	1.41	0.0549	1.257	22.91	47.3	.8821	1.004	1094.	0.0548	18031.	.00190	903.	0.236	2.825	2.858	1.360
3.50	32.80	263.6	261.6	2.05	255.5	6.09	5090.	2120.	2.40	2.36	.0222	1.470	770.	.00417	0.274	0.0203	0.0565	1.42	0.0547	1.417	25.90	52.4	.8939	1.058	1134.	0.0573	18877.	.00198	938.	0.249	2.999	3.011	1.434
4.00	32.05	262.3	260.2	2.05	254.1	6.10	5085.	2112.	2.41	2.36	.0246	1.327	769.	.00416	0.274	0.0208	0.0567	1.43	0.0545	1.605	29.43	58.5	.9052	1.118	1177.	0.0602	19808.	.00206	977.	0.264	3.192	3.179	1.516
4.50	31.21	260.6	258.6	2.05	252.6	6.00	5170.	2104.	2.46	2.40	.0271	1.199	782.	.00422	0.274	0.0213	0.0579	1.44	0.0543	1.825	33.58	65.3	.9154	1.183	1220.	0.0632	20783.	.00215	1017.	0.279	3.396	3.355	1.603
5.00	30.21	258.6	256.6	2.06	250.7	5.85	5303.	2089.	2.54	2.48	.0299	1.076	802.	.00434	0.273	0.0219	0.0598	1.45	0.0541	2.075	38.33	73.7	.9253	1.256	1264.	0.0665	21841.	.00224	1058.	0.296	3.629	3.554	1.701
5.50	29.11	256.0	253.9	2.06	248.6	5.32	5825.	2072.	2.81	2.74	.0330	0.966	881.	.00479	0.273	0.0227	0.0663	1.46	0.0539	2.358	43.73	83.4	.9342	1.334	1307.	0.0700	22939.	.00234	1100.	0.315	3.878	3.766	1.808

FORCED CONVECTION BOILING

RUN NO.114.0 WATER TEST SECTION NO. 1

FLOW RATE,W=3292. LBS/HR MASS VELOCITY,G= 324.0 LBS/SEC.SQFT POWER= 5.08 KILOWATTS HEAT FLUX,Q= 16246. BTU/HR.SQFT

REYNOLDS NO.= 121155. TEMPERATURE BEFORE FLASH= 254.0 F VELOCITY BEFORE FLASH= 4.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	28.31	251.0	250.0	1.08	248.0	1.94	8355.	2065.	4.05	4.03	.0064	4.340	1264.	.00708	0.147	0.0124	0.0955	1.46	0.0337	0.627	11.67	20.2	.7289	0.561	580.	0.0310	9668.	.00115	497.	0.134	1.471	1.606	0.711
0.25	28.64	252.2	251.1	1.08	247.7	3.47	4683.	2062.	2.27	2.26	.0070	3.983	708.	.00397	0.147	0.0124	0.0536	1.47	0.0337	0.632	11.77	21.7	.7479	0.585	600.	0.0322	10057.	.00119	515.	0.141	1.549	1.681	0.744
0.50	28.48	252.3	251.2	1.08	247.4	3.85	4216.	2060.	2.05	2.03	.0076	3.691	638.	.00357	0.147	0.0125	0.0483	1.47	0.0337	0.638	11.89	23.1	.7640	0.607	619.	0.0333	10416.	.00123	531.	0.147	1.622	1.750	0.775
0.75	28.33	252.1	251.1	1.08	247.1	4.02	4043.	2058.	1.96	1.95	.0081	3.448	612.	.00343	0.147	0.0126	0.0464	1.47	0.0536	0.645	12.03	24.6	.7778	0.627	636.	0.0343	10747.	.00126	546.	0.152	1.691	1.815	0.804
1.00	28.17	252.0	250.9	1.08	246.7	4.16	3902.	2056.	1.90	1.89	.0087	3.227	590.	.00331	0.147	0.0126	0.0448	1.47	0.0536	0.653	12.19	26.0	.7907	0.647	653.	0.0354	11080.	.00130	561.	0.158	1.760	1.880	0.834
1.50	27.84	251.6	250.5	1.08	246.1	4.43	3665.	2051.	1.79	1.77	.0099	2.855	554.	.00311	0.147	0.0128	0.0422	1.48	0.0535	0.673	12.58	29.1	.8131	0.687	685.	0.0374	11723.	.00136	590.	0.168	1.897	2.008	0.892
2.00	27.50	251.1	250.0	1.08	245.4	4.67	3477.	2046.	1.70	1.68	.0111	2.555	526.	.00295	0.147	0.0129	0.0401	1.48	0.0534	0.698	13.07	32.3	.8319	0.726	715.	0.0393	12340.	.00142	617.	0.179	2.032	2.132	0.949
2.50	27.12	250.5	249.4	1.08	244.6	4.85	3347.	2041.	1.64	1.62	.0124	2.296	506.	.00284	0.147	0.0131	0.0387	1.49	0.0533	0.730	13.69	35.9	.8488	0.766	746.	0.0412	12967.	.00148	644.	0.190	2.171	2.259	1.008
3.00	26.78	249.8	248.7	1.08	243.9	4.80	3385.	2036.	1.66	1.64	.0137	2.096	512.	.00287	0.147	0.0132	0.0393	1.49	0.0532	0.769	14.45	39.3	.8620	0.802	772.	0.0430	13526.	.00154	669.	0.199	2.298	2.374	1.062
3.50	26.40	248.9	247.8	1.08	243.1	4.76	3415.	2031.	1.68	1.66	.0150	1.912	517.	.00289	0.147	0.0134	0.0397	1.50	0.0531	0.825	15.53	43.1	.8745	0.841	799.	0.0448	14118.	.00160	694.	0.210	2.434	2.496	1.120
4.00	25.98	247.9	246.8	1.08	242.2	4.67	3478.	2025.	1.72	1.69	.0164	1.746	526.	.00295	0.147	0.0136	0.0406	1.50	0.0530	0.910	17.17	47.3	.8859	0.881	827.	0.0468	14728.	.00165	719.	0.221	2.577	2.623	1.181
4.50	25.47	246.8	245.8	1.08	241.1	4.69	3465.	2018.	1.72	1.69	.0181	1.587	524.	.00294	0.146	0.0139	0.0406	1.51	0.0529	1.077	20.37	52.3	.8971	0.927	856.	0.0489	15404.	.00172	747.	0.233	2.736	2.765	1.249
5.00	24.87	245.2	244.2	1.08	239.8	4.39	3699.	2010.	1.84	1.81	.0199	1.436	560.	.00313	0.146	0.0142	0.0435	1.52	0.0527	1.368	25.93	58.3	.9078	0.978	887.	0.0512	16146.	.00179	777.	0.246	2.915	2.921	1.325
5.50	24.09	243.0	241.9	1.08	238.0	3.95	4111.	1999.	2.06	2.02	.0223	1.279	622.	.00349	0.146	0.0146	0.0487	1.53	0.0526	1.744	33.16	66.2	.9191	1.042	923.	0.0541	17051.	.00187	813.	0.263	3.137	3.114	1.419

FORCED CONVECTION BOILING

RUN NO.115.0 WATER TEST SECTION NO. 1

FLOW RATE,W=3265. LBS/HR MASS VELOCITY,G= 321.3 LBS/SEC.SQFT POWER= 5.01 KILOWATTS HEAT FLUX,Q= 16015. BTU/HR.SQFT

REYNOLDS NO.= 127448. TEMPERATURE BEFORE FLASH= 276.8 F VELOCITY BEFORE FLASH= 4.2 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	36.93	264.1	263.1	1.06	262.4	0.64	25085.	2097.	11.96	11.81	.0156	2.141	3794.	.02131	0.148	0.0098	0.2810	1.38	0.0516	1.333	25.84	33.8	.8399	0.709	811.	0.0401	12799.	.00153	667.	0.194	2.268	2.348	1.050
0.25	36.64	265.0	263.9	1.06	262.0	1.95	8218.	2094.	3.92	3.87	.0164	2.044	1243.	.00698	0.148	0.0098	0.0922	1.38	0.0515	1.337	25.94	35.4	.8472	0.726	825.	0.0410	13073.	.00156	679.	0.199	2.335	2.408	1.079
0.50	36.35	264.9	263.8	1.06	261.5	2.33	6877.	2090.	3.29	3.24	.0171	1.955	1040.	.00584	0.148	0.0099	0.0773	1.38	0.0515	1.347	26.16	37.0	.8540	0.743	838.	0.0419	13343.	.00159	691.	0.204	2.401	2.467	1.107
0.75	36.06	264.6	263.6	1.06	261.0	2.57	6235.	2087.	2.99	2.94	.0179	1.873	943.	.00530	0.148	0.0100	0.0702	1.38	0.0514	1.358	26.40	38.6	.8603	0.759	851.	0.0427	13607.	.00162	703.	0.209	2.466	2.525	1.134
1.00	35.77	264.4	263.3	1.06	260.6	2.79	5743.	2083.	2.76	2.72	.0186	1.798	869.	.00488	0.148	0.0101	0.0648	1.39	0.0514	1.373	26.71	40.3	.8661	0.776	864.	0.0435	13867.	.00164	714.	0.214	2.531	2.583	1.162
1.50	35.19	263.8	262.7	1.06	259.6	3.11	5149.	2077.	2.48	2.44	.0201	1.661	779.	.00438	0.147	0.0102	0.0583	1.39	0.0513	1.405	27.39	43.7	.8768	0.809	889.	0.0451	14381.	.00170	737.	0.223	2.660	2.697	1.217
2.00	34.60	262.9	261.9	1.06	258.6	3.29	4868.	2070.	2.35	2.31	.0217	1.539	736.	.00414	0.147	0.0104	0.0553	1.40	0.0512	1.448	28.29	47.3	.8865	0.842	914.	0.0468	14898.	.00175	759.	0.233	2.791	2.813	1.272
2.50	33.97	262.0	260.9	1.06	257.5	3.40	4713.	2063.	2.28	2.24	.0233	1.428	713.	.00401	0.147	0.0106	0.0537	1.40	0.0511	1.502	29.42	51.2	.8954	0.877	938.	0.0485	15426.	.00180	781.	0.243	2.926	2.931	1.330
3.00	33.22	260.8	259.8	1.06	256.2	3.55	4509.	2055.	2.19	2.15	.0252	1.318	682.	.00384	0.147	0.0108	0.0516	1.41	0.0509	1.582	31.06	55.9	.9044	0.917	964.	0.0503	16016.	.00186	805.	0.255	3.079	3.064	1.395
3.50	32.37	259.5	258.5	1.06	254.7	3.79	4228.	2047.	2.07	2.02	.0273	1.210	639.	.00359	0.147	0.0110	0.0486	1.43	0.0508	1.758	34.61	61.4	.9133	0.962	993.	0.0525	16682.	.00193	832.	0.267	3.250	3.212	1.468
4.00	31.44	258.0	257.0	1.06	253.0	3.95	4053.	2038.	1.99	1.94	.0295	1.110	613.	.00344	0.147	0.0113	0.0469	1.44	0.0506	1.928	38.07	67.7	.9216	1.012	1023.	0.0548	17392.	.00199	861.	0.281	3.434	3.370	1.546
4.50	30.43	256.3	255.2	1.06	251.1	4.11	3899.	2026.	1.92	1.87	.0320	1.016	590.	.00331	0.147	0.0117	0.0454	1.45	0.0505	2.065	40.89	74.9	.9294	1.065	1052.	0.0572	18133.	.00207	890.	0.295	3.634	3.539	1.631
5.00	29.38	254.2	253.1	1.06	249.1	4.03	3975.	2011.	1.98	1.92	.0345	0.931	601.	.00339	0.146	0.0121	0.0466	1.46	0.0503	2.173	43.17	83.0	.9365	1.121	1080.	0.0597	18875.	.00213	917.	0.311	3.844	3.717	1.720
5.50	28.27	251.4	250.3	1.07	246.9	3.40	4704.	1996.	2.36	2.29	.0373	0.852	712.	.00402	0.146	0.0125	0.0556	1.47	0.0502	2.257	44.99	92.3	.9431	1.181	1109.	0.0623	19676.	.00221	947.	0.327	4.068	3.904	1.815

FORCED CONVECTION BOILING

RUN NO.116.0 WATER TEST SECTION NO. 1

FLOW RATE.W=2750. LBS/HR MASS VELOCITY.G= 270.6 LBS/SEC.SQFT POWER= 5.22 KILOWATTS HEAT FLUX.Q= 16709. BTU/HR.SQFT

REYNOLDS NO.= 95490. TEMPERATURE BEFORE FLASH= 242.2 F VELOCITY BEFORE FLASH= 3.5 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	23.10	239.9	238.8	1.12	235.7	3.08	5432.	1744.	3.11	3.10	.0069	3.649	823.	.00552	0.180	0.0187	0.0737	1.55	0.0395	0.462	11.69	20.9	.7833	0.685	554.	0.0371	9629.	.00134	486.	0.154	1.666	1.794	0.812
0.25	22.97	241.1	240.0	1.12	235.4	4.60	3632.	1742.	2.08	2.07	.0075	3.368	550.	.00369	0.180	0.0188	0.0494	1.55	0.0395	0.463	11.73	22.5	.7985	0.711	572.	0.0385	9990.	.00138	502.	0.160	1.747	1.871	0.847
0.50	22.86	241.4	240.3	1.12	235.1	5.13	3258.	1740.	1.87	1.86	.0081	3.138	493.	.00331	0.180	0.0189	0.0443	1.55	0.0395	0.464	11.76	24.0	.8112	0.736	589.	0.0397	10320.	.00142	517.	0.166	1.823	1.942	0.879
0.75	22.74	241.4	240.3	1.12	234.9	5.41	3090.	1739.	1.78	1.76	.0087	2.937	468.	.00314	0.179	0.0189	0.0421	1.56	0.0394	0.467	11.85	25.5	.8225	0.760	604.	0.0409	10638.	.00146	531.	0.172	1.897	2.010	0.911
1.00	22.62	241.3	240.2	1.12	234.6	5.64	2963.	1737.	1.71	1.69	.0093	2.757	449.	.00301	0.179	0.0190	0.0404	1.56	0.0394	0.472	11.98	27.1	.8329	0.783	620.	0.0420	10952.	.00150	545.	0.178	1.971	2.079	0.942
1.50	22.39	241.1	240.0	1.12	234.0	5.98	2795.	1733.	1.61	1.60	.0105	2.459	423.	.00284	0.179	0.0192	0.0382	1.56	0.0393	0.483	12.28	30.2	.8504	0.828	648.	0.0442	11543.	.00157	571.	0.189	2.113	2.209	1.002
2.00	22.15	240.7	239.6	1.12	233.4	6.20	2695.	1729.	1.56	1.54	.0117	2.217	408.	.00274	0.179	0.0194	0.0369	1.57	0.0393	0.502	12.79	33.4	.8651	0.872	675.	0.0463	12106.	.00163	596.	0.200	2.251	2.335	1.061
2.50	21.90	240.2	239.1	1.12	232.8	6.31	2650.	1726.	1.54	1.52	.0129	2.015	401.	.00269	0.179	0.0196	0.0364	1.57	0.0392	0.531	13.55	36.8	.8776	0.914	700.	0.0484	12654.	.00170	620.	0.210	2.388	2.459	1.119
3.00	21.62	239.6	238.5	1.12	232.1	6.38	2618.	1721.	1.52	1.50	.0142	1.837	397.	.00266	0.179	0.0198	0.0361	1.58	0.0391	0.572	14.62	40.4	.8888	0.957	725.	0.0504	13206.	.00176	643.	0.221	2.528	2.584	1.179
3.50	21.33	238.9	237.8	1.12	231.4	6.42	2601.	1717.	1.52	1.59	.0156	1.678	394.	.00265	0.179	0.0201	0.0359	1.58	0.0390	0.632	16.19	44.4	.8989	1.003	750.	0.0526	13769.	.00182	667.	0.232	2.674	2.714	1.241
4.00	20.95	238.1	236.9	1.12	230.5	6.43	2599.	1711.	1.52	1.50	.0171	1.531	394.	.00264	0.179	0.0204	0.0360	1.59	0.0390	0.710	18.22	48.9	.9084	1.051	776.	0.0548	14363.	.00189	691.	0.244	2.831	2.852	1.308
4.50	20.61	237.0	235.9	1.12	229.5	6.34	2636.	1706.	1.55	1.52	.0187	1.399	399.	.00268	0.179	0.0207	0.0367	1.60	0.0339	0.795	20.44	53.9	.9171	1.102	803.	0.0572	14980.	.00196	716.	0.256	2.996	2.996	1.378
5.00	20.13	235.6	234.5	1.12	228.4	6.03	2769.	1699.	1.63	1.60	.0204	1.279	420.	.00282	0.179	0.0211	0.0387	1.61	0.0328	0.885	22.81	59.5	.9251	1.157	829.	0.0597	15625.	.00203	742.	0.269	3.170	3.147	1.452
5.50	19.72	233.8	232.7	1.12	227.2	5.49	3043.	1692.	1.80	1.77	.0223	1.167	461.	.00309	0.179	0.0216	0.0427	1.62	0.0387	0.981	25.33	65.9	.9325	1.216	856.	0.0623	16304.	.00211	769.	0.283	3.357	3.308	1.531

FORCED CONVECTION BOILING

RUN NO.117.0 WATER TEST SECTION NO. 1

FLOW RATE.W=2763. LBS/HR MASS VELOCITY.G= 271.9 LBS/SEC.SQFT POWER= 5.20 KILOWATTS HEAT FLUX.Q= 16645. BTU/HR.SQFT

REYNOLDS NO.= 103338. TEMPERATURE BEFORE FLASH= 270.3 F VELOCITY BEFORE FLASH= 3.6 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	31.92	255.6	254.5	1.10	253.9	0.67	24874.	1803.	13.80	13.60	.0177	1.785	3761.	.02496	0.180	0.0137	0.3250	1.43	0.0386	0.865	22.41	35.8	.8731	0.847	795.	0.0475	12790.	.00179	662.	0.218	2.574	2.625	1.199
0.25	31.70	256.7	255.6	1.10	253.5	2.12	7859.	1801.	4.36	4.30	.0185	1.716	1188.	.00788	0.180	0.0138	0.1028	1.44	0.0386	0.883	22.90	37.3	.8782	0.864	807.	0.0484	13029.	.00182	672.	0.223	2.639	2.682	1.227
0.50	31.47	256.7	255.6	1.10	253.1	2.56	6490.	1799.	3.61	3.55	.0192	1.650	981.	.00651	0.180	0.0139	0.0850	1.44	0.0365	0.904	23.47	38.9	.8832	0.882	819.	0.0493	13271.	.00185	683.	0.228	2.704	2.740	1.254
0.75	31.24	256.5	255.4	1.10	252.6	2.75	6051.	1797.	3.37	3.31	.0200	1.588	915.	.00606	0.180	0.0140	0.0794	1.44	0.0385	0.928	24.12	40.4	.8878	0.900	830.	0.0502	13510.	.00188	693.	0.233	2.769	2.797	1.282
1.00	31.00	256.3	255.2	1.10	252.2	2.99	5576.	1794.	3.11	3.06	.0207	1.529	843.	.00558	0.180	0.0141	0.0732	1.45	0.0384	0.954	24.82	42.1	.8923	0.918	842.	0.0511	13751.	.00190	704.	0.238	2.835	2.855	1.310
1.50	30.50	255.7	254.6	1.10	251.3	3.33	4997.	1788.	2.79	2.74	.0223	1.418	756.	.00501	0.180	0.0143	0.0659	1.45	0.0384	1.014	26.43	45.6	.9007	0.956	865.	0.0529	14234.	.00196	724.	0.248	2.972	2.975	1.368
2.00	29.97	255.0	253.9	1.11	250.2	3.62	4603.	1780.	2.59	2.54	.0240	1.317	696.	.00463	0.180	0.0146	0.0610	1.46	0.0383	1.090	28.48	49.4	.9086	0.994	887.	0.0548	14720.	.00202	745.	0.259	3.113	3.098	1.428
2.50	29.38	254.0	252.9	1.11	249.1	3.80	4384.	1772.	2.47	2.42	.0258	1.221	663.	.00442	0.180	0.0148	0.0584	1.46	0.0382	1.191	31.19	53.6	.9160	1.034	910.	0.0567	15231.	.00208	766.	0.270	3.264	3.228	1.492
3.00	28.75	252.8	251.7	1.11	247.9	3.84	4336.	1763.	2.46	2.40	.0276	1.134	656.	.00438	0.180	0.0151	0.0580	1.46	0.0331	1.350	35.44	58.2	.9228	1.077	932.	0.0587	15757.	.00214	787.	0.281	3.420	3.363	1.559
3.50	28.03	251.5	250.4	1.11	246.4	3.95	4214.	1755.	2.40	2.34	.0297	1.047	637.	.00425	0.179	0.0155	0.0567	1.47	0.0380	1.510	39.75	63.7	.9297	1.127	957.	0.0610	16360.	.00221	811.	0.294	3.597	3.513	1.634
4.00	27.23	250.0	248.9	1.11	244.8	4.04	4116.	1747.	2.36	2.30	.0320	0.965	623.	.00416	0.179	0.0159	0.0557	1.49	0.0379	1.655	43.70	70.0	.9362	1.181	983.	0.0635	17007.	.00228	837.	0.308	3.788	3.675	1.715
4.50	26.38	248.3	247.2	1.11	243.0	4.11	4046.	1737.	2.33	2.26	.0345	0.889	612.	.00409	0.179	0.0164	0.0550	1.50	0.0377	1.780	47.15	77.1	.9423	1.240	1009.	0.0661	17690.	.00235	863.	0.323	3.992	3.846	1.802
5.00	25.46	246.2	245.1	1.11	241.1	4.08	4077.	1727.	2.36	2.29	.0371	0.817	617.	.00412	0.179	0.0169	0.0558	1.51	0.0376	1.895	50.38	85.3	.9480	1.305	1036.	0.0690	18425.	.00243	890.	0.339	4.213	4.030	1.896
5.50	24.48	243.8	242.7	1.11	238.9	3.81	4374.	1716.	2.55	2.47	.0399	0.749	662.	.00442	0.178	0.0175	0.0603	1.53	0.0375	1.997	53.29	94.6	.9533	1.375	1063.	0.0720	19204.	.00252	919.	0.356	4.450	4.227	1.997

FORCED CONVECTION BOILING

RUN NO.118.0 WATER TEST SECTION NO. 1

FLOW RATE,W= 913. LBS/HR MASS VELOCITY,G= 89.8 LBS/SEC.SQFT POWER= 5.11 KILOWATTS HEAT FLUX,Q= 16342. BTU/HR.SQFT

REYNOLDS NO.= 28462. TEMPERATURE BEFORE FLASH= 236.1 F VELOCITY BEFORE FLASH= 1.2 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	16.41	222.5	221.4	1.10	217.6	3.85	4243.	687.	6.18	6.08	.0193	1.228	644.	.01300	0.523	0.0754	0.1473	1.71	0.0057	0.123	21.57	22.5	.9343	1.556	487.	0.0892	7887.	.00337	422.	0.329	3.596	3.562	1.831
0.25	16.38	225.2	224.1	1.10	217.5	6.57	2486.	686.	3.62	3.57	.0203	1.173	378.	.00762	0.523	0.0755	0.0864	1.71	0.0057	0.129	22.66	23.6	.9374	1.590	496.	0.0910	8049.	.00343	430.	0.336	3.691	3.644	1.871
0.50	16.35	225.7	224.6	1.10	217.4	7.17	2278.	685.	3.33	3.27	.0213	1.122	346.	.00698	0.523	0.0757	0.0793	1.71	0.0057	0.135	23.75	24.7	.9403	1.623	505.	0.0928	8207.	.00349	437.	0.343	3.785	3.725	1.911
0.75	16.31	225.7	224.6	1.10	217.3	7.32	2232.	685.	3.26	3.20	.0223	1.076	339.	.00684	0.522	0.0758	0.0777	1.71	0.0057	0.141	24.85	25.8	.9429	1.656	513.	0.0945	8363.	.00355	445.	0.350	3.879	3.804	1.951
1.00	16.28	225.7	224.6	1.10	217.2	7.40	2208.	684.	3.23	3.17	.0232	1.033	335.	.00677	0.522	0.0760	0.0770	1.71	0.0057	0.147	25.95	26.9	.9454	1.688	522.	0.0962	8515.	.00361	452.	0.357	3.972	3.883	1.991
1.50	16.20	225.5	224.4	1.10	216.9	7.48	2185.	682.	3.20	3.14	.0252	0.955	332.	.00670	0.522	0.0763	0.0763	1.71	0.0056	0.160	28.34	29.2	.9498	1.752	537.	0.0995	8812.	.00372	466.	0.370	4.155	4.038	2.069
2.00	16.12	225.3	224.2	1.10	216.7	7.50	2178.	681.	3.20	3.13	.0272	0.888	331.	.00668	0.522	0.0767	0.0763	1.71	0.0056	0.174	30.92	31.6	.9536	1.814	553.	0.1027	9101.	.00383	479.	0.383	4.337	4.191	2.146
2.50	16.03	224.9	223.8	1.10	216.4	7.45	2194.	679.	3.23	3.16	.0293	0.829	333.	.00673	0.522	0.0771	0.0771	1.72	0.0056	0.189	33.70	34.0	.9570	1.876	567.	0.1059	9381.	.00393	492.	0.396	4.517	4.341	2.222
3.00	15.92	224.5	223.4	1.10	216.1	7.32	2231.	677.	3.29	3.21	.0313	0.776	339.	.00684	0.522	0.0775	0.0785	1.72	0.0056	0.204	36.50	36.5	.9600	1.937	581.	0.1090	9658.	.00404	505.	0.409	4.696	4.490	2.299
3.50	15.82	223.9	222.8	1.10	215.7	7.10	2301.	676.	3.41	3.31	.0334	0.729	350.	.00706	0.522	0.0780	0.0812	1.72	0.0056	0.220	39.50	39.0	.9627	1.997	595.	0.1120	9927.	.00414	517.	0.422	4.874	4.637	2.375
4.00	15.70	223.2	222.1	1.10	215.3	6.81	2401.	674.	3.56	3.46	.0356	0.685	365.	.00737	0.522	0.0786	0.0850	1.72	0.0055	0.236	42.53	41.7	.9652	2.058	609.	0.1151	10196.	.00424	529.	0.435	5.056	4.786	2.452
4.50	15.59	222.4	221.3	1.10	215.0	6.39	2556.	672.	3.80	3.69	.0377	0.647	388.	.00785	0.522	0.0791	0.0907	1.73	0.0055	0.252	45.57	44.4	.9674	2.118	621.	0.1181	10457.	.00434	540.	0.448	5.233	4.931	2.527
5.00	15.46	221.6	220.5	1.10	214.5	5.95	2746.	670.	4.10	3.97	.0399	0.612	417.	.00843	0.522	0.0797	0.0978	1.73	0.0055	0.268	48.63	47.2	.9694	2.179	634.	0.1211	10717.	.00444	552.	0.461	5.413	5.077	2.603
5.50	15.32	220.6	219.5	1.10	214.1	5.42	3014.	668.	4.51	4.36	.0420	0.580	458.	.00926	0.521	0.0803	0.1076	1.73	0.0055	0.	0.	50.1	.9713	2.239	646.	0.1240	10974.	.00453	563.	0.473	5.592	5.222	2.680

FORCED CONVECTION BOILING

RUN NO.119.0 WATER TEST SECTION NO. 1

FLOW RATE,W= 915. LBS/HR MASS VELOCITY,G= 90.0 LBS/SEC.SQFT POWER= 5.21 KILOWATTS HEAT FLUX,Q= 16658. BTU/HR.SQFT

REYNOLDS NO.= 28829. TEMPERATURE BEFORE FLASH= 284.4 F VELOCITY BEFORE FLASH= 1.2 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	19.78	230.7	229.6	1.12	227.4	2.28	7312.	680.	10.75	10.23	.0604	0.461	1108.	.02235	0.535	0.0645	0.2554	1.62	0.0053	0.560	106.37	56.6	.9748	2.279	742.	0.1303	11721.	.00498	618.	0.514	6.444	5.906	3.050
0.25	19.63	232.2	231.1	1.12	226.9	4.15	4014.	678.	5.92	5.62	.0617	0.450	608.	.01226	0.535	0.0650	0.1405	1.62	0.0053	0.568	108.11	58.2	.9756	2.310	748.	0.1318	11844.	.00502	623.	0.520	6.539	5.981	3.091
0.50	19.49	232.0	230.9	1.12	226.6	4.35	3826.	677.	5.65	5.36	.0629	0.440	580.	.01169	0.535	0.0654	0.1342	1.62	0.0052	0.572	109.09	59.7	.9762	2.340	753.	0.1333	11963.	.00507	628.	0.527	6.631	6.054	3.130
0.75	19.34	231.3	230.2	1.12	226.1	4.05	4108.	676.	6.08	5.76	.0642	0.430	623.	.01255	0.535	0.0659	0.1444	1.63	0.0052	0.578	110.45	61.4	.9769	2.371	759.	0.1348	12085.	.00512	632.	0.534	6.725	6.128	3.170
1.00	19.19	230.9	229.8	1.12	225.7	4.08	4087.	674.	6.06	5.74	.0655	0.420	620.	.01248	0.534	0.0664	0.1440	1.63	0.0052	0.583	111.64	63.0	.9776	2.403	764.	0.1362	12207.	.00517	637.	0.540	6.820	6.203	3.210
1.50	18.89	230.3	229.2	1.12	224.9	4.26	3912.	672.	5.82	5.50	.0681	0.402	593.	.01195	0.534	0.0674	0.1385	1.64	0.0052	0.596	114.59	66.4	.9788	2.466	774.	0.1392	12449.	.00526	647.	0.554	7.009	6.351	3.290
2.00	18.57	229.6	228.5	1.12	224.0	4.43	3760.	669.	5.62	5.30	.0708	0.384	570.	.01148	0.534	0.0684	0.1337	1.65	0.0052	0.613	118.35	70.0	.9799	2.532	784.	0.1423	12698.	.00535	657.	0.567	7.204	6.503	3.373
2.50	18.26	228.7	227.6	1.12	223.1	4.47	3725.	666.	5.59	5.26	.0734	0.368	565.	.01137	0.534	0.0695	0.1331	1.66	0.0052	0.633	122.72	73.7	.9810	2.597	794.	0.1453	12940.	.00545	666.	0.581	7.397	6.653	3.455
3.00	17.94	227.8	226.7	1.12	222.2	4.50	3706.	663.	5.59	5.25	.0761	0.353	562.	.01131	0.533	0.0706	0.1330	1.67	0.0051	0.656	127.72	77.6	.9820	2.665	804.	0.1484	13187.	.00554	676.	0.595	7.596	6.807	3.539
3.50	17.60	226.9	225.8	1.12	221.2	4.54	3672.	660.	5.56	5.21	.0789	0.338	557.	.01120	0.533	0.0719	0.1324	1.68	0.0051	0.678	132.57	81.8	.9830	2.736	814.	0.1517	13442.	.00564	685.	0.610	7.801	6.965	3.627
4.00	17.26	225.8	224.7	1.12	220.2	4.48	3716.	657.	5.66	5.28	.0816	0.324	564.	.01133	0.532	0.0732	0.1347	1.69	0.0051	0.695	136.48	86.1	.9839	2.809	823.	0.1549	13699.	.00573	694.	0.624	8.009	7.125	3.715
4.50	16.91	224.7	223.5	1.12	219.1	4.40	3788.	654.	5.80	5.40	.0844	0.310	575.	.01156	0.532	0.0746	0.1381	1.70	0.0051	0.707	139.46	90.7	.9848	2.883	832.	0.1582	13958.	.00583	704.	0.640	8.223	7.289	3.806
5.00	16.56	223.3	222.2	1.12	218.1	4.17	3999.	650.	6.15	5.72	.0873	0.298	607.	.01222	0.532	0.0761	0.1466	1.70	0.0050	0.716	141.87	95.6	.9856	2.958	841.	0.1615	14217.	.00592	713.	0.655	8.440	7.455	3.898
5.50	16.20	221.7	220.6	1.12	216.9	3.61	4614.	647.	7.13	6.61	.0901	0.286	701.	.01411	0.531	0.0776	0.1701	1.71	0.0050	0.720	143.31	100.6	.9864	3.036	849.	0.1648	14480.	.00602	722.	0.670	8.660	7.622	3.991

FORCED CONVECTION BOILING

RUN NO.152.0 WATER TEST SECTION NO. 2

FLOW RATE.W=1030. LBS/HR MASS VELOCITY.G= 235.9 LBS/SEC.SQFT POWER= 6.24 KILOWATTS HEAT FLUX.Q= 36759. BTU/HR.SQFT

REYNOLDS NO.= 61263. TEMPERATURE BEFORE FLASH= 316.5 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	41.63	277.4	274.9	2.50	269.6	5.31	6926.	1681.	4.12	3.95	.0516	0.744	687.	.00798	0.464	0.0274	0.0924	1.33	0.0474	2.480	52.28	65.4	.9413	1.423	1147.	0.0868	13827.	.00349	772.	0.367	4.755	4.529	2.291
0.10	41.37	277.8	275.3	2.50	269.3	6.04	6090.	1678.	3.63	3.48	.0525	0.731	604.	.00702	0.464	0.0275	0.0814	1.33	0.0474	2.490	52.56	66.8	.9426	1.438	1154.	0.0875	13943.	.00352	777.	0.371	4.808	4.573	2.313
0.25	41.02	277.6	275.1	2.50	268.8	6.34	5794.	1675.	3.46	3.31	.0537	0.712	575.	.00668	0.464	0.0277	0.0776	1.34	0.0473	2.495	52.78	68.8	.9443	1.460	1163.	0.0886	14105.	.00355	784.	0.376	4.884	4.635	2.346
0.50	40.38	276.9	274.4	2.50	267.8	6.58	5582.	1669.	3.35	3.19	.0559	0.681	554.	.00644	0.464	0.0281	0.0751	1.34	0.0471	2.520	53.49	72.4	.9473	1.497	1179.	0.0905	14388.	.00361	796.	0.386	5.017	4.744	2.402
0.75	39.77	276.2	273.7	2.50	266.9	6.82	5389.	1662.	3.24	3.09	.0580	0.653	535.	.00622	0.464	0.0285	0.0728	1.35	0.0470	2.540	54.08	76.1	.9499	1.535	1194.	0.0924	14657.	.00368	808.	0.395	5.148	4.851	2.458
1.00	39.13	275.4	272.9	2.50	265.9	7.00	5250.	1655.	3.17	3.02	.0602	0.625	521.	.00606	0.463	0.0290	0.0712	1.35	0.0468	2.585	55.22	79.9	.9525	1.573	1209.	0.0944	14933.	.00374	819.	0.405	5.283	4.961	2.515
1.50	37.34	273.6	271.1	2.51	263.9	7.16	5137.	1642.	3.13	2.97	.0646	0.576	509.	.00594	0.462	0.0299	0.0703	1.37	0.0465	2.700	58.05	88.1	.9571	1.652	1238.	0.0982	15482.	.00386	842.	0.424	5.554	5.181	2.630
2.00	36.45	271.4	268.9	2.51	261.7	7.29	5045.	1627.	3.10	2.93	.0693	0.530	500.	.00584	0.462	0.0309	0.0697	1.38	0.0462	2.860	61.92	97.3	.9614	1.738	1266.	0.1024	16061.	.00399	865.	0.445	5.846	5.415	2.754
2.50	34.93	268.9	266.4	2.51	259.1	7.29	5041.	1612.	3.13	2.94	.0742	0.487	500.	.00584	0.461	0.0322	0.0704	1.40	0.0459	3.120	68.05	108.0	.9655	1.832	1295.	0.1069	16685.	.00413	888.	0.467	6.159	5.665	2.886
3.00	33.26	266.0	263.5	2.52	256.3	7.20	5106.	1596.	3.20	3.00	.0794	0.446	506.	.00592	0.460	0.0337	0.0720	1.41	0.0455	3.430	75.42	120.5	.9693	1.939	1323.	0.1117	17374.	.00427	914.	0.492	6.502	5.937	3.032
3.50	31.38	262.2	259.7	2.52	252.9	6.83	5380.	1580.	3.40	3.17	.0850	0.406	533.	.00622	0.459	0.0355	0.0768	1.44	0.0451	3.930	87.15	135.8	.9729	2.067	1356.	0.1176	18179.	.00444	943.	0.519	6.891	6.242	3.197
4.00	29.12	257.1	254.6	2.53	248.6	5.96	6173.	1554.	3.97	3.68	.0915	0.365	612.	.00718	0.457	0.0380	0.0896	1.46	0.0447	4.950	110.79	156.2	.9767	2.221	1385.	0.1242	19076.	.00461	973.	0.552	7.360	6.607	3.395
4.25	27.73	253.6	251.1	2.53	245.8	5.29	6953.	1540.	4.52	4.17	.0954	0.343	690.	.00809	0.457	0.0398	0.1020	1.48	0.0444	6.100	137.27	170.0	.9787	2.323	1402.	0.1285	19658.	.00472	991.	0.573	7.653	6.834	3.520
4.50	26.05	249.1	246.6	2.54	242.3	4.29	8574.	1524.	5.63	5.17	.0998	0.318	851.	.00998	0.455	0.0422	0.1272	1.50	0.0442	8.200	185.71	188.3	.9809	2.455	1422.	0.1340	20398.	.00486	1014.	0.599	8.015	7.112	3.673
4.69	24.20	244.0	241.5	2.54	238.2	3.21	11436.	1505.	7.60	6.96	.1045	0.294	1135.	.01332	0.454	0.0451	0.1720	1.53	0.0439	11.600	264.43	210.8	.9831	2.610	1442.	0.1402	21235.	.00501	1039.	0.628	8.422	7.423	3.846

FORCED CONVECTION BOILING

RUN NO.153.0 WATER TEST SECTION NO. 2

FLOW RATE.W=2192. LBS/HR MASS VELOCITY.G= 502.0 LBS/SEC.SQFT POWER= 6.21 KILOWATTS HEAT FLUX.Q= 36611. BTU/HR.SQFT

REYNOLDS NO.= 127461. TEMPERATURE BEFORE FLASH= 252.5 F VELOCITY BEFORE FLASH= 2.8 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
1.50	32.20	268.8	266.3	2.50	254.4	11.93	3068.	3108.	0.99	0.99	.0013	19.647	304.	.00167	0.215	0.0162	0.0222	1.43	0.1969	0.036	0.18	12.6	.3229	0.304	403.	0.0176	5417.	.00067	297.	0.067	0.698	0.822	0.421
2.00	32.17	269.4	266.9	2.50	254.3	12.59	2908.	3105.	0.94	0.93	.0024	10.946	288.	.00158	0.215	0.0162	0.0211	1.43	0.1965	0.074	0.38	16.3	.4775	0.397	515.	0.0227	7079.	.00085	380.	0.088	0.929	1.068	0.519
2.50	32.10	269.8	267.3	2.50	254.2	13.10	2795.	3101.	0.90	0.90	.0036	7.543	277.	.00152	0.215	0.0163	0.0203	1.43	0.1961	0.163	0.83	20.3	.5804	0.471	601.	0.0266	8391.	.00099	444.	0.105	1.131	1.273	0.605
3.00	31.94	269.4	266.9	2.50	253.9	13.04	2808.	3096.	0.91	0.90	.0050	5.607	278.	.00153	0.215	0.0164	0.0204	1.43	0.1957	0.383	1.96	24.9	.6585	0.540	680.	0.0303	9609.	.00111	503.	0.121	1.331	1.472	0.690
3.50	31.62	268.3	265.8	2.50	253.3	12.49	2930.	3090.	0.95	0.94	.0068	4.285	290.	.00159	0.215	0.0165	0.0214	1.44	0.1952	0.960	4.92	30.7	.7231	0.613	759.	0.0341	10869.	.00124	562.	0.139	1.550	1.685	0.783
4.00	30.73	265.8	263.3	2.51	251.7	11.57	3164.	3074.	1.03	1.02	.0096	3.082	314.	.00172	0.215	0.0169	0.0232	1.45	0.1944	2.580	13.27	40.7	.7924	0.719	865.	0.0396	12658.	.00141	644.	0.166	1.878	1.995	0.923
4.25	30.00	263.2	260.7	2.51	250.3	10.36	3535.	3057.	1.16	1.15	.0116	2.561	350.	.00192	0.214	0.0173	0.0261	1.45	0.1939	4.300	22.17	48.4	.8258	0.789	928.	0.0430	13775.	.00152	694.	0.183	2.096	2.197	1.015
4.50	28.65	257.9	255.4	2.51	247.7	7.68	4765.	3028.	1.57	1.56	.0149	1.999	473.	.00261	0.214	0.0181	0.0355	1.47	0.1932	7.250	37.53	62.0	.8645	0.896	1016.	0.0481	15440.	.00168	764.	0.209	2.434	2.503	1.159
4.69	26.85	252.2	249.7	2.52	244.0	5.68	6444.	2996.	2.15	2.12	.0191	1.546	639.	.00352	0.213	0.0192	0.0486	1.49	0.1922	9.999	52.01	81.4	.8975	1.030	1113.	0.0544	17443.	.00186	846.	0.241	2.849	2.872	1.335

FORCED CONVECTION BOILING

RUN NO.154.0 WATER TEST SECTION NO. 2

FLOW RATE.W=2176. LBS/HR MASS VELOCITY.G= 498.3 LBS/SEC.SQFT POWER= 6.30 KILOWATTS HEAT FLUX.Q= 37112. BTU/HR.SQFT

REYNOLDS NO.= 143200. TEMPERATURE BEFORE FLASH= 287.1 F VELOCITY BEFORE FLASH= 2.8 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	50.34	290.2	287.7	2.51	282.0	5.70	6509.	3239.	2.01	2.00	.0057	6.223	646.	.00356	0.224	0.0109	0.0449	1.26	0.1395	1.341	7.08	20.4	.5796	0.439	716.	0.0267	8700.	.00107	492.	0.110	1.265	1.408	0.667
0.10	50.72	291.3	288.8	2.51	281.9	6.89	5384.	3237.	1.66	1.66	.0060	5.850	535.	.00295	0.224	0.0109	0.0372	1.26	0.1394	1.410	7.45	21.2	.5965	0.452	734.	0.0275	8949.	.00110	505.	0.113	1.309	1.451	0.686
0.25	50.50	291.5	289.0	2.51	281.6	7.35	5052.	3234.	1.56	1.55	.0067	5.328	502.	.00277	0.224	0.0109	0.0349	1.26	0.1892	1.460	7.72	22.6	.6217	0.472	762.	0.0286	9340.	.00114	525.	0.119	1.379	1.519	0.715
0.50	50.14	291.6	289.1	2.51	281.2	7.92	4683.	3228.	1.45	1.44	.0077	4.647	465.	.00256	0.224	0.0110	0.0324	1.26	0.1889	1.550	8.21	24.9	.6575	0.504	806.	0.0304	9942.	.00121	555.	0.128	1.489	1.626	0.762
0.75	49.74	291.6	289.1	2.51	280.7	8.42	4406.	3222.	1.37	1.36	.0089	4.099	437.	.00241	0.224	0.0111	0.0306	1.27	0.1885	1.650	8.75	27.4	.6890	0.535	847.	0.0321	10530.	.00127	585.	0.137	1.599	1.733	0.809
1.00	49.33	291.4	288.9	2.51	280.2	8.76	4236.	3217.	1.32	1.31	.0100	3.662	420.	.00232	0.224	0.0112	0.0294	1.27	0.1862	1.760	9.35	30.0	.7159	0.565	886.	0.0338	11086.	.00133	612.	0.146	1.706	1.854	0.855
1.25	48.86	291.1	288.6	2.51	279.6	9.07	4092.	3210.	1.27	1.26	.0112	3.280	406.	.00224	0.224	0.0113	0.0285	1.27	0.1879	1.880	10.01	32.8	.7411	0.596	925.	0.0355	11661.	.00139	640.	0.155	1.819	1.941	0.903
1.50	48.36	290.6	288.1	2.51	278.9	9.23	4019.	3204.	1.25	1.24	.0125	2.958	399.	.00220	0.224	0.0114	0.0281	1.28	0.1875	2.020	10.77	35.9	.7634	0.627	963.	0.0372	12227.	.00145	668.	0.164	1.933	2.047	0.951
2.00	47.24	289.0	286.5	2.51	277.4	9.03	4110.	3189.	1.29	1.27	.0152	2.444	408.	.00225	0.223	0.0116	0.0288	1.29	0.1867	2.330	12.48	42.6	.8013	0.690	1037.	0.0405	13352.	.00156	721.	0.182	2.165	2.261	1.050
2.50	45.92	286.7	284.2	2.52	275.7	8.53	4350.	3173.	1.37	1.35	.0183	2.044	432.	.00238	0.223	0.0119	0.0307	1.30	0.1859	2.730	14.69	50.4	.8329	0.756	1109.	0.0440	14503.	.00168	775.	0.201	2.410	2.483	1.154
3.00	44.36	284.1	281.6	2.52	273.5	8.03	4620.	3155.	1.46	1.44	.0217	1.718	458.	.00252	0.223	0.0123	0.0328	1.31	0.1850	3.290	17.78	59.9	.8601	0.829	1182.	0.0477	15731.	.00180	830.	0.221	2.679	2.723	1.268
3.50	42.38	280.7	278.2	2.52	270.7	7.50	4951.	3130.	1.58	1.55	.0258	1.434	491.	.00270	0.222	0.0129	0.0355	1.33	0.1839	4.110	22.34	72.3	.8847	0.914	1259.	0.0519	17115.	.00193	890.	0.245	2.992	2.999	1.401
4.00	39.82	276.2	273.6	2.53	267.0	6.69	5548.	3094.	1.79	1.75	.0309	1.180	550.	.00303	0.222	0.0136	0.0402	1.35	0.1827	5.500	30.10	89.5	.9075	1.021	1343.	0.0571	18737.	.00209	957.	0.274	3.377	3.331	1.565
4.25	37.14	272.9	270.4	2.53	262.8	7.65	4854.	3052.	1.59	1.54	.0359	0.997	481.	.00266	0.221	0.0145	0.0357	1.37	0.1817	6.900	37.97	108.8	.9244	1.129	1414.	0.0621	20257.	.00223	1016.	0.301	3.751	3.650	1.724
4.50	36.00	268.6	266.1	2.54	260.9	5.19	7153.	3033.	2.36	2.29	.0383	0.924	709.	.00392	0.221	0.0149	0.0530	1.38	0.1812	9.750	53.81	118.8	.9311	1.181	1447.	0.0645	20981.	.00230	1044.	0.315	3.935	3.805	1.801
4.69	33.56	263.8	261.3	2.54	257.0	4.29	8657.	2998.	2.89	2.79	.0428	0.809	858.	.00475	0.220	0.0159	0.0650	1.41	0.1802	15.000	83.26	139.7	.9417	1.284	1502.	0.0690	22361.	.00242	1095.	0.340	4.279	4.093	1.948

FORCED CONVECTION BOILING

RUN NO.155.0 WATER TEST SECTION NO. 2

FLOW RATE.W=2110. LBS/HR MASS VELOCITY.G= 483.2 LBS/SEC.SQFT POWER= 6.16 KILOWATTS HEAT FLUX.Q= 36287. BTU/HR.SQFT

REYNOLDS NO.= 144532. TEMPERATURE BEFORE FLASH= 309.1 F VELOCITY BEFORE FLASH= 2.8 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/D'L	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	60.89	301.0	298.6	2.44	293.6	4.96	7310.	3202.	2.28	2.25	.0174	2.427	727.	.00410	0.228	0.0093	0.0509	1.21	0.1746	2.580	14.77	38.0	.7827	0.634	1074.	0.0390	12705.	.00159	717.	0.180	2.179	2.273	1.058
0.10	60.63	301.4	299.0	2.44	293.4	5.62	6454.	3199.	2.02	1.99	.0179	2.356	641.	.00362	0.228	0.0093	0.0449	1.21	0.1745	2.630	15.07	39.0	.7886	0.643	1086.	0.0395	12879.	.00161	726.	0.183	2.218	2.309	1.075
0.25	60.22	301.3	298.8	2.44	292.9	5.90	6149.	3194.	1.93	1.90	.0188	2.253	611.	.00345	0.228	0.0094	0.0429	1.21	0.1743	2.680	15.38	40.7	.7973	0.658	1104.	0.0403	13144.	.00164	739.	0.188	2.278	2.364	1.101
0.50	59.54	300.9	298.5	2.44	292.2	6.29	5769.	3186.	1.81	1.78	.0201	2.100	573.	.00324	0.228	0.0095	0.0404	1.21	0.1739	2.790	16.04	43.4	.8105	0.682	1133.	0.0416	13571.	.00168	759.	0.196	2.376	2.453	1.142
0.75	58.83	300.4	298.0	2.44	291.4	6.58	5517.	3177.	1.74	1.71	.0216	1.960	548.	.00310	0.228	0.0096	0.0387	1.21	0.1735	2.920	16.83	46.3	.8228	0.706	1162.	0.0429	14004.	.00173	780.	0.203	2.478	2.544	1.185
1.00	58.10	299.8	297.4	2.44	290.6	6.80	5338.	3168.	1.68	1.65	.0231	1.834	530.	.00300	0.227	0.0097	0.0376	1.22	0.1731	3.060	17.67	49.4	.8342	0.731	1190.	0.0443	14433.	.00177	800.	0.211	2.579	2.635	1.229
1.50	56.49	298.3	295.9	2.45	288.8	7.08	5127.	3149.	1.63	1.59	.0262	1.610	509.	.00288	0.227	0.0099	0.0363	1.23	0.1723	3.400	19.73	56.2	.8549	0.783	1246.	0.0470	15314.	.00187	841.	0.227	2.792	2.824	1.319
2.00	54.51	296.3	293.9	2.45	286.6	7.26	4999.	3126.	1.60	1.56	.0297	1.411	497.	.00282	0.227	0.0103	0.0357	1.24	0.1715	3.840	22.39	64.4	.8739	0.841	1304.	0.0500	16261.	.00197	883.	0.245	3.028	3.030	1.419
2.50	52.52	293.7	291.3	2.45	284.1	7.17	5062.	3101.	1.63	1.59	.0335	1.240	503.	.00286	0.226	0.0106	0.0365	1.25	0.1706	4.420	25.90	73.9	.8907	0.904	1360.	0.0532	17250.	.00207	926.	0.263	3.280	3.249	1.526
3.00	50.03	290.5	288.0	2.46	281.0	7.00	5187.	3072.	1.69	1.64	.0380	1.080	515.	.00293	0.226	0.0111	0.0377	1.26	0.1695	5.170	30.50	86.1	.9068	0.979	1421.	0.0569	18386.	.00219	974.	0.285	3.574	3.500	1.651
3.50	47.12	286.4	284.0	2.46	277.3	6.72	5400.	3040.	1.78	1.71	.0431	0.933	536.	.00305	0.225	0.0118	0.0397	1.29	0.1683	6.270	37.26	101.7	.9217	1.068	1486.	0.0612	19698.	.00232	1027.	0.310	3.915	3.789	1.796
4.00	45.63	281.5	279.0	2.47	272.5	6.49	5589.	3005.	1.86	1.79	.0492	0.796	555.	.00314	0.224	0.0126	0.0417	1.31	0.1669	8.200	49.14	122.9	.9357	1.180	1558.	0.0664	21281.	.00247	1088.	0.339	4.327	4.133	1.971
4.25	41.55	278.4	276.0	2.47	269.5	6.46	5620.	2979.	1.89	1.81	.0528	0.728	558.	.00316	0.224	0.0132	0.0423	1.33	0.1660	9.500	57.22	137.1	.9427	1.250	1596.	0.0695	22211.	.00255	1122.	0.357	4.579	4.341	2.078
4.50	39.01	274.3	271.8	2.47	265.7	6.12	5932.	2944.	2.01	1.92	.0572	0.656	588.	.00334	0.223	0.0140	0.0452	1.36	0.1652	11.750	71.15	156.4	.9501	1.340	1639.	0.0735	23330.	.00266	1162.	0.380	4.893	4.599	2.211
4.69	36.70	269.0	266.5	2.48	262.1	4.46	8136.	2910.	2.80	2.66	.0613	0.597	807.	.00460	0.223	0.0148	0.0628	1.38	0.1644	15.000	91.24	176.4	.9560	1.428	1676.	0.0773	24366.	.00276	1197.	0.401	5.191	4.841	2.337

FORCED CONVECTION BOILING

RUN NO.156.0 WATER TEST SECTION NO. 2

FLOW RATE,W=3174. LBS/HR MASS VELOCITY,G= 726.8 LBS/SEC.SQFT POWER= 6.24 KILOWATTS HEAT FLUX,Q= 36759. BTU/HR.SQFT

REYNOLDS NO.= 183318. TEMPERATURE BEFORE FLASH= 248.8 F VELOCITY BEFORE FLASH= 4.0 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
3.00	31.29	264.0	261.5	2.52	252.7	8.76	4196.	4172.	1.01	1.01	.0004	60.006	416.	.00157	0.149	0.0116	0.0227	1.44	0.3774	0.033	0.09	14.1	.1226	0.172	297.	0.0097	4157.	.00036	224.	0.038	0.378	0.466	0.247
3.25	31.29	264.0	261.5	2.52	252.7	8.82	4167.	4171.	1.00	1.00	.0008	30.218	413.	.00156	0.149	0.0116	0.0225	1.44	0.3771	0.055	0.15	16.1	.2305	0.235	396.	0.0131	5694.	.00048	299.	0.051	0.512	0.621	0.303
3.50	31.24	264.0	261.5	2.52	252.6	8.83	4163.	4169.	1.00	1.00	.0012	19.936	413.	.00156	0.149	0.0116	0.0225	1.44	0.3769	0.193	0.51	18.2	.3224	0.285	472.	0.0156	6890.	.00057	357.	0.062	0.628	0.751	0.353
3.75	31.15	263.9	261.4	2.52	252.5	8.86	4147.	4166.	1.00	0.99	.0018	14.300	411.	.00155	0.149	0.0116	0.0224	1.44	0.3765	0.480	1.27	20.9	.4080	0.332	542.	0.0181	8024.	.00065	411.	0.073	0.746	0.879	0.403
4.00	30.96	263.6	261.1	2.52	252.1	8.96	4105.	4162.	0.99	0.98	.0025	10.386	407.	.00154	0.149	0.0117	0.0222	1.45	0.3761	0.850	2.26	24.5	.4965	0.385	619.	0.0208	9295.	.00074	470.	0.085	0.889	1.028	0.464
4.25	30.71	263.1	260.6	2.52	251.7	8.93	4116.	4154.	0.99	0.99	.0034	7.878	408.	.00154	0.149	0.0118	0.0223	1.45	0.3757	1.290	3.43	28.9	.5737	0.438	694.	0.0235	10551.	.00082	528.	0.098	1.038	1.181	0.527
4.50	30.34	262.0	259.5	2.52	251.0	8.49	4328.	4142.	1.04	1.04	.0045	6.051	429.	.00162	0.149	0.0119	0.0236	1.45	0.3751	1.830	4.88	34.6	.6447	0.495	772.	0.0264	11906.	.00092	589.	0.112	1.209	1.352	0.600
4.69	29.93	259.2	256.7	2.52	250.2	6.56	5608.	4129.	1.36	1.35	.0056	4.915	556.	.00211	0.149	0.0120	0.0306	1.46	0.3746	2.310	6.17	40.6	.6970	0.547	839.	0.0289	13096.	.00099	641.	0.126	1.367	1.506	0.667

FORCED CONVECTION BOILING

RUN NO.157.0 WATER TEST SECTION NO. 2

FLOW RATE,W=3158. LBS/HR MASS VELOCITY,G= 723.2 LBS/SEC.SQFT POWER= 6.10 KILOWATTS HEAT FLUX,Q= 35922. BTU/HR.SQFT

REYNOLDS NO.= 207440. TEMPERATURE BEFORE FLASH= 279.1 F VELOCITY BEFORE FLASH= 4.1 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
1.50	49.60	291.1	288.7	2.43	280.5	8.17	4399.	4368.	1.01	1.01	.0007	38.751	437.	.00166	0.149	0.0074	0.0225	1.27	0.3670	0.367	1.00	14.8	.1546	0.177	388.	0.0107	4783.	.00043	273.	0.042	0.457	0.558	0.280
1.75	49.51	291.5	289.1	2.43	280.4	8.71	4125.	4365.	0.94	0.94	.0012	24.212	409.	.00156	0.149	0.0074	0.0211	1.27	0.3667	0.380	1.04	16.3	.2358	0.220	473.	0.0131	5934.	.00052	333.	0.052	0.570	0.687	0.328
2.00	49.41	291.9	289.5	2.43	280.3	9.23	3890.	4363.	0.89	0.89	.0018	17.667	386.	.00147	0.149	0.0074	0.0199	1.27	0.3664	0.394	1.08	17.9	.3048	0.254	540.	0.0151	6855.	.00060	381.	0.061	0.668	0.795	0.370
2.25	49.30	292.3	289.9	2.43	280.1	9.75	3684.	4360.	0.85	0.84	.0023	13.911	366.	.00139	0.149	0.0075	0.0189	1.27	0.3661	0.413	1.13	19.6	.3640	0.284	596.	0.0167	7648.	.00065	421.	0.069	0.758	0.891	0.408
2.50	49.18	292.7	290.3	2.43	280.0	10.35	3470.	4357.	0.80	0.79	.0028	11.456	344.	.00131	0.149	0.0075	0.0178	1.27	0.3658	0.439	1.20	21.3	.4155	0.310	646.	0.0182	8359.	.00071	457.	0.077	0.842	0.980	0.444
3.00	48.96	292.3	289.9	2.43	279.7	10.20	3522.	4351.	0.81	0.81	.0039	8.548	350.	.00133	0.149	0.0075	0.0181	1.27	0.3652	0.545	1.49	24.7	.4966	0.355	730.	0.0207	9557.	.00080	517.	0.090	0.992	1.133	0.508
3.50	48.66	291.6	289.2	2.43	279.3	9.88	3635.	4344.	0.84	0.83	.0051	6.702	361.	.00137	0.149	0.0076	0.0187	1.27	0.3645	0.830	2.28	28.5	.5645	0.398	807.	0.0230	10682.	.00088	572.	0.102	1.140	1.283	0.571
4.00	47.97	290.4	287.9	2.43	278.4	9.55	3760.	4332.	0.87	0.86	.0068	5.098	373.	.00142	0.149	0.0077	0.0194	1.28	0.3635	1.950	5.36	34.3	.6388	0.453	902.	0.0259	12113.	.00098	641.	0.119	1.338	1.478	0.655
4.25	47.28	289.1	286.7	2.43	277.5	9.19	3910.	4321.	0.90	0.90	.0082	4.294	388.	.00147	0.149	0.0078	0.0202	1.29	0.3628	3.350	9.23	39.0	.6831	0.492	965.	0.0280	13113.	.00105	688.	0.131	1.482	1.617	0.716
4.50	46.03	286.7	284.3	2.43	275.8	8.48	4236.	4303.	0.98	0.98	.0104	3.428	420.	.00160	0.149	0.0080	0.0220	1.29	0.3617	6.450	17.83	46.9	.7371	0.551	1054.	0.0310	14561.	.00115	754.	0.148	1.698	1.822	0.808
4.65	44.75	283.5	281.1	2.44	274.1	6.99	5136.	4285.	1.20	1.19	.0125	2.855	510.	.00193	0.149	0.0082	0.0268	1.31	0.3607	10.300	28.55	55.1	.7768	0.605	1130.	0.0337	15864.	.00124	812.	0.164	1.899	2.010	0.894

FORCED CONVECTION BOILING

RUN NO.153.0 WATER TEST SECTION NO. 2

FLOW RATE,W=2805. LBS/HR MASS VELOCITY,G= 642.3 LBS/SEC.SQFT POWER= 6.31 KILOWATTS HEAT FLUX,Q= 37201. BTU/HR.SQFT

REYNOLDS NO.= 197798. TEMPERATURE BEFORE FLASH= 299.9 F VELOCITY BEFORE FLASH= 3.7 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	64.13	305.7	303.2	2.50	297.1	6.17	6028.	4096.	1.47	1.47	.0032	11.638	599.	.00253	0.176	0.0068	0.0328	1.19	0.2942	1.021	3.47	18.0	.3810	0.291	652.	0.0181	7572.	.00075	439.	0.076	0.862	0.999	0.468
0.25	63.86	306.3	303.8	2.50	296.8	7.05	5279.	4091.	1.29	1.29	.0039	9.575	525.	.00222	0.176	0.0068	0.0287	1.19	0.2939	1.130	3.84	19.7	.4338	0.318	707.	0.0197	8279.	.00081	476.	0.084	0.957	1.098	0.509
0.50	63.57	306.7	304.2	2.50	296.5	7.73	4810.	4086.	1.18	1.17	.0047	8.114	478.	.00202	0.176	0.0069	0.0262	1.19	0.2935	1.260	4.29	21.4	.4800	0.344	756.	0.0212	8930.	.00087	510.	0.092	1.048	1.191	0.547
0.75	63.24	306.9	304.4	2.50	296.2	8.28	4493.	4081.	1.10	1.10	.0055	6.996	447.	.00189	0.176	0.0069	0.0245	1.20	0.2932	1.410	4.81	23.3	.5218	0.369	804.	0.0226	9556.	.00092	543.	0.099	1.139	1.282	0.586
1.00	62.87	306.9	304.4	2.50	295.8	8.68	4286.	4075.	1.05	1.05	.0064	6.102	426.	.00180	0.176	0.0069	0.0234	1.20	0.2928	1.580	5.40	25.3	.5601	0.393	849.	0.0240	10171.	.00097	574.	0.107	1.231	1.373	0.625
1.25	62.43	306.6	304.1	2.50	295.3	8.85	4204.	4068.	1.03	1.03	.0074	5.351	418.	.00177	0.176	0.0070	0.0230	1.20	0.2923	1.780	6.09	27.5	.5965	0.418	895.	0.0254	10799.	.00102	606.	0.115	1.327	1.468	0.666
1.50	61.94	306.2	303.7	2.50	294.8	8.96	4150.	4060.	1.02	1.02	.0084	4.735	413.	.00175	0.176	0.0070	0.0228	1.20	0.2919	2.020	6.92	29.9	.6296	0.443	940.	0.0268	11418.	.00108	637.	0.123	1.425	1.563	0.708
2.00	60.74	305.0	302.5	2.50	293.5	9.02	4125.	4042.	1.02	1.01	.0107	3.761	410.	.00174	0.176	0.0072	0.0227	1.21	0.2909	2.600	8.94	35.5	.6891	0.496	1029.	0.0297	12685.	.00118	700.	0.140	1.632	1.762	0.796
2.50	59.23	302.9	300.4	2.50	291.9	8.59	4331.	4020.	1.08	1.07	.0134	3.033	430.	.00183	0.176	0.0073	0.0240	1.21	0.2897	3.420	11.81	42.4	.7402	0.551	1118.	0.0327	13997.	.00128	763.	0.158	1.857	1.973	0.891
3.00	57.10	299.5	297.0	2.51	289.5	7.58	4907.	3990.	1.23	1.21	.0170	2.412	488.	.00208	0.175	0.0076	0.0274	1.22	0.2883	4.600	15.96	51.9	.7890	0.620	1217.	0.0363	15548.	.00141	835.	0.179	2.134	2.228	1.009
3.50	54.38	295.5	293.0	2.51	286.3	6.72	5537.	3951.	1.40	1.38	.0213	1.917	550.	.00235	0.175	0.0079	0.0313	1.24	0.2366	6.300	21.98	64.7	.8317	0.700	1322.	0.0404	17279.	.00154	913.	0.204	2.458	2.521	1.147
4.00	50.93	291.0	288.5	2.52	282.1	6.34	5872.	3902.	1.50	1.47	.0267	1.512	583.	.00249	0.174	0.0084	0.0336	1.26	0.2846	8.850	31.09	82.5	.8690	0.797	1433.	0.0453	19281.	.00169	999.	0.234	2.849	2.867	1.313
4.25	48.72	287.8	285.3	2.52	279.4	5.93	6270.	3872.	1.62	1.58	.0301	1.326	622.	.00266	0.174	0.0088	0.0362	1.27	0.2833	10.600	37.42	95.0	.8869	0.859	1496.	0.0483	20509.	.00178	1049.	0.252	3.094	3.080	1.417
4.50	45.80	283.5	281.0	2.53	275.5	5.44	6841.	3835.	1.78	1.73	.0346	1.132	679.	.00290	0.173	0.0093	0.0399	1.30	0.2815	12.600	44.75	113.4	.9058	0.944	1574.	0.0522	22126.	.00190	1113.	0.276	3.417	3.359	1.554
4.65	43.85	280.3	277.8	2.53	272.8	4.93	7552.	3811.	1.98	1.92	.0377	1.026	749.	.00320	0.173	0.0097	0.0444	1.31	0.2804	14.200	50.64	127.1	.9164	1.003	1623.	0.0549	23220.	.00197	1155.	0.292	3.638	3.547	1.648

FORCED CONVECTION BOILING

RUN NO.159.0 WATER TEST SECTION NO. 2

FLOW RATE,W=1055. LBS/HR MASS VELOCITY,G= 241.6 LBS/SEC.SQFT POWER= 14.94 KILOWATTS HEAT FLUX,Q= 88009. BTU/HR.SQFT

REYNOLDS NO.= 60076. TEMPERATURE BEFORE FLASH= 243.0 F VELOCITY BEFORE FLASH= 1.3 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.50	29.52	280.2	274.2	5.99	249.4	24.79	3551.	1717.	2.07	2.07	.0014	17.232	352.	.00402	1.070	0.0878	0.0467	1.46	0.0552	0.188	3.40	1.7	.3503	0.495	387.	0.0305	4619.	.00115	272.	0.143	1.597	1.725	1.294
0.75	29.47	281.9	276.0	5.98	249.3	26.68	3299.	1712.	1.93	1.92	.0014	16.950	327.	.00374	1.070	0.0879	0.0435	1.46	0.0550	0.290	5.28	6.5	.3693	0.499	388.	0.0307	4642.	.00116	273.	0.143	1.603	1.731	1.297
1.00	29.37	281.7	275.8	5.98	249.1	26.66	3301.	1707.	1.93	1.93	.0043	6.189	327.	.00374	1.070	0.0882	0.0436	1.46	0.0547	0.405	7.41	11.4	.6424	0.791	592.	0.0476	7353.	.00174	417.	0.187	2.114	2.257	1.514
1.25	29.26	281.4	275.4	5.98	248.9	26.50	3321.	1702.	1.95	1.94	.0073	3.861	329.	.00377	1.069	0.0885	0.0440	1.46	0.0544	0.515	9.47	16.5	.7525	0.982	719.	0.0584	9109.	.00210	507.	0.219	2.501	2.631	1.679
1.50	29.12	280.8	274.9	5.99	248.6	26.25	3353.	1697.	1.98	1.96	.0103	2.817	333.	.00381	1.069	0.0889	0.0446	1.46	0.0541	0.675	12.47	21.6	.8122	1.135	818.	0.0669	10501.	.00238	578.	0.246	2.835	2.945	1.821
2.00	28.72	279.0	273.0	5.99	247.8	25.13	3503.	1685.	2.08	2.05	.0165	1.816	347.	.00398	1.069	0.0901	0.0469	1.47	0.0536	1.010	18.86	32.7	.8764	1.393	976.	0.0809	12783.	.00284	690.	0.292	3.435	3.489	2.076
2.50	28.12	274.9	268.9	6.00	246.6	22.25	3955.	1672.	2.37	2.32	.0232	1.317	392.	.00449	1.068	0.0918	0.0534	1.47	0.0530	1.440	27.18	45.0	.9110	1.624	1107.	0.0932	14759.	.00323	784.	0.336	4.001	3.986	2.316
3.00	27.27	266.7	260.7	6.03	244.9	15.82	5565.	1656.	3.36	3.28	.0305	1.012	552.	.00632	1.066	0.0945	0.0759	1.49	0.0524	1.980	37.82	59.3	.9330	1.850	1221.	0.1048	16603.	.00358	868.	0.379	4.563	4.467	2.555
3.50	26.12	262.7	256.7	6.04	242.5	14.24	6182.	1638.	3.77	3.66	.0384	0.801	613.	.00703	1.065	0.0983	0.0853	1.50	0.0517	2.530	48.95	76.4	.9485	2.089	1327.	0.1166	18443.	.00393	948.	0.424	5.152	4.961	2.805
4.00	24.47	258.1	252.1	6.05	238.9	13.23	6653.	1614.	4.12	3.96	.0474	0.637	660.	.00756	1.062	0.1044	0.0933	1.53	0.0510	3.650	71.63	99.1	.9607	2.369	1430.	0.1298	20463.	.00430	1030.	0.476	5.822	5.511	3.088
4.25	23.43	254.8	248.8	6.06	236.5	12.28	7164.	1599.	4.48	4.29	.0525	0.568	711.	.00815	1.060	0.1087	0.1014	1.54	0.0506	4.500	88.99	113.7	.9660	2.535	1482.	0.1373	21579.	.00450	1073.	0.507	6.202	5.818	3.249
4.50	22.02	248.7	242.7	6.08	233.1	9.58	9191.	1580.	5.82	5.54	.0585	0.498	913.	.01047	1.058	0.1151	0.1319	1.57	0.0501	6.000	119.68	133.5	.9713	2.747	1538.	0.1466	22947.	.00473	1123.	0.544	6.669	6.193	3.446
4.65	20.85	242.7	236.6	6.09	230.2	6.46	13633.	1564.	8.71	8.27	.0630	0.453	1354.	.01553	1.056	0.1211	0.1978	1.59	0.0498	8.700	174.57	150.8	.9747	2.923	1577.	0.1541	24010.	.00491	1160.	0.575	7.034	6.481	3.600

FORCED CONVECTION BOILING

RUN NO.160.0 WATER TEST SECTION NO. 2

FLOW RATE,W=1055. LBS/HR MASS VELOCITY,G= 241.6 LBS/SEC.SQFT POWER= 14.80 KILOWATTS HEAT FLUX,Q= 87202. BTU/HR.SQFT

REYNOLDS NO.= 63862. TEMPERATURE BEFORE FLASH= 284.9 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	39.56	286.0	280.1	5.92	266.6	13.53	6445.	1747.	3.69	3.63	.0201	1.754	639.	.00726	1.073	0.0664	0.0828	1.35	0.0525	1.120	21.33	29.8	.8638	1.263	1055.	0.0773	12514.	.00288	709.	0.273	3.496	3.544	2.104
0.10	39.43	289.0	283.1	5.91	266.4	16.74	5210.	1745.	2.99	2.93	.0214	1.653	517.	.00587	1.073	0.0666	0.0670	1.35	0.0524	1.160	22.14	31.5	.8715	1.299	1079.	0.0793	12846.	.00295	726.	0.280	3.593	3.630	2.146
0.25	39.27	289.7	283.8	5.91	266.1	17.74	4917.	1741.	2.82	2.77	.0233	1.526	488.	.00554	1.073	0.0669	0.0634	1.35	0.0522	1.220	23.36	34.1	.8813	1.349	1114.	0.0822	13307.	.00305	749.	0.291	3.732	3.752	2.205
0.50	38.96	289.9	284.0	5.91	265.6	18.40	4739.	1735.	2.73	2.67	.0265	1.348	470.	.00534	1.073	0.0674	0.0613	1.36	0.0519	1.330	25.61	38.5	.8953	1.431	1168.	0.0867	14049.	.00320	786.	0.308	3.960	3.951	2.301
0.75	38.62	289.5	283.6	5.91	265.1	18.50	4713.	1728.	2.73	2.66	.0298	1.206	467.	.00532	1.072	0.0679	0.0612	1.36	0.0517	1.450	28.07	43.1	.9068	1.510	1218.	0.0911	14752.	.00335	820.	0.325	4.183	4.143	2.396
1.00	38.26	288.6	282.7	5.91	264.6	18.10	4817.	1721.	2.80	2.72	.0331	1.089	478.	.00543	1.072	0.0685	0.0629	1.36	0.0514	1.580	30.76	47.8	.9162	1.587	1266.	0.0952	15421.	.00349	853.	0.341	4.401	4.330	2.489
1.50	37.42	286.4	280.5	5.92	263.2	17.30	5041.	1706.	2.95	2.86	.0399	0.905	500.	.00569	1.071	0.0699	0.0664	1.37	0.0508	1.880	37.01	57.9	.9314	1.739	1354.	0.1034	16709.	.00375	913.	0.373	4.838	4.700	2.674
2.00	36.38	284.0	278.0	5.92	261.5	16.51	5283.	1690.	3.13	3.01	.0471	0.765	524.	.00597	1.069	0.0718	0.0703	1.38	0.0502	2.260	45.02	69.3	.9432	1.895	1435.	0.1115	17966.	.00401	970.	0.406	5.284	5.071	2.863
2.50	35.08	281.0	275.1	5.93	259.4	15.67	5566.	1671.	3.33	3.18	.0548	0.653	552.	.00630	1.068	0.0742	0.0749	1.39	0.0496	2.760	55.67	82.4	.9527	2.061	1512.	0.1199	19242.	.00427	1026.	0.441	5.753	5.456	3.062
3.00	33.46	277.4	271.5	5.94	256.7	14.80	5893.	1651.	3.57	3.39	.0630	0.559	584.	.00667	1.066	0.0775	0.0804	1.41	0.0489	3.420	69.93	98.2	.9607	2.246	1586.	0.1289	20591.	.00454	1081.	0.479	6.258	5.865	3.276
3.50	31.57	272.6	266.7	5.95	253.2	13.45	6481.	1630.	3.98	3.75	.0718	0.480	642.	.00731	1.063	0.0818	0.0896	1.44	0.0482	4.300	89.18	117.4	.9675	2.459	1660.	0.1389	22067.	.00482	1140.	0.520	6.813	6.308	3.510
4.00	29.13	267.0	261.0	5.97	248.6	12.39	7037.	1598.	4.40	4.11	.0817	0.408	698.	.00799	1.059	0.0881	0.0993	1.46	0.0475	5.650	119.00	143.2	.9737	2.715	1730.	0.1504	23699.	.00513	1199.	0.570	7.464	6.821	3.786
4.25	27.57	263.3	257.3	5.98	245.5	11.79	7395.	1580.	4.68	4.35	.0874	0.373	733.	.00840	1.057	0.0927	0.1057	1.48	0.0471	6.750	143.40	160.8	.9767	2.882	1767.	0.1576	24713.	.00531	1233.	0.600	7.863	7.132	3.954
4.50	25.70	257.2	251.2	6.00	241.6	9.59	9094.	1559.	5.83	5.39	.0938	0.337	902.	.01033	1.054	0.0989	0.1319	1.51	0.0466	8.600	184.52	183.8	.9798	3.093	1808.	0.1664	25948.	.00552	1273.	0.638	8.337	7.498	4.154
4.65	24.25	250.6	244.6	6.02	238.4	6.23	14006.	1543.	9.08	8.35	.0984	0.313	1390.	.01593	1.052	0.1044	0.2054	1.53	0.0463	10.600	228.98	203.1	.9819	3.262	1835.	0.1733	26899.	.00568	1303.	0.667	8.701	7.777	4.308

FORCED CONVECTION BOILING

RUN NO.161.0 WATER TEST SECTION NO. 2

FLOW RATE,W=1055. LBS/HR MASS VELOCITY,G= 241.6 LBS/SEC.SQFT POWER= 14.88 KILOWATTS HEAT FLUX,Q= 87632. BTU/HR.SQFT

REYNOLDS NO.= 66009. TEMPERATURE BEFORE FLASH= 326.4 F VELOCITY BEFORE FLASH= 1.4 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	50.05	297.2	291.3	5.92	281.1	10.23	8565.	1746.	4.91	4.71	.0505	0.825	850.	.00967	1.090	0.0537	0.1096	1.26	0.0493	2.380	48.32	55.9	.9291	1.636	1482.	0.1016	16739.	.00390	953.	0.374	5.096	4.918	2.795
0.10	49.82	300.2	294.3	5.91	280.8	13.53	6479.	1743.	3.72	3.56	.0519	0.802	643.	.00732	1.090	0.0539	0.0831	1.27	0.0491	2.400	48.84	57.6	.9313	1.660	1496.	0.1029	16941.	.00394	962.	0.379	5.171	4.981	2.827
0.25	49.45	299.9	294.0	5.91	280.3	13.71	6390.	1738.	3.68	3.52	.0541	0.770	634.	.00722	1.090	0.0543	0.0822	1.27	0.0490	2.430	49.64	60.2	.9344	1.696	1517.	0.1049	17247.	.00401	976.	0.388	5.286	5.077	2.876
0.50	48.83	299.3	293.4	5.91	279.5	13.90	6305.	1731.	3.64	3.47	.0577	0.720	626.	.00712	1.089	0.0550	0.0814	1.27	0.0486	2.490	51.18	64.6	.9392	1.756	1552.	0.1081	17749.	.00412	1000.	0.402	5.478	5.235	2.957
0.75	48.21	298.6	292.7	5.91	278.7	14.03	6246.	1723.	3.62	3.45	.0613	0.675	620.	.00705	1.089	0.0556	0.0811	1.28	0.0483	2.560	52.96	69.2	.9435	1.816	1585.	0.1112	18241.	.00422	1022.	0.415	5.669	5.391	3.038
1.00	47.54	297.9	292.0	5.91	277.8	14.17	6186.	1716.	3.61	3.42	.0650	0.634	614.	.00698	1.088	0.0563	0.0807	1.28	0.0480	2.630	54.76	74.0	.9474	1.877	1618.	0.1144	18734.	.00433	1044.	0.429	5.862	5.549	3.120
1.50	46.14	296.2	290.3	5.92	276.0	14.30	6130.	1700.	3.61	3.40	.0724	0.564	608.	.00691	1.086	0.0579	0.0807	1.29	0.0474	2.830	59.69	84.2	.9542	2.001	1679.	0.1208	19705.	.00453	1086.	0.457	6.252	5.864	3.285
2.00	44.58	294.1	288.2	5.92	273.8	14.37	6097.	1684.	3.62	3.39	.0801	0.503	605.	.00687	1.085	0.0598	0.0811	1.31	0.0468	3.110	66.48	95.6	.9600	2.132	1738.	0.1274	20696.	.00474	1128.	0.487	6.658	6.189	3.457
2.50	42.96	291.3	285.3	5.93	271.6	13.77	6362.	1667.	3.82	3.55	.0879	0.452	631.	.00716	1.083	0.0619	0.0856	1.32	0.0462	3.520	76.27	108.0	.9649	2.267	1793.	0.1340	21677.	.00494	1168.	0.516	7.071	6.516	3.631
3.00	41.02	287.4	281.5	5.94	268.8	12.73	6881.	1646.	4.18	3.86	.0962	0.405	683.	.00775	1.080	0.0646	0.0938	1.34	0.0455	4.130	90.77	122.9	.9695	2.421	1846.	0.1413	22712.	.00516	1207.	0.549	7.524	6.873	3.823
3.50	38.72	282.3	276.3	5.96	265.3	11.08	7909.	1620.	4.88	4.47	.1051	0.361	784.	.00892	1.078	0.0681	0.1096	1.36	0.0448	5.250	117.08	141.1	.9737	2.600	1896.	0.1496	23824.	.00540	1248.	0.586	8.031	7.267	4.037
4.00	35.73	276.9	270.9	5.97	260.5	10.44	8393.	1589.	5.28	4.79	.1151	0.318	832.	.00949	1.074	0.0733	0.1188	1.39	0.0441	6.750	152.94	166.0	.9780	2.830	1948.	0.1598	25167.	.00567	1293.	0.631	8.647	7.741	4.298
4.25	33.84	272.9	266.9	5.98	257.3	9.61	9120.	1571.	5.81	5.24	.1209	0.295	904.	.01033	1.071	0.0771	0.1307	1.41	0.0437	8.000	182.98	182.9	.9802	2.981	1976.	0.1662	26026.	.00584	1320.	0.659	9.028	8.032	4.458
4.50	31.53	266.3	260.3	6.00	253.2	7.13	12291.	1551.	7.92	7.10	.1274	0.271	1218.	.01387	1.068	0.0823	0.1786	1.44	0.0433	10.440	241.24	205.5	.9825	3.180	2009.	0.1745	27132.	.00604	1354.	0.694	9.491	8.383	4.653
4.65	25.77	259.5	253.5	6.02	249.9	3.62	24239.	1533.	15.81	14.12	.1320	0.254	2403.	.02744	1.066	0.0868	0.3567	1.46	0.0430	13.370	311.07	224.4	.9841	3.333	2028.	0.1807	27931.	.00618	1376.	0.721	9.847	8.650	4.803

FORCED CONVECTION BOILING

RUN NO.162.0 WATER TEST SECTION NO. 2

FLOW RATE.W=2177. LBS/HR MASS VELOCITY.G= 498.5 LBS/SEC.SQFT POWER= 14.83 KILOWATTS HEAT FLUX.Q= 87390. BTU/HR.SQFT

REYNOLDS NO.= 136862. TEMPERATURE BEFORE FLASH= 261.3 F VELOCITY BEFORE FLASH= 2.8 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
1.50	41.72	299.6	293.7	5.89	269.9	23.88	3660.	3196.	1.15	1.15	.0014	20.608	363.	.00200	0.523	0.0307	0.0257	1.33	0.1933	0.075	0.39	5.1	.6662	0.351	536.	0.0210	6585.	.00078	373.	0.080	0.991	1.113	0.722
2.00	41.72	301.6	295.7	5.89	269.8	25.94	3369.	3188.	1.06	1.06	.0014	20.218	334.	.00184	0.523	0.0307	0.0237	1.33	0.1923	0.295	1.53	12.0	.2901	0.354	539.	0.0212	6627.	.00078	374.	0.081	0.997	1.119	0.724
2.50	41.43	302.6	296.7	5.88	269.3	27.39	3191.	3178.	1.00	1.00	.0045	6.971	317.	.00174	0.522	0.0309	0.0225	1.33	0.1913	0.860	4.49	19.9	.5724	0.578	840.	0.0337	10780.	.00120	586.	0.124	1.487	1.630	0.933
3.00	40.86	297.8	291.9	5.90	268.5	23.38	3738.	3164.	1.18	1.17	.0081	4.092	371.	.00204	0.522	0.0313	0.0265	1.34	0.1902	1.980	10.41	29.1	.7089	0.740	1045.	0.0425	13740.	.00149	731.	0.158	1.899	2.032	1.108
3.50	39.77	290.5	284.6	5.92	266.9	17.71	4935.	3141.	1.57	1.56	.0125	2.717	490.	.00269	0.521	0.0321	0.0353	1.35	0.1890	3.600	19.05	41.3	.7955	0.901	1230.	0.0509	16552.	.00175	864.	0.192	2.331	2.437	1.292
4.00	36.96	281.8	275.9	5.94	262.5	13.43	6508.	3092.	2.11	2.07	.0198	1.723	645.	.00356	0.520	0.0343	0.0473	1.38	0.1872	5.870	31.35	64.2	.8697	1.137	1457.	0.0628	20374.	.00211	1033.	0.243	2.971	3.016	1.563
4.25	35.12	277.2	271.3	5.95	259.5	11.83	7390.	3060.	2.41	2.37	.0243	1.396	733.	.00405	0.519	0.0360	0.0543	1.39	0.1862	6.900	37.06	80.1	.8963	1.273	1568.	0.0693	22449.	.00229	1120.	0.272	3.340	3.340	1.720
4.50	33.33	270.6	264.6	5.97	256.4	8.19	10668.	3031.	3.52	3.44	.0288	1.165	1057.	.00585	0.517	0.0378	0.0792	1.41	0.1850	7.750	41.89	97.7	.9154	1.407	1667.	0.0755	24421.	.00246	1199.	0.300	3.700	3.650	1.872
4.65	32.10	266.1	260.1	5.98	254.2	5.89	14829.	3014.	4.92	4.79	.0318	1.044	1470.	.00812	0.517	0.0391	0.1108	1.43	0.1843	8.170	44.34	110.6	.9257	1.501	1730.	0.0797	25744.	.00257	1251.	0.318	3.942	3.857	1.974

FORCED CONVECTION BOILING

RUN NO.163.0 WATER TEST SECTION NO. 2

FLOW RATE.W=2177. LBS/HR MASS VELOCITY.G= 498.5 LBS/SEC.SQFT POWER= 14.74 KILOWATTS HEAT FLUX.Q= 86831. BTU/HR.SQFT

REYNOLDS NO.= 147024. TEMPERATURE BEFORE FLASH= 287.5 F VELOCITY BEFORE FLASH= 2.8 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	54.67	309.3	303.5	5.83	286.7	16.81	5166.	3282.	1.57	1.57	.0009	33.682	513.	.00282	0.526	0.0238	0.0351	1.24	0.1906	0.395	2.07	10.4	.1694	0.255	458.	0.0161	5080.	.00064	305.	0.061	0.863	0.970	0.670
0.10	54.62	311.6	305.8	5.82	286.6	19.17	4529.	3280.	1.38	1.38	.0015	21.250	450.	.00247	0.526	0.0238	0.0308	1.24	0.1905	0.420	2.21	11.6	.2540	0.314	556.	0.0197	6273.	.00077	371.	0.072	0.985	1.106	0.721
0.25	54.55	311.7	305.9	5.82	286.5	19.36	4486.	3277.	1.37	1.37	.0024	13.937	446.	.00245	0.526	0.0238	0.0305	1.24	0.1902	0.465	2.45	13.3	.3525	0.381	664.	0.0237	7608.	.00091	443.	0.086	1.134	1.267	0.785
0.50	54.41	311.7	305.9	5.82	286.4	19.52	4448.	3272.	1.36	1.36	.0039	8.934	442.	.00243	0.526	0.0239	0.0303	1.24	0.1897	0.565	2.98	16.3	.4718	0.468	799.	0.0287	9319.	.00109	534.	0.104	1.344	1.485	0.874
0.75	54.25	311.6	305.8	5.82	286.2	19.63	4423.	3267.	1.35	1.35	.0055	6.604	439.	.00242	0.526	0.0239	0.0302	1.24	0.1892	0.705	3.73	19.3	.5558	0.537	905.	0.0327	10692.	.00123	606.	0.120	1.526	1.669	0.952
1.00	54.05	311.4	305.6	5.82	285.9	19.69	4411.	3261.	1.35	1.34	.0071	5.227	438.	.00241	0.526	0.0240	0.0302	1.24	0.1867	0.900	4.77	22.5	.6192	0.599	997.	0.0362	11890.	.00135	668.	0.134	1.695	1.836	1.023
1.50	53.48	310.7	304.9	5.82	285.3	19.62	4426.	3247.	1.36	1.35	.0105	3.636	440.	.00242	0.525	0.0243	0.0304	1.24	0.1877	1.350	7.19	29.4	.7097	0.709	1156.	0.0424	14011.	.00156	775.	0.159	2.015	2.143	1.159
2.00	52.41	308.7	302.9	5.83	284.0	18.88	4599.	3228.	1.42	1.41	.0145	2.674	457.	.00251	0.525	0.0247	0.0318	1.25	0.1865	1.950	10.46	38.0	.7764	0.821	1305.	0.0486	16100.	.00177	878.	0.186	2.353	2.458	1.303
2.50	50.88	304.8	299.0	5.84	282.1	16.90	5137.	3205.	1.60	1.58	.0193	2.039	510.	.00281	0.524	0.0254	0.0358	1.26	0.1851	2.800	15.13	48.7	.8265	0.939	1448.	0.0549	18206.	.00197	977.	0.215	2.715	2.788	1.457
3.00	49.13	300.1	294.2	5.85	279.9	14.34	6054.	3179.	1.90	1.87	.0243	1.622	601.	.00331	0.523	0.0262	0.0426	1.27	0.1837	3.950	21.51	60.8	.8619	1.054	1575.	0.0609	20196.	.00216	1068.	0.242	3.075	3.108	1.609
3.50	46.94	295.2	289.3	5.87	277.0	12.30	7060.	3150.	2.24	2.19	.0300	1.307	701.	.00386	0.522	0.0274	0.0501	1.29	0.1820	5.100	28.02	75.9	.8903	1.182	1702.	0.0673	22308.	.00235	1161.	0.272	3.470	3.453	1.777
4.00	44.17	289.9	284.1	5.88	273.3	10.80	8038.	3116.	2.58	2.50	.0366	1.056	798.	.00439	0.521	0.0290	0.0578	1.31	0.1803	6.700	37.17	95.6	.9136	1.331	1829.	0.0745	24640.	.00256	1258.	0.306	3.919	3.838	1.967
4.25	42.38	286.5	280.7	5.89	270.7	9.93	8746.	3093.	2.83	2.74	.0406	0.942	868.	.00477	0.520	0.0301	0.0634	1.33	0.1792	8.900	49.66	108.8	.9245	1.423	1898.	0.0788	25998.	.00268	1313.	0.327	4.188	4.065	2.081
4.50	39.85	281.4	275.5	5.90	267.0	8.49	10231.	3057.	3.35	3.22	.0458	0.819	1015.	.00558	0.518	0.0318	0.0751	1.35	0.1790	12.500	70.23	128.3	.9364	1.549	1978.	0.0846	27747.	.00283	1379.	0.353	4.546	4.365	2.232
4.65	37.35	275.2	269.3	5.92	263.1	6.17	14084.	3018.	4.67	4.48	.0505	0.725	1397.	.00771	0.517	0.0338	0.1048	1.37	0.1770	19.500	110.16	149.0	.9456	1.674	2044.	0.0901	29356.	.00297	1437.	0.379	4.885	4.645	2.376

FORCED CONVECTION BOILING

RUN NO.164.0 WATER TEST SECTION NO. 2

FLOW RATE.W=2177. LBS/HR MASS VELOCITY.G= 498.5 LBS/SEC.SQFT POWER= 14.88 KILOWATTS HEAT FLUX.Q= 37655. BTU/HR.SQFT

REYNOLDS NO.= 154552. TEMPERATURE BEFORE FLASH= 312.9 F VELOCITY BEFORE FLASH= 2.9 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	68.22	318.0	312.1	5.86	301.2	10.97	7994.	3343.	2.39	2.37	.0134	3.252	795.	.00432	0.537	0.0196	0.0532	1.18	0.1851	2.580	13.94	29.8	.7114	0.689	1280.	0.0428	14440.	.00165	827.	0.164	2.142	2.263	1.220
0.10	67.96	320.7	314.8	5.85	300.9	13.93	6295.	3340.	1.88	1.86	.0142	3.072	626.	.00340	0.537	0.0196	0.0419	1.18	0.1849	2.630	14.23	31.1	.7245	0.708	1309.	0.0439	14815.	.00168	846.	0.169	2.204	2.321	1.247
0.25	67.56	320.8	314.9	5.85	300.5	14.41	6081.	3334.	1.82	1.80	.0154	2.836	605.	.00328	0.537	0.0197	0.0406	1.18	0.1845	2.720	14.74	33.3	.7424	0.736	1351.	0.0455	15362.	.00174	873.	0.176	2.295	2.405	1.285
0.50	66.38	320.3	314.5	5.85	299.9	14.61	5999.	3325.	1.80	1.78	.0175	2.511	597.	.00324	0.537	0.0199	0.0401	1.18	0.1838	2.850	15.50	36.9	.7683	0.780	1416.	0.0480	16230.	.00182	917.	0.188	2.443	2.542	1.348
0.75	66.13	319.9	314.0	5.86	299.1	14.93	5869.	3314.	1.77	1.74	.0198	2.241	584.	.00317	0.536	0.0201	0.0394	1.18	0.1832	3.020	16.49	40.8	.7909	0.825	1479.	0.0505	17079.	.00191	959.	0.199	2.594	2.679	1.412
1.00	65.34	319.3	313.4	5.86	298.3	15.13	5794.	3302.	1.75	1.72	.0220	2.018	576.	.00314	0.536	0.0204	0.0390	1.19	0.1825	3.190	17.48	44.8	.8104	0.869	1538.	0.0529	17898.	.00199	999.	0.211	2.742	2.813	1.475
1.50	63.63	317.7	311.8	5.86	296.5	15.29	5733.	3278.	1.75	1.71	.0266	1.672	570.	.00311	0.535	0.0209	0.0389	1.19	0.1812	3.620	19.98	53.5	.8422	0.955	1649.	0.0576	19469.	.00214	1074.	0.233	3.036	3.075	1.600
2.00	61.73	315.6	309.8	5.87	294.5	15.22	5759.	3251.	1.77	1.73	.0316	1.410	573.	.00313	0.534	0.0215	0.0394	1.20	0.1798	4.130	22.98	63.3	.8674	1.042	1751.	0.0622	21006.	.00229	1145.	0.256	3.336	3.338	1.727
2.50	59.47	312.8	306.9	5.87	292.1	14.78	5929.	3221.	1.84	1.79	.0369	1.199	589.	.00323	0.533	0.0222	0.0410	1.21	0.1782	4.830	27.10	74.9	.8886	1.135	1851.	0.0670	22589.	.00244	1215.	0.280	3.656	3.615	1.862
3.00	56.80	308.4	302.5	5.89	289.1	13.36	6562.	3187.	2.06	1.99	.0428	1.022	652.	.00358	0.532	0.0232	0.0459	1.22	0.1766	5.750	32.56	88.9	.9069	1.240	1949.	0.0722	24270.	.00260	1287.	0.306	4.006	3.914	2.011
3.50	53.65	303.5	297.6	5.90	285.5	12.12	7230.	3146.	2.30	2.21	.0494	0.870	718.	.00395	0.530	0.0244	0.0513	1.24	0.1749	7.350	42.02	106.3	.9228	1.359	2048.	0.0780	26079.	.00277	1361.	0.335	4.397	4.242	2.176
4.00	49.70	297.2	291.3	5.92	280.6	10.71	8181.	3097.	2.64	2.52	.0571	0.733	812.	.00448	0.528	0.0262	0.0590	1.27	0.1729	9.400	54.36	130.0	.9376	1.509	2151.	0.0850	28216.	.00296	1443.	0.369	4.865	4.631	2.374
4.25	47.25	294.1	288.2	5.93	277.4	10.75	8151.	3070.	2.66	2.52	.0617	0.665	809.	.00446	0.527	0.0275	0.0594	1.29	0.1717	10.700	62.31	146.1	.9448	1.605	2209.	0.0893	29542.	.00308	1492.	0.390	5.154	4.867	2.496
4.50	44.33	288.4	282.5	5.94	273.5	9.01	9727.	3038.	3.20	3.03	.0670	0.597	965.	.00531	0.526	0.0291	0.0717	1.31	0.1704	12.600	73.94	167.2	.9522	1.724	2273.	0.0946	31143.	.00321	1549.	0.416	5.498	5.147	2.642
4.65	42.40	282.7	276.7	5.96	270.8	5.98	14652.	3016.	4.86	4.58	.0705	0.557	1454.	.00799	0.525	0.0304	0.1089	1.33	0.1696	13.800	81.39	182.7	.9564	1.808	2312.	0.0982	32207.	.00330	1585.	0.433	5.732	5.336	2.741

FORCED CONVECTION BOILING

RUN NO.165.0 WATER TEST SECTION NO. 2

FLOW RATE.W=2755. LBS/HR MASS VELOCITY.G= 630.9 LBS/SEC.SQFT POWER= 14.87 KILOWATTS HEAT FLUX.Q= 87614. BTU/HR.SQFT

REYNOLDS NO.= 184094. TEMPERATURE BEFORE FLASH= 275.8 F VELOCITY BEFORE FLASH= 3.6 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
2.00	52.47	310.5	304.7	5.88	284.1	20.61	4251.	3946.	1.08	1.09	.0006	46.495	422.	.00184	0.418	0.0197	0.0241	1.25	0.2892	0.685	2.37	9.3	.1701	0.214	443.	0.0131	5147.	.00051	301.	0.050	0.691	0.786	0.534
2.25	52.25	311.4	305.5	5.88	283.8	21.71	4035.	3940.	1.02	1.02	.0007	39.182	401.	.00174	0.418	0.0198	0.0229	1.25	0.2885	0.860	2.98	12.8	.1498	0.231	475.	0.0142	5563.	.00054	323.	0.054	0.724	0.825	0.548
2.50	51.96	311.4	305.6	5.88	283.4	22.14	3957.	3932.	1.01	1.00	.0022	14.691	393.	.00171	0.418	0.0199	0.0225	1.25	0.2879	1.100	3.82	16.6	.3444	0.363	717.	0.0217	8720.	.00080	489.	0.080	1.005	1.137	0.668
3.00	51.18	307.4	301.5	5.89	282.5	19.07	4593.	3915.	1.17	1.17	.0054	6.503	456.	.00199	0.418	0.0201	0.0262	1.26	0.2864	1.950	6.81	25.0	.5669	0.529	1004.	0.0310	12656.	.00112	687.	0.117	1.429	1.572	0.848
3.50	49.92	302.6	296.8	5.90	280.9	15.86	5525.	3892.	1.42	1.41	.0092	3.953	548.	.00239	0.417	0.0206	0.0317	1.27	0.2847	3.750	13.17	35.7	.6972	0.670	1228.	0.0386	15889.	.00136	844.	0.149	1.826	1.958	1.017
4.00	47.38	296.3	290.4	5.92	277.6	12.77	6860.	3854.	1.78	1.76	.0149	2.494	681.	.00296	0.416	0.0216	0.0398	1.28	0.2823	7.300	25.86	52.9	.7975	0.842	1468.	0.0475	19644.	.00164	1017.	0.190	2.332	2.430	1.232
4.25	45.25	291.7	285.8	5.93	274.8	11.06	7919.	3825.	2.07	2.04	.0191	1.953	786.	.00342	0.416	0.0226	0.0464	1.30	0.2807	9.450	33.67	66.9	.8407	0.957	1607.	0.0532	22020.	.00181	1121.	0.217	2.670	2.736	1.375
4.50	42.70	285.5	279.6	5.95	271.2	8.36	10484.	3790.	2.77	2.71	.0239	1.546	1040.	.00452	0.414	0.0238	0.0620	1.32	0.2788	11.600	41.60	85.0	.8756	1.087	1746.	0.0594	24586.	.00198	1229.	0.246	3.050	3.073	1.536
4.65	40.87	280.0	274.0	5.96	268.5	5.50	15920.	3760.	4.23	4.14	.0273	1.339	1579.	.00686	0.414	0.0248	0.0950	1.34	0.2776	12.800	46.12	99.2	.8939	1.178	1833.	0.0637	26292.	.00210	1297.	0.266	3.314	3.303	1.648

FORCED CONVECTION BOILING

RUN NO.166.0 WATER TEST SECTION NO. 2

FLOW RATE,W=2755. LBS/HR MASS VELOCITY,G= 630.9 LBS/SEC.SQFT POWER= 14.67 KILOWATTS HEAT FLUX,Q= 86418. BTU/HR.SQFT

REYNOLDS NO.= 191004. TEMPERATURE BEFORE FLASH= 287.5 F VELOCITY BEFORE FLASH= 3.6 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
1.00	59.48	315.0	309.2	5.79	292.1	17.05	5068.	4011.	1.26	1.26	.0009	33.973	504.	.00218	0.415	0.0173	0.0282	1.21	0.2879	0.500	1.74	8.8	.2408	0.235	518.	0.0147	5860.	.00057	346.	0.054	0.751	0.857	0.558
1.50	59.15	316.1	310.3	5.78	291.8	18.56	4656.	4000.	1.16	1.16	.0016	20.961	463.	.00200	0.415	0.0174	0.0259	1.21	0.2867	0.875	3.05	14.6	.2497	0.294	633.	0.0181	7301.	.00070	423.	0.066	0.878	1.000	0.612
2.00	58.53	316.5	310.7	5.78	291.1	19.62	4405.	3985.	1.11	1.10	.0045	8.188	438.	.00190	0.415	0.0176	0.0246	1.22	0.2853	1.520	5.33	21.3	.4873	0.453	936.	0.0273	11220.	.00102	628.	0.102	1.282	1.424	0.784
2.50	57.44	315.8	310.1	5.78	289.8	20.21	4276.	3965.	1.08	1.07	.0079	4.829	425.	.00184	0.415	0.0179	0.0240	1.22	0.2838	2.430	8.56	29.6	.6330	0.581	1160.	0.0344	14274.	.00126	781.	0.133	1.648	1.786	0.939
3.00	55.88	310.8	305.0	5.80	288.1	16.95	5097.	3939.	1.29	1.28	.0120	3.282	506.	.00220	0.414	0.0183	0.0289	1.23	0.2820	3.720	13.19	39.8	.7285	0.699	1352.	0.0408	17021.	.00147	914.	0.162	2.009	2.131	1.093
3.50	53.37	304.9	299.1	5.81	285.4	13.69	6310.	3900.	1.62	1.60	.0171	2.331	627.	.00272	0.413	0.0191	0.0361	1.24	0.2800	5.500	19.64	53.7	.8001	0.828	1541.	0.0476	19885.	.00168	1047.	0.194	2.417	2.507	1.266
3.75	52.05	301.7	295.8	5.82	283.5	12.30	7028.	3877.	1.81	1.78	.0201	1.982	698.	.00304	0.413	0.0196	0.0405	1.25	0.2789	6.700	24.03	62.7	.8294	0.901	1635.	0.0513	21417.	.00179	1116.	0.212	2.646	2.714	1.363
4.00	50.26	298.3	292.4	5.83	281.3	11.11	7775.	3850.	2.02	1.98	.0235	1.686	772.	.00336	0.412	0.0202	0.0451	1.26	0.2775	8.000	28.83	73.6	.8554	0.981	1732.	0.0553	23067.	.00191	1187.	0.231	2.899	2.939	1.470
4.25	48.21	294.7	288.9	5.84	278.7	10.20	8471.	3821.	2.22	2.17	.0274	1.439	841.	.00366	0.411	0.0210	0.0496	1.28	0.2759	9.600	34.79	86.7	.8779	1.070	1830.	0.0596	24831.	.00204	1262.	0.253	3.175	3.182	1.588
4.50	45.59	289.2	283.4	5.85	275.2	8.17	10580.	3787.	2.79	2.72	.0321	1.211	1050.	.00457	0.410	0.0221	0.0625	1.30	0.2741	11.600	42.32	104.5	.8995	1.181	1939.	0.0648	26948.	.00218	1347.	0.278	3.511	3.473	1.730
4.65	43.61	282.5	276.7	5.87	272.5	4.16	20759.	3762.	5.52	5.36	.0356	1.079	2060.	.00895	0.409	0.0230	0.1236	1.32	0.2728	13.000	47.65	119.1	.9122	1.264	2012.	0.0686	28494.	.00228	1407.	0.297	3.759	3.685	1.835

FORCED CONVECTION BOILING

RUN NO.167.0 WATER TEST SECTION NO. 2

FLOW RATE,W=2727. LBS/HR MASS VELOCITY,G= 624.5 LBS/SEC.SQFT POWER= 14.76 KILOWATTS HEAT FLUX,Q= 86949. BTU/HR.SQFT

REYNOLDS NO.= 195913. TEMPERATURE BEFORE FLASH= 299.1 F VELOCITY BEFORE FLASH= 3.6 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	67.37	319.5	313.7	5.81	300.3	13.34	6516.	4046.	1.61	1.61	.0014	24.815	648.	.00281	0.425	0.0157	0.0358	1.18	0.2819	0.890	3.16	8.1	.3500	0.262	607.	0.0166	6668.	.00066	398.	0.060	0.839	0.955	0.601
0.25	67.14	321.2	315.4	5.81	300.1	15.24	5705.	4041.	1.41	1.41	.0001	51.471	567.	.00246	0.425	0.0157	0.0314	1.18	0.2812	0.975	3.47	10.7	.0138	0.078	198.	0.0052	1974.	.00023	129.	0.025	0.496	0.539	0.455
0.50	66.91	321.6	315.8	5.80	299.9	15.93	5458.	4035.	1.35	1.35	.0013	27.185	543.	.00235	0.425	0.0158	0.0301	1.18	0.2806	1.080	3.85	13.4	.1903	0.252	582.	0.0159	6383.	.00063	381.	0.058	0.814	0.927	0.591
0.75	66.62	321.8	316.0	5.80	299.6	16.40	5303.	4027.	1.32	1.31	.0027	13.797	527.	.00229	0.425	0.0158	0.0293	1.18	0.2799	1.210	4.32	16.3	.3335	0.343	773.	0.0214	8706.	.00083	507.	0.078	1.037	1.170	0.685
1.00	66.32	322.0	316.2	5.80	299.3	16.90	5144.	4020.	1.28	1.28	.0041	9.370	511.	.00222	0.425	0.0159	0.0285	1.18	0.2793	1.340	4.80	19.2	.4353	0.410	908.	0.0253	10388.	.00097	596.	0.094	1.217	1.358	0.762
1.50	65.57	321.7	315.9	5.80	298.5	17.34	5015.	4004.	1.25	1.25	.0071	5.662	499.	.00217	0.424	0.0161	0.0279	1.19	0.2779	1.730	6.22	25.5	.5756	0.518	1116.	0.0315	13064.	.00119	735.	0.121	1.533	1.675	0.896
2.00	64.54	320.6	314.8	5.81	297.5	17.32	5021.	3985.	1.26	1.25	.0104	3.968	499.	.00217	0.424	0.0163	0.0280	1.19	0.2764	2.350	8.50	32.6	.6698	0.613	1288.	0.0369	15351.	.00137	851.	0.145	1.829	1.961	1.022
2.50	63.03	317.8	312.0	5.81	295.9	16.05	5417.	3960.	1.37	1.35	.0143	2.947	539.	.00234	0.424	0.0167	0.0305	1.20	0.2748	3.600	13.10	41.3	.7406	0.707	1447.	0.0421	17568.	.00154	959.	0.169	2.137	2.251	1.153
3.00	60.65	312.9	307.1	5.83	293.4	13.69	6353.	3924.	1.62	1.59	.0193	2.205	631.	.00276	0.423	0.0173	0.0361	1.21	0.2727	5.300	19.43	53.4	.8006	0.818	1614.	0.0479	20039.	.00173	1075.	0.198	2.502	2.585	1.308
3.50	57.82	307.8	301.9	5.84	290.3	11.66	7459.	3882.	1.92	1.88	.0248	1.710	741.	.00324	0.422	0.0181	0.0428	1.22	0.2704	6.900	25.51	68.1	.8449	0.933	1769.	0.0538	22495.	.00191	1186.	0.228	2.885	2.928	1.470
4.00	54.20	302.0	296.1	5.86	286.1	10.04	8663.	3829.	2.26	2.21	.0314	1.335	861.	.00378	0.420	0.0192	0.0505	1.24	0.2679	8.900	33.22	88.0	.8810	1.067	1924.	0.0605	25187.	.00211	1301.	0.261	3.327	3.316	1.658
4.25	51.85	298.6	292.7	5.87	283.3	9.40	9249.	3795.	2.44	2.37	.0355	1.168	918.	.00404	0.419	0.0200	0.0544	1.25	0.2665	10.800	40.53	101.7	.8975	1.151	2009.	0.0645	26769.	.00223	1365.	0.281	3.596	3.547	1.771
4.50	48.70	292.7	286.8	5.88	279.3	7.48	11628.	3752.	3.10	3.00	.0407	0.999	1154.	.00508	0.418	0.0212	0.0693	1.27	0.2645	15.000	56.71	121.3	.9148	1.262	2107.	0.0697	28805.	.00237	1445.	0.308	3.944	3.844	1.919
4.65	46.25	287.2	281.4	5.90	276.1	5.22	16648.	3721.	4.47	4.31	.0447	0.894	1652.	.00726	0.417	0.0222	0.1001	1.29	0.2630	19.200	73.00	138.1	.9256	1.353	2178.	0.0737	30388.	.00247	1504.	0.328	4.213	4.070	2.033

FORCED CONVECTION BOILING

RUN NO.168.0 WATER TEST SECTION NO. 2

FLOW RATE,W= 595. LBS/HR MASS VELOCITY,G= 136.3 LBS/SEC.SQFT POWER= 14.70 KILOWATTS HEAT FLUX,Q= 86595. BTU/HR.SQFT

REYNOLDS NO.= 31965. TEMPERATURE BEFORE FLASH= 239.0 F VELOCITY BEFORE FLASH= 0.8 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	23.90	266.4	260.5	5.93	237.6	22.91	3780.	1057.	3.58	3.57	.0016	14.088	375.	.00762	1.851	0.1862	0.0809	1.54	0.0203	0.220	10.82	4.1	.4423	0.647	308.	0.0412	3545.	.00160	217.	0.248	2.455	2.587	2.108
0.10	23.86	267.0	261.1	5.93	237.5	23.61	3668.	1055.	3.48	3.47	.0035	6.838	364.	.00740	1.851	0.1864	0.0787	1.54	0.0203	0.233	11.50	6.4	.6392	0.901	417.	0.0564	4931.	.00214	294.	0.280	2.828	2.972	2.267
0.25	23.84	267.2	261.3	5.93	237.4	23.85	3631.	1053.	3.45	3.43	.0064	3.950	360.	.00732	1.851	0.1867	0.0781	1.54	0.0202	0.255	12.65	9.8	.7654	1.158	524.	0.0715	6328.	.00266	369.	0.316	3.261	3.392	2.451
0.50	23.77	267.2	261.3	5.93	237.3	24.03	3604.	1048.	3.44	3.41	.0113	2.363	358.	.00727	1.851	0.1872	0.0778	1.54	0.0200	0.301	15.06	15.4	.8525	1.465	648.	0.0893	7977.	.00327	457.	0.361	3.836	3.928	2.696
0.75	23.68	267.1	261.2	5.93	237.1	24.10	3594.	1044.	3.44	3.40	.0162	1.696	357.	.00725	1.850	0.1878	0.0780	1.54	0.0198	0.355	17.92	21.2	.8933	1.706	741.	0.1030	9248.	.00374	522.	0.398	4.327	4.369	2.905
1.00	23.59	266.9	261.0	5.93	236.9	24.12	3590.	1039.	3.46	3.40	.0211	1.328	356.	.00724	1.850	0.1885	0.0782	1.54	0.0196	0.425	21.64	27.0	.9167	1.909	817.	0.1145	10303.	.00412	576.	0.431	4.766	4.753	3.091
1.50	23.34	265.9	259.9	5.93	236.3	23.65	3662.	1029.	3.56	3.47	.0311	0.925	363.	.00739	1.849	0.1904	0.0806	1.55	0.0193	0.627	32.48	39.1	.9430	2.258	942.	0.1337	12066.	.00476	664.	0.490	5.562	5.433	3.430
2.00	22.98	263.4	257.5	5.94	235.4	22.09	3921.	1019.	3.85	3.72	.0414	0.704	389.	.00791	1.848	0.1931	0.0872	1.55	0.0190	0.925	48.79	52.0	.9576	2.569	1044.	0.1504	13565.	.00531	735.	0.544	6.303	6.047	3.744
2.50	22.39	260.2	254.2	5.95	234.0	20.24	4279.	1007.	4.25	4.07	.0522	0.559	425.	.00864	1.846	0.1978	0.0963	1.56	0.0186	1.260	67.73	66.5	.9672	2.877	1134.	0.1664	14967.	.00581	799.	0.599	7.042	6.648	4.058
3.00	21.58	256.3	250.4	5.96	232.0	18.34	4721.	993.	4.76	4.51	.0635	0.456	469.	.00954	1.844	0.2046	0.1078	1.58	0.0182	1.690	92.64	83.1	.9741	3.194	1214.	0.1821	16324.	.00630	858.	0.657	7.796	7.249	4.378
3.50	20.62	252.1	246.2	5.97	229.6	16.61	5212.	978.	5.33	5.01	.0753	0.379	518.	.01053	1.841	0.2134	0.1210	1.60	0.0179	2.210	123.60	102.3	.9793	3.528	1286.	0.1982	17646.	.00677	913.	0.716	8.573	7.858	4.706
4.00	19.41	247.3	241.3	5.98	226.3	14.98	5781.	960.	6.02	5.59	.0877	0.318	575.	.01167	1.837	0.2256	0.1368	1.63	0.0175	3.030	173.00	125.6	.9834	3.904	1354.	0.2155	19023.	.00727	966.	0.783	9.409	8.503	5.060
4.25	18.38	243.8	237.8	5.99	224.1	13.74	6300.	950.	6.63	6.13	.0945	0.289	626.	.01271	1.834	0.2350	0.1509	1.65	0.0173	3.770	217.62	140.7	.9853	4.137	1388.	0.2259	19818.	.00754	994.	0.823	9.893	8.872	5.264
4.50	17.53	238.7	232.7	6.01	221.0	11.69	7408.	937.	7.91	7.25	.1020	0.261	737.	.01493	1.830	0.2479	0.1800	1.68	0.0171	4.950	289.09	160.0	.9872	4.424	1422.	0.2382	20741.	.00786	1026.	0.872	10.455	9.297	5.501
4.65	16.75	236.3	230.3	6.01	218.6	11.64	7437.	928.	8.02	7.32	.1070	0.244	740.	.01501	1.827	0.2586	0.1827	1.70	0.0170	6.100	358.97	174.9	.9883	4.634	1443.	0.2469	21391.	.00807	1046.	0.908	10.851	9.594	5.668

FORCED CONVECTION BOILING

RUN NO.169.0 WATER TEST SECTION NO. 2

FLOW RATE,W= 595. LBS/HR MASS VELOCITY,G= 136.3 LBS/SEC.SQFT POWER= 14.70 KILOWATTS HEAT FLUX,Q= 86595. BTU/HR.SQFT

REYNOLDS NO.= 32742. TEMPERATURE BEFORE FLASH= 286.0 F VELOCITY BEFORE FLASH= 0.8 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	30.16	270.8	264.9	5.92	250.7	14.28	6063.	1055.	5.75	5.57	.0381	0.859	601.	.01215	1.868	0.1501	0.1296	1.45	0.0189	0.855	45.30	37.7	.9409	2.137	1019.	0.1317	12046.	.00493	688.	0.463	5.767	5.607	3.527
0.10	30.11	273.7	267.8	5.91	250.5	17.32	4998.	1053.	4.75	4.59	.0401	0.818	496.	.01002	1.868	0.1504	0.1071	1.45	0.0188	0.885	47.06	39.7	.9439	2.187	1039.	0.1346	12302.	.00503	701.	0.472	5.898	5.717	3.583
0.25	29.98	274.5	268.6	5.91	250.3	18.31	4731.	1049.	4.51	4.35	.0432	0.761	469.	.00949	1.868	0.1510	0.1017	1.45	0.0187	0.930	49.73	42.7	.9481	2.263	1067.	0.1388	12680.	.00517	719.	0.487	6.096	5.881	3.667
0.50	29.74	274.4	268.5	5.91	249.8	18.74	4622.	1043.	4.43	4.26	.0484	0.681	458.	.00928	1.867	0.1522	0.0999	1.46	0.0185	1.010	54.51	47.9	.9540	2.385	1110.	0.1455	13282.	.00540	749.	0.510	6.421	6.148	3.805
0.75	29.49	274.2	268.3	5.91	249.3	18.99	4559.	1037.	4.39	4.21	.0537	0.615	452.	.00916	1.866	0.1533	0.0992	1.46	0.0184	1.100	59.92	53.3	.9589	2.503	1151.	0.1519	13850.	.00562	776.	0.533	6.737	6.406	3.940
1.00	29.22	273.6	267.7	5.91	248.8	18.90	4582.	1031.	4.44	4.23	.0589	0.561	454.	.00922	1.866	0.1546	0.1002	1.46	0.0182	1.200	65.98	58.8	.9629	2.618	1189.	0.1581	14390.	.00583	801.	0.555	7.050	6.658	4.072
1.50	28.54	271.5	265.6	5.92	247.5	18.08	4790.	1018.	4.70	4.44	.0698	0.472	475.	.00965	1.864	0.1580	0.1062	1.47	0.0178	1.460	81.84	70.6	.9695	2.851	1259.	0.1703	15441.	.00624	849.	0.601	7.680	7.162	4.340
2.00	27.73	269.0	263.1	5.92	245.8	17.27	5013.	1006.	4.99	4.66	.0809	0.403	497.	.01010	1.862	0.1623	0.1126	1.48	0.0175	1.770	101.20	83.6	.9746	3.089	1324.	0.1825	16462.	.00663	894.	0.647	8.318	7.664	4.610
2.50	26.71	266.1	260.2	5.93	243.7	16.42	5273.	992.	5.32	4.92	.0924	0.348	523.	.01063	1.859	0.1680	0.1202	1.49	0.0171	2.080	121.39	98.5	.9787	3.344	1384.	0.1950	17492.	.00702	936.	0.697	8.984	8.181	4.892
3.00	25.43	262.4	256.5	5.94	241.0	15.47	5599.	976.	5.74	5.25	.1044	0.301	555.	.01128	1.855	0.1759	0.1297	1.51	0.0168	2.700	161.07	116.2	.9822	3.631	1440.	0.2085	18576.	.00743	979.	0.751	9.703	8.732	5.196
3.50	23.83	257.5	251.5	5.95	237.5	14.03	6171.	958.	6.44	5.83	.1171	0.261	612.	.01245	1.851	0.1864	0.1458	1.54	0.0164	3.420	208.68	137.9	.9853	3.957	1493.	0.2234	19728.	.00785	1020.	0.812	10.490	9.329	5.528
3.75	22.99	254.8	248.9	5.96	235.4	13.43	6448.	948.	6.80	6.12	.1237	0.242	640.	.01301	1.848	0.1930	0.1541	1.55	0.0162	3.860	238.28	150.7	.9866	4.142	1518.	0.2315	20347.	.00807	1041.	0.845	10.919	9.650	5.709
4.00	21.93	252.0	246.0	5.97	232.9	13.12	6600.	937.	7.04	6.30	.1308	0.224	655.	.01333	1.845	0.2016	0.1597	1.57	0.0160	4.430	276.83	166.2	.9880	4.359	1543.	0.2407	21047.	.00831	1064.	0.884	11.400	10.009	5.912
4.25	20.59	249.0	243.0	5.98	229.7	13.28	6519.	924.	7.05	6.26	.1383	0.206	647.	.01317	1.841	0.2127	0.1600	1.60	0.0158	5.220	330.33	185.3	.9893	4.619	1568.	0.2516	21840.	.00859	1089.	0.929	11.945	10.412	6.142
4.50	19.24	243.0	237.0	5.99	225.9	11.13	7779.	910.	8.55	7.53	.1464	0.188	773.	.01570	1.836	0.2275	0.1943	1.63	0.0156	6.300	403.87	205.6	.9907	4.942	1595.	0.2648	22765.	.00891	1116.	0.983	12.578	10.876	6.408
4.65	18.18	235.5	229.5	6.02	222.9	6.58	13153.	899.	14.63	12.82	.1517	0.177	1308.	.02653	1.833	0.2398	0.3329	1.66	0.0155	7.150	462.12	229.0	.9915	5.191	1611.	0.2748	23448.	.00914	1135.	1.024	13.036	11.210	6.601

FORCED CONVECTION BOILING

RUN NO.170.0 WATER TEST SECTION NO. 2

FLOW RATE,W= 595. LBS/HR MASS VELOCITY,G= 136.3 LBS/SEC.SQFT POWER= 14.81 KILOWATTS HEAT FLUX,Q= 87249. BTU/HR.SQFT

REYNOLDS NO.= 32901. TEMPERATURE BEFORE FLASH= 329.8 F VELOCITY BEFORE FLASH= 0.8 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	35.62	278.0	272.1	5.94	260.3	11.75	7426.	1040.	7.14	6.70	.0761	0.479	736.	.01489	1.895	0.1298	0.1606	1.39	0.0175	1.680	96.14	62.8	.9657	2.627	1307.	0.1627	14918.	.00623	849.	0.569	7.655	7.148	4.347
0.10	35.44	279.7	273.8	5.94	260.0	13.74	6348.	1037.	6.12	5.73	.0783	0.464	629.	.01273	1.895	0.1304	0.1377	1.39	0.0174	1.710	98.25	64.9	.9669	2.668	1319.	0.1649	15100.	.00630	857.	0.577	7.772	7.241	4.397
0.25	35.13	280.0	274.1	5.94	259.6	14.51	6013.	1033.	5.82	5.44	.0816	0.444	596.	.01206	1.894	0.1313	0.1309	1.39	0.0173	1.755	101.45	68.0	.9686	2.728	1338.	0.1681	15368.	.00641	870.	0.590	7.947	7.379	4.471
0.50	34.73	279.8	273.8	5.94	258.8	15.04	5801.	1027.	5.65	5.25	.0872	0.414	575.	.01164	1.893	0.1329	0.1271	1.40	0.0171	1.830	106.87	73.3	.9710	2.829	1368.	0.1733	15807.	.00659	889.	0.611	8.239	7.609	4.594
0.75	34.26	279.4	273.4	5.94	258.0	15.42	5657.	1020.	5.55	5.13	.0928	0.387	561.	.01135	1.892	0.1346	0.1248	1.40	0.0169	1.920	113.29	78.9	.9733	2.930	1396.	0.1785	16236.	.00677	908.	0.632	8.531	7.837	4.718
1.00	33.77	278.7	272.7	5.94	257.2	15.57	5603.	1013.	5.53	5.09	.0985	0.363	555.	.01125	1.891	0.1364	0.1245	1.41	0.0168	2.020	120.44	84.6	.9752	3.031	1423.	0.1837	16658.	.00694	926.	0.653	8.824	8.065	4.842
1.50	32.70	276.9	270.9	5.95	255.3	15.64	5580.	1000.	5.58	5.08	.1099	0.320	553.	.01119	1.888	0.1405	0.1257	1.42	0.0164	2.240	136.42	97.0	.9787	3.242	1475.	0.1943	17499.	.00729	961.	0.695	9.423	8.526	5.096
2.00	31.51	274.3	268.3	5.95	253.1	15.18	5746.	986.	5.83	5.25	.1215	0.284	570.	.01150	1.885	0.1454	0.1313	1.44	0.0161	2.540	158.05	110.7	.9816	3.467	1524.	0.2052	18352.	.00764	994.	0.740	10.043	8.998	5.358
2.50	30.14	271.6	265.7	5.96	250.6	15.12	5772.	970.	5.95	5.30	.1335	0.253	572.	.01157	1.882	0.1514	0.1342	1.45	0.0157	2.920	185.76	126.5	.9841	3.707	1567.	0.2165	19201.	.00799	1025.	0.788	10.700	9.494	5.636
3.00	28.51	266.3	260.3	5.97	247.4	12.89	6770.	951.	7.12	6.27	.1460	0.225	671.	.01364	1.878	0.1594	0.1607	1.47	0.0154	3.380	220.03	145.4	.9864	3.976	1606.	0.2286	20086.	.00834	1055.	0.841	11.419	10.031	5.939
3.50	26.58	261.5	255.5	5.99	243.7	11.83	7376.	933.	7.91	6.88	.1589	0.199	732.	.01486	1.873	0.1695	0.1787	1.49	0.0150	4.020	268.05	168.0	.9884	4.291	1645.	0.2424	21088.	.00873	1088.	0.900	12.206	10.612	6.271
3.75	25.62	259.0	253.0	5.99	241.4	11.60	7519.	923.	8.15	7.05	.1657	0.187	746.	.01515	1.870	0.1760	0.1842	1.51	0.0148	4.460	301.25	181.8	.9894	4.477	1665.	0.2502	21654.	.00894	1105.	0.934	12.647	10.936	6.457
4.00	24.45	256.3	250.3	6.00	238.8	11.48	7598.	912.	8.33	7.16	.1727	0.175	754.	.01532	1.867	0.1838	0.1886	1.53	0.0146	4.980	340.79	197.7	.9904	4.685	1683.	0.2589	22268.	.00917	1123.	0.971	13.127	11.285	6.659
4.25	23.11	252.5	246.5	6.01	235.7	10.79	8089.	900.	8.99	7.67	.1800	0.163	803.	.01632	1.863	0.1936	0.2037	1.55	0.0144	5.810	402.92	217.1	.9913	4.929	1701.	0.2687	22959.	.00941	1142.	1.014	13.666	11.676	6.887
4.50	21.48	246.6	240.6	6.03	231.8	8.79	9921.	885.	11.21	9.49	.1880	0.151	985.	.02004	1.858	0.2070	0.2541	1.58	0.0142	7.200	506.48	242.6	.9923	5.238	1720.	0.2809	23810.	.00970	1165.	1.067	14.312	12.141	7.159
4.65	20.29	239.5	233.4	6.05	228.7	4.74	18395.	875.	21.02	17.70	.1933	0.142	1827.	.03716	1.854	0.2182	0.4773	1.60	0.0141	8.400	596.17	262.9	.9930	5.481	1731.	0.2903	24438.	.00991	1181.	1.106	14.784	12.478	7.357

FORCED CONVECTION BOILING

RUN NO.171.0 WATER TEST SECTION NO. 2

FLOW RATE,W= 595. LBS/HR MASS VELOCITY,G= 136.3 LBS/SEC.SQFT POWER= 6.43 KILOWATTS HEAT FLUX,Q= 37872. BTU/HR.SQFT

REYNOLDS NO.= 30184. TEMPERATURE BEFORE FLASH= 243.3 F VELOCITY BEFORE FLASH= 0.8 FT/SEC

L.FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	20.28	239.9	237.3	2.62	228.7	8.58	4413.	1026.	4.30	4.25	.0153	1.666	438.	.00891	0.805	0.0947	0.0976	1.60	0.0200	0.355	17.77	23.0	.9017	1.421	570.	0.0846	7531.	.00322	419.	0.308	3.312	3.350	1.872
0.10	20.25	242.7	240.1	2.62	228.6	11.48	3300.	1025.	3.22	3.18	.0163	1.579	328.	.00667	0.805	0.0949	0.0731	1.60	0.0199	0.367	18.40	24.2	.9069	1.457	583.	0.0866	7713.	.00329	428.	0.314	3.403	3.430	1.910
0.25	20.19	243.6	241.0	2.62	228.5	12.52	3025.	1024.	2.95	2.91	.0176	1.464	301.	.00611	0.804	0.0951	0.0671	1.61	0.0199	0.382	19.20	26.2	.9139	1.510	600.	0.0895	7977.	.00339	442.	0.324	3.537	3.548	1.967
0.50	20.09	244.2	241.6	2.62	228.2	13.38	2831.	1021.	2.77	2.73	.0199	1.305	281.	.00572	0.804	0.0955	0.0629	1.61	0.0198	0.408	20.59	29.4	.9236	1.594	628.	0.0941	8397.	.00355	462.	0.341	3.755	3.738	2.060
0.75	19.90	244.1	241.5	2.62	227.7	13.83	2738.	1018.	2.69	2.64	.0225	1.162	272.	.00553	0.804	0.0964	0.0611	1.61	0.0197	0.440	22.29	33.2	.9325	1.686	657.	0.0991	8845.	.00372	484.	0.359	3.992	3.942	2.161
1.00	19.87	243.5	240.9	2.62	227.6	13.27	2855.	1016.	2.81	2.75	.0246	1.069	284.	.00577	0.804	0.0965	0.0638	1.61	0.0197	0.475	24.16	36.2	.9381	1.752	679.	0.1027	9171.	.00385	500.	0.372	4.174	4.098	2.239
1.50	19.61	242.1	239.5	2.62	226.9	12.64	2996.	1010.	2.96	2.89	.0295	0.901	298.	.00605	0.804	0.0977	0.0674	1.62	0.0195	0.563	28.86	43.3	.9486	1.903	725.	0.1107	9891.	.00412	535.	0.402	4.582	4.442	2.412
2.00	19.29	240.6	237.9	2.62	226.0	11.92	3176.	1004.	3.16	3.08	.0344	0.774	316.	.00641	0.803	0.0992	0.0719	1.63	0.0193	0.675	34.88	50.9	.9566	2.051	767.	0.1185	10573.	.00438	566.	0.431	4.984	4.777	2.583
2.50	18.91	238.8	236.2	2.62	225.0	11.19	3383.	998.	3.39	3.28	.0396	0.674	336.	.00683	0.803	0.1011	0.0771	1.64	0.0192	0.825	42.99	59.2	.9629	2.200	8C7.	0.1261	11237.	.00463	596.	0.461	5.389	5.110	2.755
3.00	18.43	236.7	234.1	2.63	223.6	10.46	3621.	990.	3.66	3.52	.0450	0.590	360.	.00731	0.802	0.1035	0.0832	1.65	0.0190	1.045	54.93	68.6	.9682	2.358	845.	0.1340	11912.	.00488	626.	0.492	5.810	5.453	2.934
3.50	17.81	234.3	231.7	2.63	221.8	9.85	3845.	981.	3.92	3.76	.0509	0.518	382.	.00775	0.801	0.1069	0.0892	1.67	0.0189	1.350	71.61	79.8	.9728	2.535	882.	0.1425	12628.	.00515	656.	0.527	6.268	5.821	3.128
4.00	17.01	231.2	228.6	2.63	219.5	9.11	4156.	971.	4.28	4.08	.0573	0.453	414.	.00838	0.800	0.1115	0.0975	1.69	0.0187	1.785	95.61	93.3	.9769	2.736	920.	0.1520	13409.	.00543	687.	0.565	6.775	6.223	3.343
4.25	16.54	228.9	226.3	2.64	218.0	8.27	4577.	964.	4.75	4.51	.0607	0.423	456.	.00924	0.799	0.1144	0.1082	1.71	0.0186	2.115	113.87	101.4	.9789	2.849	938.	0.1572	13830.	.00557	704.	0.586	7.054	6.443	3.461
4.50	16.00	225.7	223.1	2.64	216.3	6.80	5569.	957.	5.82	5.52	.0644	0.394	554.	.01126	0.798	0.1180	0.1327	1.72	0.0185	2.570	139.13	110.7	.9807	2.975	956.	0.1627	14288.	.00573	721.	0.610	7.357	6.680	3.590
4.69	15.46	222.0	219.4	2.65	214.6	4.75	7970.	951.	8.38	7.93	.0676	0.371	794.	.01614	0.797	0.1216	0.1913	1.73	0.0184	3.040	165.30	119.7	.9822	3.092	972.	0.1678	14701.	.00586	735.	0.631	7.629	6.892	3.705

FORCED CONVECTION BOILING

RUN NO.172.0 WATER TEST SECTION NO. 2

FLOW RATE,W= 595. LBS/HR MASS VELOCITY,G= 136.3 LBS/SEC.SQFT POWER= 6.39 KILOWATTS HEAT FLUX,Q= 37642. BTU/HR.SQFT

REYNOLDS NO.= 31102. TEMPERATURE BEFORE FLASH= 284.9 F VELOCITY BEFORE FLASH= 0.8 FT/SEC

L,FT	PSIA	TO	TI	TO-TI	TB	TI-TB	HBOIL	HLIQ	HB/HL	HB/HO	X	XTT	NUB	STANTN	BO E4	BOMOD
0.	25.67	250.0	247.4	2.60	241.5	5.90	6385.	1027.	6.22	5.98	.0464	0.663	633.	.01287	0.807	0.0758
0.10	25.57	251.3	248.7	2.59	241.3	7.42	5071.	1026.	4.94	4.75	.0475	0.649	503.	.01022	0.807	0.0761
0.25	25.42	251.9	249.4	2.59	241.0	8.39	4489.	1024.	4.38	4.21	.0490	0.627	445.	.00904	0.807	0.0765
0.50	25.13	251.8	249.2	2.59	240.3	8.83	4263.	1020.	4.18	4.00	.0517	0.593	423.	.00859	0.806	0.0773
0.75	24.86	251.1	248.5	2.59	239.8	8.72	4314.	1017.	4.24	4.06	.0544	0.563	428.	.00869	0.806	0.0781
1.00	24.57	250.3	247.8	2.59	239.1	8.67	4344.	1013.	4.29	4.09	.0571	0.535	431.	.00876	0.805	0.0789
1.50	23.93	248.8	246.2	2.60	237.6	8.62	4369.	1005.	4.35	4.13	.0627	0.484	434.	.00881	0.805	0.0809
2.00	23.19	247.1	244.5	2.60	235.9	8.61	4374.	997.	4.39	4.15	.0684	0.438	434.	.00883	0.804	0.0832
2.50	22.33	245.0	242.4	2.60	234.0	8.46	4451.	988.	4.51	4.24	.0744	0.397	442.	.00899	0.803	0.0860
3.00	21.37	242.1	239.5	2.60	231.5	8.04	4682.	977.	4.79	4.48	.0809	0.359	465.	.00946	0.801	0.0897
3.50	20.17	238.5	235.9	2.61	228.4	7.49	5023.	965.	5.21	4.84	.0880	0.322	499.	.01015	0.800	0.0946
3.75	19.48	236.5	233.9	2.61	226.5	7.36	5116.	957.	5.34	4.95	.0918	0.304	508.	.01033	0.799	0.0978
4.00	18.80	234.4	231.8	2.61	224.7	7.16	5258.	950.	5.53	5.11	.0956	0.288	523.	.01061	0.798	0.1010
4.25	18.00	231.8	229.2	2.62	222.4	6.83	5513.	942.	5.85	5.38	.0998	0.270	548.	.01112	0.796	0.1052
4.50	17.07	227.9	225.3	2.62	219.6	5.62	6700.	932.	7.19	6.58	.1044	0.253	667.	.01351	0.795	0.1104
4.65	16.44	224.0	221.3	2.63	217.7	3.66	10272.	925.	11.10	10.14	.1074	0.241	1022.	.02074	0.794	0.1144

L,FT	NUB/RE	PRNOL	DP/DLL	DP/DLTP	TP/LIQ	VELOC	ALPHA	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8 E4	Q9 E4	Q10E4
0.	0.1406	1.51	0.0187	1.010	54.00	52.5	.9581	1.984	857.	0.1194	10832.	.00466	602.	0.439	5.440	5.152	2.779
0.10	0.1118	1.51	0.0187	1.027	55.01	53.8	.9592	2.007	864.	0.1206	10940.	.00470	607.	0.444	5.510	5.210	2.809
0.25	0.0991	1.51	0.0186	1.055	56.66	55.8	.9607	2.042	873.	0.1225	11099.	.00476	615.	0.452	5.615	5.295	2.853
0.50	0.0945	1.52	0.0155	1.080	58.27	59.4	.9632	2.102	890.	0.1256	11374.	.00487	627.	0.465	5.797	5.443	2.931
0.75	0.0960	1.52	0.0184	1.160	62.87	62.9	.9653	2.160	906.	0.1286	11635.	.00497	639.	0.478	5.974	5.585	3.006
1.00	0.0970	1.53	0.0184	1.220	66.42	66.6	.9674	2.220	921.	0.1316	11898.	.00507	650.	0.491	6.155	5.731	3.082
1.50	0.0984	1.54	0.0182	1.355	74.46	74.7	.9711	2.345	951.	0.1379	12428.	.00528	673.	0.517	6.526	6.027	3.240
2.00	0.0994	1.55	0.0180	1.530	84.88	83.7	.9744	2.478	980.	0.1444	12978.	.00548	696.	0.546	6.915	6.334	3.405
2.50	0.1021	1.56	0.0178	1.800	100.86	93.8	.9773	2.621	1008.	0.1512	13545.	.00570	719.	0.575	7.324	6.656	3.579
3.00	0.1087	1.58	0.0177	2.190	124.00	106.2	.9801	2.788	1037.	0.1590	14178.	.00592	743.	0.609	7.782	7.011	3.772
3.50	0.1183	1.61	0.0175	2.530	144.81	121.6	.9828	2.988	1066.	0.1680	14889.	.00618	769.	0.647	8.301	7.412	3.993
3.75	0.1214	1.62	0.0174	2.730	157.14	130.9	.9841	3.106	1080.	0.1732	15285.	.00633	783.	0.669	8.593	7.635	4.116
4.00	0.1258	1.64	0.0173	2.980	172.48	140.8	.9853	3.228	1095.	0.1786	15686.	.00647	797.	0.692	8.889	7.860	4.242
4.25	0.1332	1.67	0.0172	3.340	194.46	152.8	.9865	3.372	1110.	0.1848	16147.	.00664	812.	0.717	9.229	8.118	4.386
4.50	0.1637	1.69	0.0171	3.970	232.62	167.7	.9878	3.544	1126.	0.1920	16682.	.00682	829.	0.747	9.619	8.412	4.551
4.65	0.2531	1.71	0.0170	4.650	273.63	178.6	.9886	3.664	1135.	0.1968	17046.	.00694	840.	0.768	9.890	8.615	4.666