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Measurement of Heat Transfer and Pressure Drop in Rectangular Channels With Turbulence Promoters

J. C. Han, J. S. Park,
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Nomenclature

A	heat transfer surface area
D	channel hydraulic diameter
e	rib height
e^+	roughness Reynolds number, $(e/D)Re(f_r/2)^{1/2}$
\bar{e}^+	average roughness Reynolds number, $(e/D)Re(\bar{f}/2)^{1/2}$
f_r	friction factor for four sided ribbed channel
f_s	friction factor for four sided smooth channel, the same as $f(FD)$
\bar{f}	average friction factor in a channel with two opposite ribbed walls
$\bar{f}/f(FD)$	ratio of ribbed channel average friction factor to fully developed four sided smooth channel friction factor
g_c	conversion factor
G	mass flux, $\rho\bar{v}$
h	heat transfer coefficients
H	heat transfer roughness function; also flow channel height
H(R)	heat transfer roughness function based on ribbed side wall only
K	thermal conductivity of air
L	test channel length for frictional pressure drop
LHS	left hand side wall
Nu	Nusselt number, hD/K
Nu(FD)	fully developed four sided smooth channel Nusselt number
Nu(R)	Nusselt number based on ribbed side wall only
ΔP	pressure drop across the test section
P	rib pitch
Pr	Prandtl number of air
q''	heat transfer rate per unit surface area

R	momentum transfer roughness function
Re	Reynolds number, GD/μ
RHS	right hand side wall
St (R)	Stanton number based on ribbed side wall only
St (s)	Stanton number based on smooth side wall only
St _r	Stanton number, $Nu/(Re Pr)$, for four sided ribbed channel
St _s	Stanton number for four sided smooth channel, the same as St(FD)
\bar{St}	average Stanton number in a channel with two opposite ribbed walls
$\bar{St}/St(FD)$	Ratio of ribbed channel average Stanton number to fully developed four sided smooth channel Stanton number
T _b	bulk mean temperature of air
T _w	local wall temperature
\bar{V}	average velocity of air
W	flow channel width
W/H	channel aspect ratio, ribs on W side
X	the axial distance from the heated test channel
α	rib angle-of-attack
ρ	average density of air
μ	average viscosity of air

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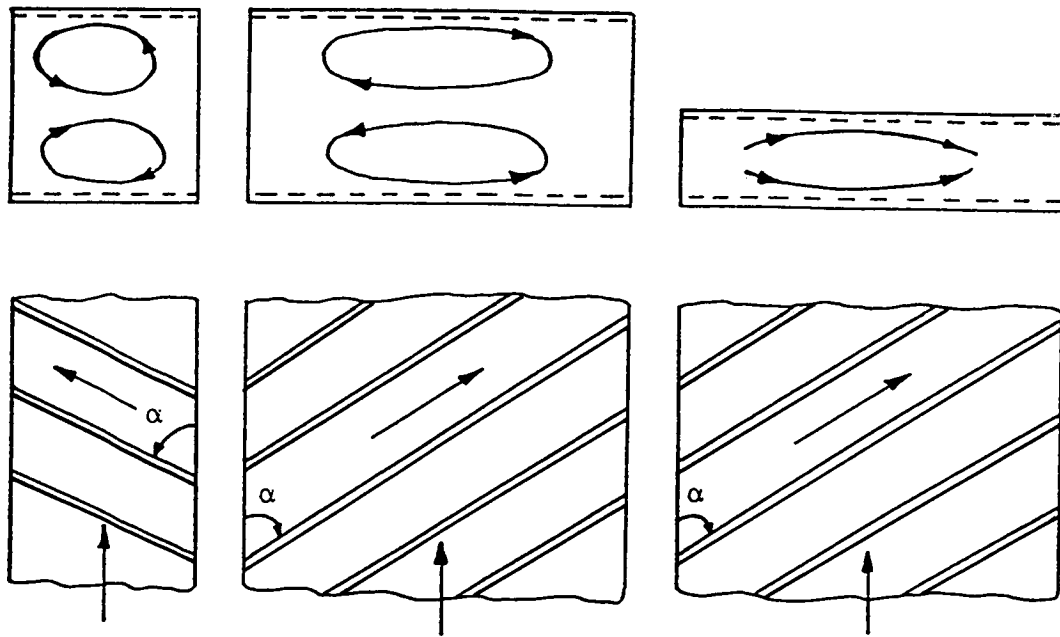
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MEASUREMENT OF HEAT TRANSFER AND PRESSURE DROP IN RECTANGULAR CHANNELS WITH TURBULENCE PROMOTERS

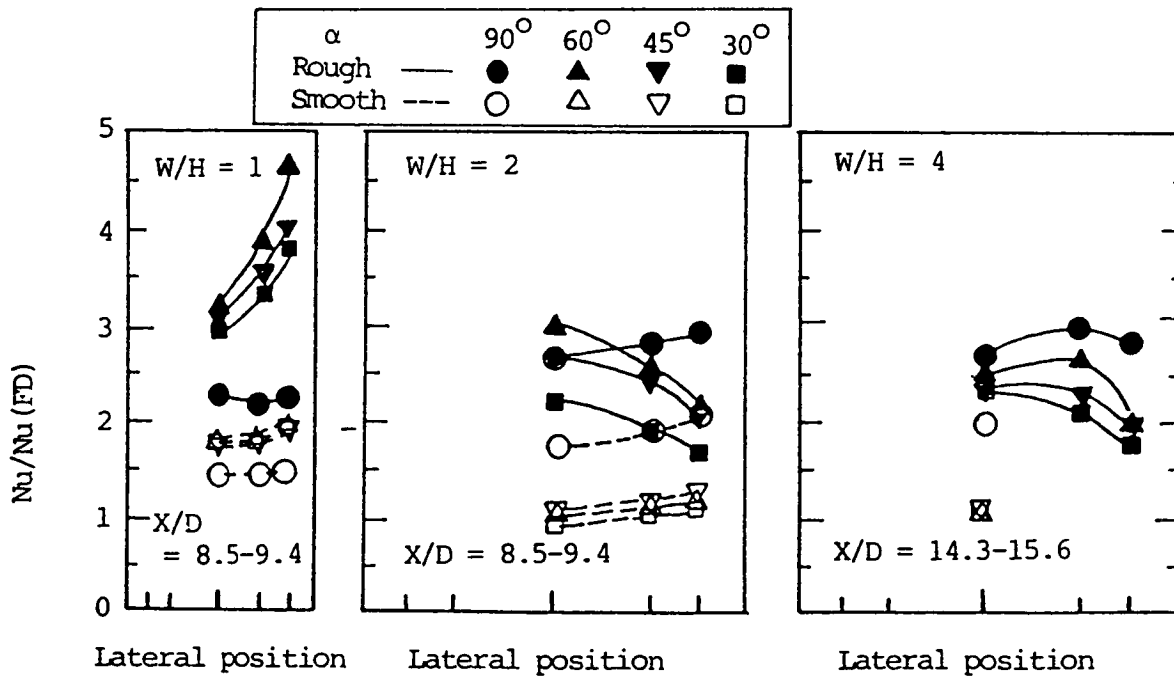
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The rib angles shown in Figures 28(a) and (b), (pp. 60 and 61), were shown with the same orientation as the rib angles for the other two aspect ratios (Figs. 29 and 30). The orientation of the rib angles for the square duct (Figs. 28(a) and (b)) was incorrect. The correct orientation for the rib angles for all three aspect ratios is shown in Figure A1(a). This figure shows a different orientation for the square duct and the same rib angle orientation for the two rectangular ducts.

Figures 28 to 30 of NASA CR-4015 show the distribution of the local heat transfer coefficients for three ducts with different aspect ratios. Because of the orientation of the ribs shown in these figures, it could be inferred that the differences in the heat transfer distributions among the three ducts were due solely to the different aspect ratios of the ducts. The location of the heat transfer measurement relative to the flow direction and rib angle orientation also influences the comparison among the different heat transfer distributions. Figure A1(b) gives the heat transfer distribution as a function of lateral position for each duct geometry for four rib angle orientations at $P/e = 10$ and $Re = 30\ 000$. The heat transfer results are given for $x/10$ values where the entrance effect was no longer significant. Results are shown for the wall with turbulence promoters and for the adjacent smooth wall. Figure A1(a) shows the suspected secondary flow patterns induced by the turbulence promoters for ribs inclined at an angle to the flow. The different secondary flow patterns will influence the local heat transfer. For the square duct the heat transfer measurements were made in the trailing region relative to the centerline flow. For the other two ducts the measurements were made in the leading region relative to the centerline flow. At a rib angle of 90° the trailing and leading regions are indistinguishable. The heat transfer distributions at this angle show the effect of duct aspect ratio. The results at the other rib angles show that the suspected secondary flow patterns may strongly influence the local heat transfer.



(a)



(b)

Fig. A1 (a) Effect of rib angle on secondary flow
 (b) Effect of rib angle on lateral Nusselt number ratio at $P/e = 10$, $Re = 30,000$.

1.0 SUMMARY

This is the final report for the program of Measurement of Heat Transfer and Pressure Drop in Rectangular Channels with Turbulence Promoters. This project was conducted by the Turbomachinery Laboratories of the Texas A&M University and was funded through Curtis Walker at the U.S. Army Research and Technology Laboratories. The project was monitored by Robert Boyle at the NASA-Lewis Research Center under NASA Contract No. NAS3-24227.

Periodic rib turbulators have been used in advanced turbine cooling designs to enhance the internal heat transfer. The previous studies (NASA CR 3837) showed that the slant ribs provided a higher heat transfer than that the transverse ribs in a square channel for a constant pumping power. The objective of the present project was to investigate the combined effects of the rib angle-of-attack and the channel aspect ratio on the local heat transfer and pressure drop in rectangular channels with two opposite ribbed walls for Reynolds number varied from 10,000 to 60,000. The channel aspect ratio (W/H) was varied from 1 to 2 to 4. The rib height-to-hydraulic diameter ratio (e/D) was varied from 0.047 to 0.078, the rib pitch-to-height ratio (P/e) was varied from 10 to 20, and the rib angle-of-attack (α) was varied from 90° to 60° to 45° to 30° , respectively.

The highly detailed heat transfer coefficient distribution on both the smooth side and the ribbed side walls from the channel sharp entrance to the downstream region were measured. The results did confirm that, in the square channel, the heat transfer for the slant ribs ($\alpha = 30^\circ$ - 45°) was about 30% higher than that the transverse ribs ($\alpha = 90^\circ$) for a constant pumping power. However, in the rectangular channels ($W/H = 2$ and 4 , ribs on W side), the heat transfer at $\alpha = 30^\circ$ -

45° was only about 5% higher than that $\alpha = 90^\circ$. The results also showed that, in the square channel, the highest heat transfer was obtained at $\alpha = 60^\circ$ accompanying with the highest pressure drop, however, in the rectangular channel with $W/H = 4$, both the highest heat transfer and pressure drop were obtained at $\alpha = 90^\circ$. The average heat transfer and friction correlations were developed to account for rib spacing, rib angle, and channel aspect ratio over the range of roughness Reynolds number. The correlations can be used in the design of gas turbine airfoil cooling passages.

2.0 INTRODUCTION

2.1 Background

In advanced gas turbine blades and vanes, turbulence promoters (rib turbulators) are cast onto two opposite walls of the shaped internal cooling passages to enhance the heat transfer to the cooling air. The cutaway views of a typical advanced gas turbine airfoil are shown in Figure 1. The internal cooling passages can be approximately modeled as rectangular channels with two opposite rib-roughened walls. In [1] and [2, 3], the effects of the rib pitch-to-height ratio (P/e 10 to 40), the rib height-to-channel hydraulic diameter ratio ($e/D = 0.021$ to 0.063), and the rib angle-of-attack ($\alpha = 30^\circ$ to 90°) on the average heat transfer and the pressure drop for fully developed turbulent air flow ($Re = 7,000$ to $90,000$) in a uniformly heated, straight, square channel with two opposite ribbed walls were systematically investigated. The results showed that, at $P/e = 10$ to 20 , the maximum heat transfer occurred at rib angles-of-attack between 60° and 75° , whereas the optimum heat transfer occurred at rib angles-of-attack between 30° and 45° . The maximum heat transfer was defined as the highest heat transfer rate which occurred at the cost of the highest pressure drop, while the optimum heat transfer was defined as the highest heat transfer rate which could be obtained for a given constant pumping power. Semi-empirical correlations for friction factor and heat transfer coefficients were developed to account for rib spacing and rib angle over the range of Reynolds number.

The friction and average heat transfer results obtained for fully developed flow in [1-3] can serve as reference data for turbine airfoil internal cooling designs. However, the results obtained in [1-3] are primarily for the square channel with two opposite ribbed walls. The

effect of the channel aspect ratio on the heat transfer performance is lacking. Moreover, the local heat transfer coefficient on both the smooth side and the rib-roughened side walls of the test channel, from the channel entrance to the downstream region, has not been reported. The local heat transfer coefficient distribution is essential to engineers in the design of effectively cooled turbine airfoils which are not susceptible to structural failure due to uneven metal temperature distributions. Therefore, a systematic investigation to determine the combined effects of the flow channel aspect ratio (W/H), the rib geometry ($P/e, \alpha$), and the roughness Reynolds number (e^+) on the local heat transfer coefficient distribution should be performed.

2.2 Objective

The objective of the project was to investigate the combined effects of the channel aspect ratio and the rib angle-of-attack on the friction factor and the local and the average heat transfer coefficients in rectangular channels with two opposite ribbed walls for Reynolds number varied from 10,000 to 60,000. Three flow channel aspect ratios (W/H) were examined, namely, 1, 2, and 4, respectively. In each channel, periodic ribs were placed on the channel width side (W). The rib height-to-hydraulic diameter ratio (e/D) was varied from 0.047 to 0.078, the rib pitch-to-height ratio (P/e) was varied from 10 to 20, whereas the corresponding rib angle-of-attack (α) was varied from 90° to 60° to 45° to 30° , respectively. The local heat transfer coefficient distributions on the smooth side and the ribbed side walls, from the channel entrance to the downstream region, were measured. Heat transfer performance was compared, and the best rib geometry was identified. Semi-empirical correlations for the average friction and heat transfer coefficients were developed to account for channel aspect ratio, rib

spacing, and rib angle. The correlations can be used in the design of gas turbine airfoil cooling passages.

3.0 EXPERIMENTAL APPARATUS AND DATA REDUCTION

3.1 Experimental Apparatus

A schematic of the experimental apparatus is shown in Figure 2. A 5 HP blower forced air through a settling chamber and a 4 in. diameter pipe, equipped with a 1.5 in. diameter orifice plate to measure flow rate. A plexiglass plenum was connected between the pipe and the test channel, to ensure that the air entering the test channel had a sharp contraction entrance condition. At the end of the test channel, the air was exhausted into the atmosphere. The Reynolds number based on the channel hydraulic diameter (D) was varied between 10,000 and 60,000.

Both square and rectangular channels were constructed. The square channel had a cross-section of 2" x 2", while the rectangular channel I had 4" x 2". The same rectangular channel I was also served as the rectangular channel II by replacing the channel height (H) from 2" to 1". The periodic ribs were placed on the channel width (W) side. The dimensions of the three test channels and the associated plenums are shown in Figure 3.

The rectangular channel I ($W/H = 4"/2"$) consisted of four wood-plexiglass plates with a total thickness of 0.75 in., as shown in Figure 4. Each plate was covered separately by the 0.001 in. thick stainless steel foil, which was cemented to the front surface of each plate and could be individually controlled by a variac transformer, to provide a controllable electrical heat to the test channel. A single strip foil with a width of $1 \frac{7}{8}$ " was used for the channel height (H) side. Meanwhile, three parallel strip foils with each a width of $1 \frac{1}{4}$ ", connected in series from one end to the other by the buss bar, was used for the channel width (W) side, as shown in Figure 4.

The same rectangular I was also used for the rectangular channel II ($W/H = 4"/1"$) by changing the strip foil on the channel height (H) from a width of $1\ 7/8"$ to that of $7/8"$. The square channel ($W/H = 2"/2"$) was constructed in a same way as that of the rectangular I, except that a single strip foil with a width of $1\ 7/8"$ was used separately for each side wall of the channel.

For the case of ribbed channel tests, the brass ribs of a square cross-section were glued periodically in line onto the top and bottom plates (i.e., the width side of the channel) of the foil-heated channels in a required distribution. The rib geometries for each test channel are shown in Figure 5.

The detailed thermocouple locations for each test channel are shown in Figure 6. The square channel had 180, 36 gauge, copper-constantan thermocouples in the strategic locations to measure the local surface temperature. Ninety of them were placed on the bottom ribbed wall (channel width side), while the other ninety on the right hand side smooth wall (channel height side). Sixty out of each ninety thermocouples were placed along the centerline of the ribbed and the smooth walls, respectively. The rest of each thirty thermocouples were well distributed on the middleline and the edgeline of each walls, as shown in Figure 6. The thermocouple locations for the rectangular channel I were similar to that the square channel. In order to check the symmetry of thermocouple readings on the opposite smooth walls, there were two thermocouples placed on the left hand side smooth wall (LHS), at the downstream region of the channel I. The same bottom ribbed wall of the rectangular channel I was used for that of the rectangular channel II. But, on the right hand side smooth wall (RHS) of the channel II, the thermocouples were only placed along the

centerline of the test plate. The thermocouples were soldered underneath the thin foil through holes in the wood-plexiglass plate, as shown in Figure 7. Each test channel was well insulated by fiberglass material. A Fluke 2280 A Data Logger and a TI PC were used for temperature readings and storages.

The pressure tap locations are shown in Figure 8. Six pressure taps along the top ribbed wall, and the other six along the left hand side smooth wall were used for the static pressure drop measurements. A pressure tap was also installed in the plenum to check the static pressure of air entering the test channel. A Dwyer Microtector with an accuracy up to 0.001" water was used for pressure drop measurements in the test channel. Figure 9 shows a photograph of the test channels.

3.2 Data Reduction

The local heat transfer coefficient was calculated from the local net heat transfer rate per unit surface area from the wall to the cooling air, the local wall temperature, and the local bulk mean air temperature as

$$h = \frac{q}{A(T_w - T_b)} \quad (1)$$

Equation (1) was used respectively for the ribbed side wall and the smooth side wall heat transfer coefficient calculations. The local net heat transfer rate was the electrical power generated from the foil, subtracting heat loss to the outside of the test channel. The electrical power generated from the foil was determined from the measured foil resistance and the current through the foil on each plate. The electrical power was also checked with the measured voltage drop

across the foil on each plate. In order to place the results on a common basis, the heat transfer area used in equation (1) was always that of a smooth foil on each wall. It was found that the foil provided a nearly uniform heat flux on each wall of the test channel. The maximum heat loss from the ribbed side wall and the smooth side wall was estimated to be less than 3% and 5%, respectively, for Reynolds numbers greater than 10,000. The net heat flux (q/A) level was varied from about 300 to 800 Btu/hr-ft² depending upon the test conditions.

The local wall temperature used in equation (1) was derived from the thermocouple measurement. The bulk mean air temperatures entering and leaving the test channel were measured by thermocouples which could be travelled vertically and horizontally. The local bulk mean air temperature used in equation (1) was calculated, assuming a linear air temperature rise along the flow channel. It was checked that the total net heat transfer from the test channel to the cooling air agreed well with the cooling air enthalpy rise along the test channel. The inlet bulk mean air temperature was about 75° to 85°F depending upon the test conditions.

The reported local Nusselt number was normalized by the Nusselt number for the fully developed turbulent channel flow derived by Dittus and Boelter as

$$\frac{Nu}{Nu(FD)} = \frac{hD/K}{0.023 Re^{0.8} Pr^{0.4}} \quad (2)$$

The maximum uncertainty in the Nusselt number was estimated to be less than 8% for Reynolds numbers larger than 10,000 by using the uncertainties estimation method in [4].

The pressure drop across the test channel was measured by a microtector. In fully developed channel flow, the average friction factor was calculated from the pressure drop across the flow channel and the mass flow rate of the air as

$$\bar{f} = \frac{\Delta P}{4(L/D) (G^2/2\rho g_c)} \quad (3)$$

The average friction factor of the present investigation was based on the adiabatic conditions (tests without heating). The maximum uncertainty in the average friction factor was estimated to be less than 9% for Reynolds numbers greater than 10,000.

4.0 EXPERIMENTAL RESULTS

4.1 Experimental Results for Smooth Channels

The typical results for the four-sided smooth channels are shown in Figures 10-12. In general, the local Nusselt number ratios along the bottom wall (channel width side) and the right hand side (RHS) wall of the test channels exhibit the same trend, except that the local Nusselt number ratios along the right hand side wall (channel height side) are slightly higher than that along the bottom wall for the rectangular channels I and II, respectively. It can be seen that flow separation occurs right after the entrance due to sharp contraction, and then the flow reattachment attains at about 0.5 D from the entrance, producing a high heat transfer coefficient. At further downstream from the entrance, for the square channel the Nusselt numbers are about 5 to 10 percent higher than that the fully developed turbulent flow results, while for the rectangular channels the Nusselt numbers are about 5 to 20 percent higher than that the fully developed values.

The experimental results from Boelter, Young, and Iversen [5] and Sparrow and Cur [6] are also included in Figures 10-12 for comparisons. In reference [5], the results were obtained for flow in a circular tube with a sharp entrance and heated by condensing steam. In reference [6], the data were based on the local measurements for flow in a high-aspect-ratio rectangular duct ($W/H = 18$) with a sharp entrance by using the Naphthalene sublimation technique. In the developing region ($X/D = 1 \sim 6$), the present data agree qualitatively with those of [5] and [6]. In the fully developed region ($X/D = 8 \sim 10$), the present data agree fairly well with those of [5] and [6]. It is interesting to note that both the present study and the reference [6] show that the flow reattachment attains at about 0.5 D from the entrance. These smooth channel results

prove that the test sections are reliable to reproduce data for the cases when the periodic ribs are applied.

The average friction factor and the average heat transfer coefficient in the fully developed region are shown in Figure 13 and compared with the results given in the literature. The friction factor differs by up to 12% from the Blasius friction factor equation, and the Nusselt number differs by up to 10% from the Dittus-Boelter equation. The Blasius equation for the four-sided smooth channel friction factor is:

$$f(\text{FD}) = 0.079 (\text{Re})^{-0.25} \quad (4)$$

The Dittus-Boelter equation for the four-sided smooth channel heat transfer is:

$$\text{Nu}(\text{FD}) = 0.023 \text{Re}^{0.8} \text{Pr}^{0.4} \quad (5)$$

4.2 Experimental Results for Rib-Roughened Channels

The brass ribs of a square cross-section were glued periodically in-line onto the top and bottom walls of the test channels in patterns to achieve the desired spacing and angle-of-attack. In each channel, a total of eight rib geometries (two rib spacings, $P/e = 10$ and 20 ; each rib spacing having four different rib angles-of-attack, $\alpha = 90^\circ$, 60° , 45° , and 30°) were tested respectively for three Reynolds numbers, $\text{Re} = 10,000$, $30,000$, and $60,000$, as indicated in Figure 5. Additionally, the rectangular channels I ($W/H = 4"/2"$, ribs on W side) and II ($W/H = 4"/1"$, ribs on W side) were modified to become the rectangular channels IA ($W/H = 2"/4"$, ribs on W side) and IIA ($W/H = 1"/4"$, ribs on W side), respectively, by simply replacing the periodic ribs from the top and

bottom walls to the right and left hand side walls, for two rib spacings ($P/e = 10$ and 20), one rib angle ($\alpha = 90^\circ$), and three Reynolds numbers, respectively. The detailed raw data for all test runs are given in Appendix. Only the most representative results will be presented as follows.

4.2.1 Local Heat Transfer and Pressure Drop Data

Figures 14-16 show the typical local temperature distribution along the centerline in both the bottom ribbed wall and the RHS smooth wall of the test channels. As expected that the ribbed wall heat flux is higher than the smooth wall. These wall temperature profiles were used for determining the local heat loss through the test plate and the insulation material to the outside of the test channel. These wall temperature profiles were also used for calculating the local heat transfer coefficient according to equation (1).

Effect of rib spacing. The typical results to illustrate the effect of rib spacing on the centerline heat transfer coefficient on both the ribbed side wall and the smooth side wall of the test channels are shown in Figures 17-19 for the case of $Re = 30,000$ and $\alpha = 90^\circ$. The results show that the local Nusselt number ratios on the RHS smooth wall of the ribbed channels decrease sharply with distance for both P/e ratios. These are similar to the four-sided smooth channel results, except that the former have some small fluctuations and about 20-100% higher values than that the latter, due to the influence of the adjacent periodic ribs. However, the local Nusselt number ratios on the ribbed side wall have larger fluctuations and decrease slowly with distance after the first two ribs ($X/D > 2.0$), due to flow separation from ribs and reattachment between ribs. For the case of $P/e = 10$, heat transfer coefficients increase after flow separating from ribs and decrease after

flow reattaching on the surface (about 4 rib height downstream from separation) and then increase again before flow hits next rib.

For the case of $P/e = 20$, the similar flow and heat transfer patterns are observed, except that heat transfer coefficients are about 10-20% lower than that of $P/e = 10$, because of wider rib spacing creating thicker boundary layer thickness after flow reattachment between ribs. The periodic heat transfer profiles are obtained after $X/D > 3$. At $X/D < 1.0$, for both $P/e = 10$ and 20 the Nusselt number ratios on both the ribbed side and the smooth side walls are about the same, while at $X/D > 1.0$, the ribbed side wall Nusselt number ratios are gradually departed from that the smooth wall values and up to about two times higher at the downstream fully developed region, $X/D > 7.5$.

Effect of Reynolds number. The typical results to demonstrate the effect of Reynolds number on the centerline heat transfer coefficient of the ribbed channels are shown in Figures 20-22 for the case of $P/e = 20$ and $\alpha = 90^\circ$. In general, the Nusselt number ratios for $Re = 10,000$ and 60,000 shown in Figures 20-22 have the same trend as that for $Re = 30,000$ shown in Figures 17-19. It can be seen that flow tends to reattach quicker for $Re = 60,000$, about 2 rib height downstream from separation, than that for $Re = 10,000$, about 6 rib height downstream from separation. Therefore, the Nusselt number ratio decreases with increasing Reynolds number.

Effect of channel aspect ratio. The typical results to show the effect of channel aspect ratio on the centerline heat transfer coefficient are shown in Figures 23-24 for the case of $\alpha = 90^\circ$ and $Re = 30,000$. In general, the Nusselt number ratios on both the ribbed side and the smooth side walls show the same trend for different channel

aspect ratios. It can be seen that the Nusselt number ratio gradually increases with increasing channel aspect ratio. This is because that, for the same rib geometry ($e/D = 0.047$, $\alpha = 90^\circ$, $P/e = 10$ or 20) and flow condition ($Re = 30,000$), the high aspect ratio channels ($W/H = 2, 4$) have wider ribbed side surfaces (i.e., narrower smooth side walls) to produce higher heat transfer coefficient, while the low aspect ratio channels ($W/H = 1/2, 1/4$) have narrower ribbed side surfaces (i.e., wider smooth side walls) to produce lower heat transfer coefficient.

Combined effects of rib angle-of-attack and channel aspect ratio.

The typical results to show the combined effects of rib angle-of-attack and channel aspect ratio on the centerline heat transfer coefficient are plotted in Figures 25-27 for the case of $P/e = 10$ and $Re = 30,000$. In general, the heat transfer patterns of the ribbed side wall are non-similar for different rib angle-of-attack. In the square channel, the Nusselt number ratio for $\alpha = 90^\circ$ maintains about the same level after $X/D > 3$, which implies that the periodic heat transfer distribution at the downstream region ($X/D > 7.5$) is observed. It can be seen that the Nusselt number ratio for $\alpha = 60^\circ, 45^\circ$, and 30° increase after $X/D > 3$. Therefore, at $X/D > 3$, the Nusselt number ratio for $\alpha = 60^\circ, 45^\circ$, and 30° , is higher than that for $\alpha = 90^\circ$. However, as shown in Figure 26, the rib angle effect on the local heat transfer is reduced for the rectangular channel I ($W/H = 2$) and the rib angle effect is completely diminished for the rectangular channel II ($W/H = 4$) as shown in Figure 27. In other words, in rectangular channel II the Nusselt number ratio for $\alpha = 90^\circ$ is higher than that for $\alpha = 60^\circ, 45^\circ$, and 30° , respectively.

In order to examine closely the combined effects of rib angle and channel aspect ratio on the local heat transfer behavior at the downstream region, the typical Nusselt number ratios ($Nu/Nu(FD)$) are

tabulated in Figures 28-30 for $P/e = 10$ and $Re = 30,000$. In the square channel as shown in Figure 28, for $\alpha = 90^\circ$ the Nusselt number ratio on the ribbed side wall varies periodically in the streamwise (axial) direction, and the edgeline Nusselt number ratio is slightly higher than that the centerline values. For $\alpha = 60^\circ, 45^\circ, \text{ and } 30^\circ$, the Nusselt number ratio on the ribbed side wall varies in both the streamwise and the spanwise (lateral) directions, and the edgeline Nusselt number ratio is much higher than that the centerline values. Meanwhile, the centerline Nusselt number ratio for $\alpha = 60^\circ, 45^\circ, \text{ and } 30^\circ$, is higher than that for $\alpha = 90^\circ$ at the same values of $e/D, P/e, \text{ and } Re$.

In the rectangular channel I ($W/H = 2$) as shown in Figure 29, for $\alpha = 90^\circ$ the Nusselt number ratio behaves similarly to that the square channel as discussed above. However, for $\alpha = 60^\circ, 45^\circ, \text{ and } 30^\circ$, the edgeline Nusselt number ratio is lower, instead of higher in the case of the square channel, than that the centerline values. Meanwhile, the centerline Nusselt number ratio for angled rib ($\alpha = 60^\circ$ et al.) is only slightly higher than that the transverse rib ($\alpha = 90^\circ$) at the same values of $e/D, P/e, \text{ and } Re$. In the rectangular channel II ($W/H = 4$) as shown in Figure 30, the Nusselt number ratio shows the same trend as that in the rectangular channel I for all different rib angles, except that the centerline Nusselt number ratio for angled rib is now lower than that the transverse rib at the same conditions.

At this point, we find that the angled rib has the biggest effect for the square channel ($W/H = 1$), however, the effect is diminished for the rectangular channel II ($W/H = 4$). The same conclusions are also applied for the case of $P/e = 20$ and other Reynolds numbers. It also can be seen that, on the smooth side wall, the edgeline Nusselt number

ratios are always higher than that the centerline values in each channel due to the adjacent rib effect. Meanwhile, in the square channel the smooth side wall Nusselt number ratios for the angled rib are higher than that for the transverse rib, but in the rectangular channels the smooth side wall Nusselt number ratios for the angled rib are much lower than that for the transverse rib.

Figure 31 shows the effect of rib orientations on the temperatures of the opposite smooth walls in the square and rectangular channels. It can be seen that, in the square channel [1], the temperatures on both the RHS and LHS smooth walls are about the same for all α . However, in the rectangular channel I, the temperatures on both smooth walls are about the same only for $\alpha = 90^\circ$. When $\alpha = 60^\circ$, 45° , and 30° , the temperatures on the RHS smooth wall are much higher (30-40% higher) than that on the LHS smooth wall. This implies that the RHS smooth wall heat transfer is lower than that the LHS smooth wall for the rectangular channel I with angled ribs.

The present square channel results confirm what we observed in our previous report [1], except that in the present square channel the highly detailed heat transfer distributions along the ribbed side and the smooth side walls are obtained. However, the rib angle effect for the rectangular channels are beyond our expectations. Based on this observations, it seems that a highly swirling flow (or secondary flow) may be created along the rib angle direction from the left hand side edge to the right hand side edge producing a higher heat transfer at the edgeline than that the centerline for the square channel. However, this swirling flow generated by the angled rib may be damped away for the rectangular channel II ($W/H = 4$, ribs on W side) due to the wider ribbed side wall and the narrower smooth side wall (i.e., the swirling flow

cannot penetrate into the edge, or boundary layer effect on the edge). This may be the reason why the angled rib heat transfer is lower than that the transverse rib for the rectangular channel II, and the edgeline heat transfer is lower than that the centerline on the ribbed side wall and the LHS smooth wall heat transfer is higher than that the RHS smooth wall for the rectangular channel with angled ribs. It is suggested that this results need to be further investigated and confirmed.

Local pressure drop data. Figures 32-34 show the pressure drop ($\Delta P = P - P_{atm}$) along the test channels for $P/e = 10$ and $Re = 30,000$. In the square channel the 60° rib angle produces the highest pressure drop than other rib angles. However, the rib angle effect is gradually decreased for the rectangular channel I, and diminished for the rectangular channel II. It is noted that the pressure distribution is approximately a linear when $X/D > 5$ for all tests. These figures also indicate that the sharp pressure drop between the plenum and the channel entrance is about the same for a given Reynolds number in a given channel regardless the rib angles in each channel.

4.2.2 Average Heat Transfer and Pressure Drop Data

In order to develop the heat transfer and friction correlations and to compare the heat transfer performance in each channel, the average heat transfer coefficient and friction factor are required. Based on the local heat transfer and pressure distribution, it was found that, for $\alpha = 90^\circ$, the Nusselt number became a periodic profile and the friction factor became a constant value in the region where $X/D > 3$. Therefore, the heat transfer and pressure data in the region with $X/D > 3$ in each channel was used to provide the average Nusselt number and the average friction factor, respectively. In this report, the average

Nusselt number on both the smooth and the ribbed side walls was based on the average value of the centerline Nusselt number between $X/D = 2.9-3.7$ and $X/D = 8.5-9.4$ for both the square channel and the rectangular channel I. The average Nusselt number was the average value of the centerline Nusselt number between $X/D = 4.8-6.2$ and $X/D = 14.2-15.6$ for the rectangular channel II. The average Nusselt numbers and the average friction factor for all test runs are tabulated in Appendix. Only the most representative results are discussed here.

The typical results to show the effect of Reynolds number and P/e ratio on the Nusselt number and friction factor ratios in each channel are plotted in Figures 35-37 for the case of $\alpha = 90^\circ$. As expected that the average heat transfer ratios on both the ribbed and smooth walls decrease with increasing with Reynolds number for all channels, whereas the average friction factor ratios increase with Reynolds number. The results also show that, for a given Reynolds number, both the average heat transfer and friction factor ratios decrease with increasing the P/e ratio for all channels. The typical results to illustrate the effect of the channel aspect ratio on the average heat transfer and friction ratios are also shown in Figures 36-37. Again the results show that the average Nusselt number and friction factor ratios increase with increasing the channel aspect ratio from $1/2$ to 2 , and $1/4$ to 4 .

The typical results to illustrate the combined effects of the channel aspect ratio and the rib angle on the average heat transfer and the average friction factor ratios are shown in Figures 38-40. In the square channel, both the average Nusselt number and friction factor ratios increase with decreasing α and reach a maximum value at $\alpha = 60^\circ$, then decrease with further decreasing α . In the rectangular channel I, both the average Nusselt number and friction factor ratios increase very

much slightly with decreasing α and reach a peak value at $\alpha = 60^\circ$, then decrease with further decreasing α . However, in the rectangular channel II, both the average heat transfer and friction factor decrease monotonically with decreasing α .

4.2.3 Heat Transfer Performance Comparison

The typical results of the increased Stanton number of the ribbed side wall, $St(R)/St(FD)$, and the accompanying increased average friction factor, $\bar{f}/f(FD)$, in each channel vs α for $P/e = 10$ and $Re = 30,000$ is shown in Figure 41. It is noted that, in the square channel, both the highest Stanton number and friction factor ratios occur at $\alpha = 60^\circ$, however, in the rectangular channel II (4" x 1"), both the highest Stanton number and friction factor ratios occur at $\alpha = 90^\circ$. Specifically, in the square channel the Stanton number ratio at $\alpha = 60^\circ$ is about 30% higher than that at $\alpha = 90^\circ$ and the accompanying friction factor ratio is about 40% higher.

The typical efficiency index, $St(R)/St(FD)/(\bar{f}/f(FD))$, in each channel vs α for $P/e = 10$ and $Re = 30,000$ is shown in Figure 42. The Stanton number shown in the upper plot of Figure 42 was that of the ribbed side wall, while the Stanton number shown in the lower plot of Figure 42 was that of the average value (weighted by area) between the ribbed side and the smooth side walls. It can be seen that the 30° rib has the highest efficiency index and the 60° rib has the lowest in each channel. At any rib angle, the square channel has a better efficiency index than the rectangular channels I and II.

One of the performance evaluation criteria was to compare the increased heat transfer, $St(R)/St(FD)/(\bar{f}/f(FD))^{1/3}$, for equal surface area and pumping power as presented in [1, 3]. The typical results of

the effect of rib angle on the increased heat transfer in each channel is shown in Figure 43 and Figure 44, respectively, for $Re = 30,000$ and $\bar{e}^+ = 200$. The results show that the highest heat transfer for a constant pumping power occurs at $\alpha = 30^\circ$ for the square channel and at $\alpha = 45^\circ$ for the rectangular channels I and II. Specifically, in the square channel the increased heat transfer at $\alpha = 30^\circ$ is about 25% higher than $\alpha = 90^\circ$, however, in the rectangular channels I and II, the increased heat transfer at $\alpha = 45^\circ$ is only about 5% higher than $\alpha = 90^\circ$. Similarly, for a typical average roughness Reynolds number $\bar{e}^+ = 200$, in the square channel the increased heat transfer at $\alpha = 30^\circ$ is about 30% higher than $\alpha = 90^\circ$, while in the rectangular channels I and II, the increased heat transfer at $\alpha = 45^\circ$ is only about 5% higher than $\alpha = 90^\circ$.

The increased heat transfer for a constant pumping power vs α , or vs W/H , is summarized in Figure 45 for $\bar{e}^+ = 200$. One can conclude that, in general, the square channel ($W/H = 1$) provides a better heat transfer than the rectangular channels ($W/H = 2, 4$). In the square channel, the heat transfer increases with decreasing the rib angle, however, in the rectangular channels, the dependence of the heat transfer on the rib angle is dramatically reduced. The heat transfer for rectangular channels with $W/H = 1/2$ and $1/4$ (ribs on the W side) at $\alpha = 90^\circ$ is also included in Figure 45 for reference. Unfortunately, the data with other rib angles are not available.

4.2.4 Heat Transfer and Friction Correlations

For the results of the rectangular channels with turbulence promoters to be most useful for designers, general correlations are required for both the average heat transfer and friction which cover a wide range of parameters, e/D , P/e , α , W/H , and Re .

Based on the theoretical analysis derived in [2] for fully developed turbulent flow in rectangular channels with four sided ribbed walls, the friction factor, the channel aspect ratio, and the rib height-to-hydraulic diameter ratio, should be able to be correlated into a so-called momentum transfer roughness function, R , as

$$R = (2/f_r)^{1/2} + 2.5 \ln[(2e/D) (2W/(H+W))] + 2.5 \quad (6)$$

In order to apply equation (6) for rectangular channels with two opposite ribbed walls of the present study, the friction factor may be replaced by the average friction factor (weighted by area), as discussed in [2], by

$$f_r = \bar{f} + (H/W) (\bar{f} - f_s) \quad (7)$$

By substituting equation (7) into equation (6), the momentum transfer roughness function of the present study can be written as

$$R = \left[\frac{2}{\bar{f} + (H/W) (\bar{f} - f_s)} \right]^{1/2} + 2.5 \ln[(2e/D) \cdot (2W/(H+W))] + 2.5 \quad (8)$$

where f_s , the friction factor in smooth rectangular channels, can be calculated from equation (4).

Correlation of the present friction data is shown in Figures 46-47. The data for the non-geometrically similar roughness are displaced due to their different value of α , W/H , and P/e . The dependence of R on α , P/e , and W/H shown in Figure 47 is

$$R/[(P/e/10)^{0.35} (W/H)^m] = 12.31 - 27.07(\alpha/90^\circ) + 17.86(\alpha/90^\circ)^2 \quad (9)$$

Where $m = 0$, for $\alpha = 90^\circ$

$m = 0.35$, for $\alpha < 90^\circ$, if $W/H > 2$, let $W/H = 2$.

The average friction factor (\bar{f}) can be determined by combining equations (8) and (9) for a given e/D , P/e , α , W/H , and Re .

Similarly, in rectangular channels with four sided ribbed walls, the friction factor, the momentum transfer roughness function, and the Stanton number, can be correlated into a so-called heat transfer roughness function, H , as

$$H = R + [f_r / (2 St_r) - 1] / (f_r / 2)^{1/2} \quad (10)$$

To apply equation (10) for rectangular channels with two opposite ribbed walls of the present study, the Stanton number in equation (10) should be replaced by the average Stanton number (weighted by area) in the following equation, according to [2],

$$St_r = \bar{St} + (H/W) (\bar{St} - St_s) \quad (11)$$

where St_s , the Stanton number in smooth rectangular channels, can be calculated from equation (5).

Correlation of the present heat transfer data is shown in Figures 48-49. No significant dependence of H (heat transfer roughness function) on P/e and W/H (channel aspect ratio) is observed. For a Prandtl number of 0.7 of the present study, the dependence of H on α and e^+ can be represented by

$$H = 1.88 (W/H)^{0.1} (e^+)^{0.35} (\alpha/90^\circ)^m (P/e/10)^n \quad (12)$$

for square channel: $m = 0.35$

$$n = 0.1$$

for rectangular channels I and II:

$$m = 0$$

$$n = 0$$

The average Stanton number (\overline{St}) can be found by combining equations (10) to (12) for a given e/D , P/e , α , W/H , and Re .

In design consideration, correlations for the ribbed side wall Stanton number, $St(R)$, and the smooth side wall Stanton number, $St(s)$, may be useful. Assuming that equation (10) can be used to correlate the ribbed side wall heat transfer data by replacing $H(R)$ and $St(R)$ for H and St_r , one obtains

$$H(R) = R + (f_r / (2St(R)) - 1) / (f_r / 2)^{1/2} \quad (13)$$

Heat transfer correlation of the ribbed side wall shown in Figure 49 is

$$H(R) = 2.24 (W/H)^{0.1} (e^+)^{0.35} (\alpha/90^\circ)^m (P/e/10)^n \quad (14)$$

where the m and n values are the same as that in equation (12). The deviation of equation (14) is about $\pm 10\%$ for 90% of data shown in Figure 49. If $H(R)$, R , and f_r are known for a given e/D , P/e , α , W/H , and Re , the ribbed side wall Stanton number, $St(R)$, can be calculated by combining equations (13) and (14). After determining \overline{St} and $St(R)$, the smooth side wall Stanton number $St(s)$ can be found by

$$St(s) = \overline{St} + (W/H) (\overline{St} - St(R)) \quad (15)$$

5.0 CONCLUSIONS AND RECOMMENDATIONS

1. The results obtained in the square channel of the present investigation confirm that was observed in the previous study [1]. In that, the heat transfer in the square channel with angled ribs ($\alpha = 30^\circ$ to 45°) is about 30% higher than that the transverse ribs ($\alpha = 90^\circ$) for a constant pumping power. However, the heat transfer in the rectangular channels I and II at $\alpha = 30^\circ$ - 45° is only about 5% higher than at $\alpha = 90^\circ$.

2. The highest heat transfer and pressure drop can be obtained at $\alpha = 60^\circ$ in the square channel, while the highest heat transfer and pressure drop are occurred at $\alpha = 90^\circ$ in the rectangular channel with a channel aspect ratio of 4 ($W/H = 4$). The heat transfer and pressure drop at $\alpha = 60^\circ$ are only slightly higher than that at $\alpha = 90^\circ$ in the rectangular channel with a channel aspect ratio of 2 ($W/H = 2$).

3. The heat transfer and friction decrease with decreasing the channel aspect ratio, W/H , from 4 to 2, to 1, to $1/2$, and to $1/4$, if the turbulence promoters are placed on the "W" side of the channel (i.e., the channel width).

4. For $\alpha = 90^\circ$, the local heat transfer after $X/D > 3$ becomes a periodic distribution in the streamwise direction in each channel. However, for $\alpha = 60^\circ$, 45° , or 30° , the local heat transfer varies in both the streamwise and the spanwise directions in each channel.

5. In the square channel the edgeline heat transfer on the ribbed side wall is higher than that the centerline at all rib angles, however, in the rectangular channels the edgeline heat transfer on the ribbed side wall is lower than that the centerline for the cases of angled ribs. Meanwhile, the edgeline heat transfer on the smooth side wall is always higher than that the centerline in all channels.

6. In the square channel, the RHS and LHS smooth wall temperatures are about the same for all rib angles. In the rectangular channel, the RHS smooth wall temperature is higher (30-40%) than that the LHS smooth wall when the ribs have angles ($\alpha = 60^\circ, 45^\circ, \text{ or } 30^\circ$) to the flow. However, the RHS and LHS smooth wall temperatures are about the same for the $\alpha = 90^\circ$ and for the four sided smooth channel. It is recommended that this unexpected results need to be further investigated and confirmed.

7. The heat transfer and friction correlations are developed to account for rib spacing, rib angle, channel aspect ratio, and roughness Reynolds number.

8. It is suggested that the effect of rib angle for the rectangular channels with $W/H = 1/2$ and $1/4$ needs to be studied.

6.0 REFERENCES

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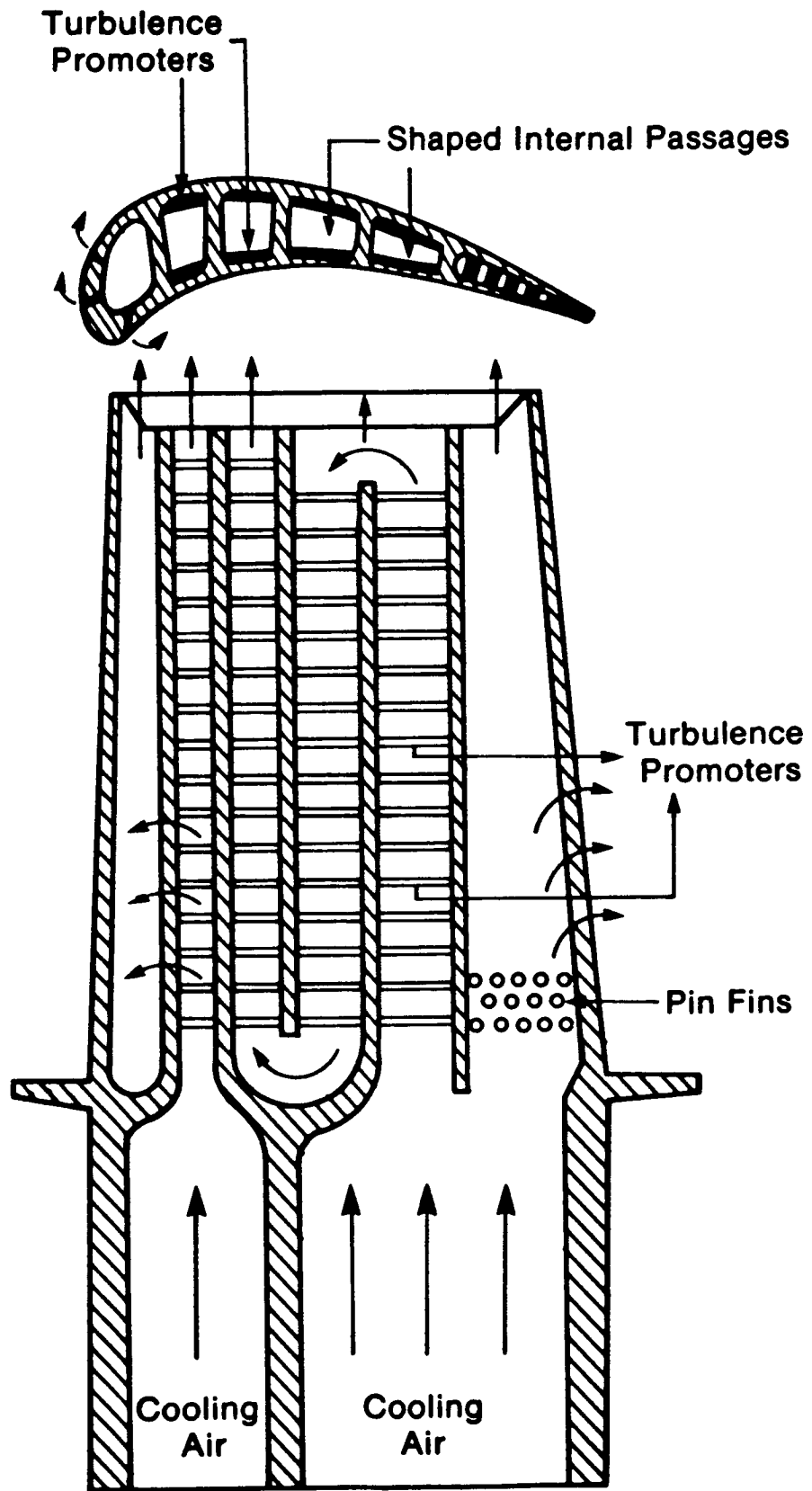


Figure 1. Cooling concept of a modern multipass turbine blade [1]

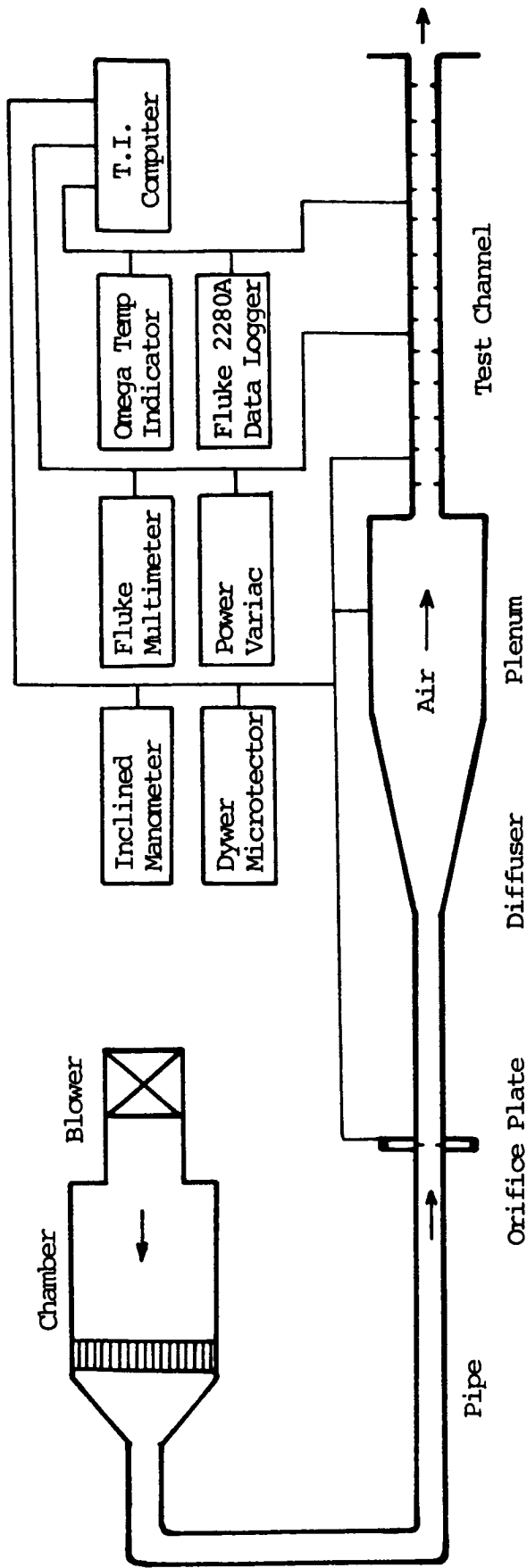
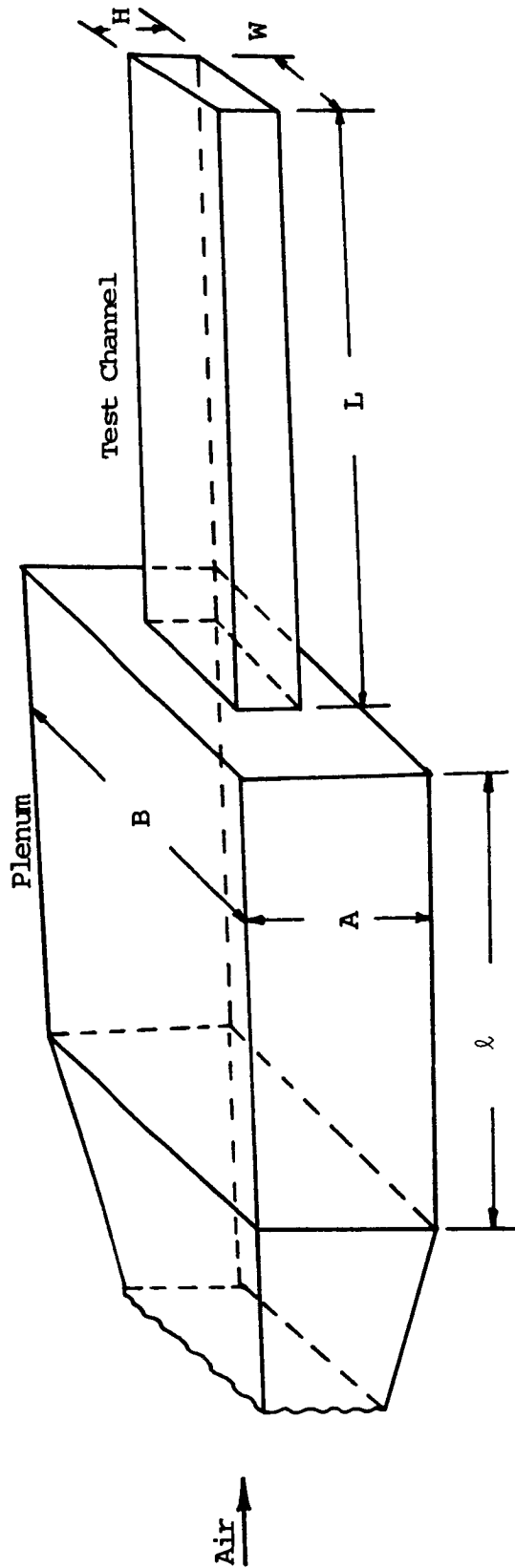


Figure 2. A schematic of the test rig with instrumentations.



	W	H	W/H	D	L	L/D	B	A	CR	l
Square channel	2"	2"	1	2"	50"	25	6"	6"	9	15D
Rectangular channel I	4"	2"	2	8/3"	50"	18.75	12"	6"	9	15D
Rectangular channel II	4"	1"	4	1.6"	50"	31.25	12"	6"	18	25D

CR: contraction ratio between plenum and test channel, BA/WH .
D: channel hydraulic diameter, $2WH/(W + H)$.

Figure 3. Dimensions of the test channels and the associated plenums.

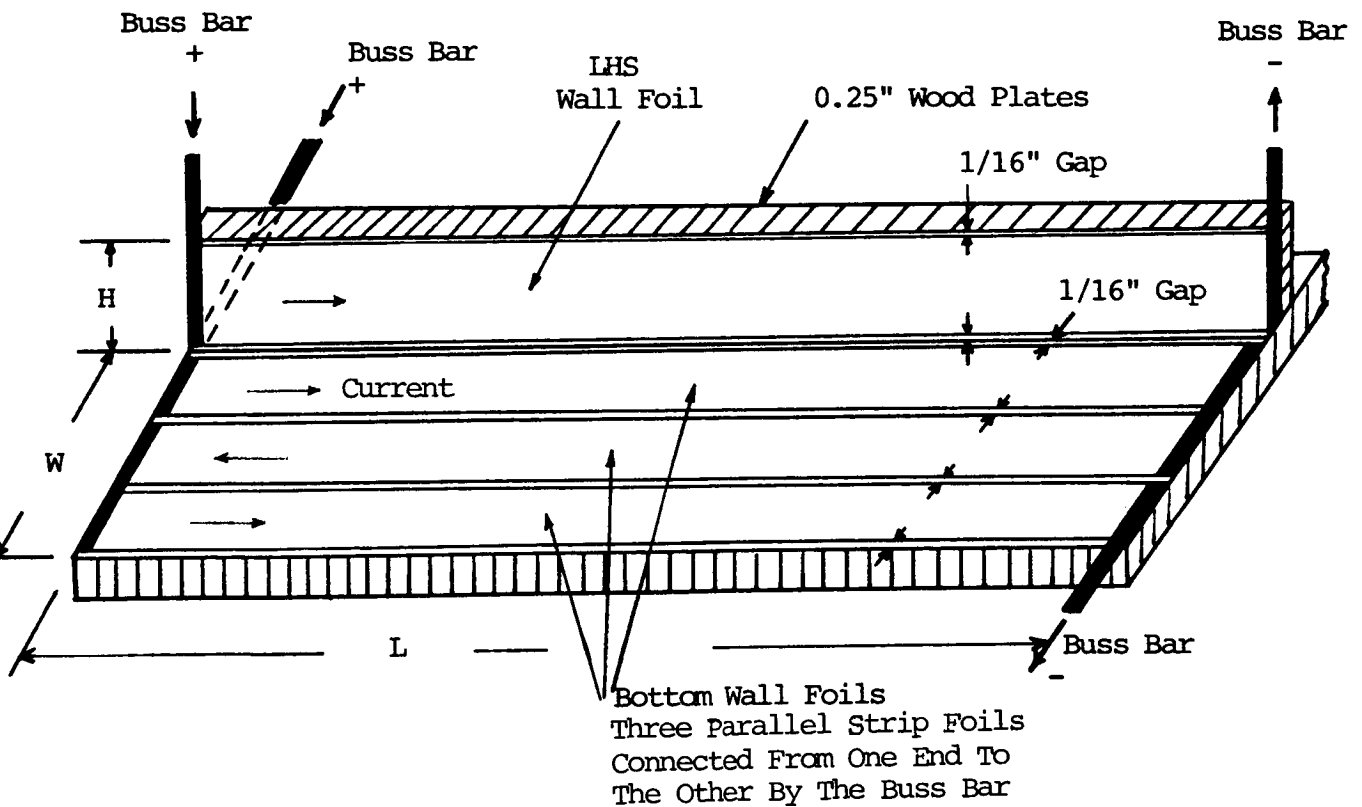
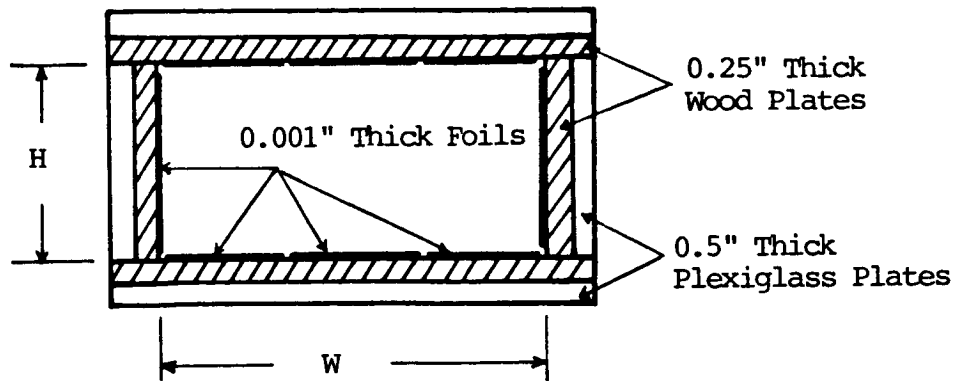
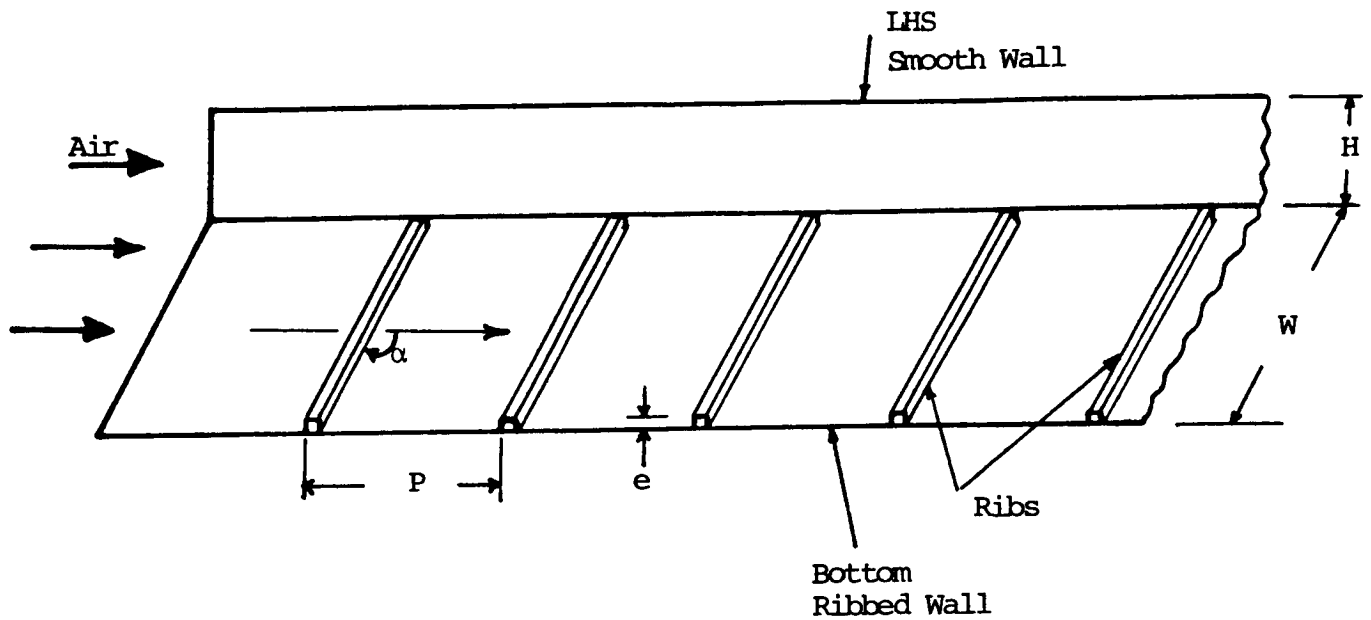
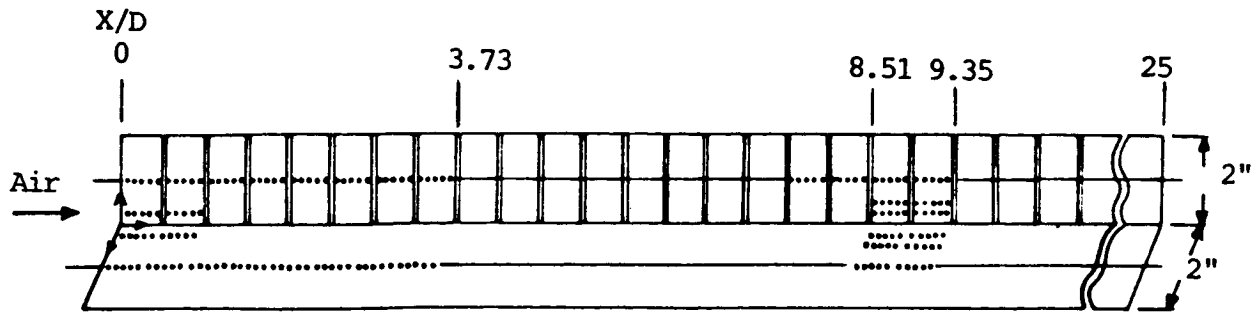


Figure 4. Test channel cross section and distributions of electrical foil heaters.

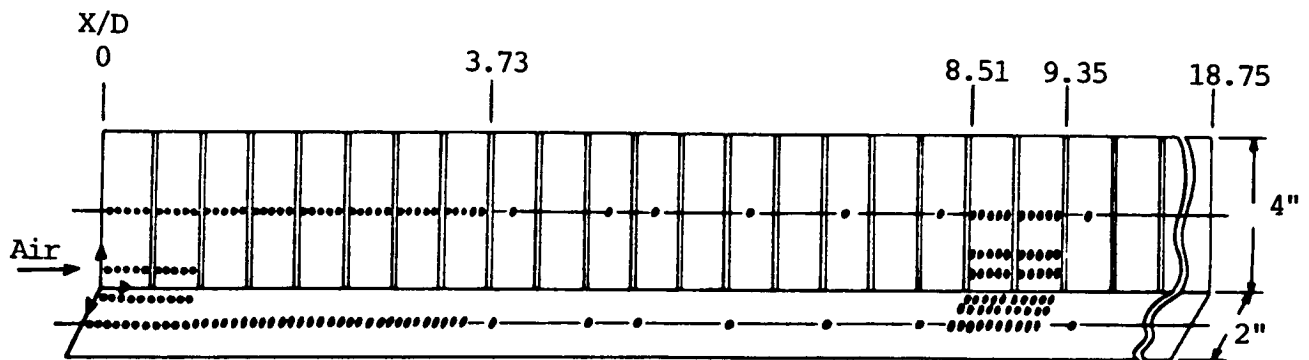


	W/H	e	e/D	P/e	α	Re x 10 ⁻³
Square channel	1	$\frac{1.5''}{16}$	0.047	10	90°, 60°	10
						20
						30
Rectangular channel I	2	$\frac{2''}{16}$	0.047	10	90°, 60°	10
						20
						30
Rectangular channel II	4	$\frac{2''}{16}$	0.078	10	90°, 60°	10
						20
						30
Rectangular channel IA	$\frac{1}{2}$	$\frac{2''}{16}$	0.047	10	90°	10
						20
						30
Rectangular channel IIA	$\frac{1}{4}$	$\frac{2''}{16}$	0.078	10	90°	10
						20
						30
						60

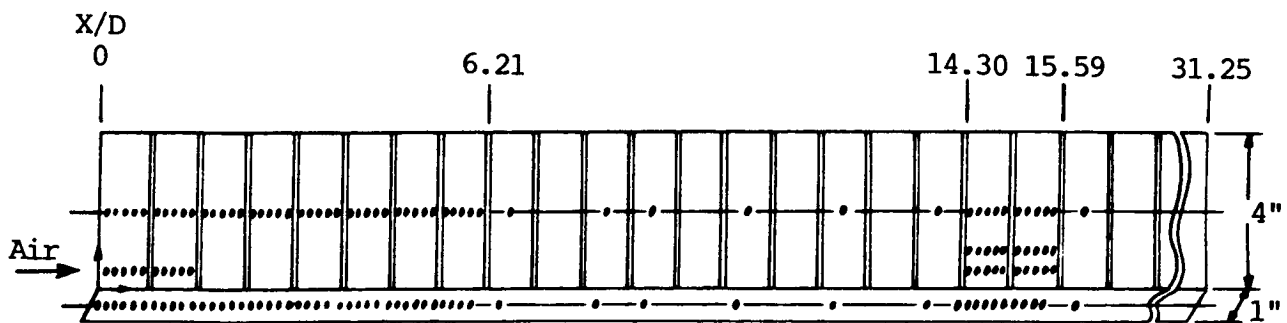
Figure 5. Rib geometries in each test channel.



(a) Square channel: 90 T.C. on Bottom Ribbed Wall
90 T.C. on RHS Smooth Wall



(b) Rectangular channel I: 90 T.C. on Bottom Ribbed Wall
90 T.C. on RHS Smooth Wall



(c) Rectangular channel II: 90 T.C. on Bottom Ribbed Wall
60 T.C. on RHS Smooth Wall

Figure 6. Detailed thermocouple locations in each test channel.

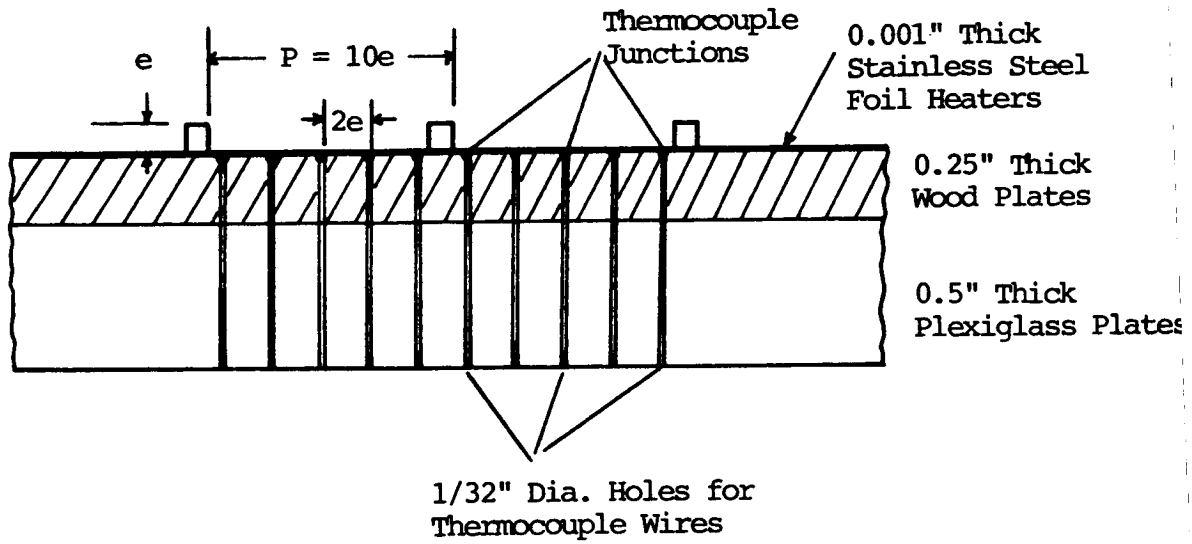
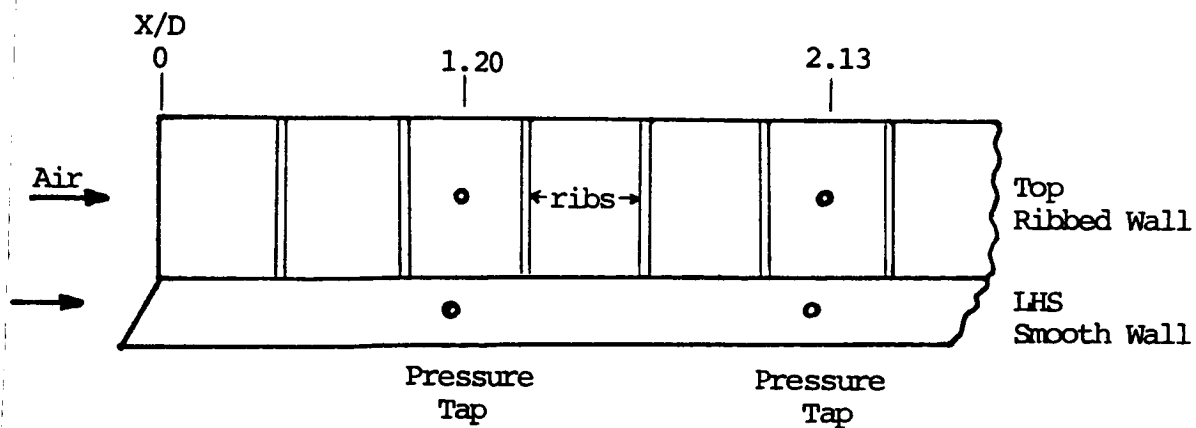


Figure 7. Detailed thermocouple construction.



		PT1	PT2	PT3	PT4	PT5	PT6
Square channel	X/D	1.20	2.13	5.41	10.10	15.26	18.07
Rectangular channel I	X/D	1.20	2.13	5.41	10.10	15.26	18.07
Rectangular channel II	X/D	1.99	3.56	9.02	16.84	25.43	30.18

PT: pressure tap number on both the top ribbed wall and the LHS smooth wall.

Figure 8. The pressure tap locations in each test channel.

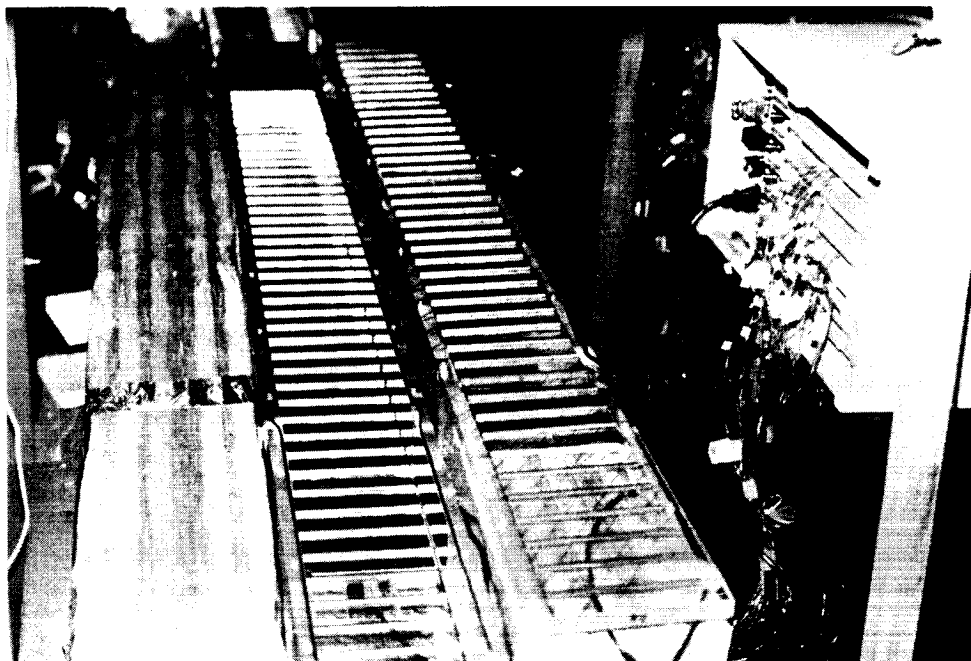


Figure 9. Photograph of test channels
Upper photo: Square channel with top cover open, repeated-ribs shown on the top and bottom walls.
Lower photo: Rectangular channel I with top cover open, repeated-ribs shown on the top and bottom walls.

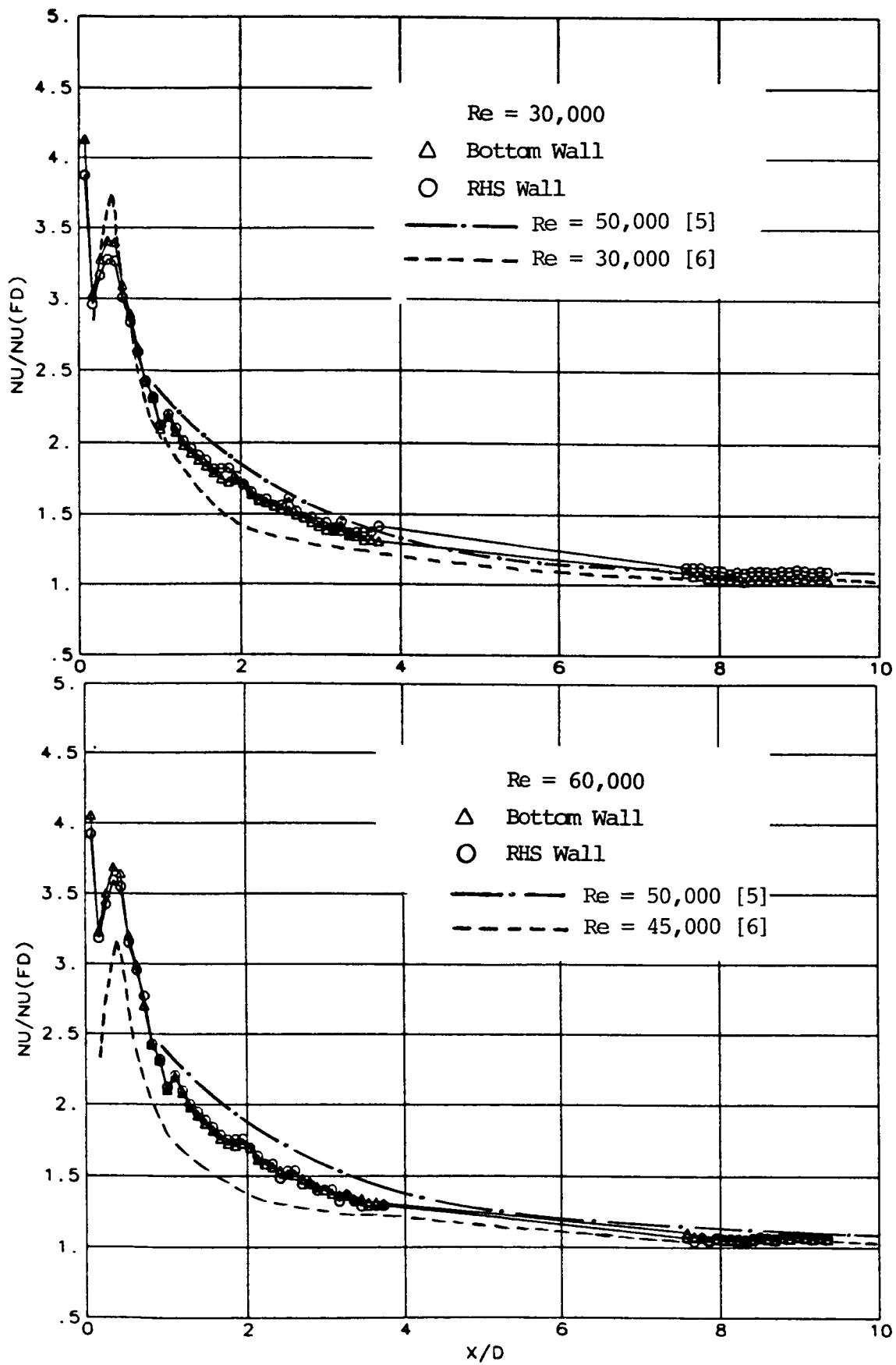


Figure 10. The local Nusselt number ratio vs X/D in the smooth square channel.

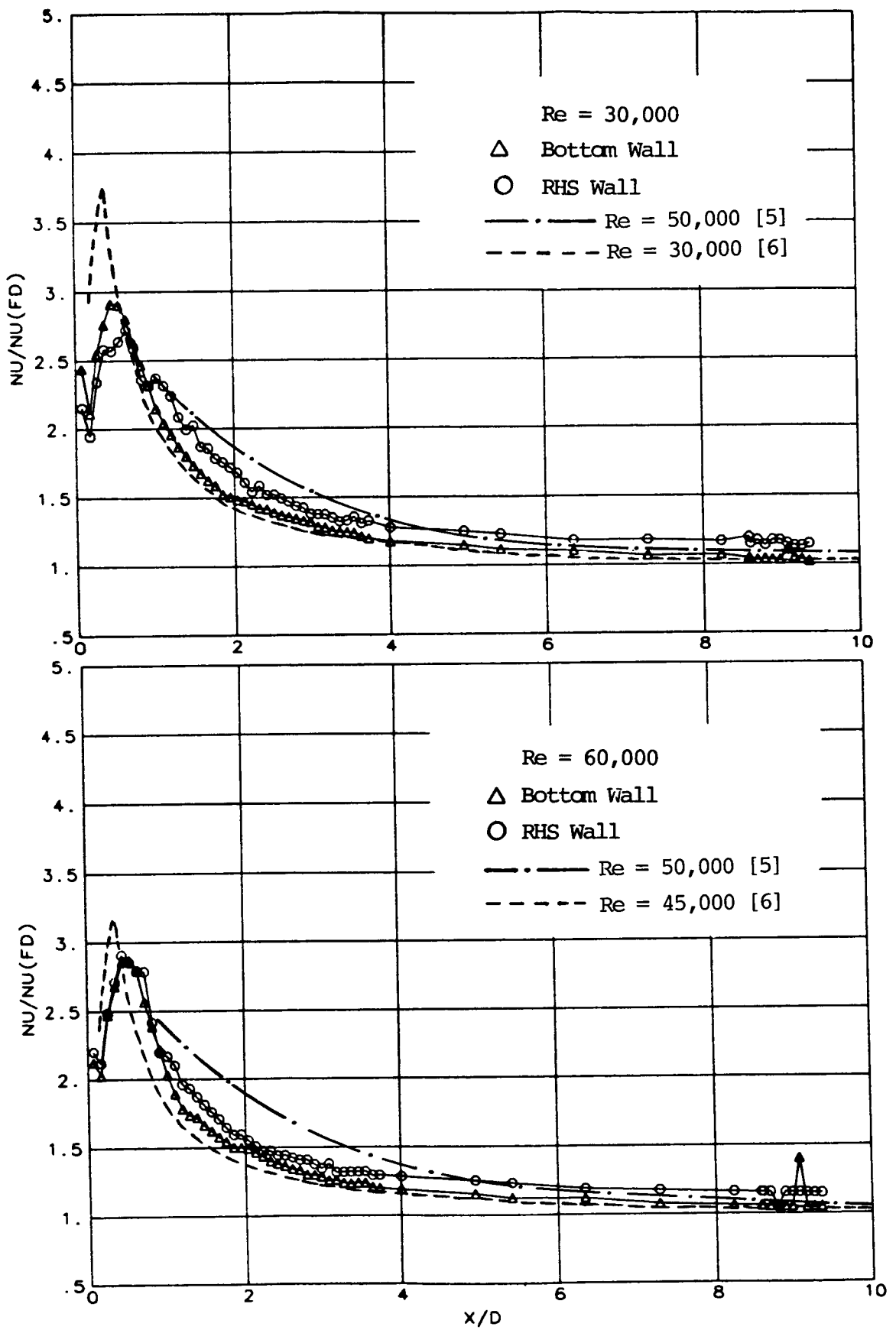


Figure 11. The local Nusselt number ratio vs X/D in the smooth rectangular channel I.

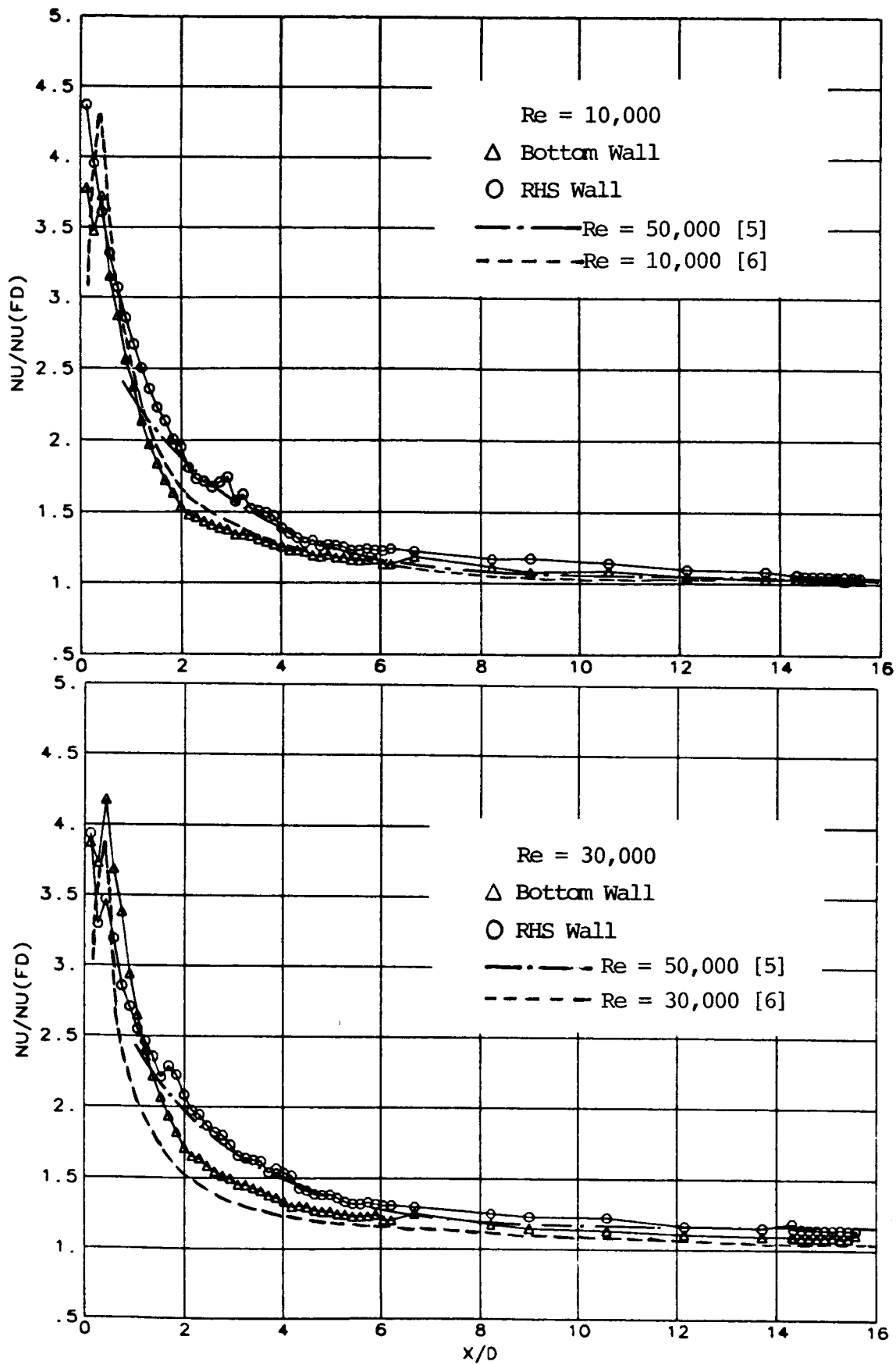


Figure 12. The local Nusselt number ratio vs X/D in the smooth rectangular channel II.

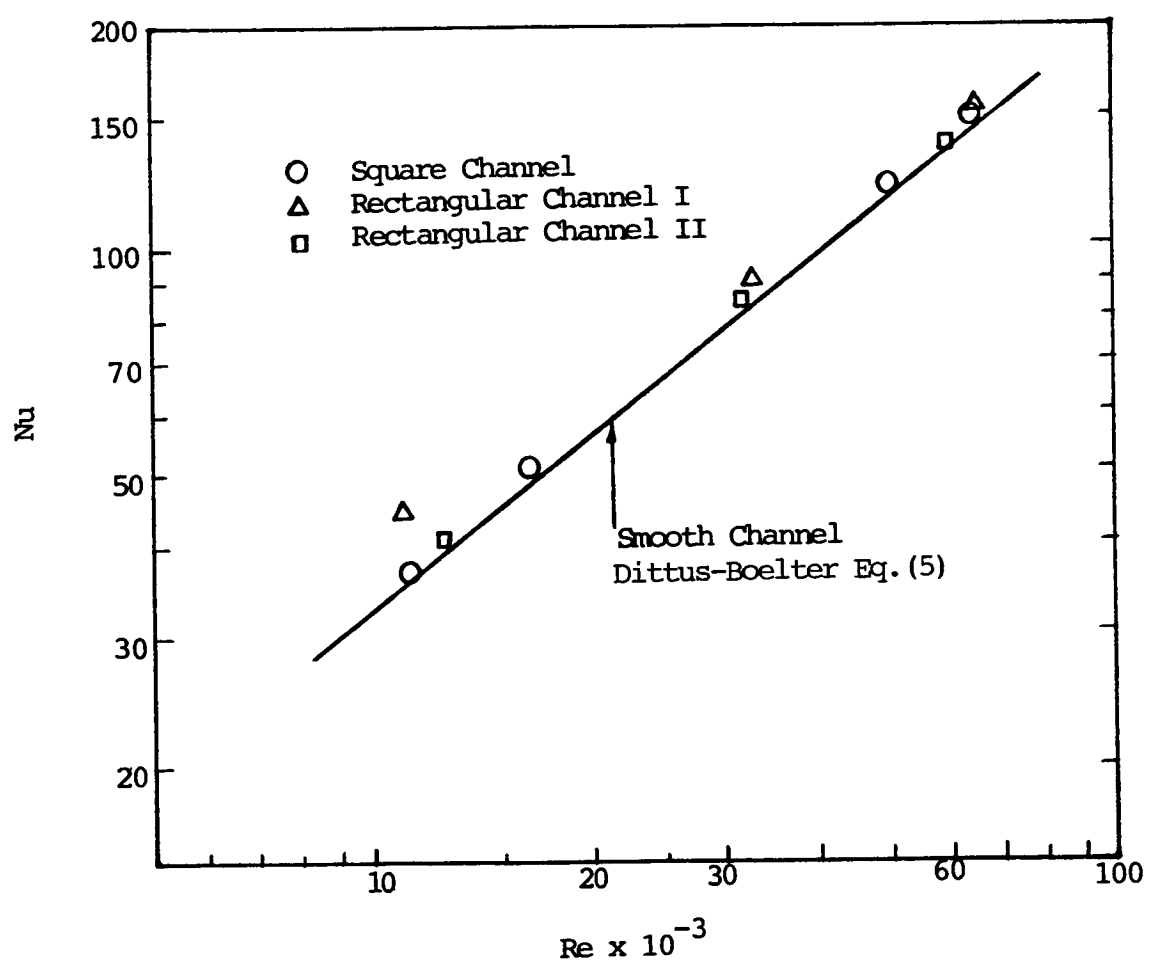
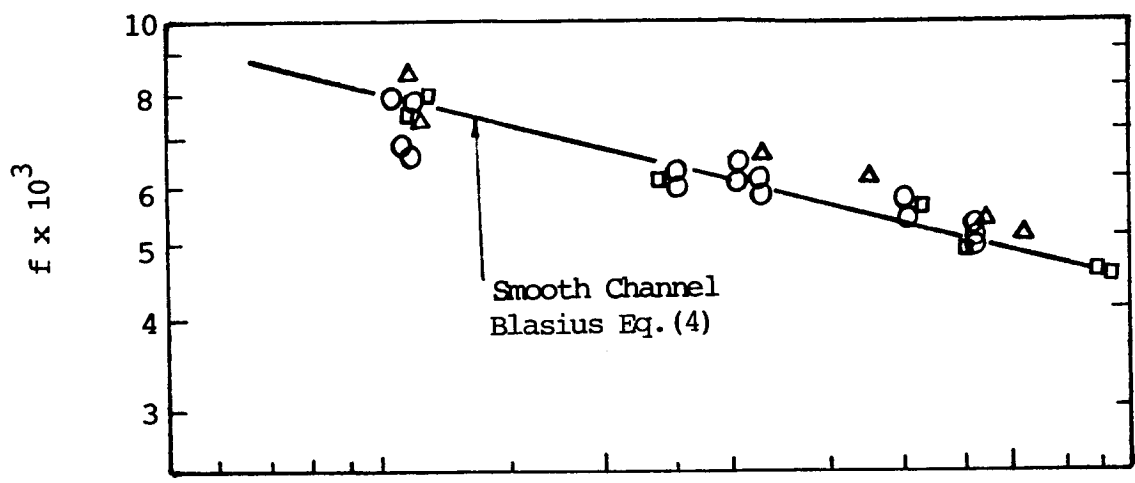


Figure 13. Friction and heat transfer results for smooth channels.

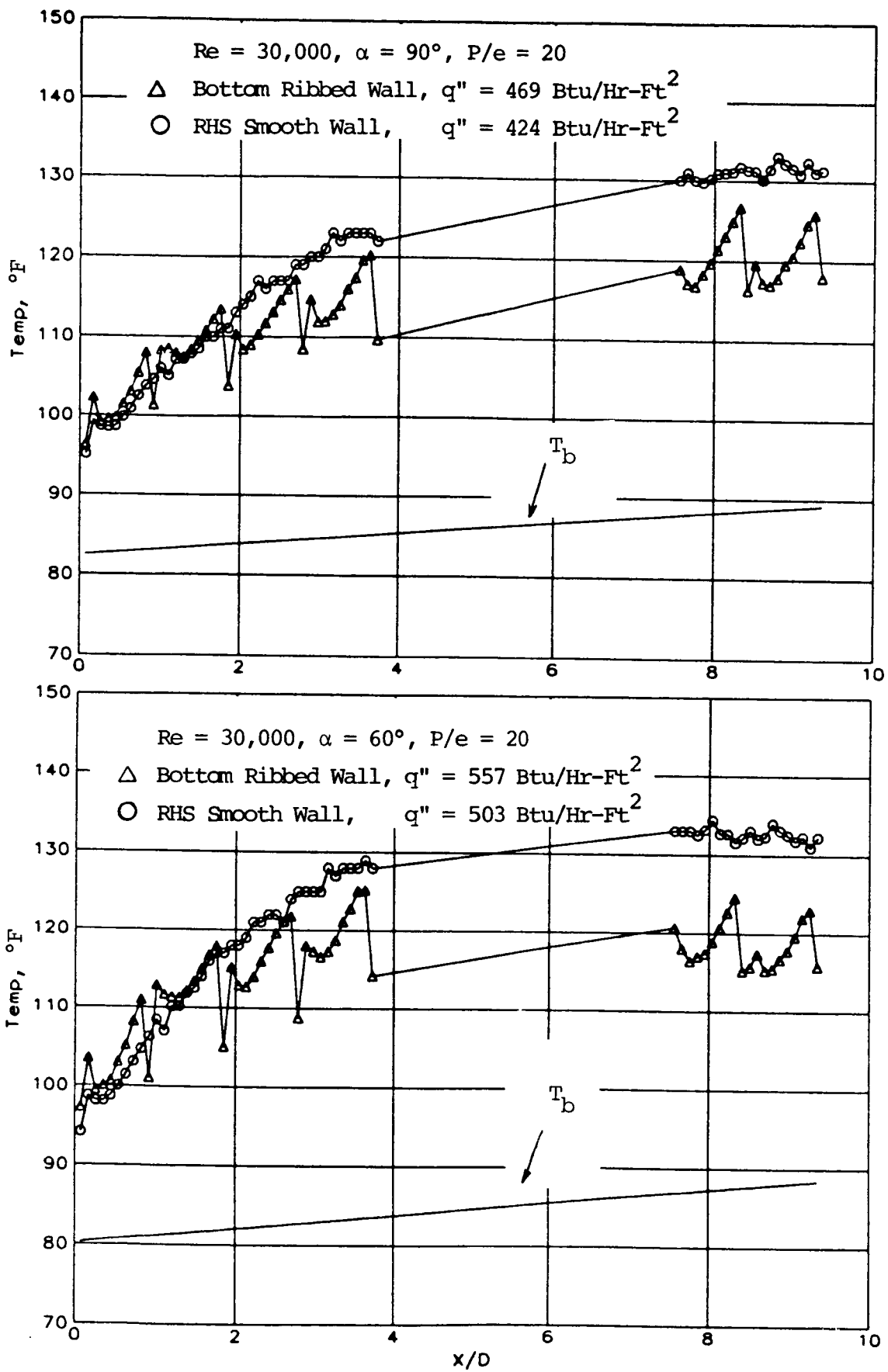


Figure 14. The typical local wall temperature distribution in the square channel.

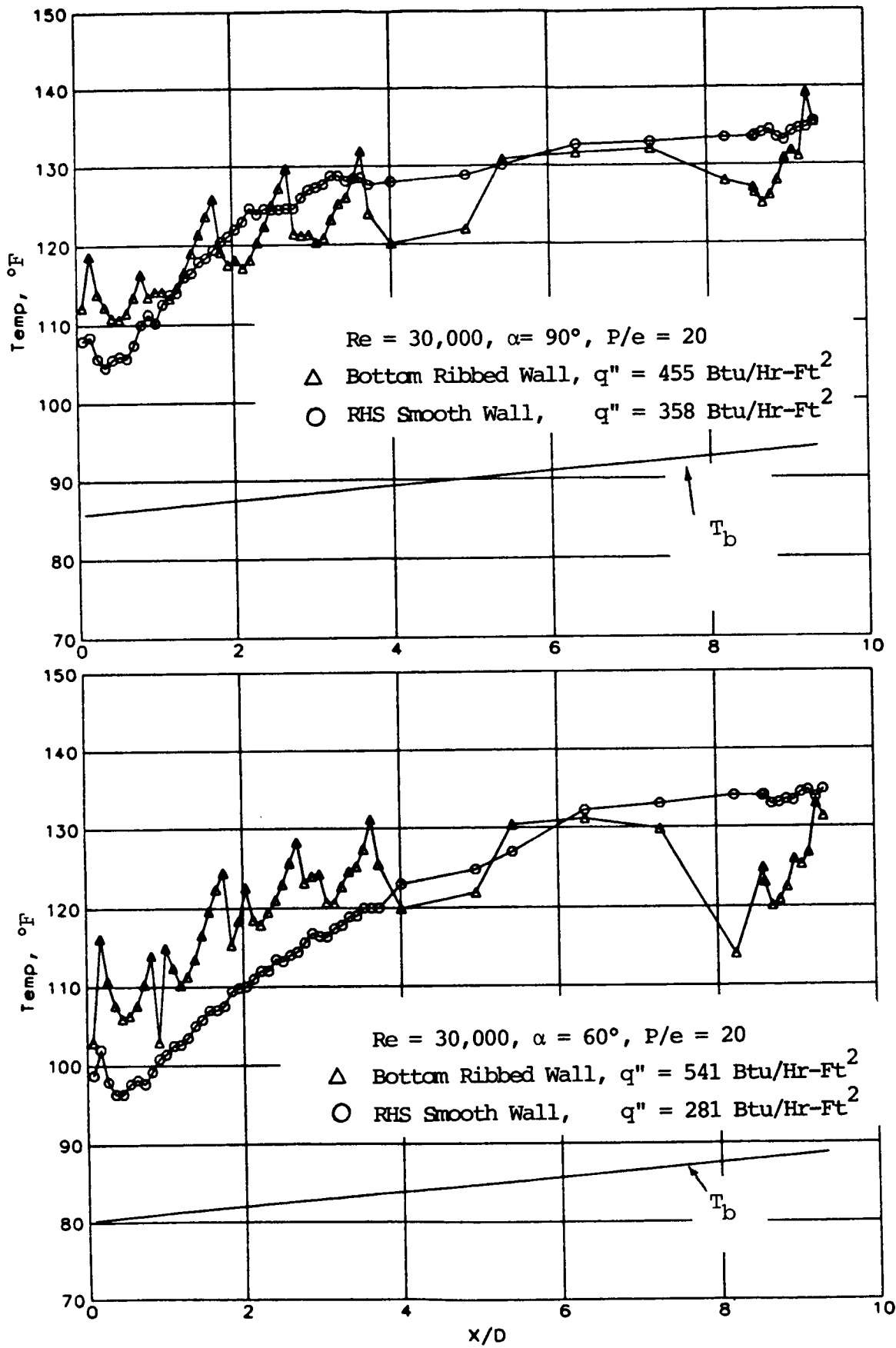


Figure 15. The typical local wall temperature distribution in the rectangular channel I.

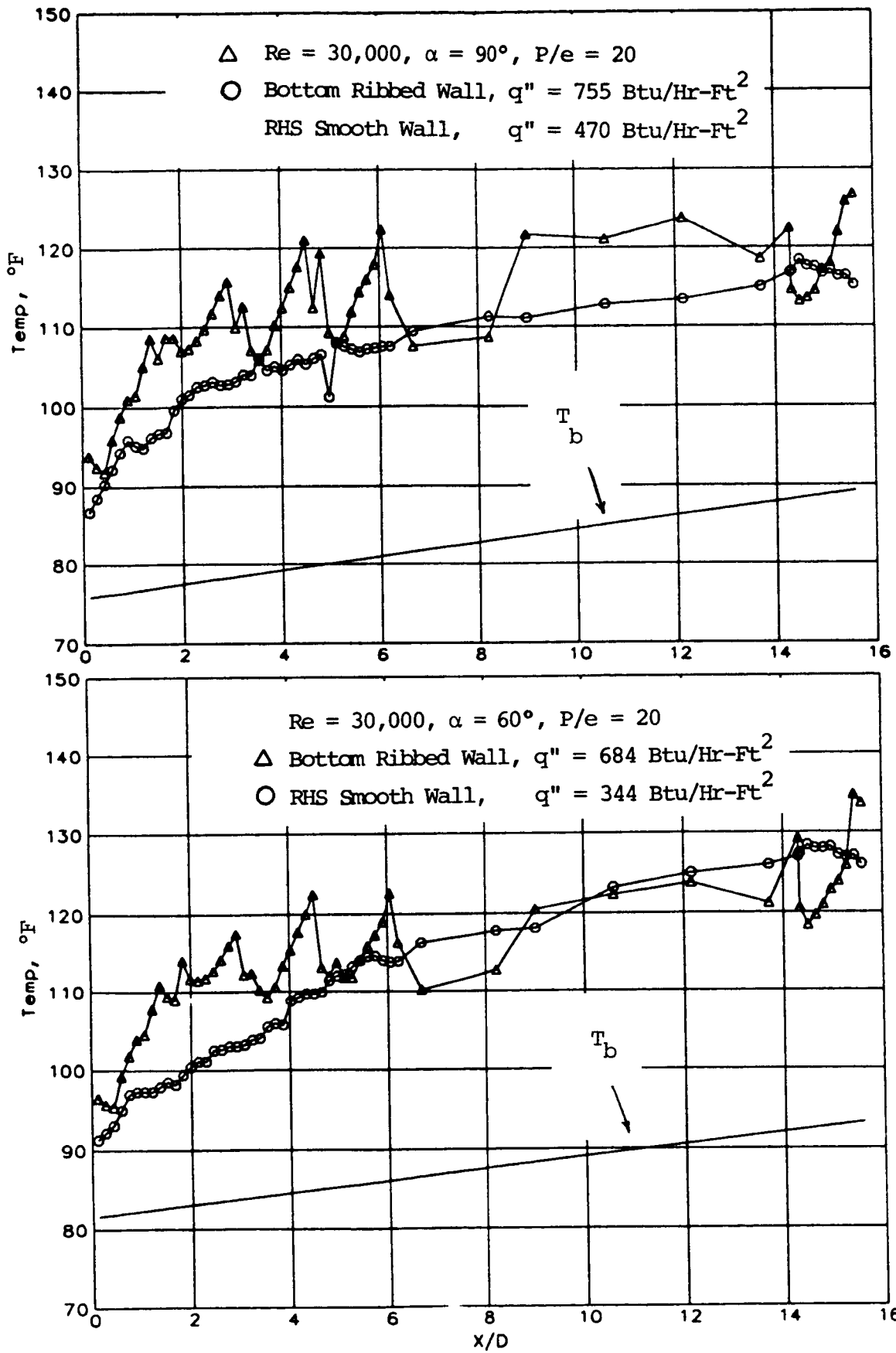


Figure 16. The typical local wall temperature distribution in the rectangular channel II.

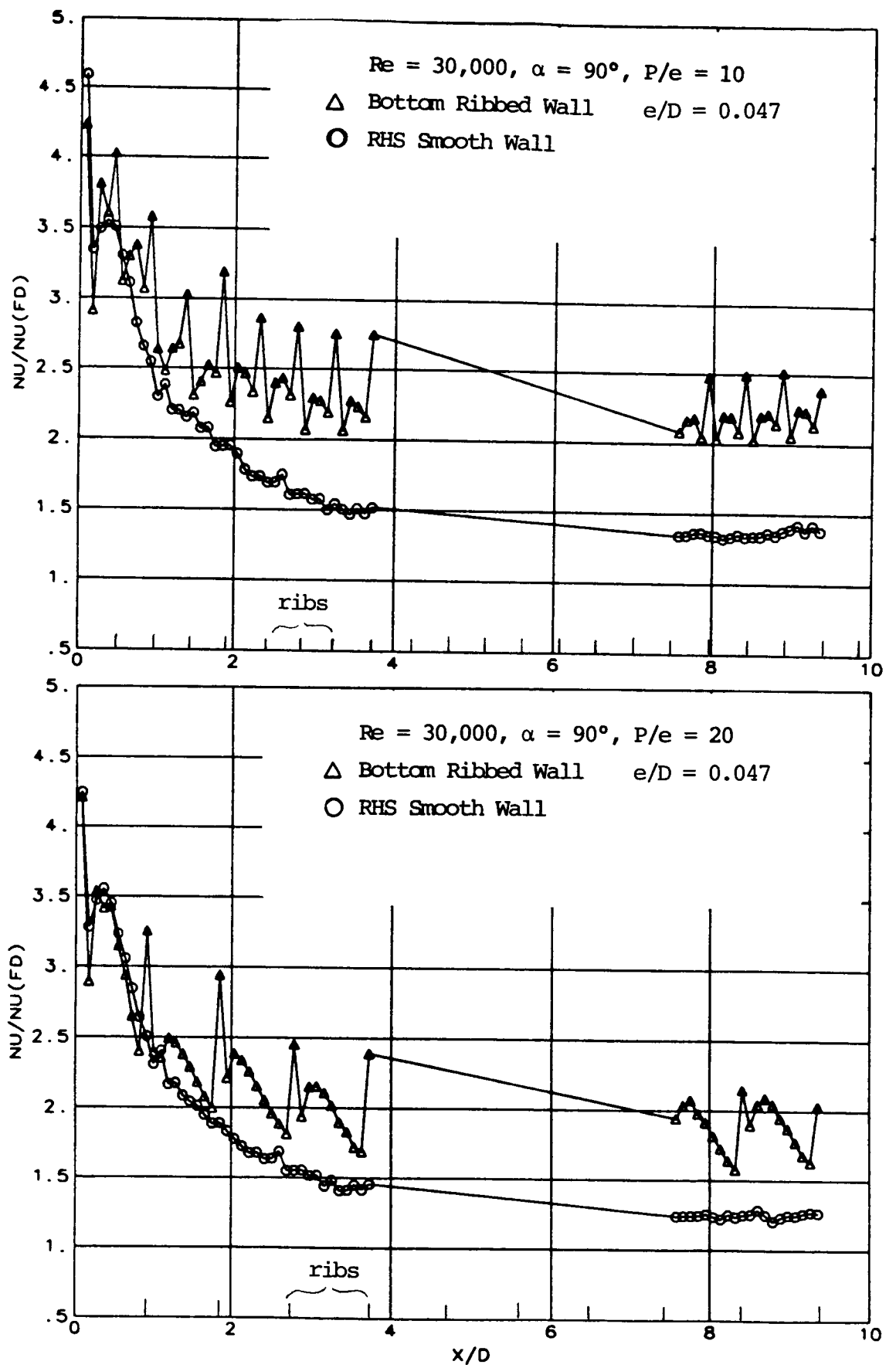


Figure 17. The effect of rib spacing on the centerline heat transfer distribution in the square channel.

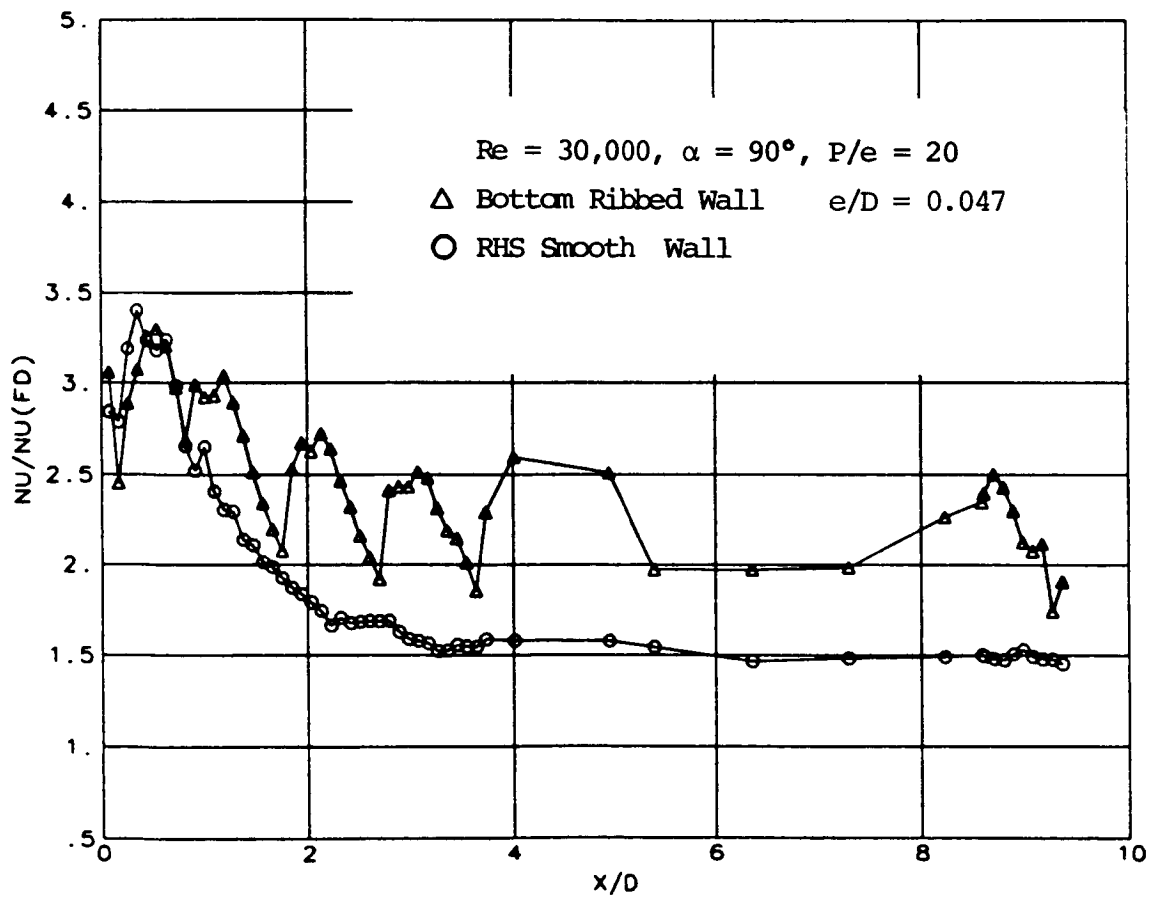
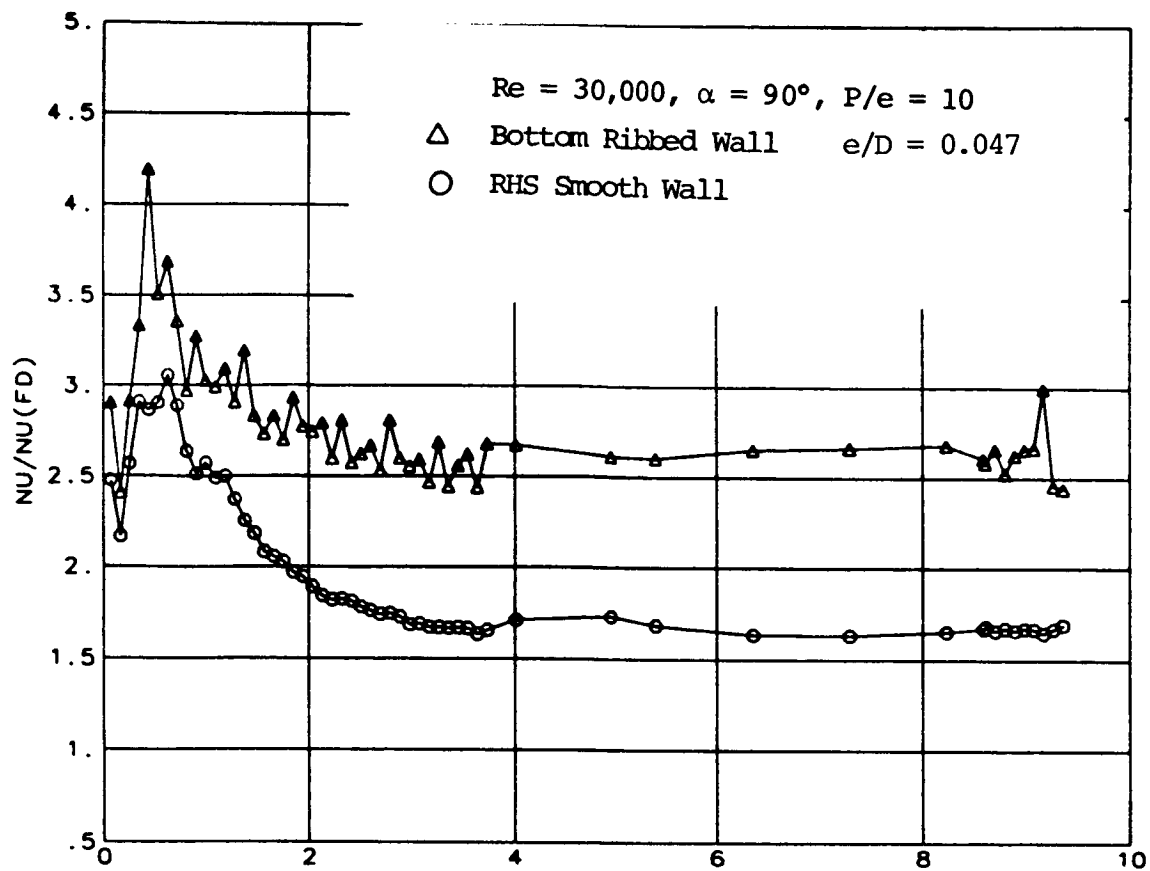


Figure 18. The effect of rib spacing on the centerline heat transfer distribution in the rectangular channel I.

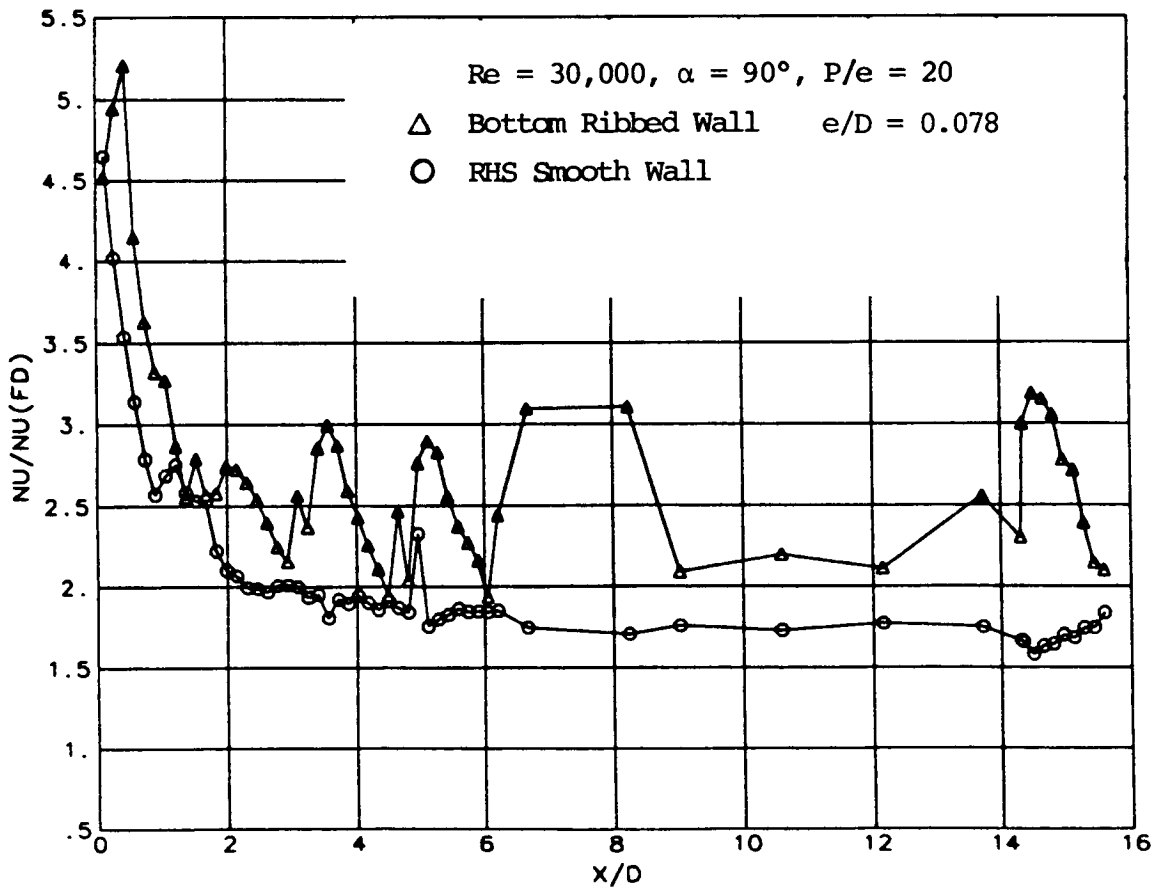
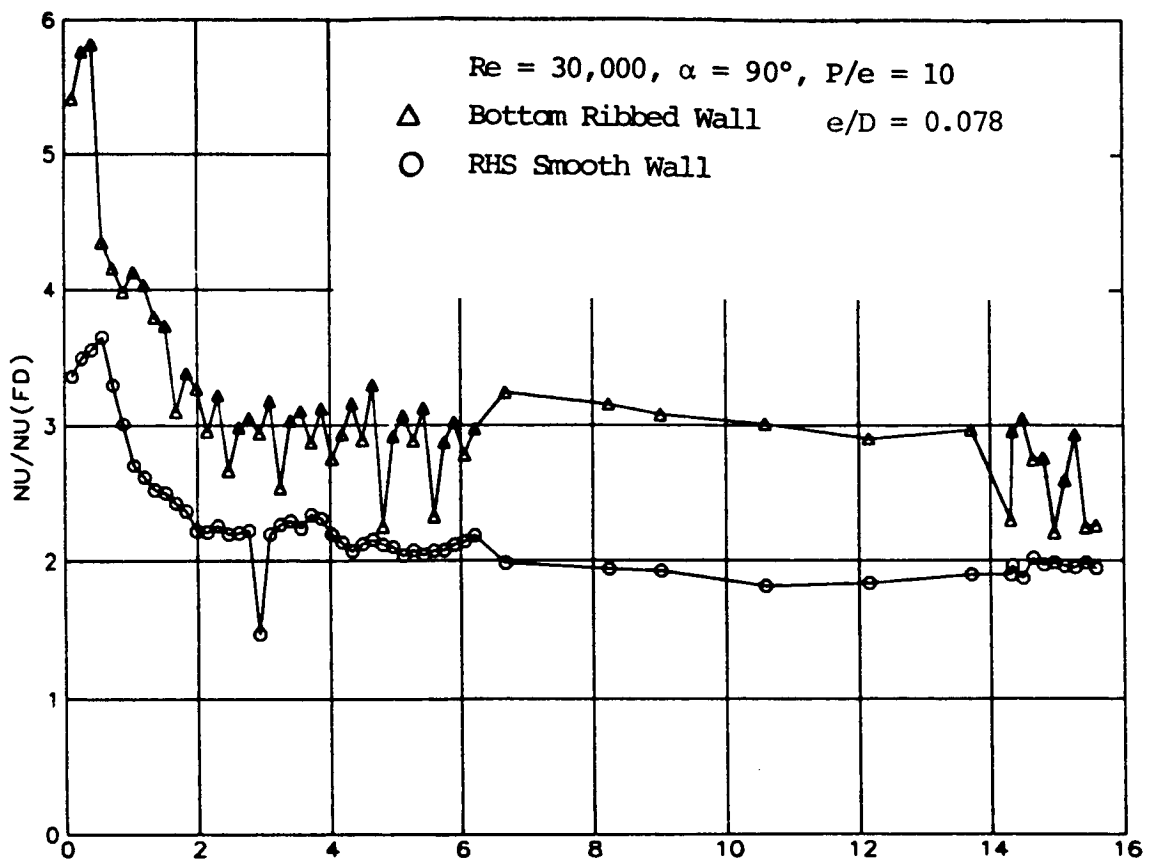


Figure 19. The effect of rib spacing on the centerline heat transfer distribution in the rectangular channel II.

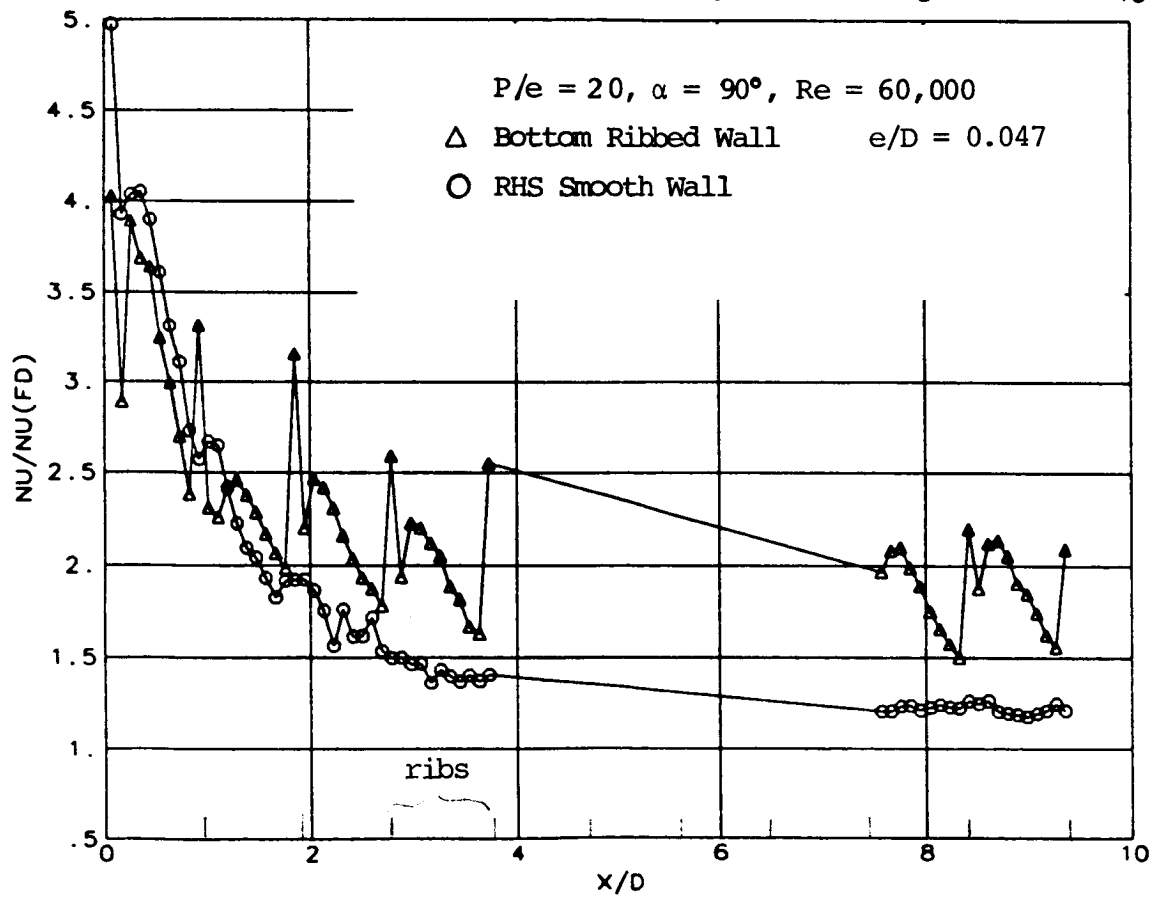
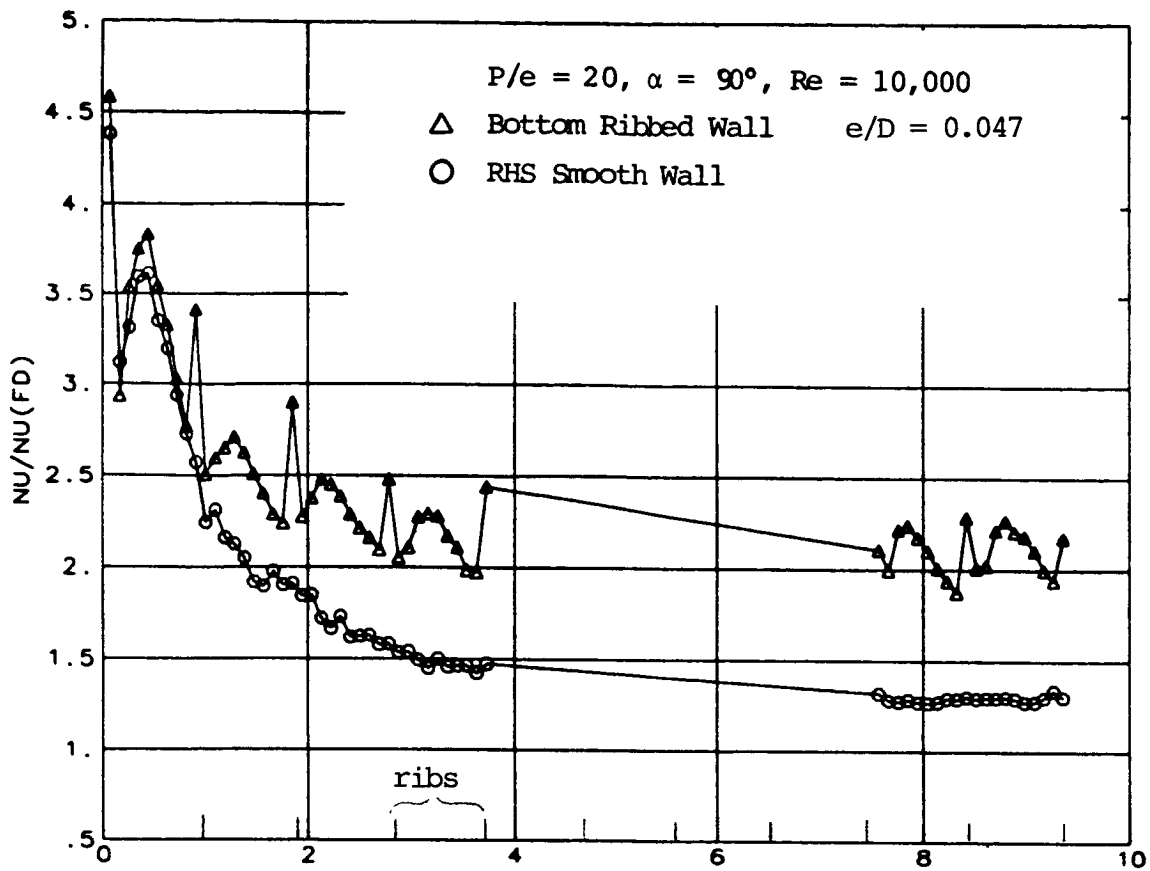


Figure 20. The effect of Reynolds number on the centerline heat transfer distribution in the square channel.

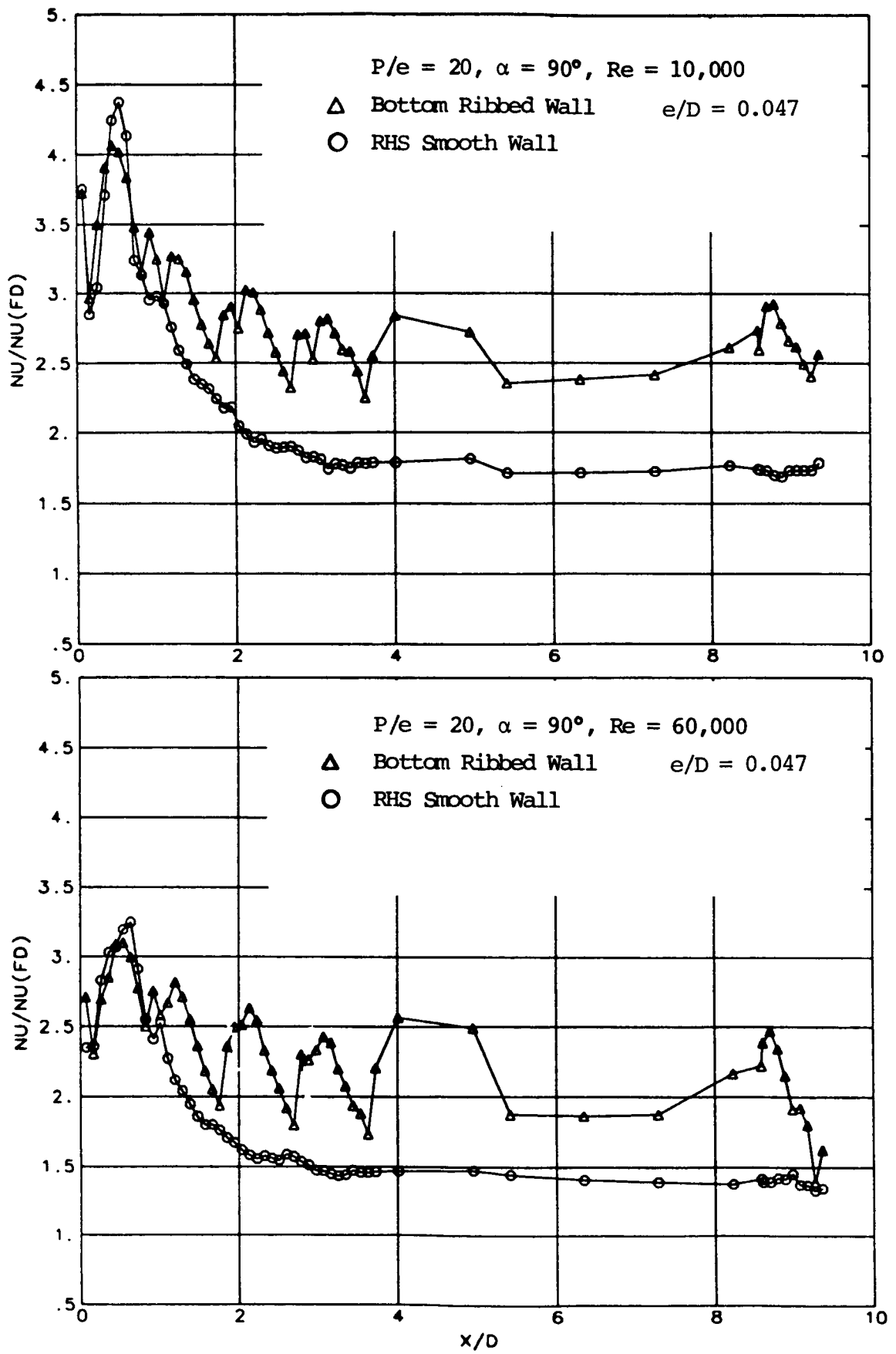


Figure 21. The effect of Reynolds number on the centerline heat transfer distribution in the rectangular channel I.

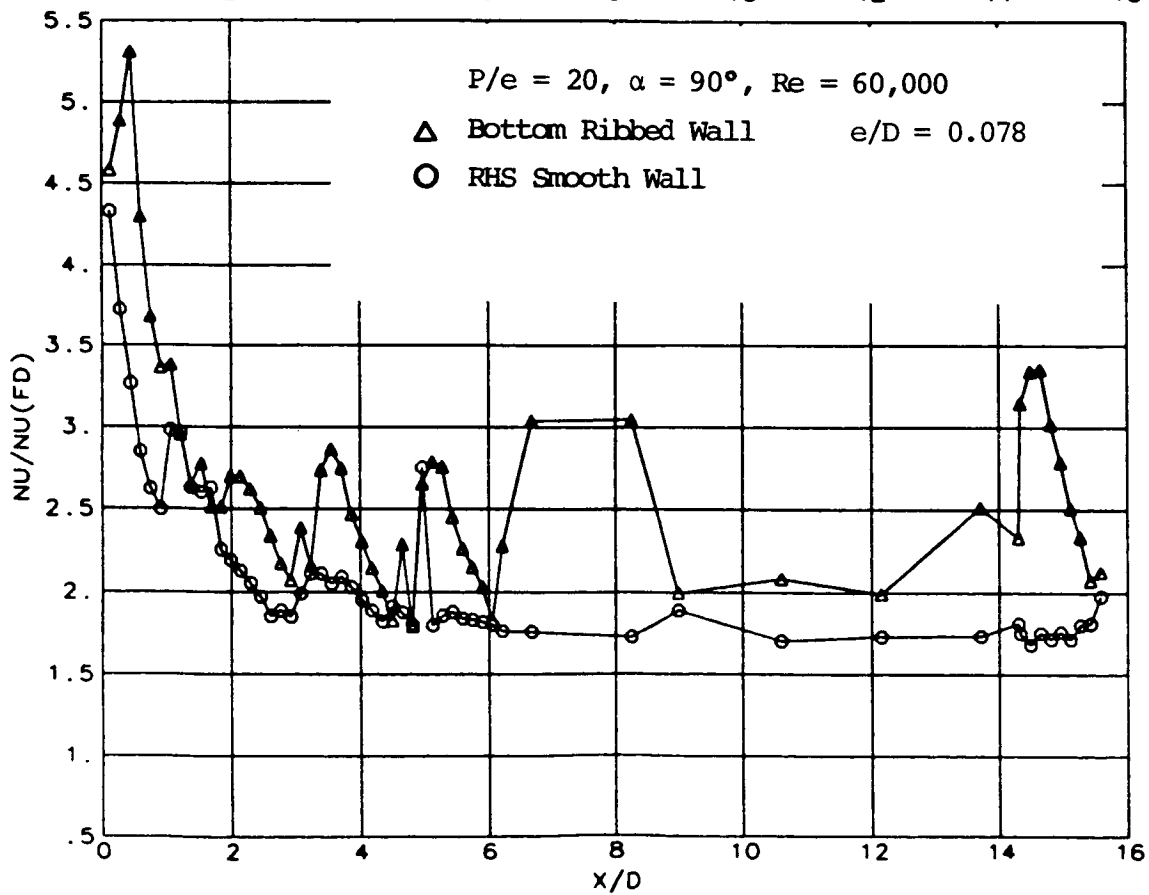
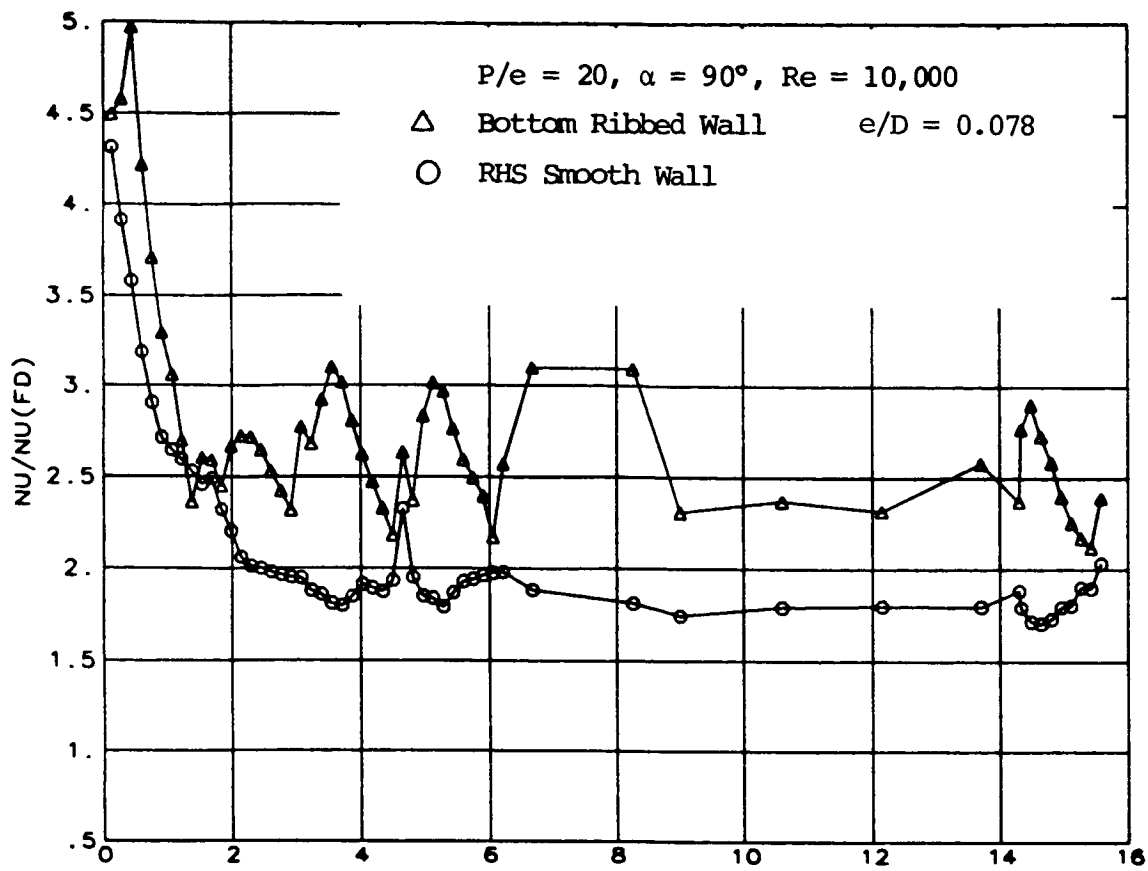


Figure 22. The effect of Reynolds number on the centerline heat transfer distribution in the rectangular channel II.

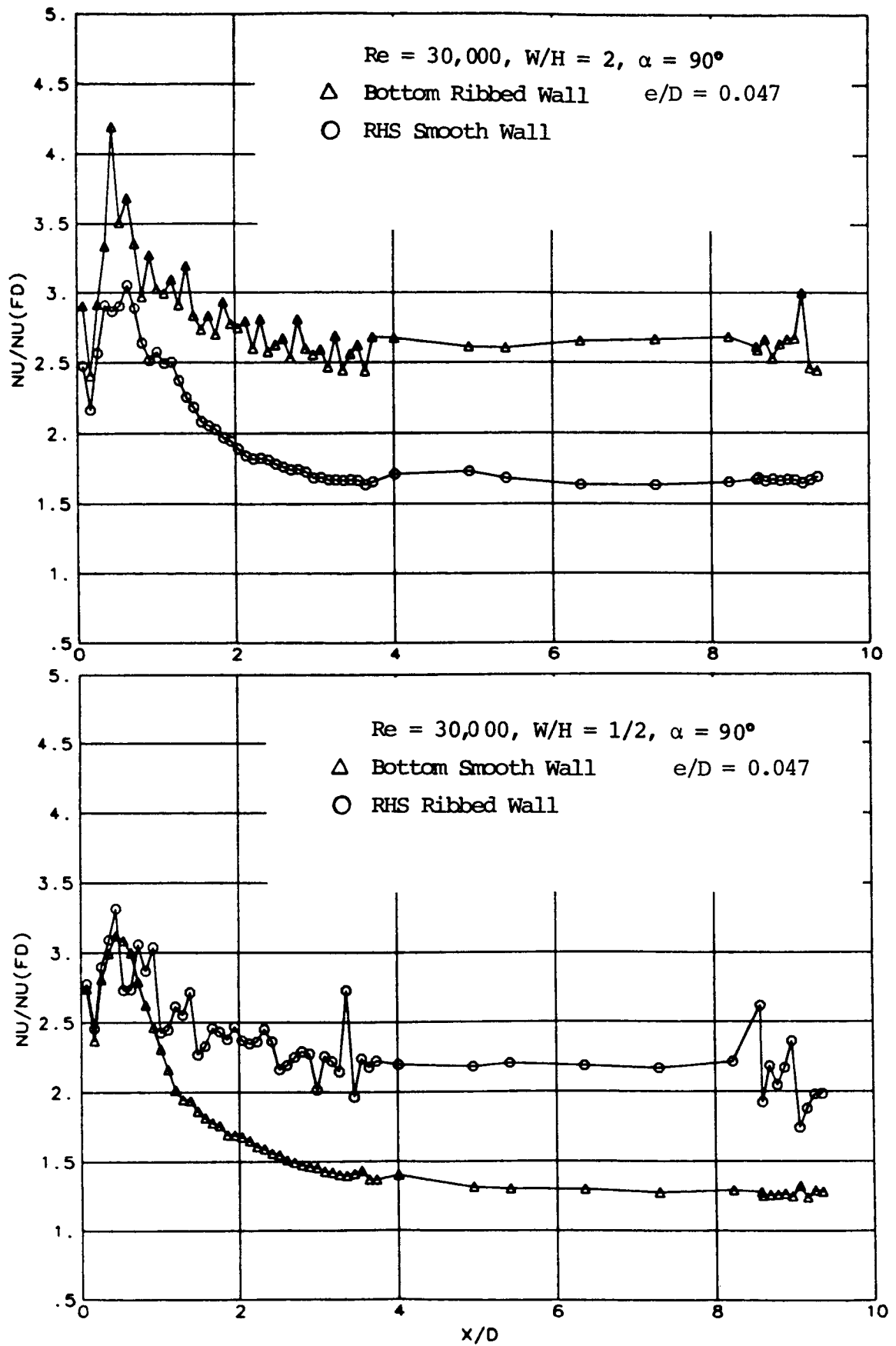


Figure 23(a). The effect of channel aspect ratio ($W/H = 2, 1/2$) on the centerline heat transfer distribution for $P/e = 10$.

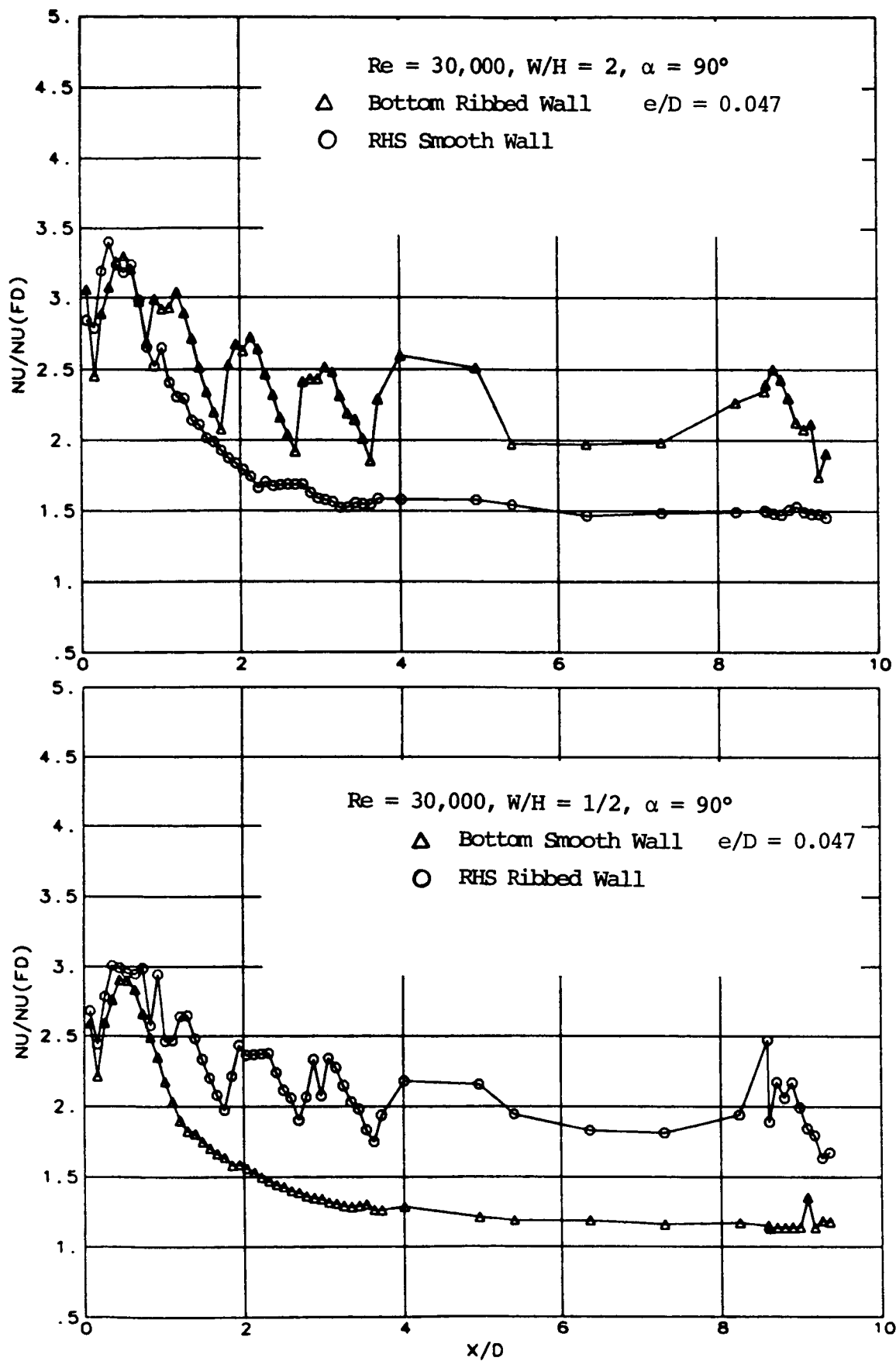


Figure 23(b). The effect of channel aspect ratio ($W/H = 2, 1/2$) on the centerline heat transfer distribution for $P/e = 20$.

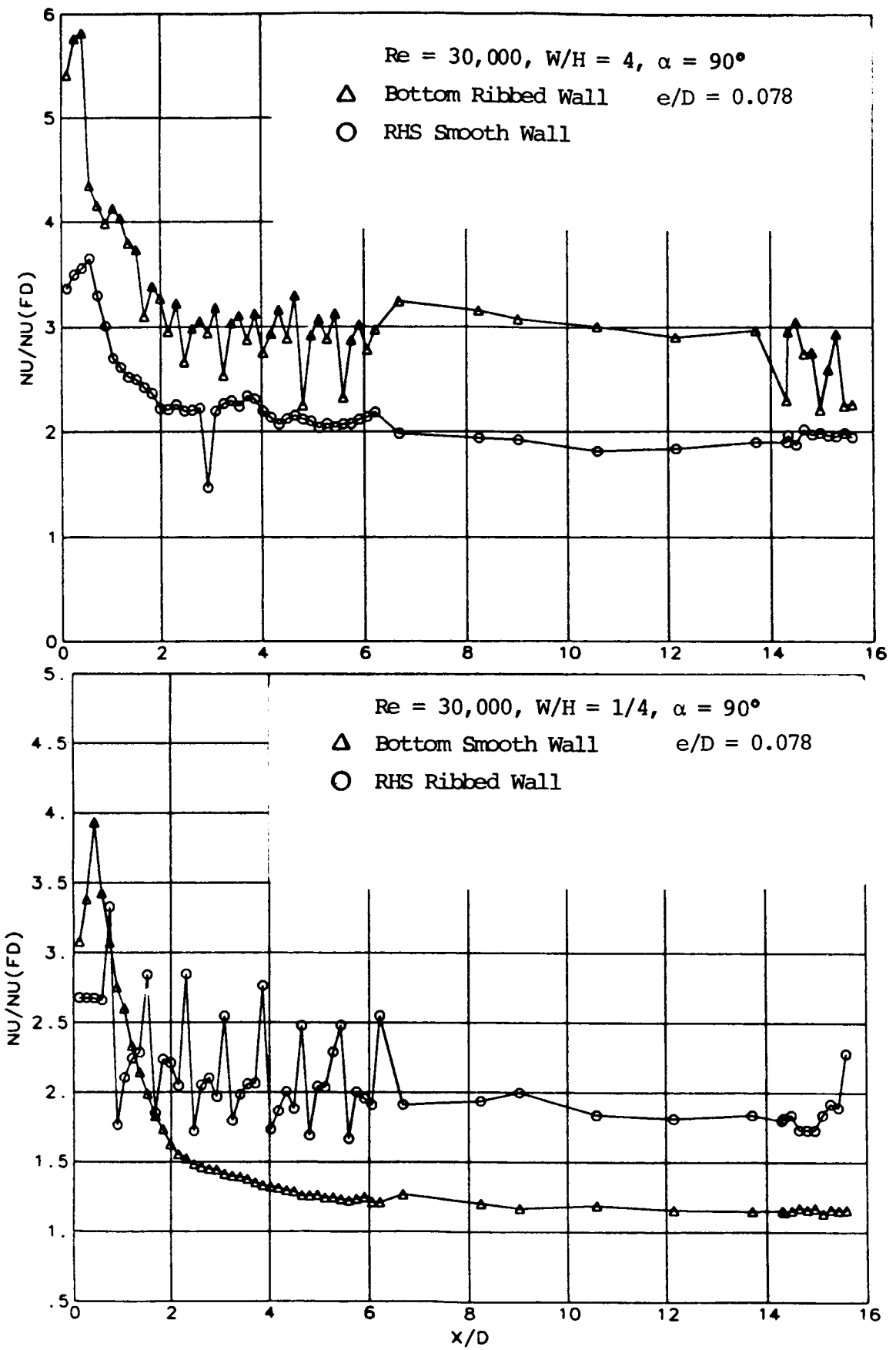


Figure 24(a). The effect of channel aspect ratio ($W/H = 4, 1/4$) on the centerline heat transfer distribution for $P/e = 10$.

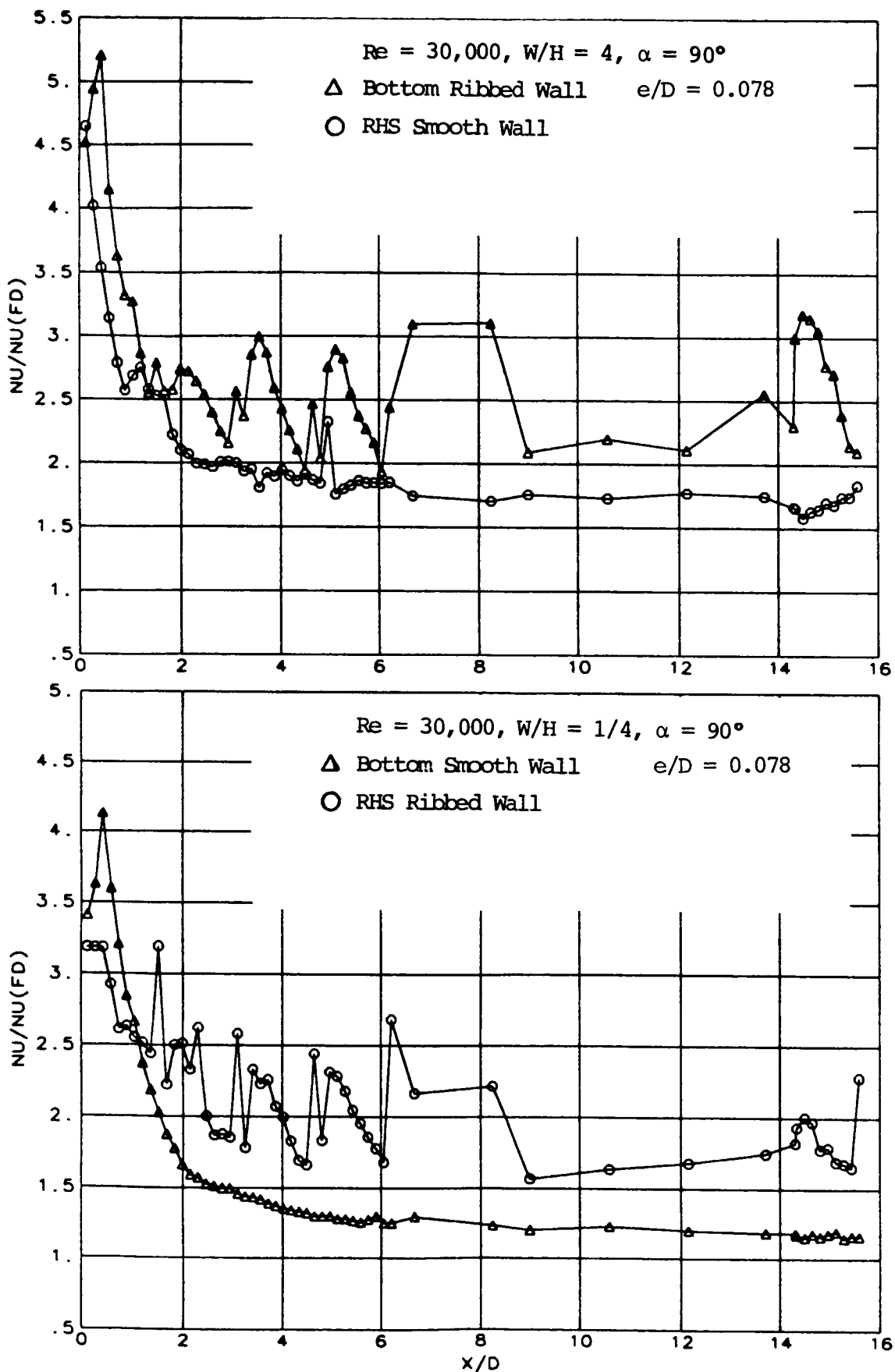


Figure 24(b). The effect of channel aspect ratio ($W/H = 4, 1/4$) on the centerline heat transfer distribution for $P/e = 20$.

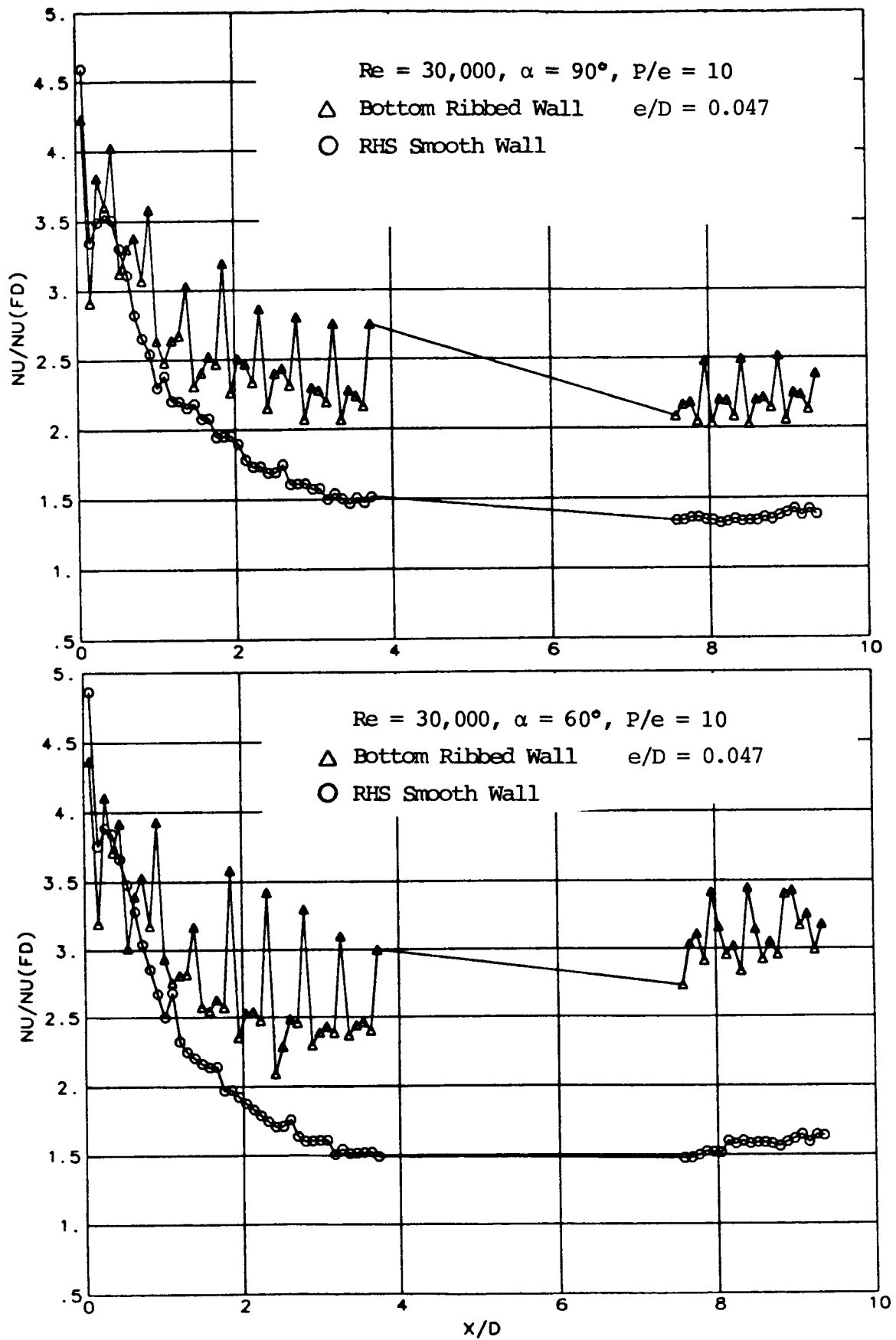


Figure 25(a). The effect of rib angle on the centerline heat transfer distribution in the square channel for $\alpha = 90^\circ, 60^\circ$.

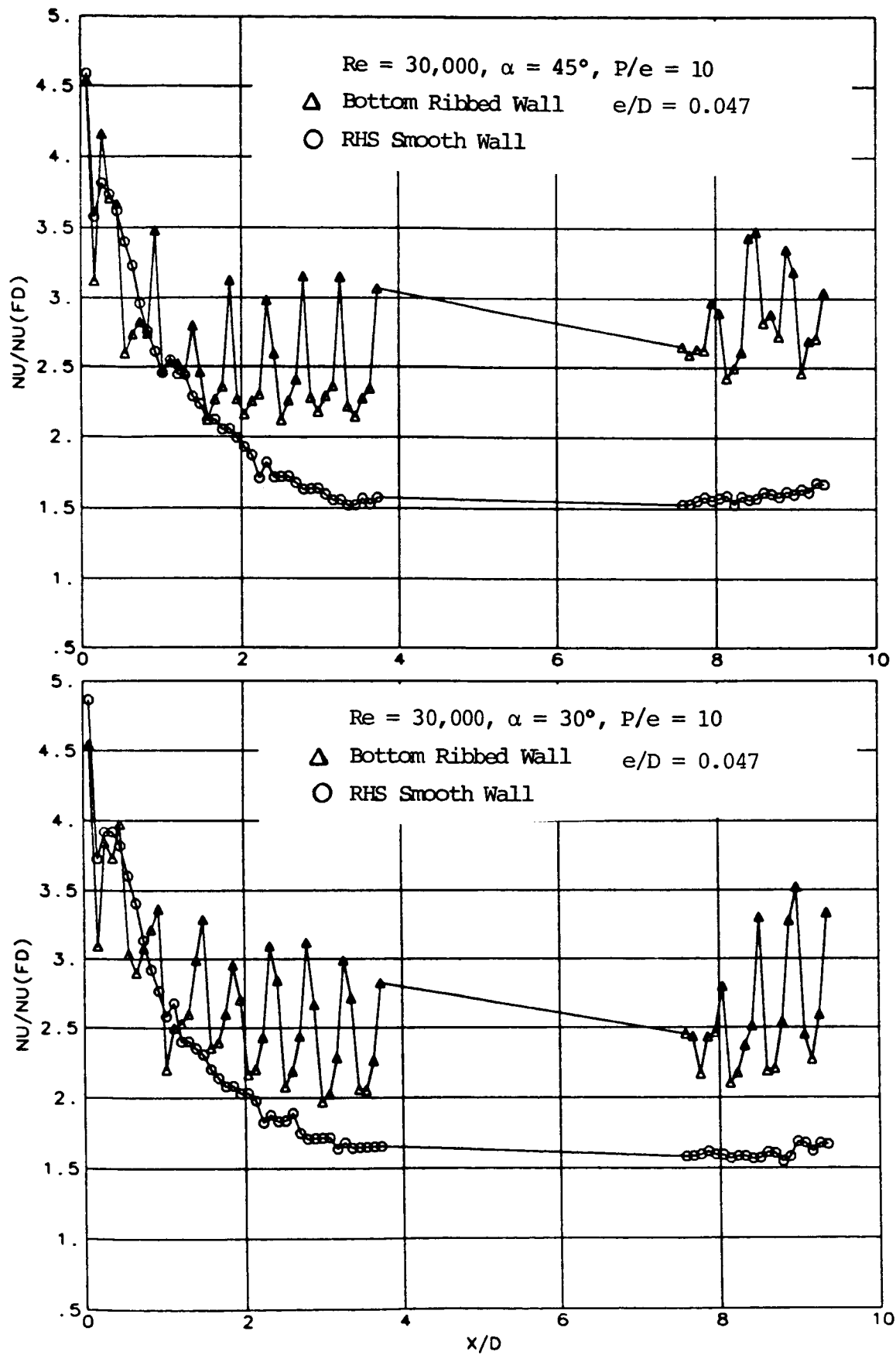


Figure 25(b). The effect of rib angle on the centerline heat transfer distribution in the square channel for $\alpha = 45^\circ, 30^\circ$.

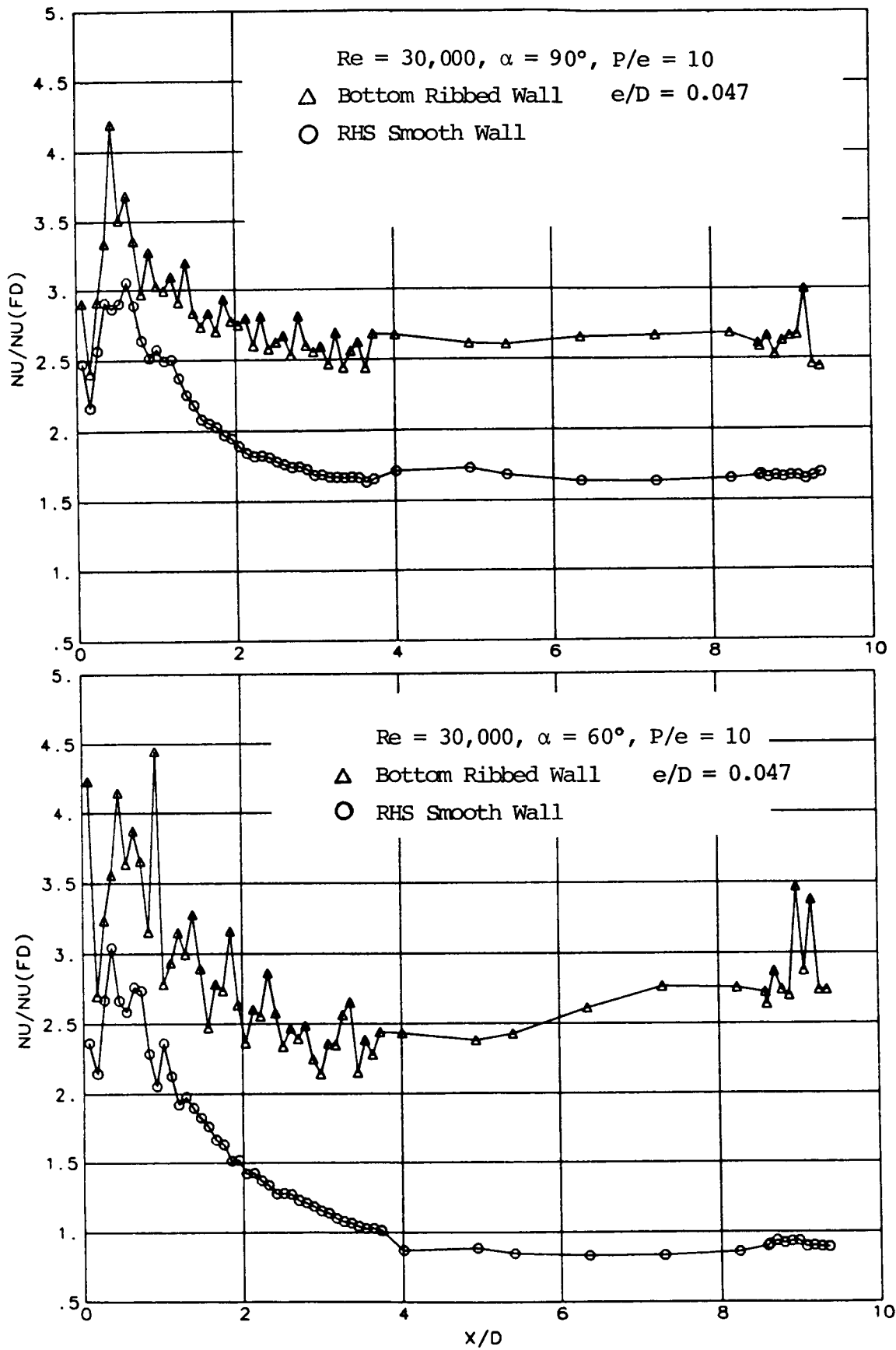


Figure 26(a). The effect of rib angle on the centerline heat transfer distribution in the rectangular channel I for $\alpha = 90^\circ, 60^\circ$.

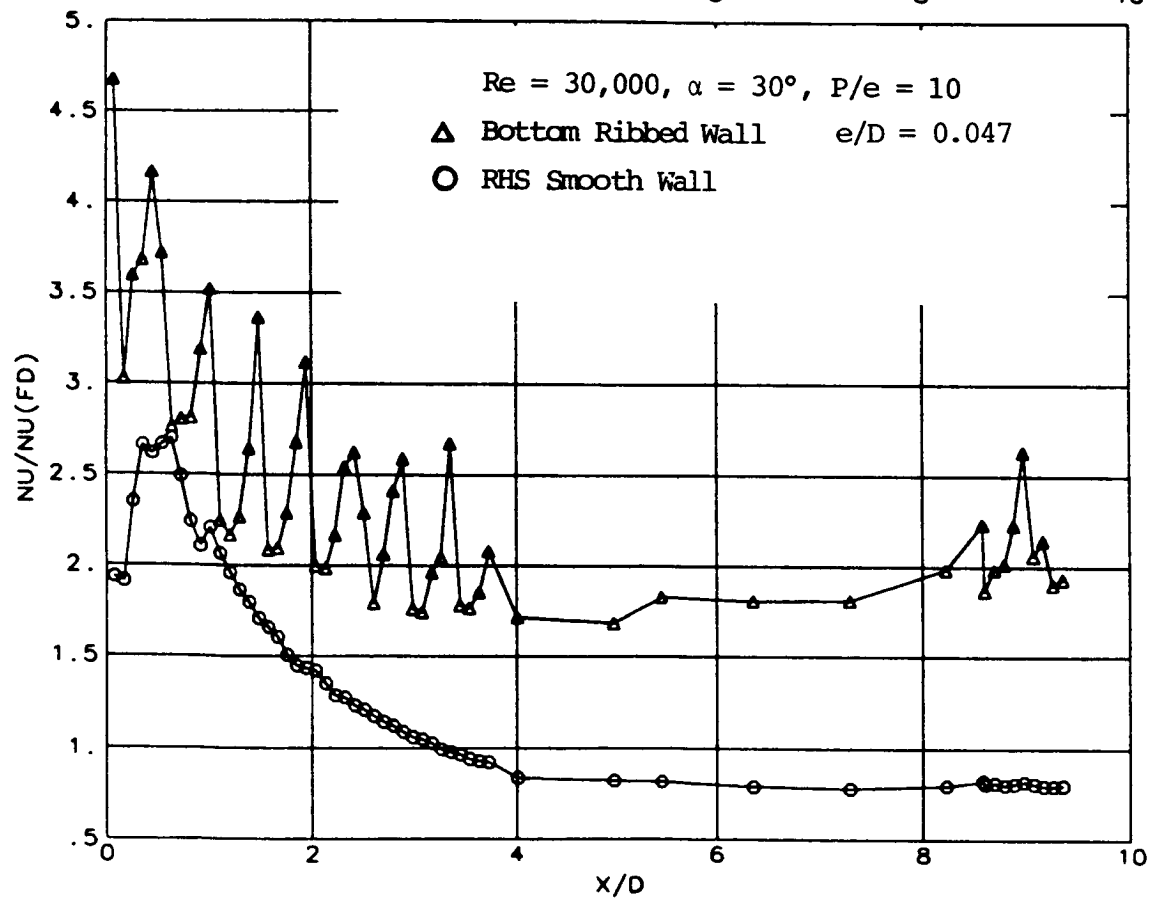
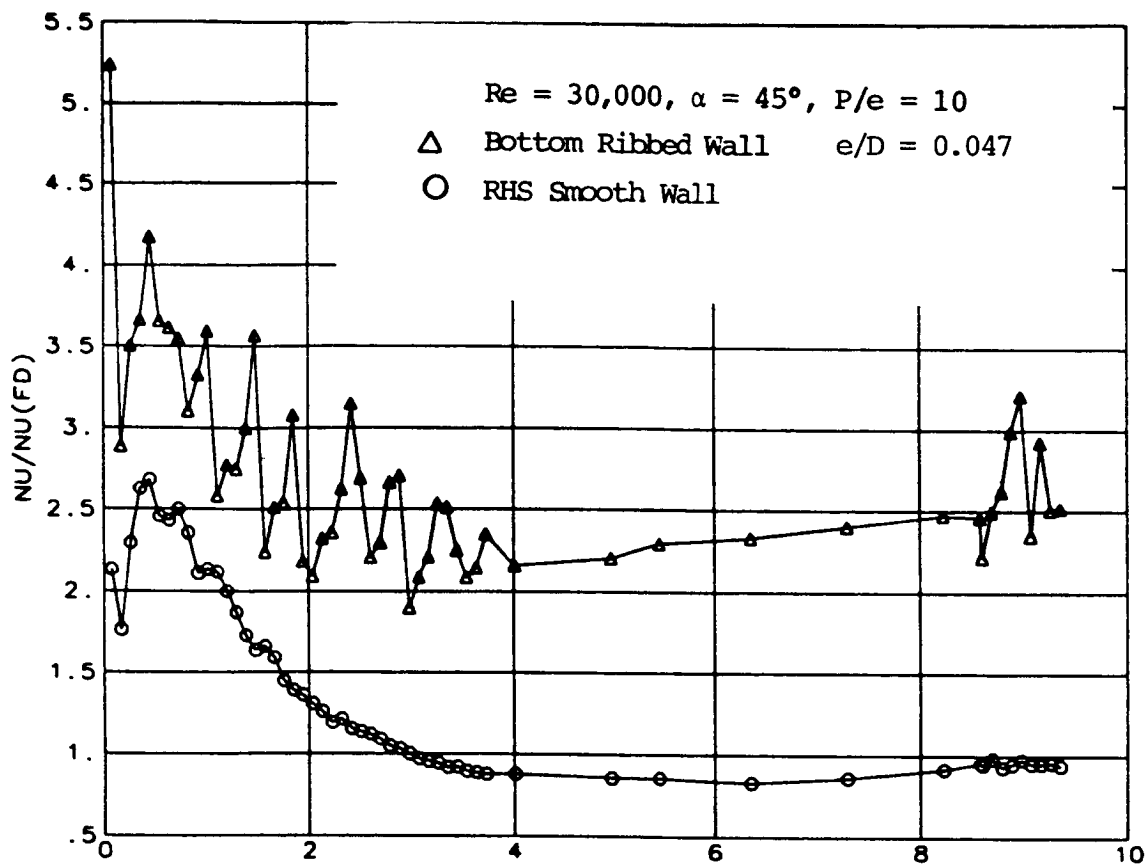


Figure 26(b). The effect of rib angle on the centerline heat transfer distribution in the rectangular channel I for $\alpha = 45^\circ, 30^\circ$.

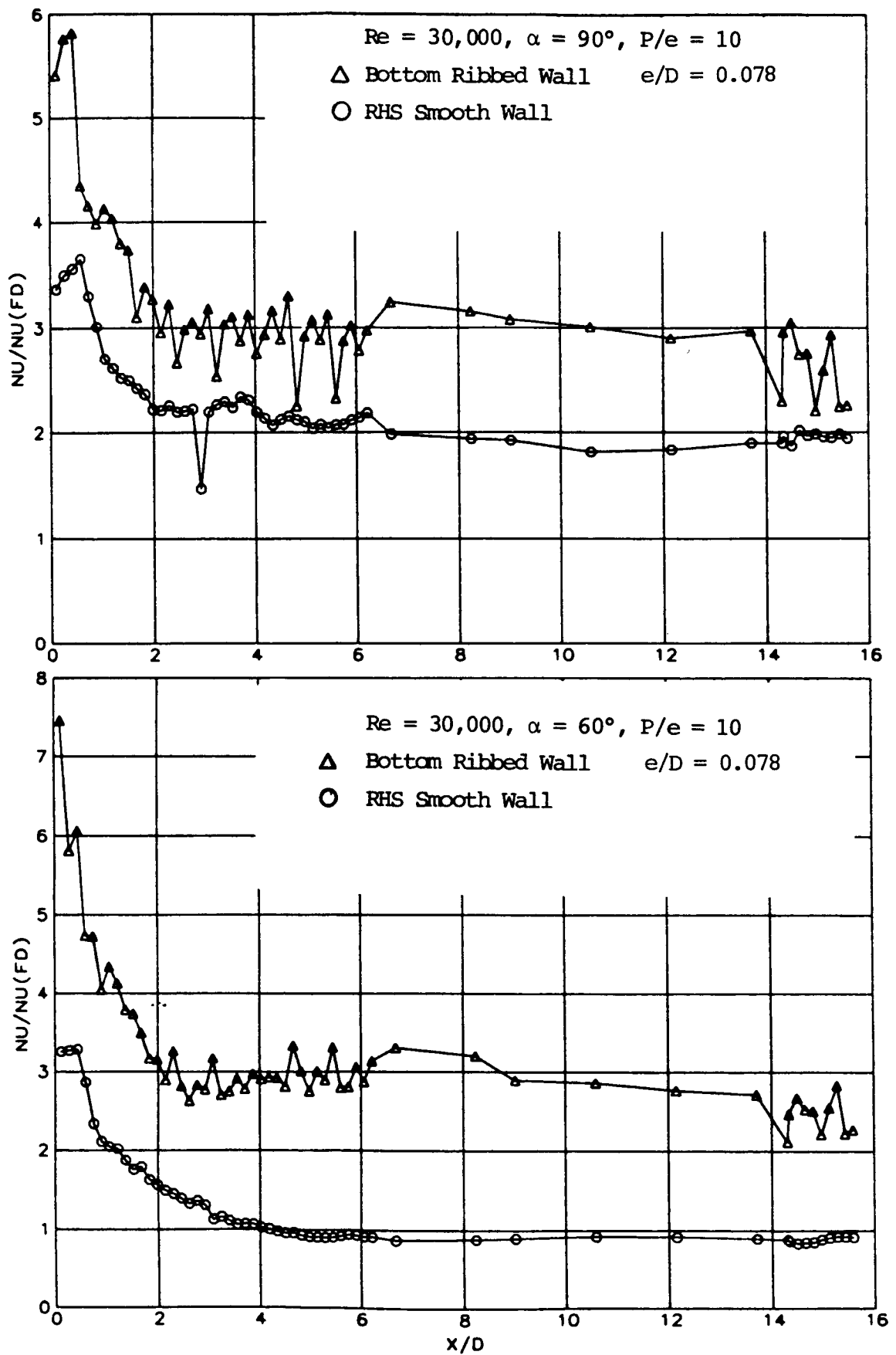


Figure 27(a). The effect of rib angle on the centerline heat transfer distribution in the rectangular channel II for $\alpha = 90^\circ, 60^\circ$.

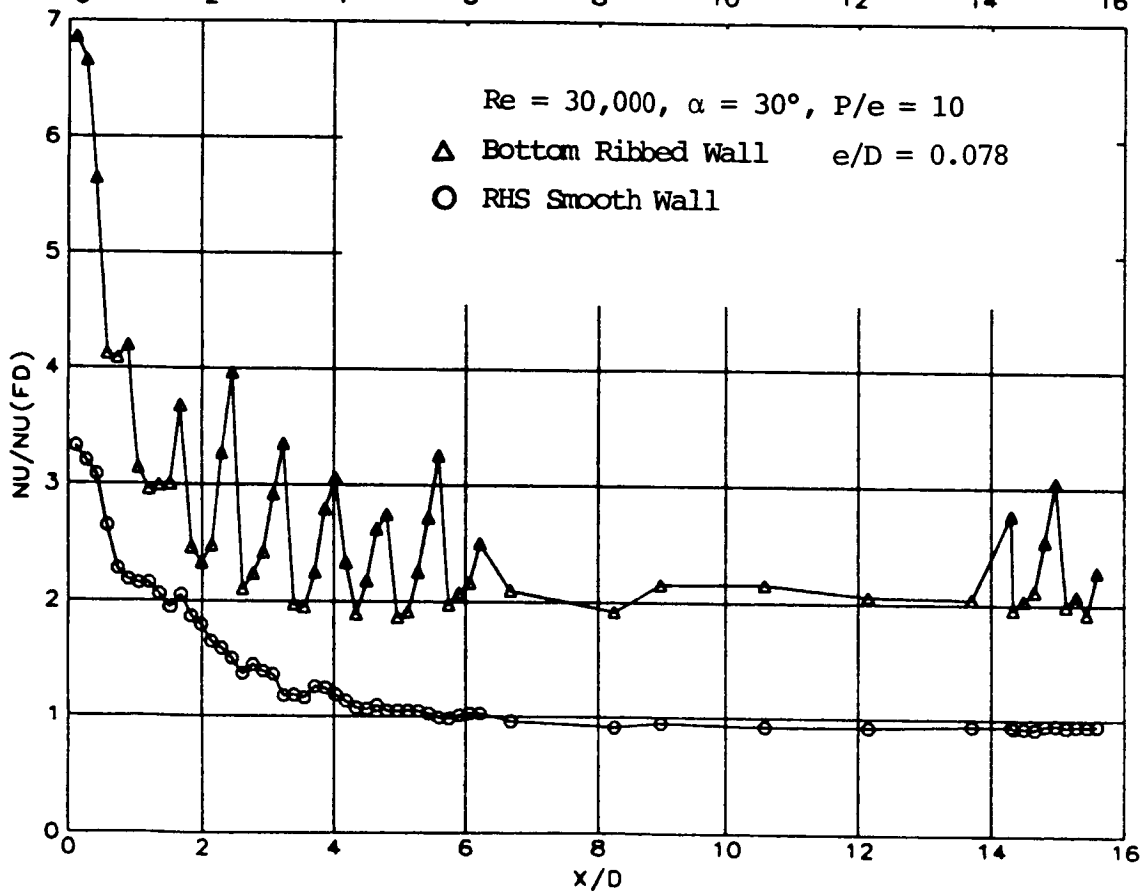
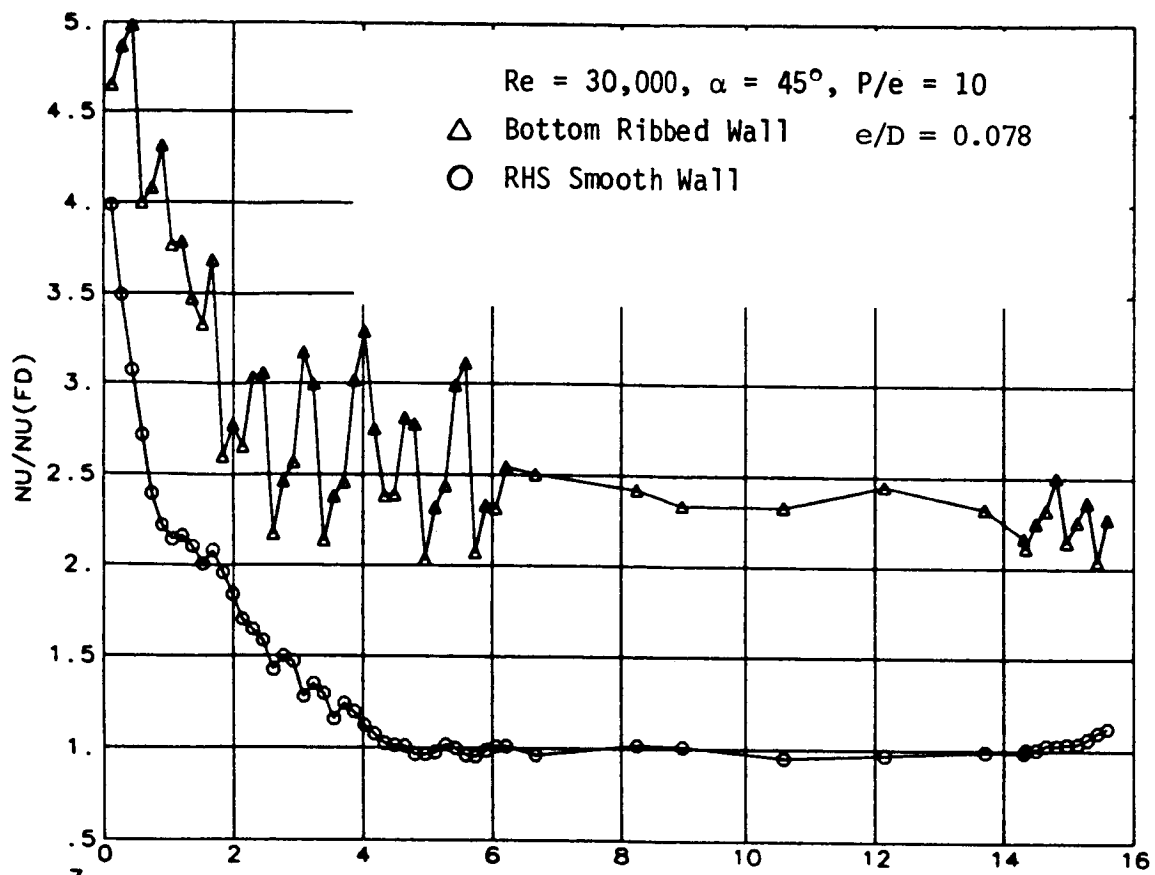


Figure 27(b). The effect of rib angle on the centerline heat transfer distribution in the rectangular channel II for $\alpha = 45^\circ, 30^\circ$.

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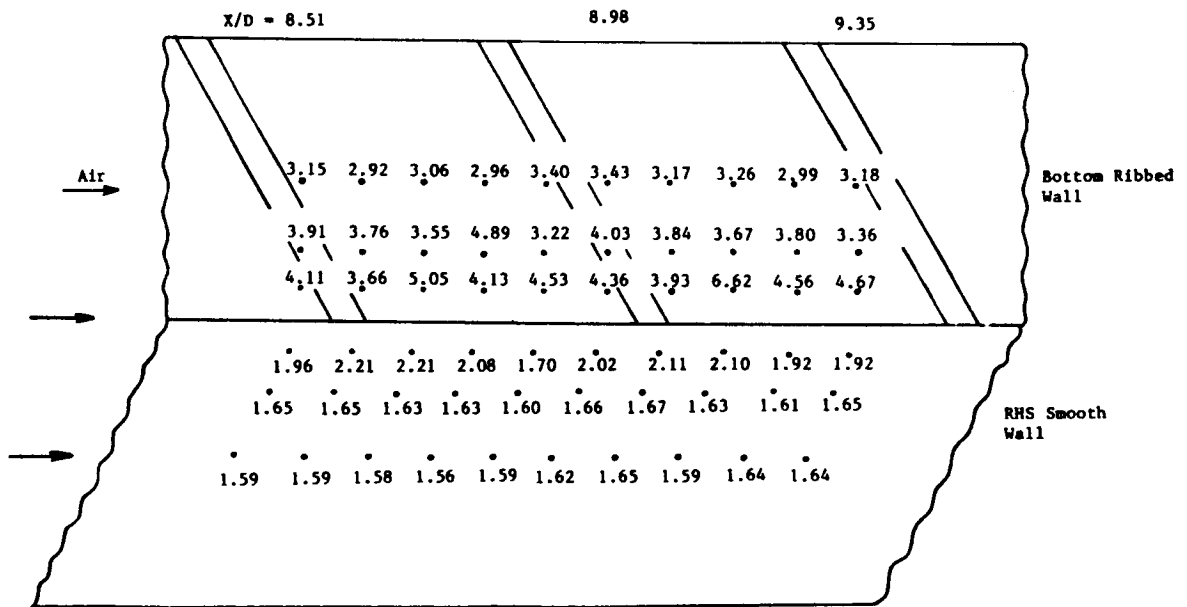
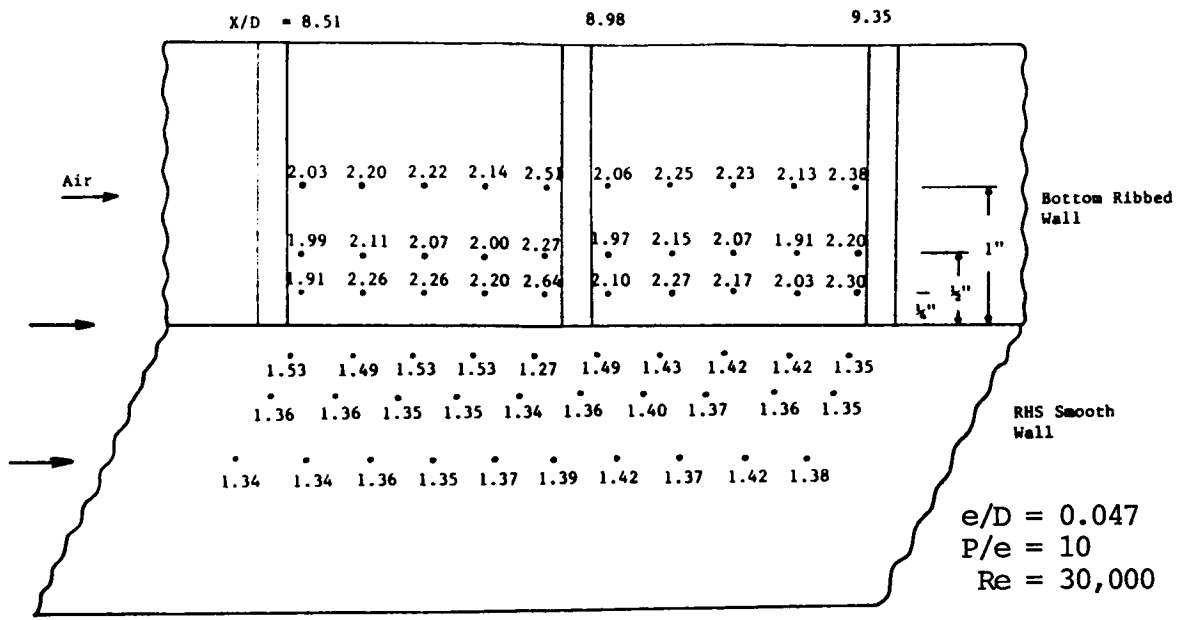


Figure 28(a). The effect of rib angle on the local heat transfer distribution at the downstream region of the square channel for $\alpha = 90^\circ, 60^\circ$.

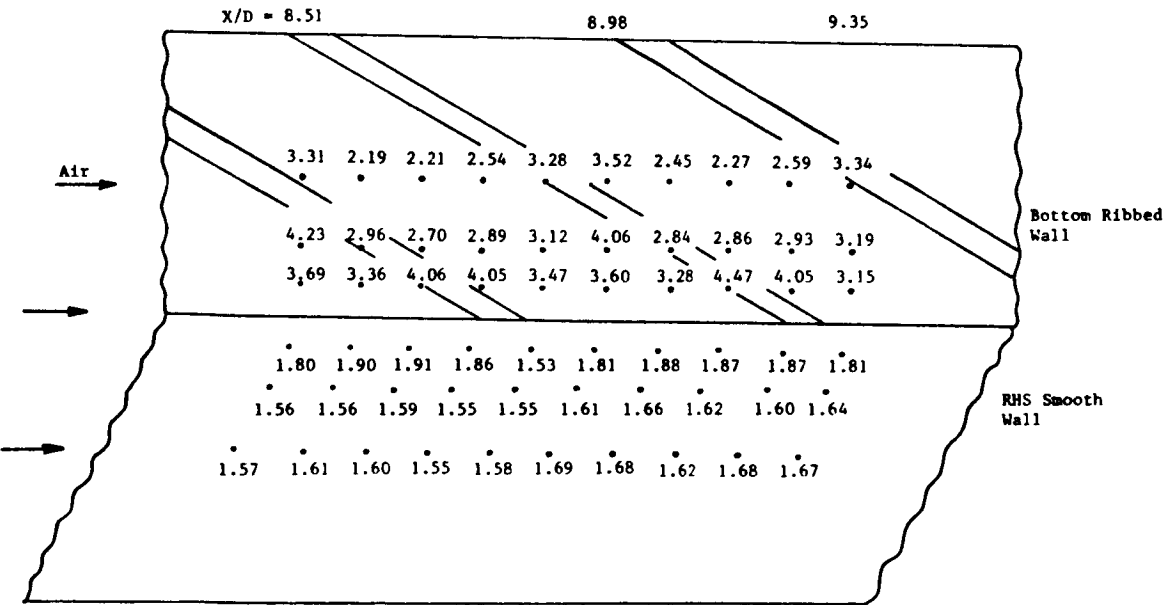
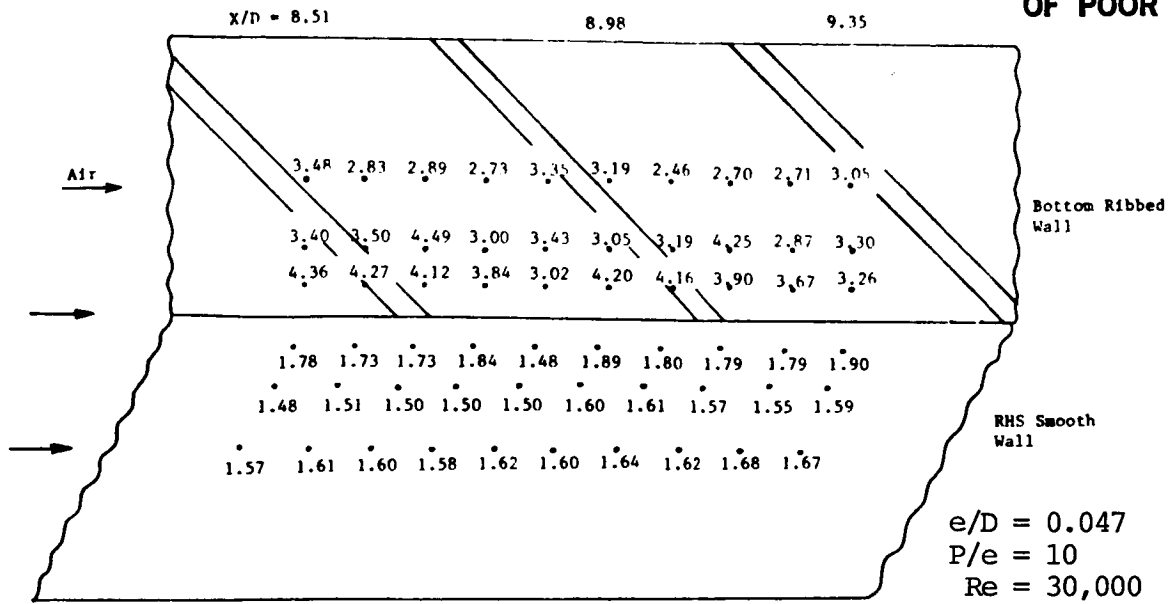


Figure 28(b). The effect of rib angle on the local heat transfer distribution at the downstream region of the square channel for $\alpha = 45^\circ, 30^\circ$.

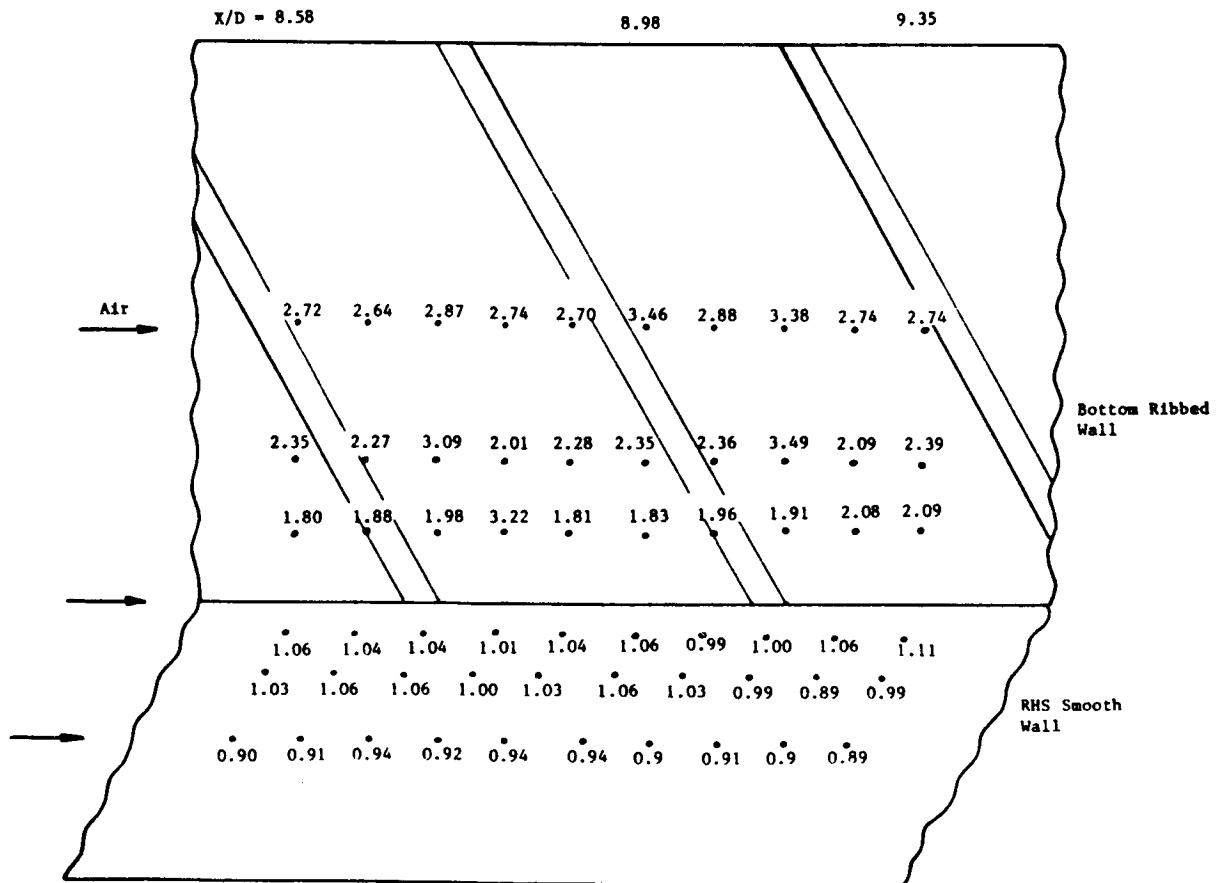
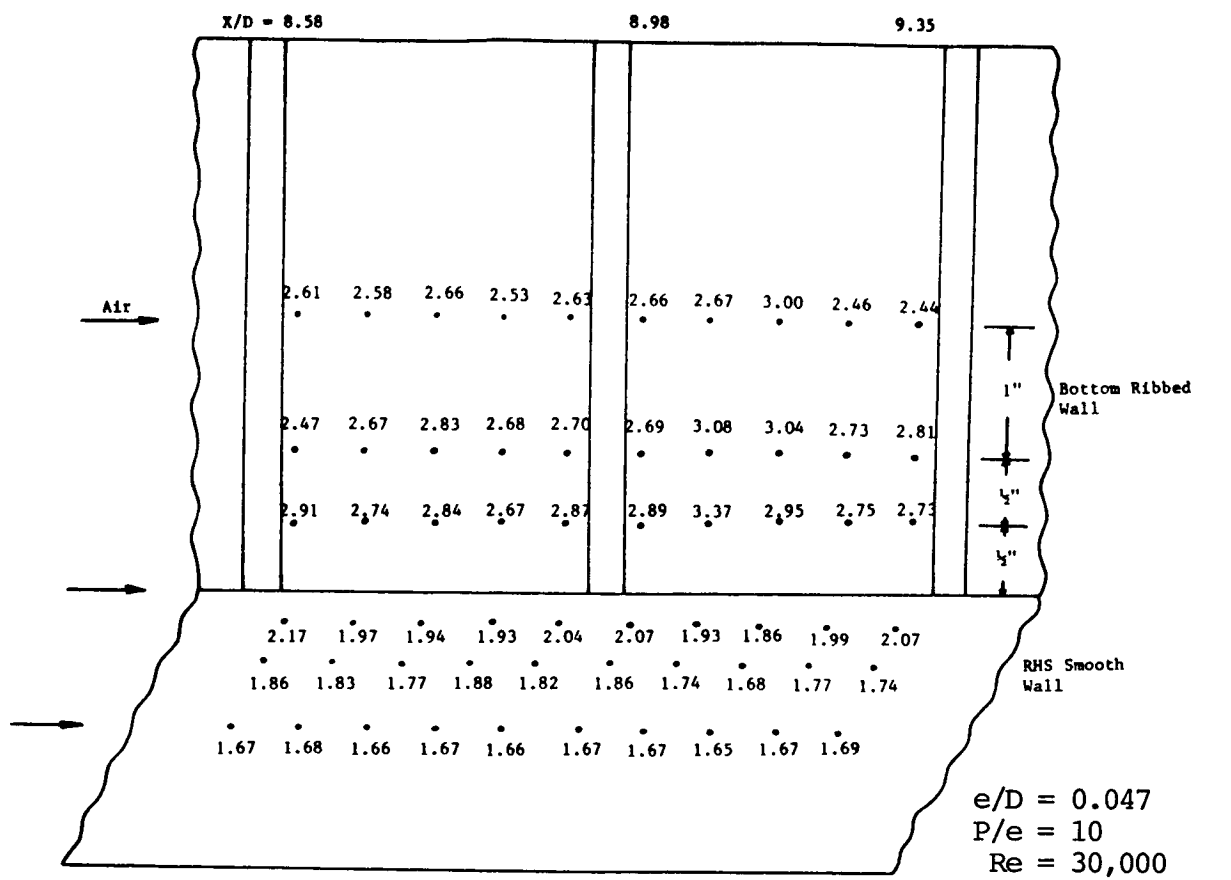


Figure 29(a). The effect of rib angle on the local heat transfer distribution at the downstream region of the rectangular channel I for $\alpha = 90^\circ, 60^\circ$.

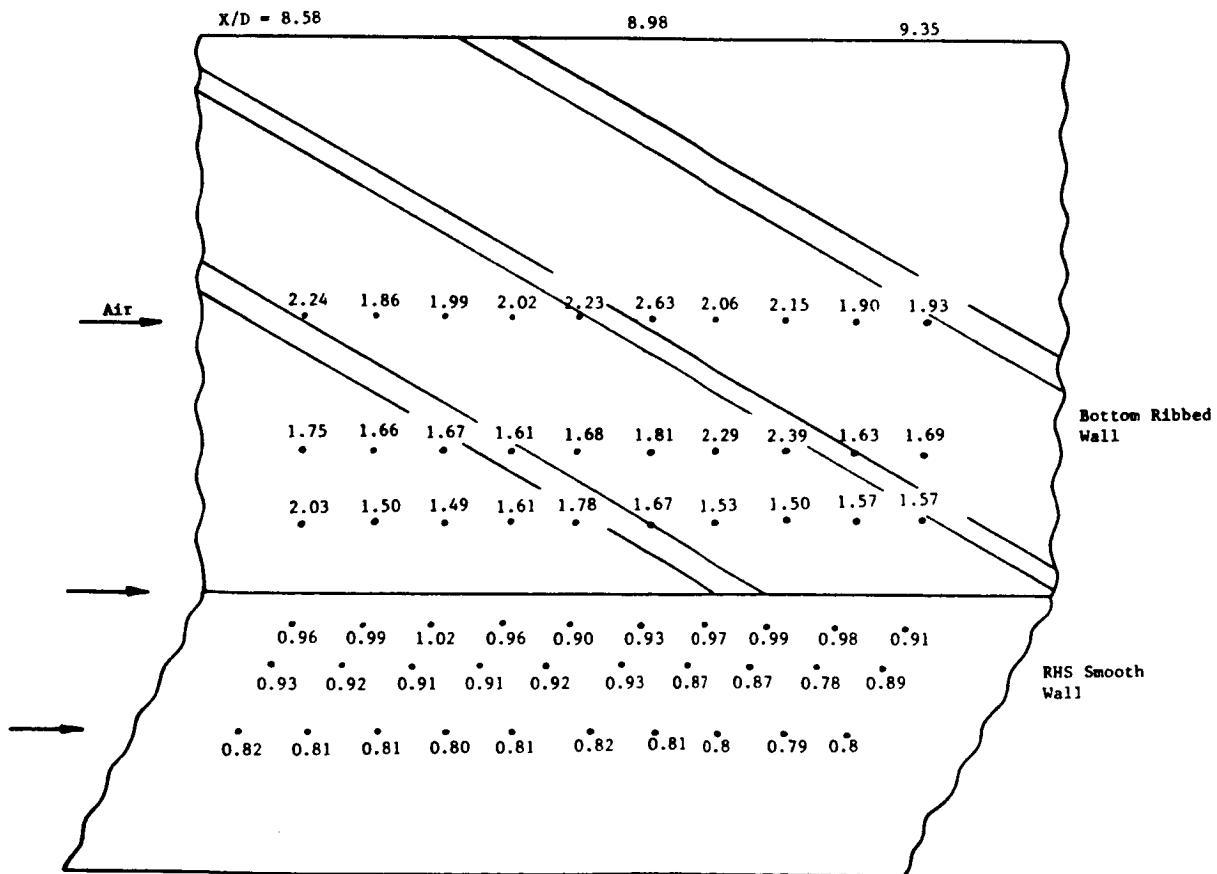
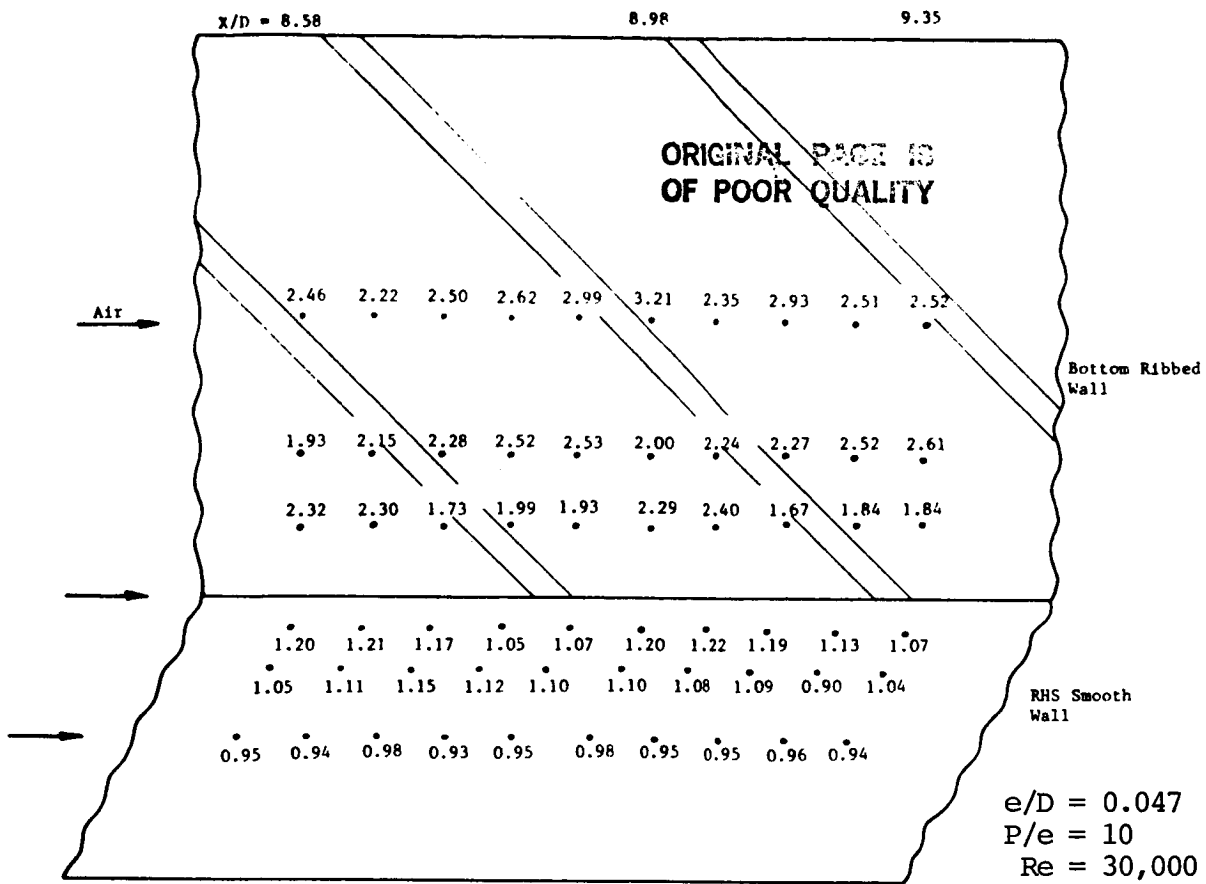


Figure 29(b). The effect of rib angle on the local heat transfer distribution at the downstream region of the rectangular channel I for $\alpha = 45^\circ, 30^\circ$.

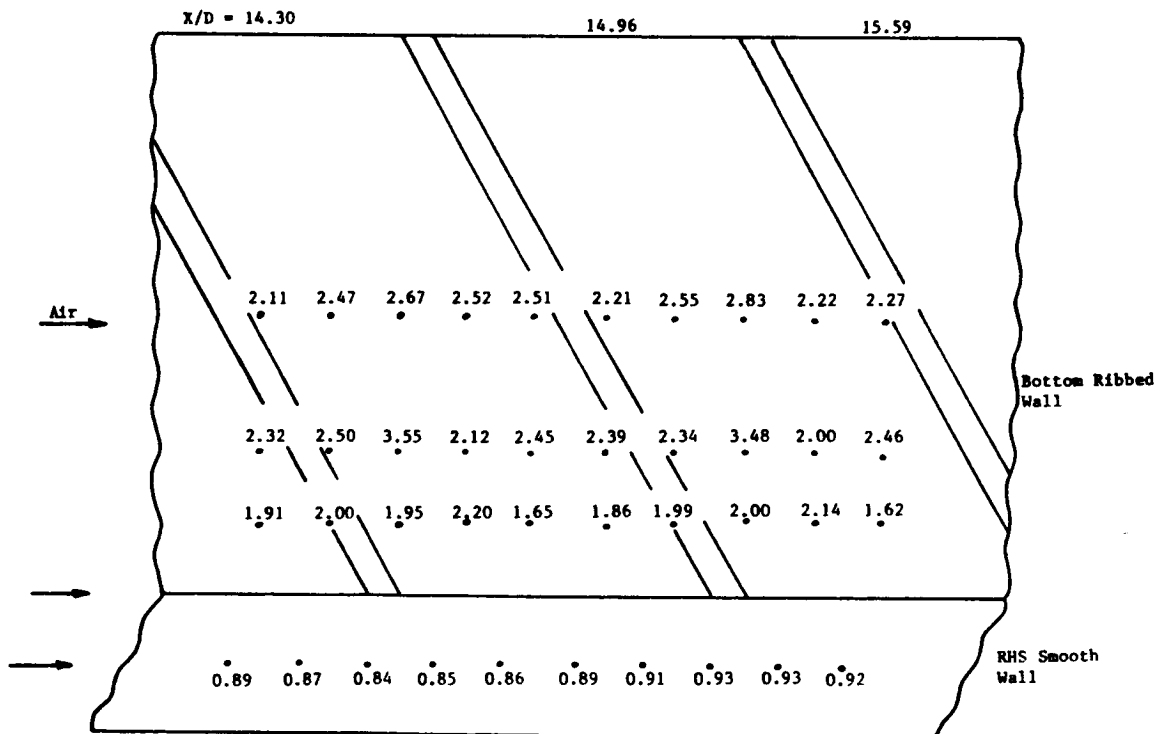
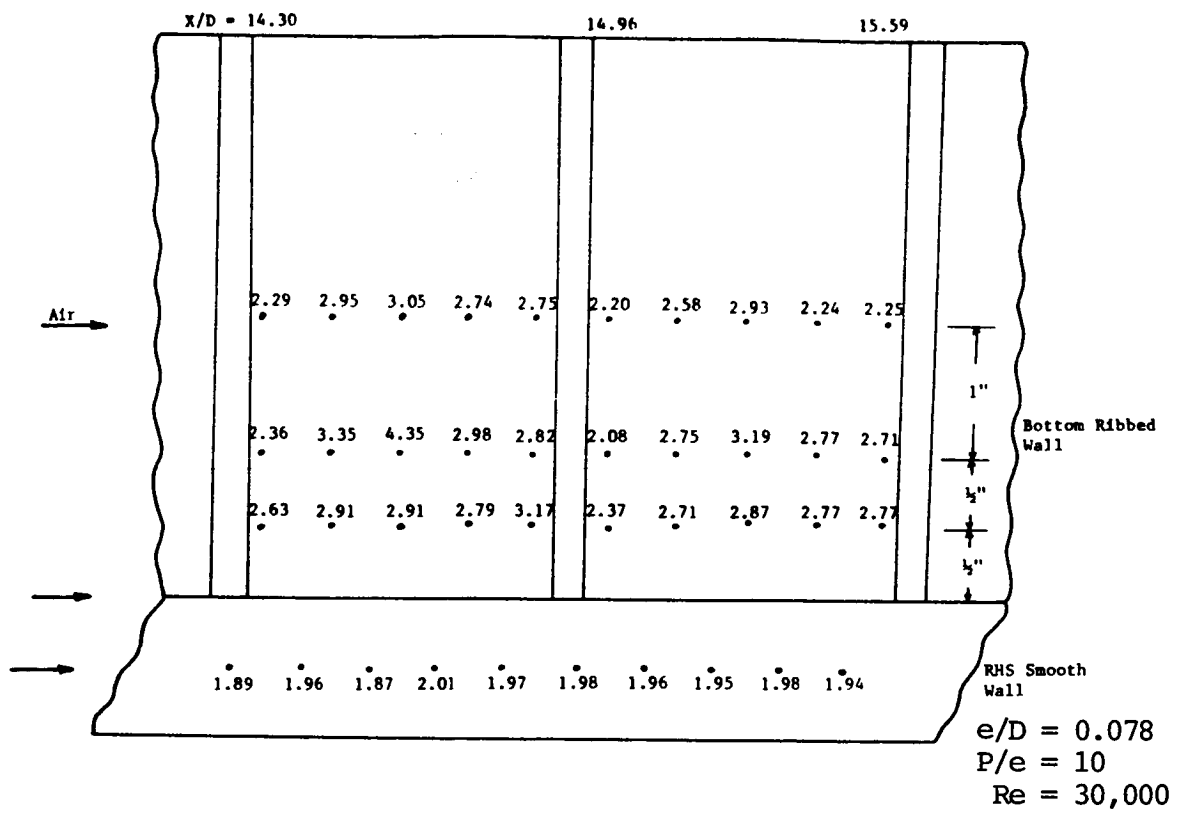


Figure 30(a). The effect of rib angle on the local heat transfer distribution at the downstream region of the rectangular channel II for $\alpha = 90^\circ, 60^\circ$.

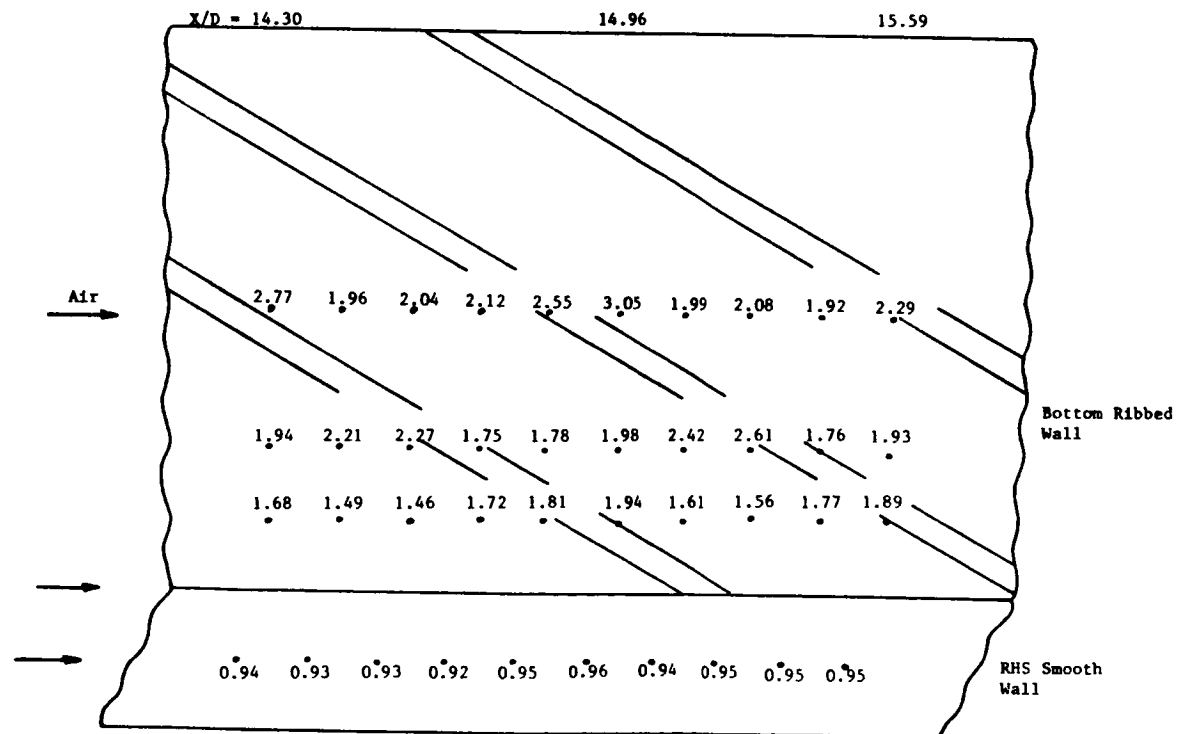
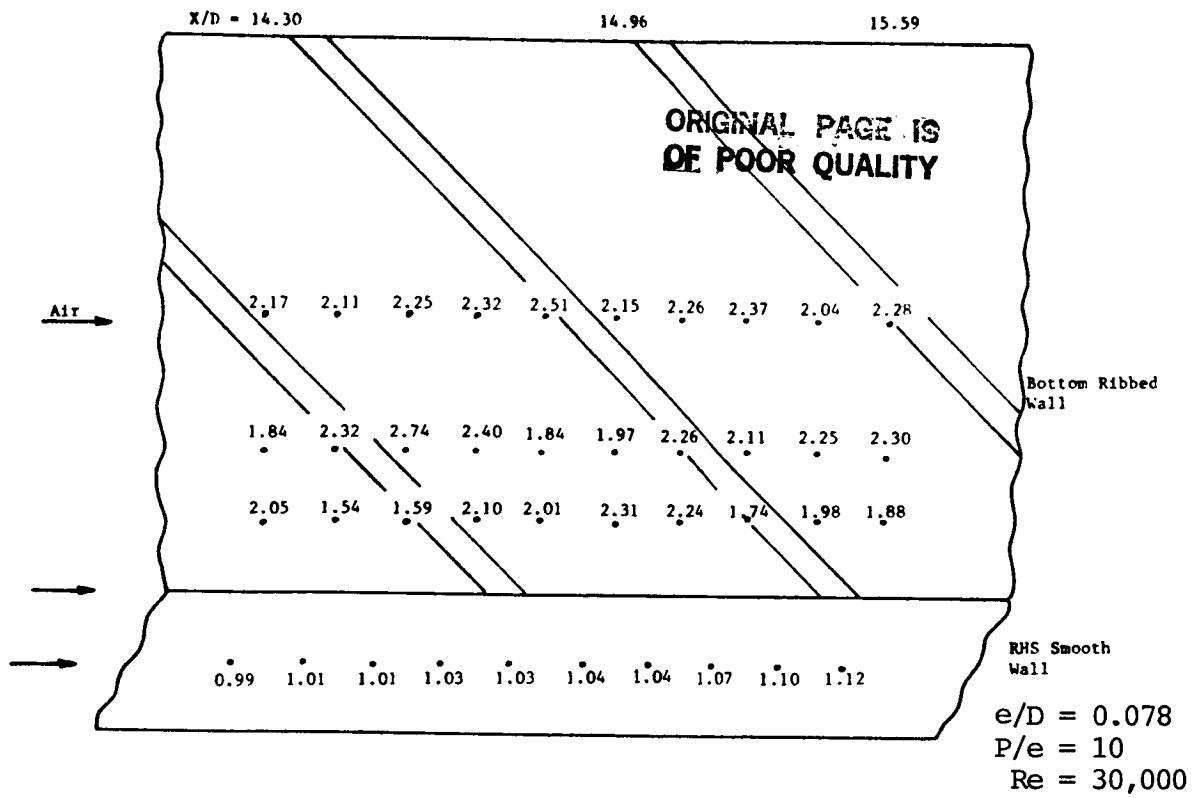
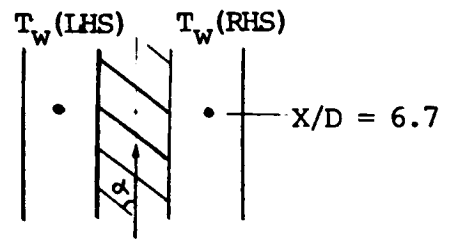


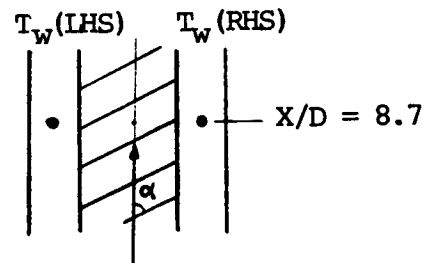
Figure 30 (b). The effect of rib angle on the local heat transfer distribution at the downstream region of the rectangular channel II for $\alpha = 45^\circ, 30^\circ$.

- (A). 3" x 3" square channel [1]
 $P/e = 10, X/D = 6.7$
 T_w (RHS) = Right Hand Side Smooth
 Wall Temperature
 T_w (LHS) = Left Hand Side Smooth
 Wall Temperature
 $T_w - T_b = 45^\circ\text{F}$



		$\alpha = 90^\circ$	60°	45°	30°	Smooth
Re = 20,000	T_w (RHS)	138.6	136.7	133.2	140.2	147.2
	T_w (LHS)	138.1	141.2	135.5	145.0	147.2
Re = 60,000	T_w (RHS)	142.6	138.4	134.4	137.7	150.7
	T_w (LHS)	142.2	142.4	136.3	142.5	150.0

- (B). 4" x 2" rectangular channel I
 $P/e = 10, X/D = 8.7$
 $T_w - T_b = 45^\circ\text{F}$



		$\alpha = 90^\circ$	60°	45°	30°	Smooth
Re = 30,000	T_w (RHS)	129.8	127.0	125.8	130.1	126.2
	T_w (LHS)	131.0	106.9	109.4	108.0	127.0
Re = 60,000	T_w (RHS)	136.6	130.0	128.7	133.0	
	T_w (LHS)	136.5	112.6	114.8	113.6	

Figure 31. Temperature difference between RHS and LHS smooth walls.

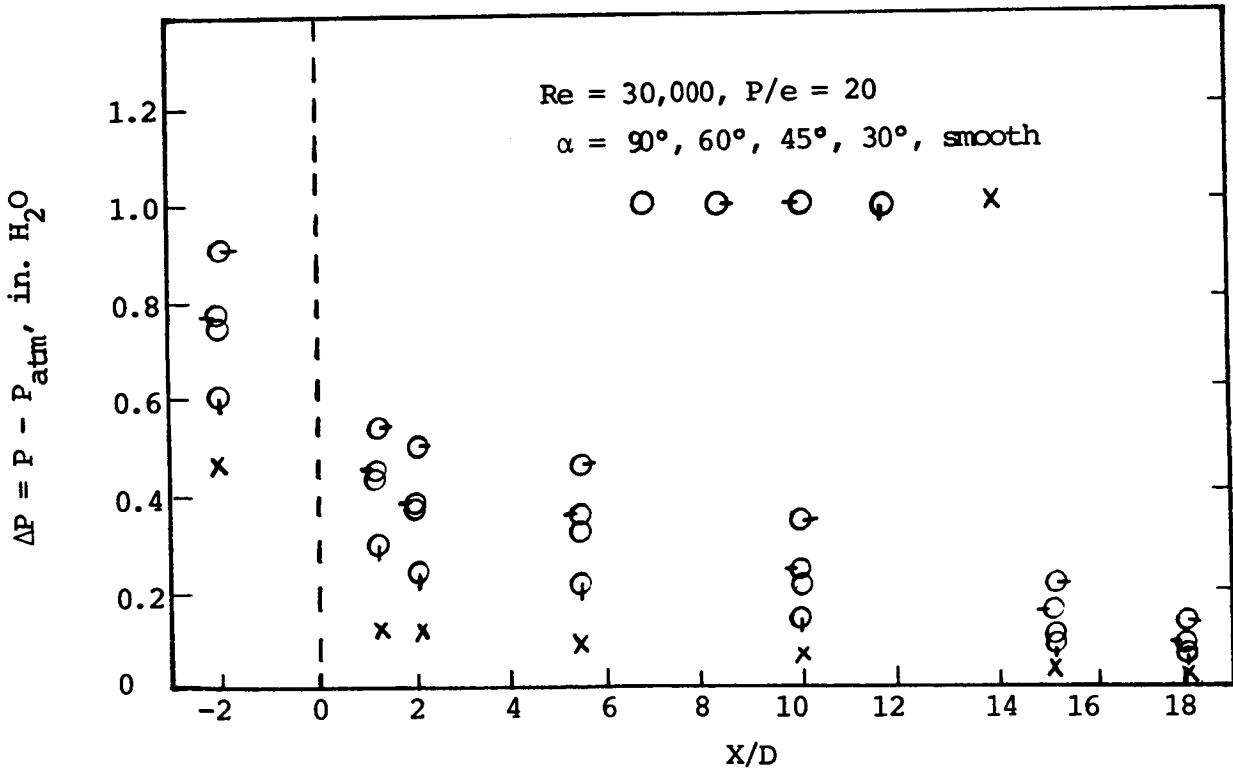
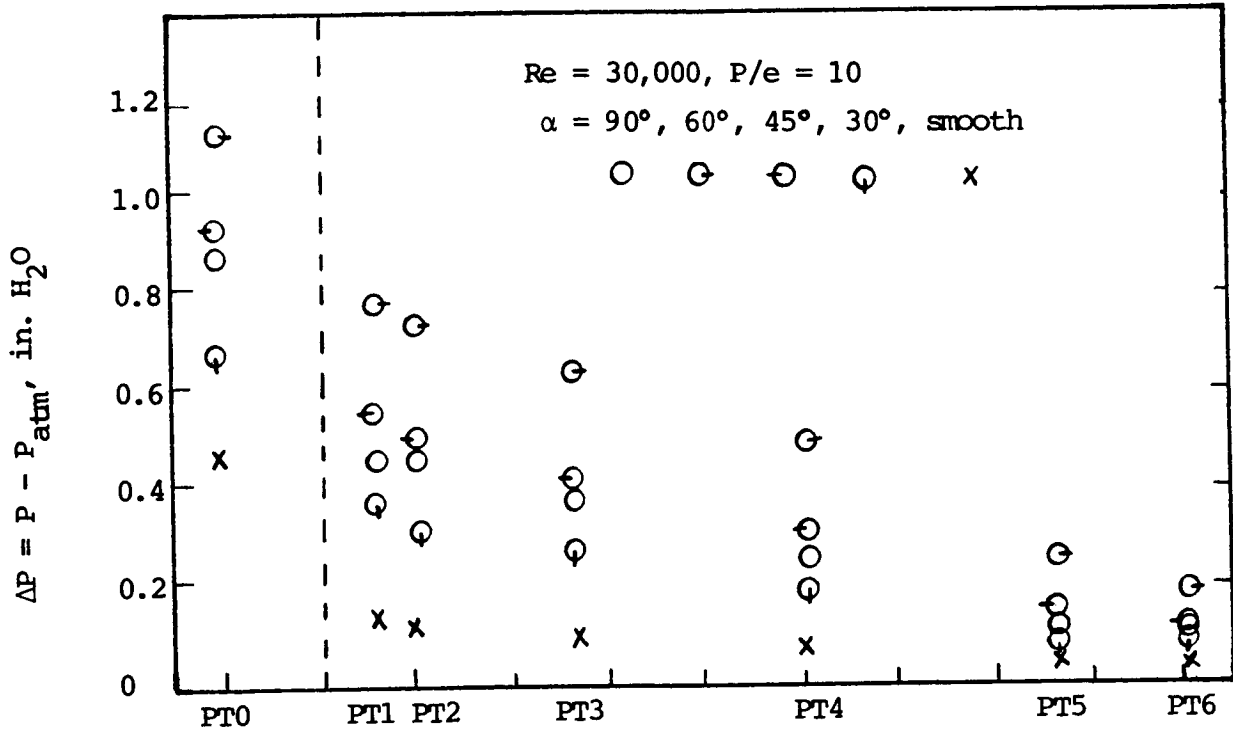


Figure 32. Pressure drop distribution for square channel.

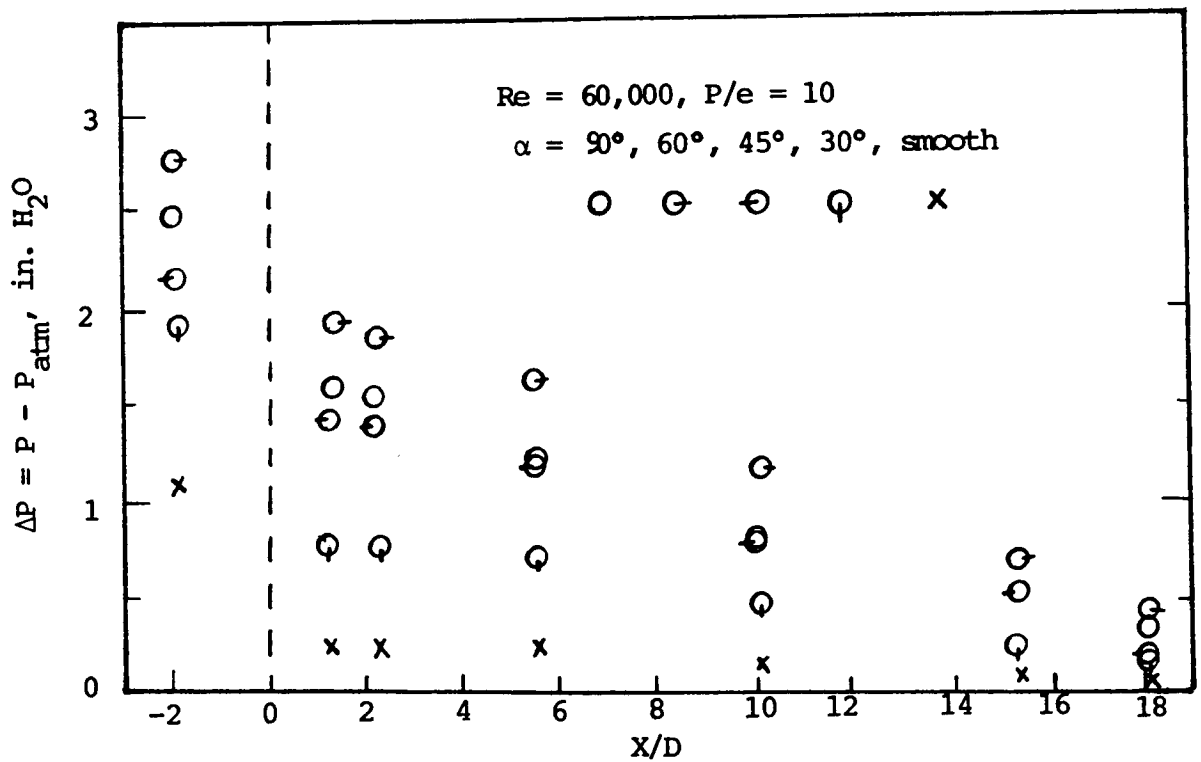
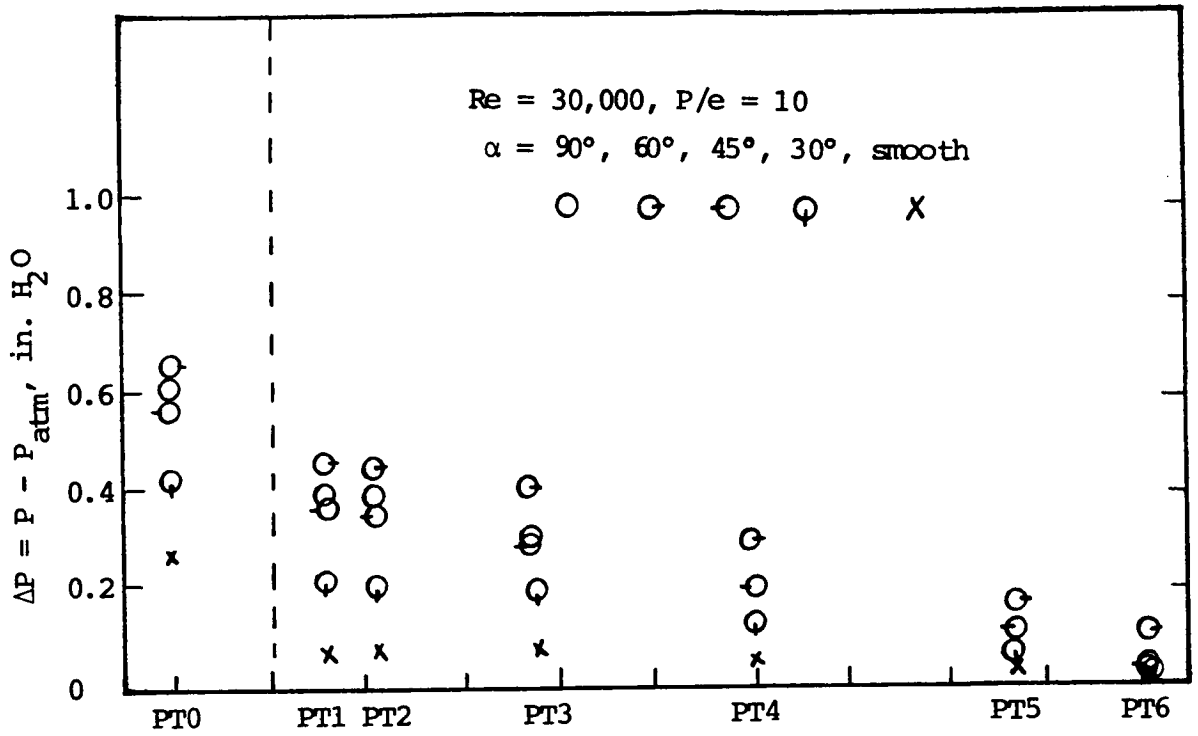


Figure 33. Pressure drop distribution for rectangular channel I.

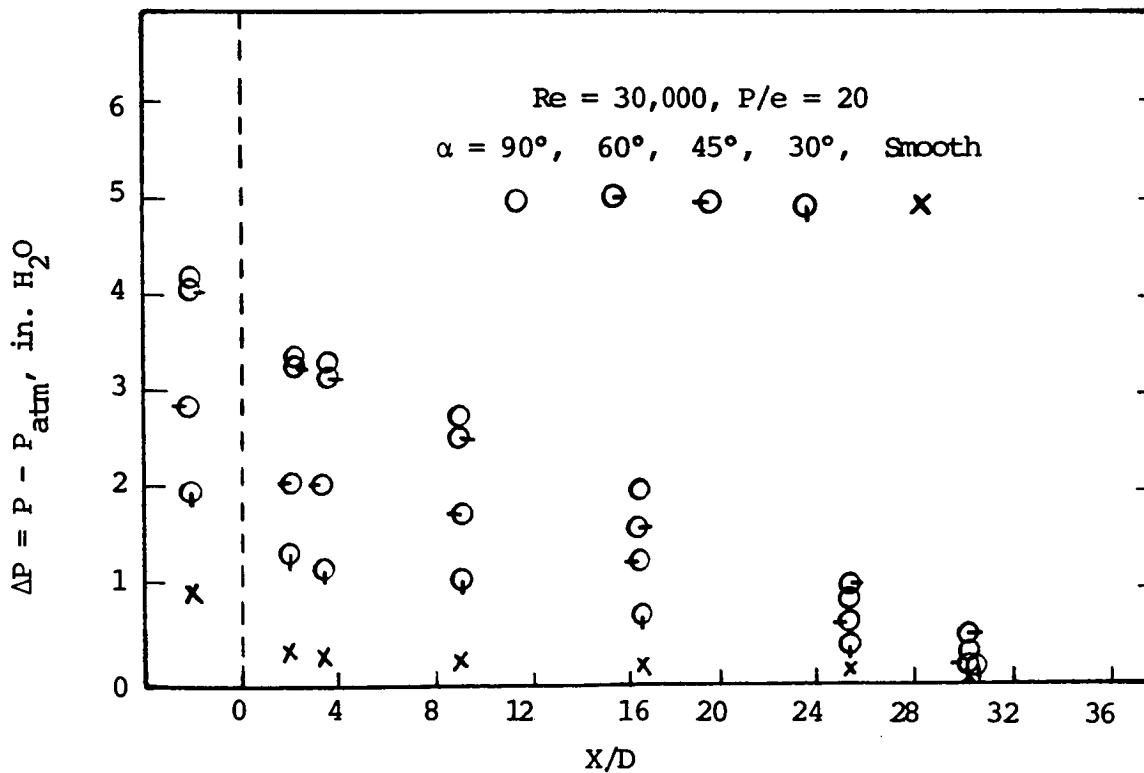
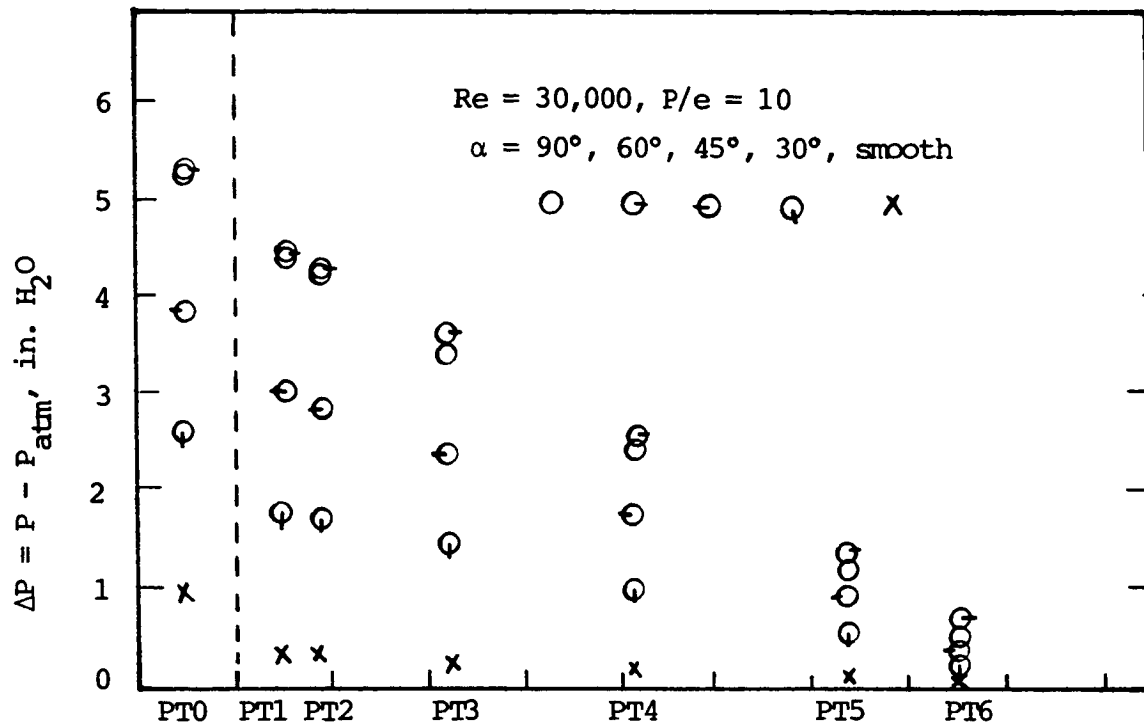


Figure 34. Pressure drop distribution for rectangular channel II.

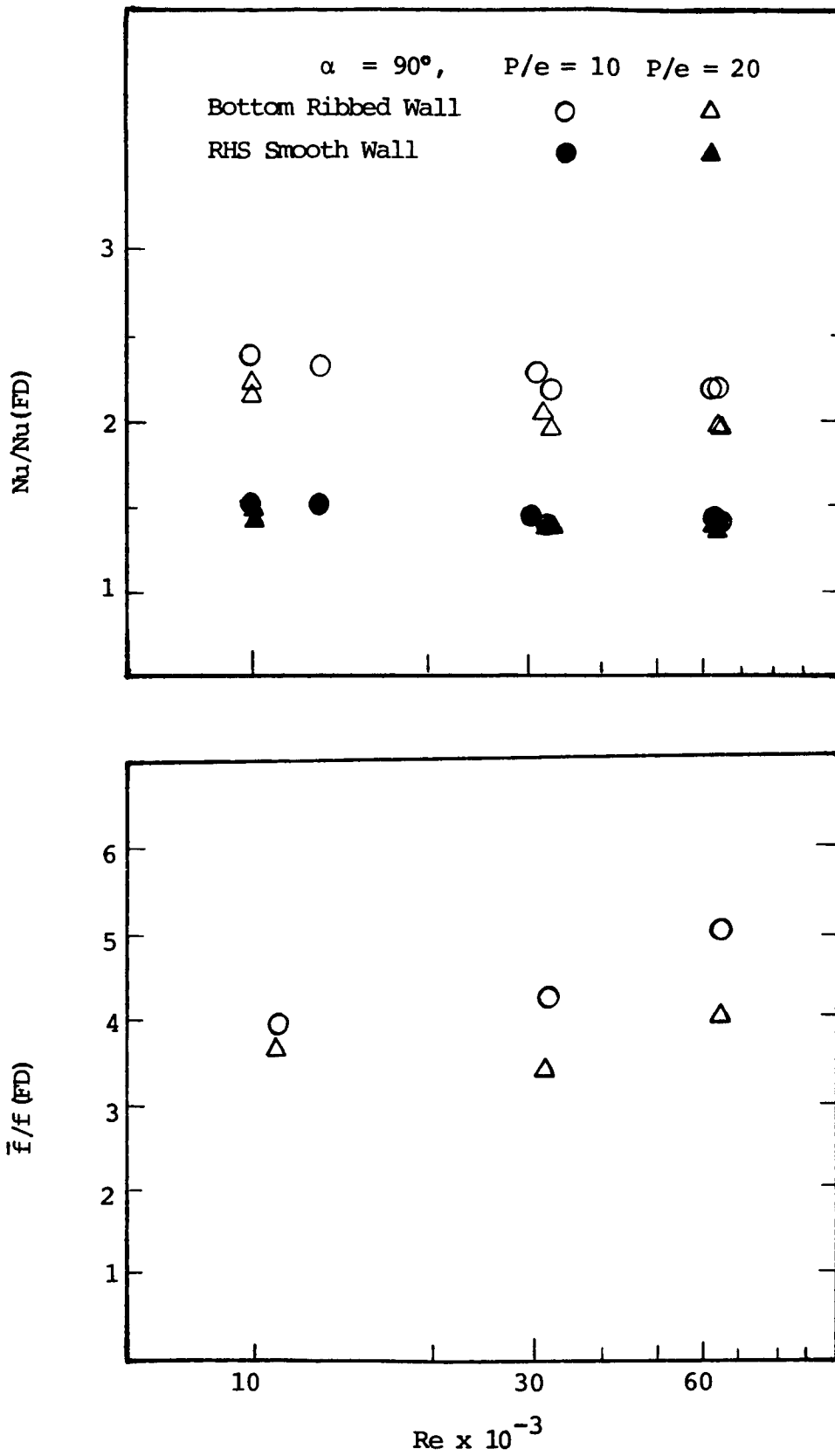


Figure 35. Heat transfer and friction vs Re for square channel.

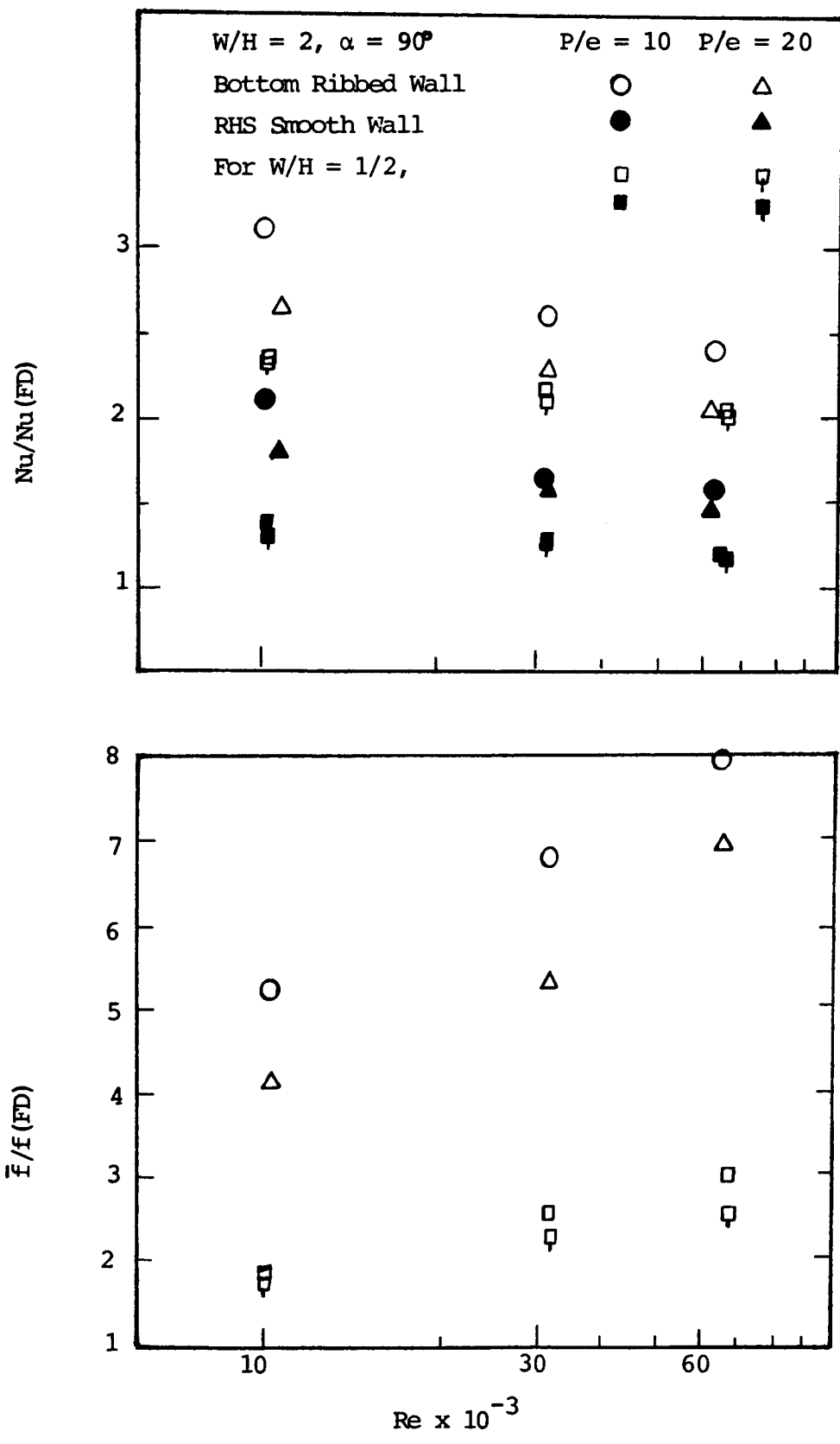


Figure 36. Heat transfer and friction vs Re for rectangular channel I.

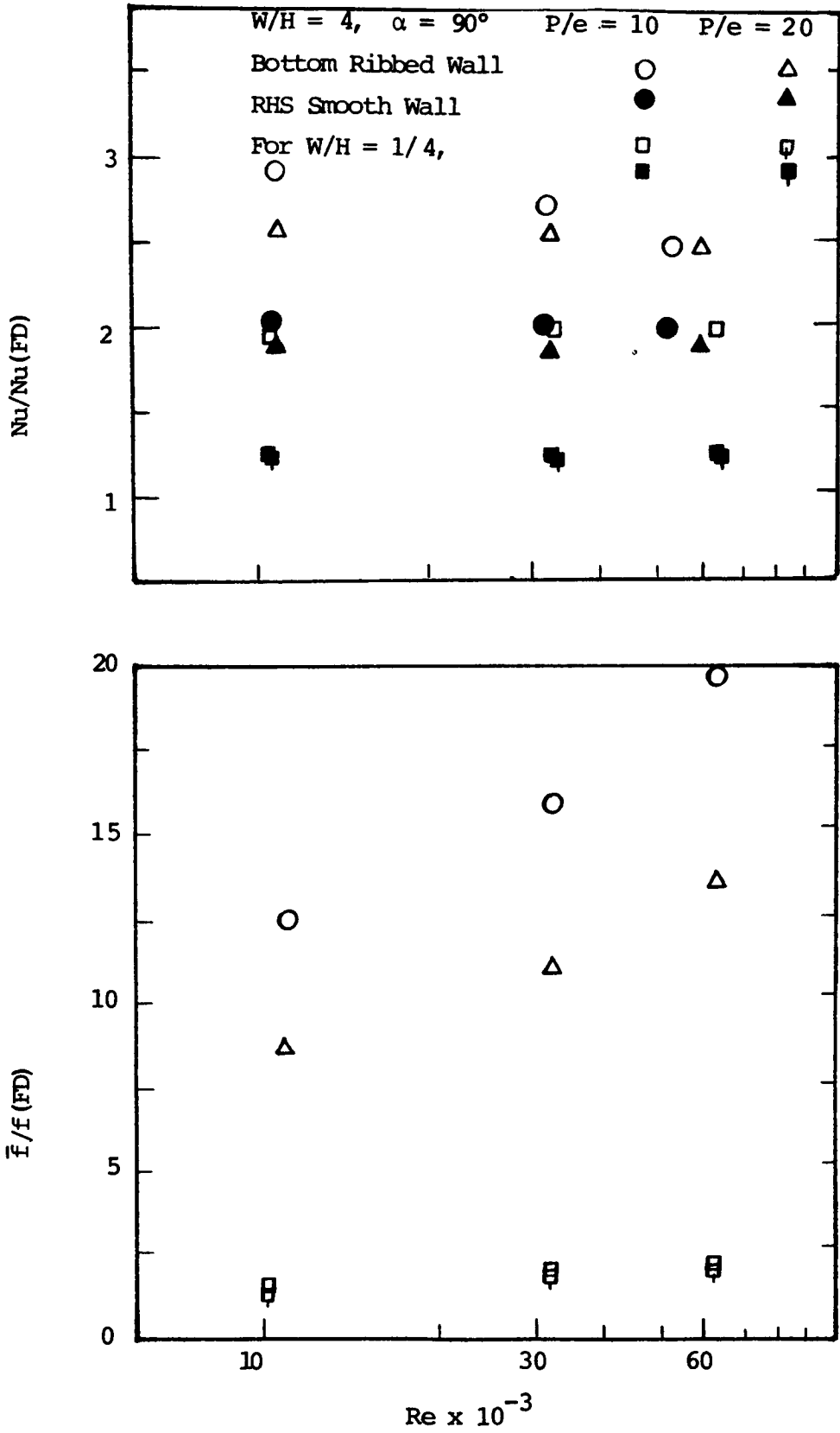


Figure 37. Heat transfer and friction vs Re for rectangular channel II.

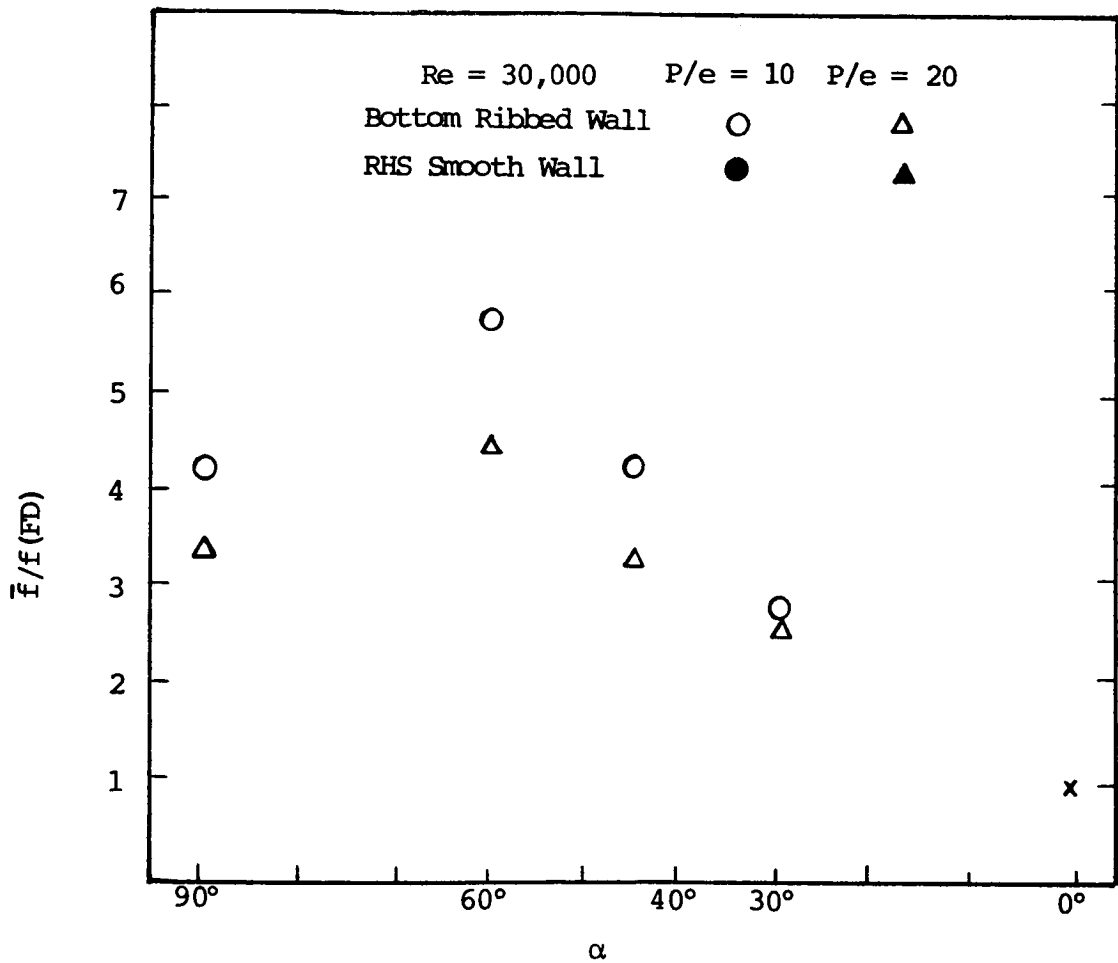
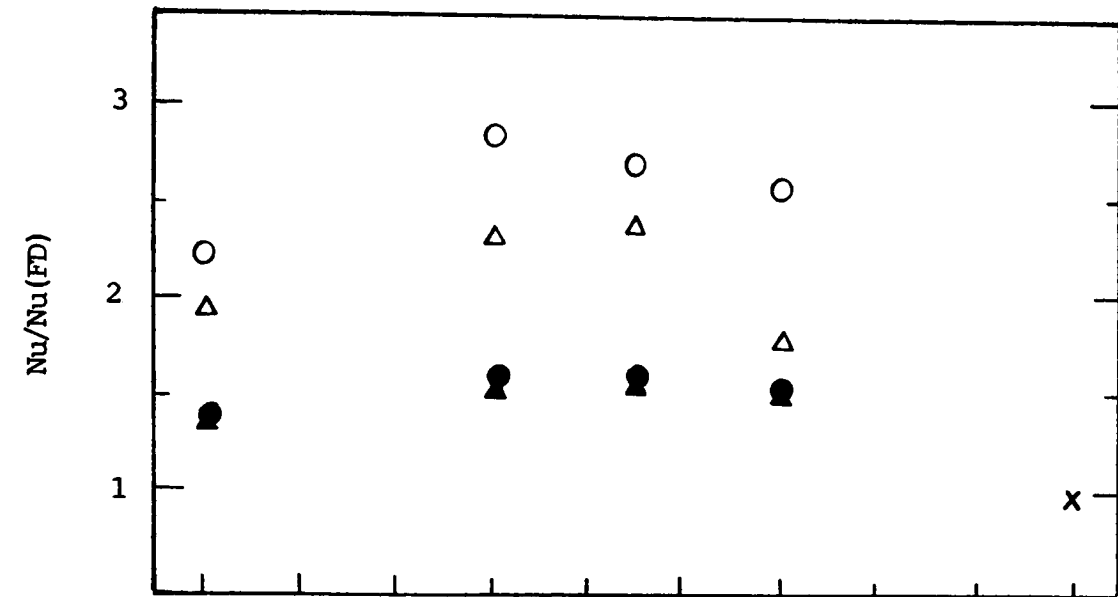


Figure 38. Heat transfer and friction vs α for square channel.

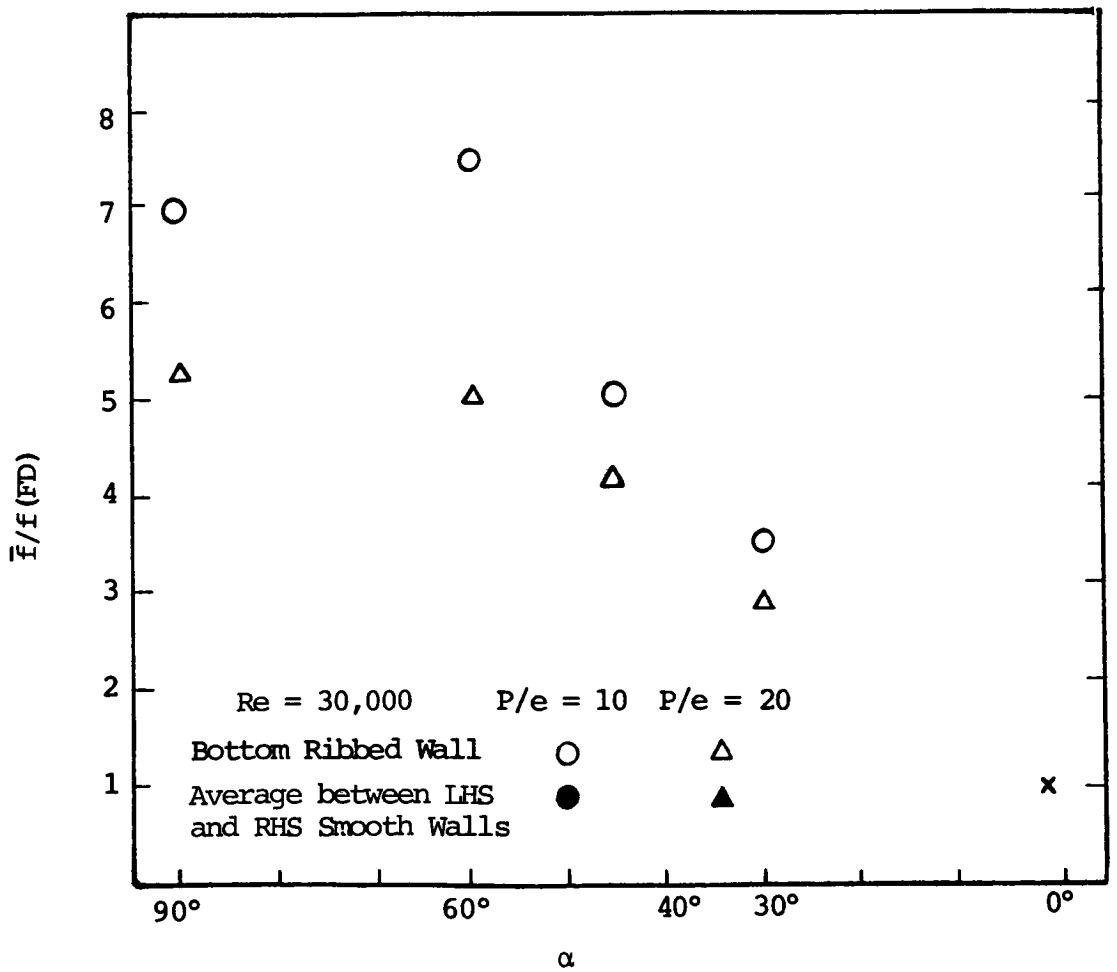
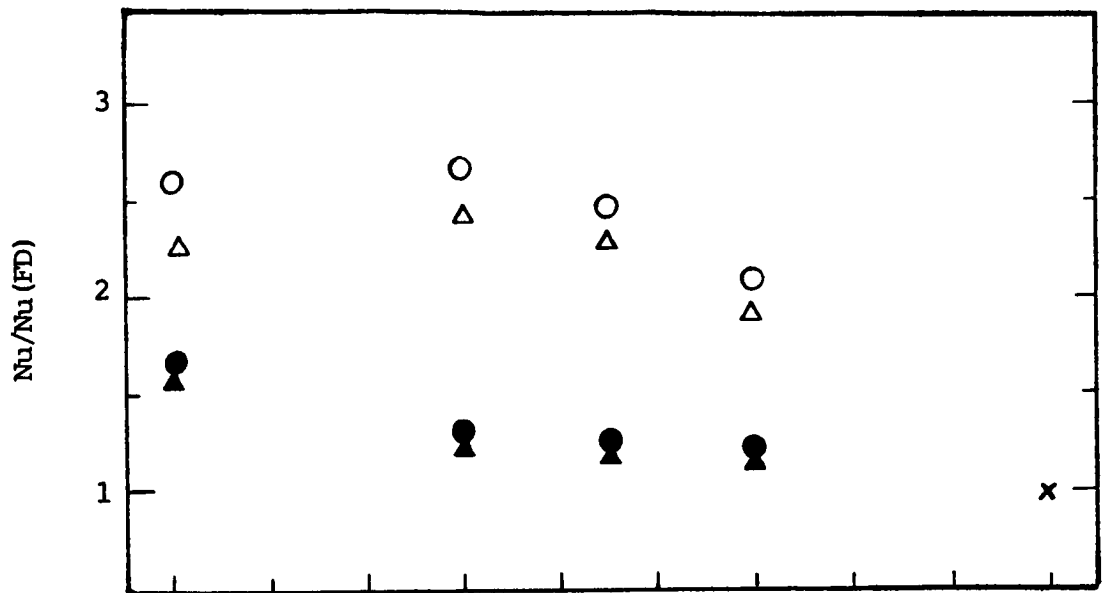


Figure 39. Heat transfer and friction vs α for rectangular channel I.

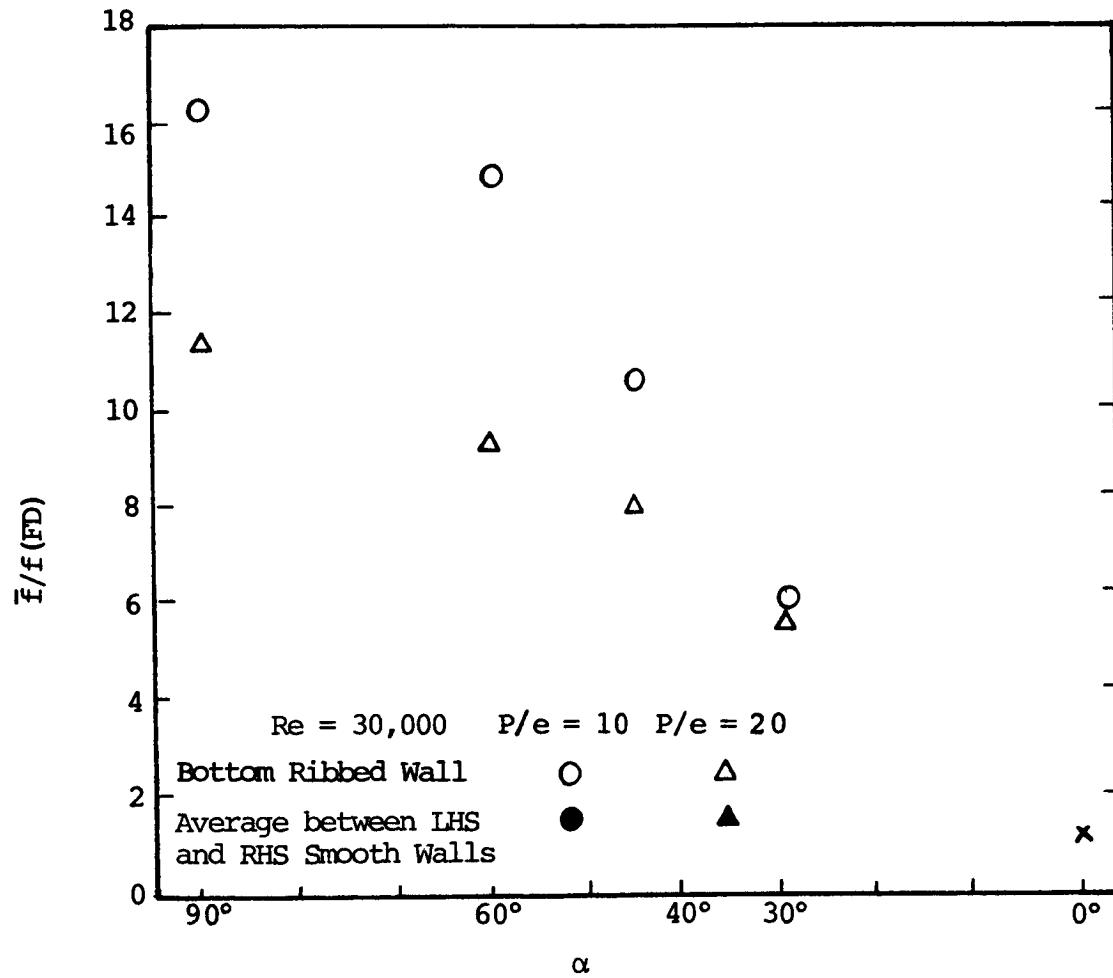
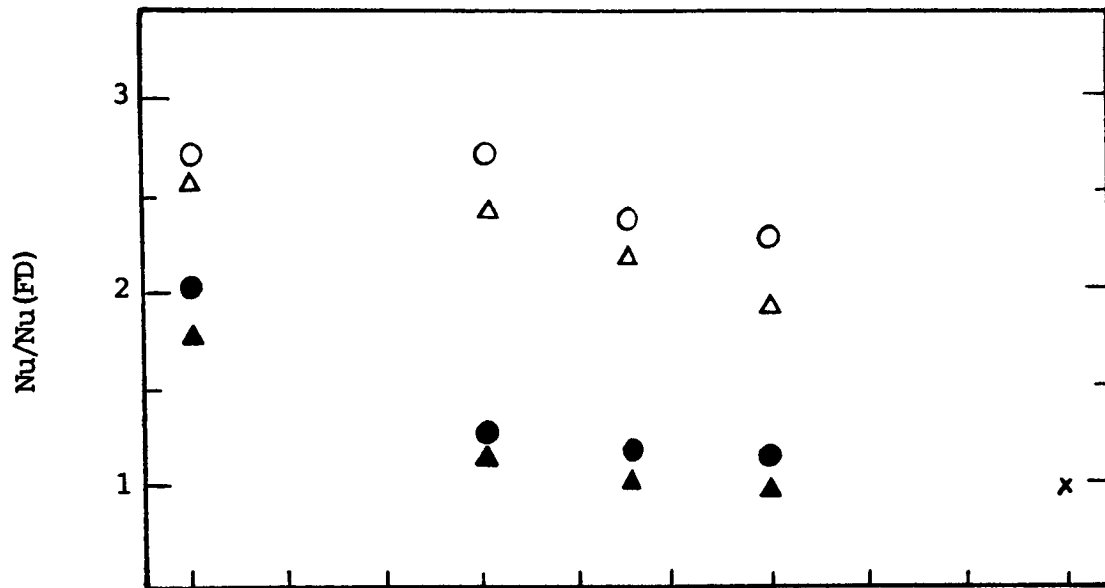


Figure 40. Heat transfer and friction vs α for rectangular channel II.

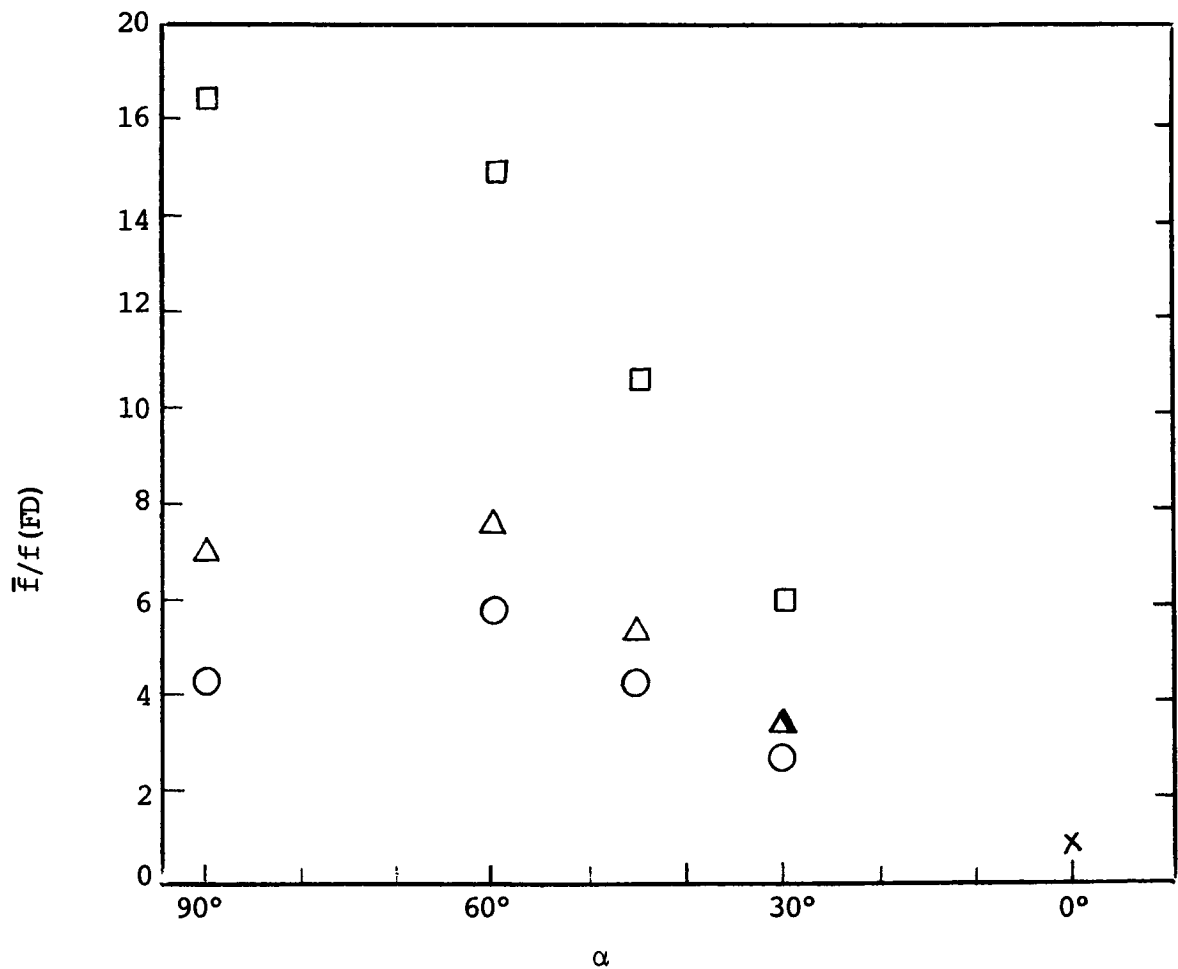
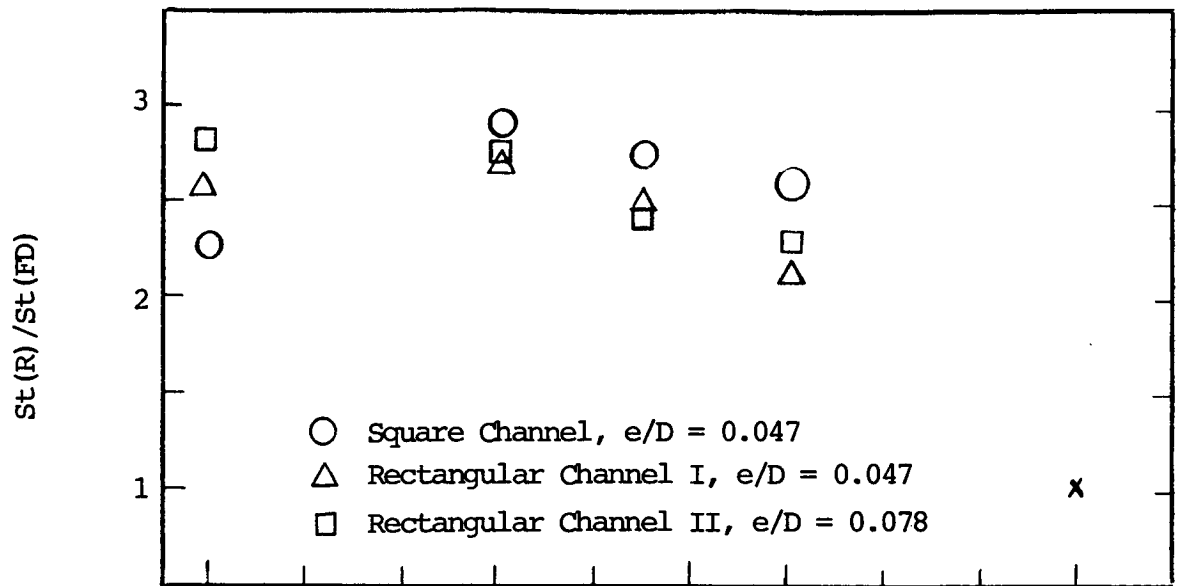


Figure 41. Increased Stanton number and friction factor vs α in each channel at $Re = 30,000$, $P/e = 10$.

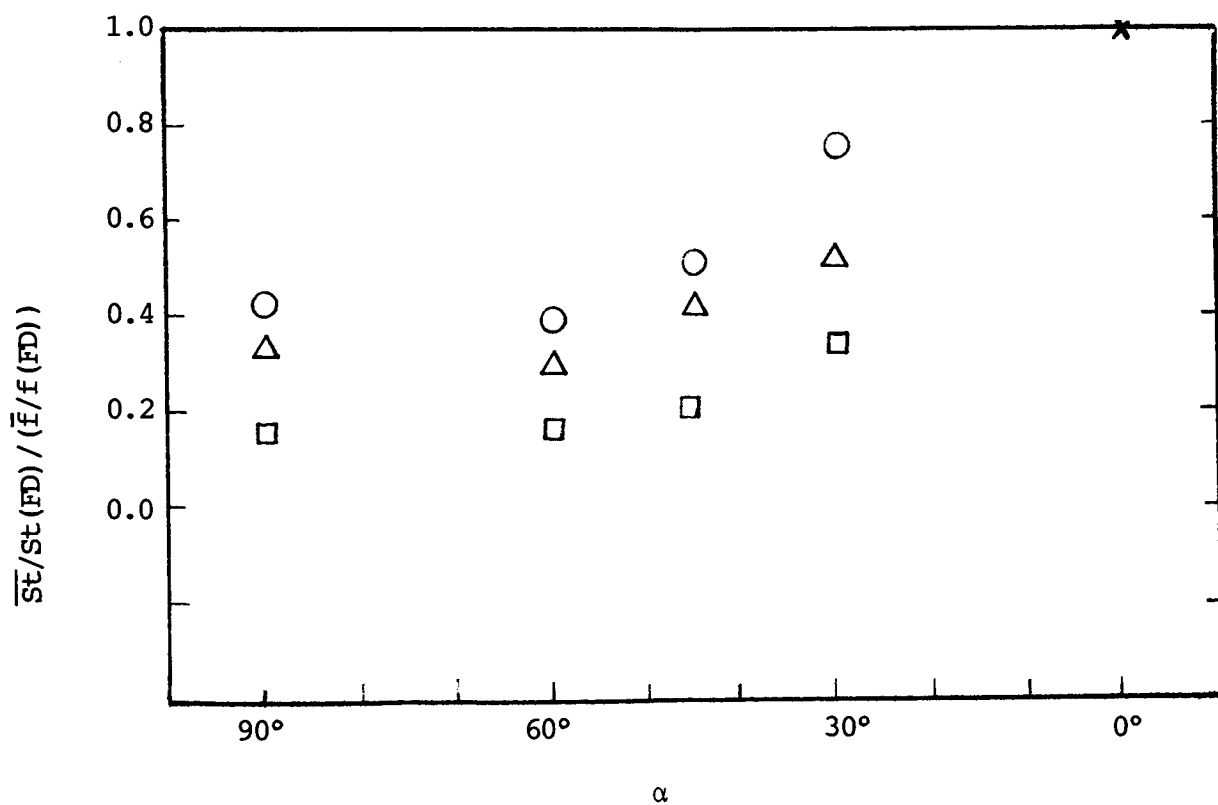
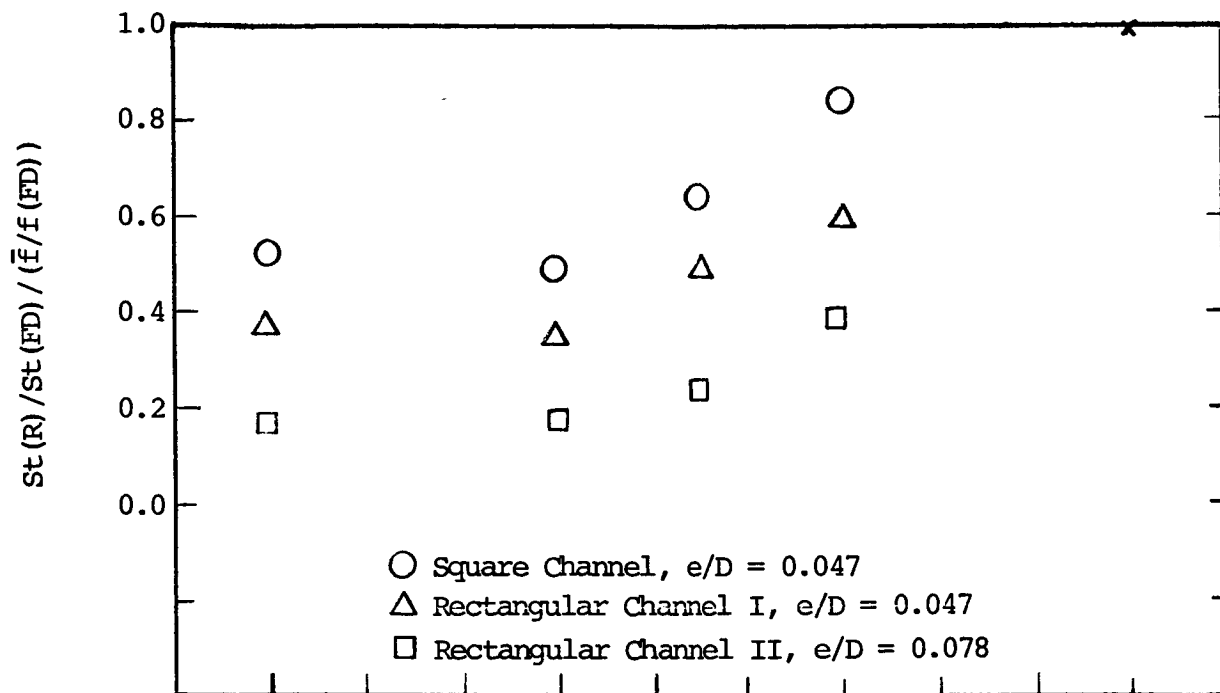


Figure 42. Efficiency index vs α in each channel at $Re = 30,000$, $P/e = 10$.

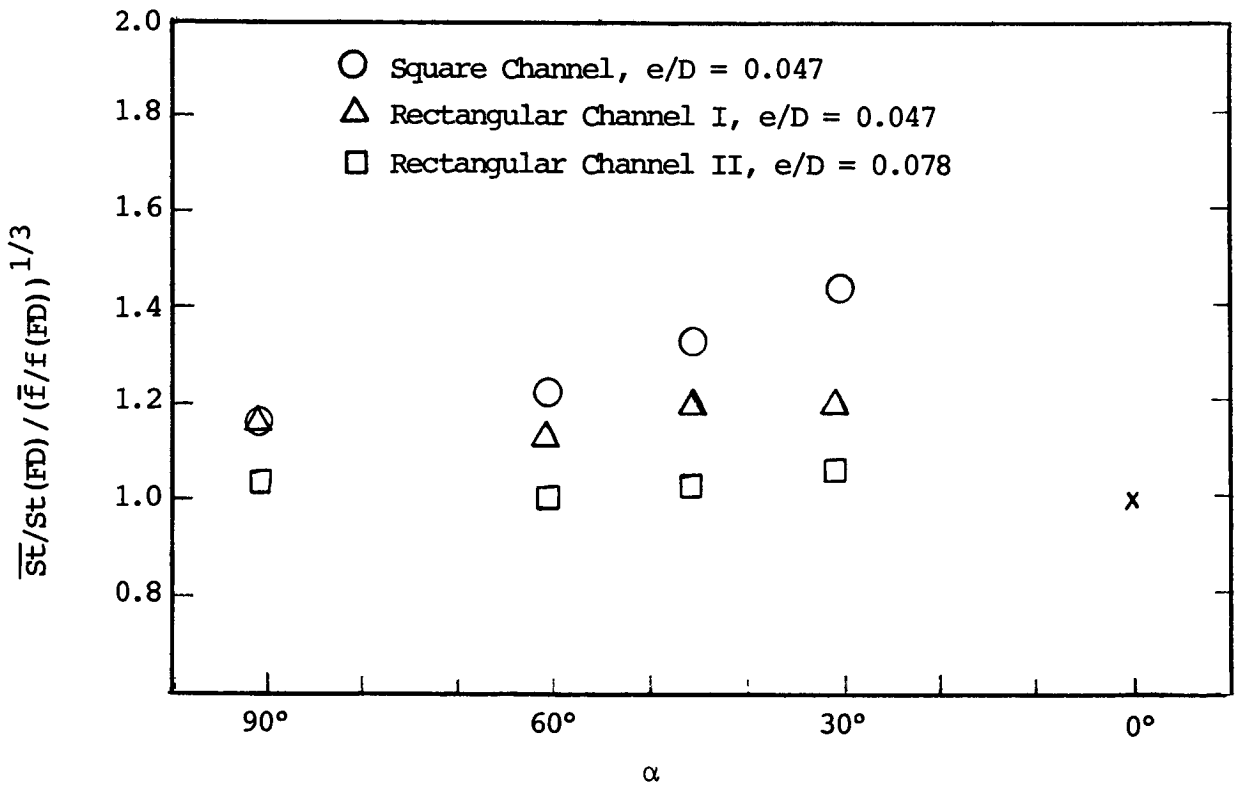
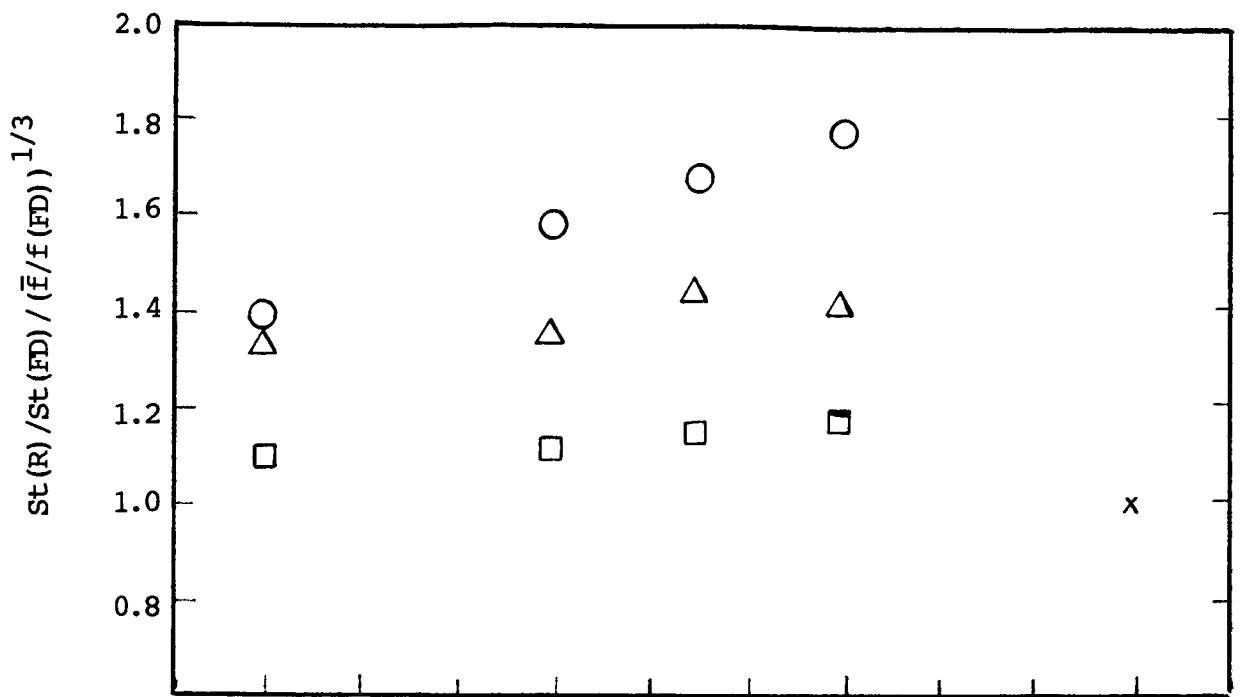


Figure 43. Increased heat transfer vs α in each channel at $Re = 30,000$, $P/e = 10$.

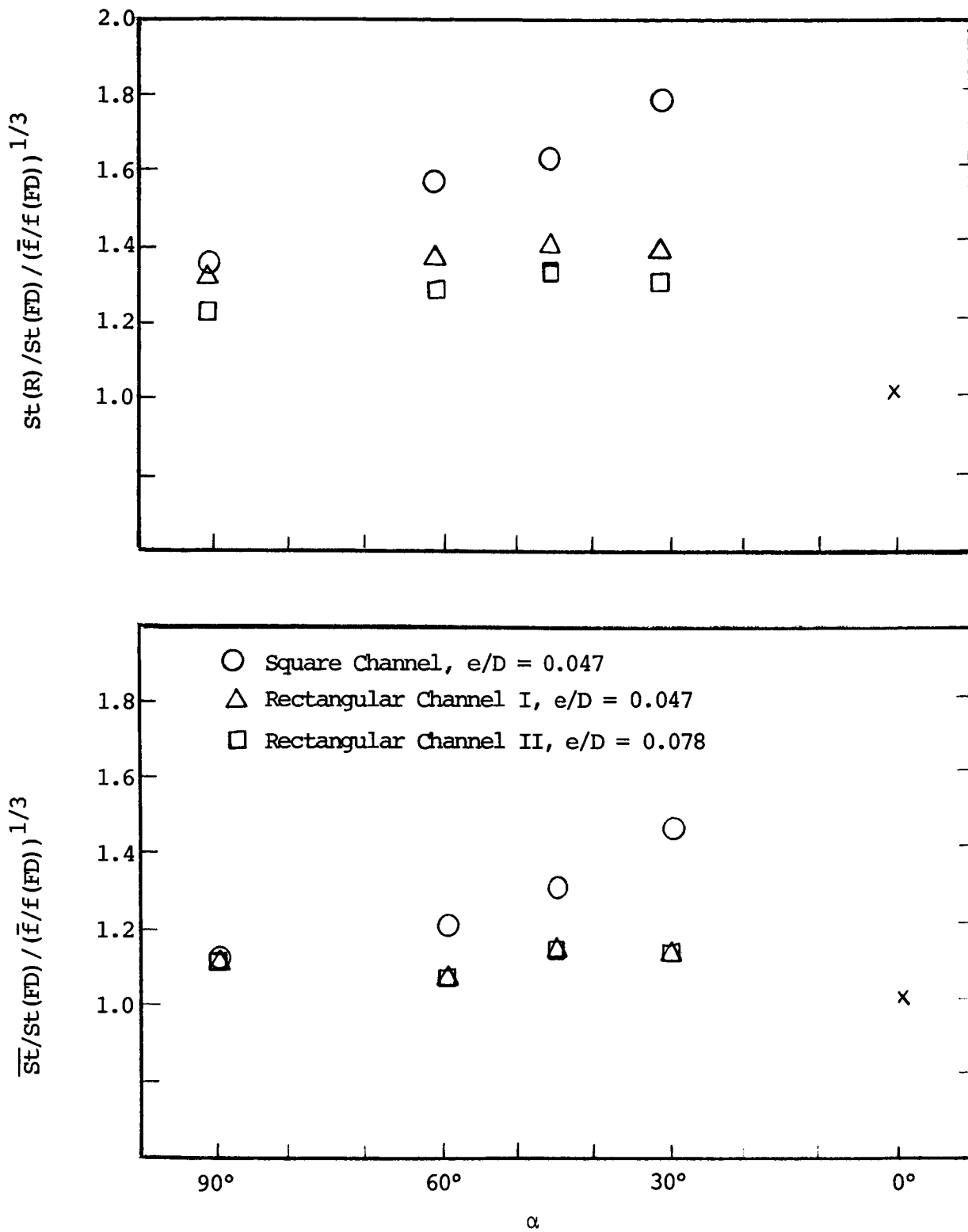


Figure 44. Increased heat transfer for a constant pumping power vs α in each channel at $\bar{e}^+ = 200$, $P/e = 10$.

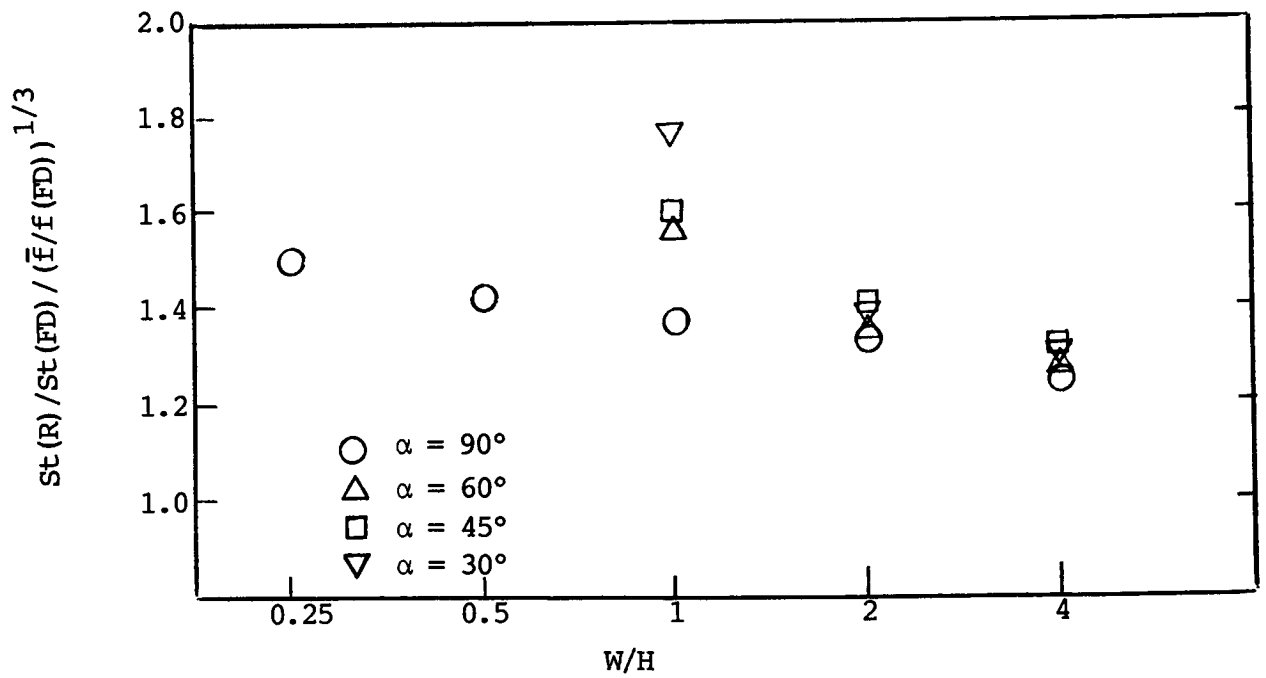
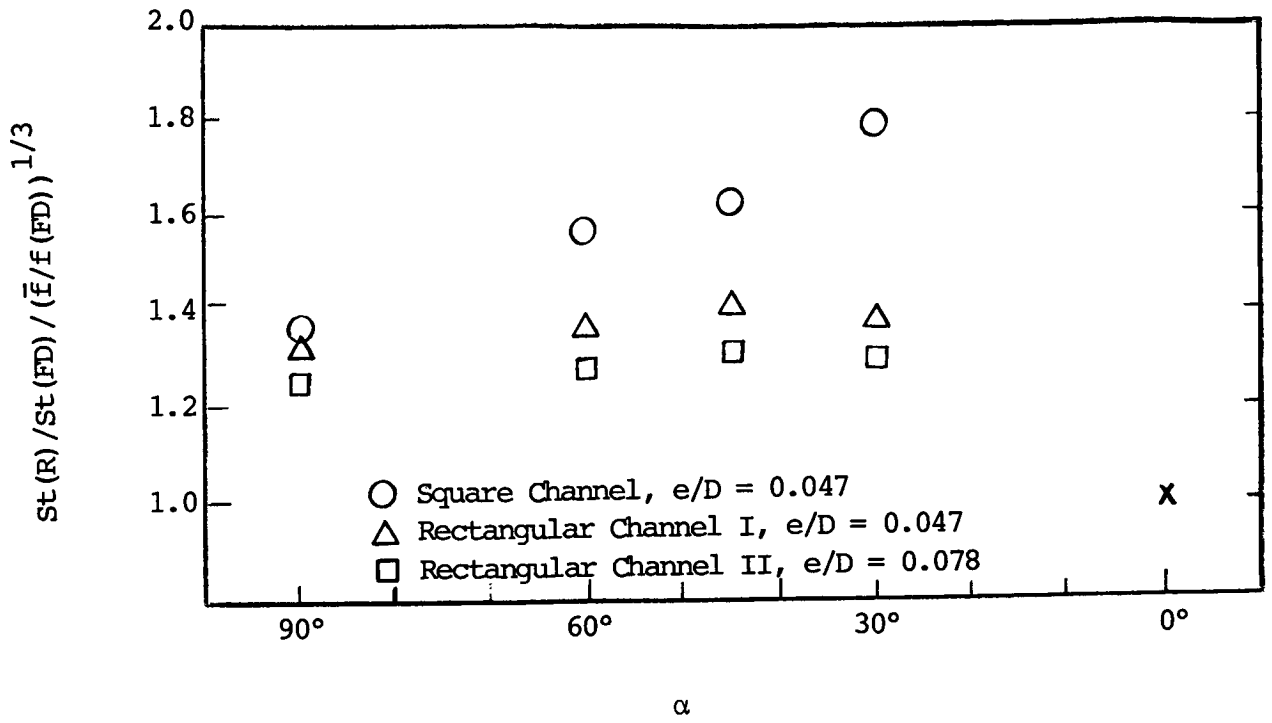


Figure 45. Increased heat transfer for a constant pumping power at $e^+ = 200$, $P/e = 10$.

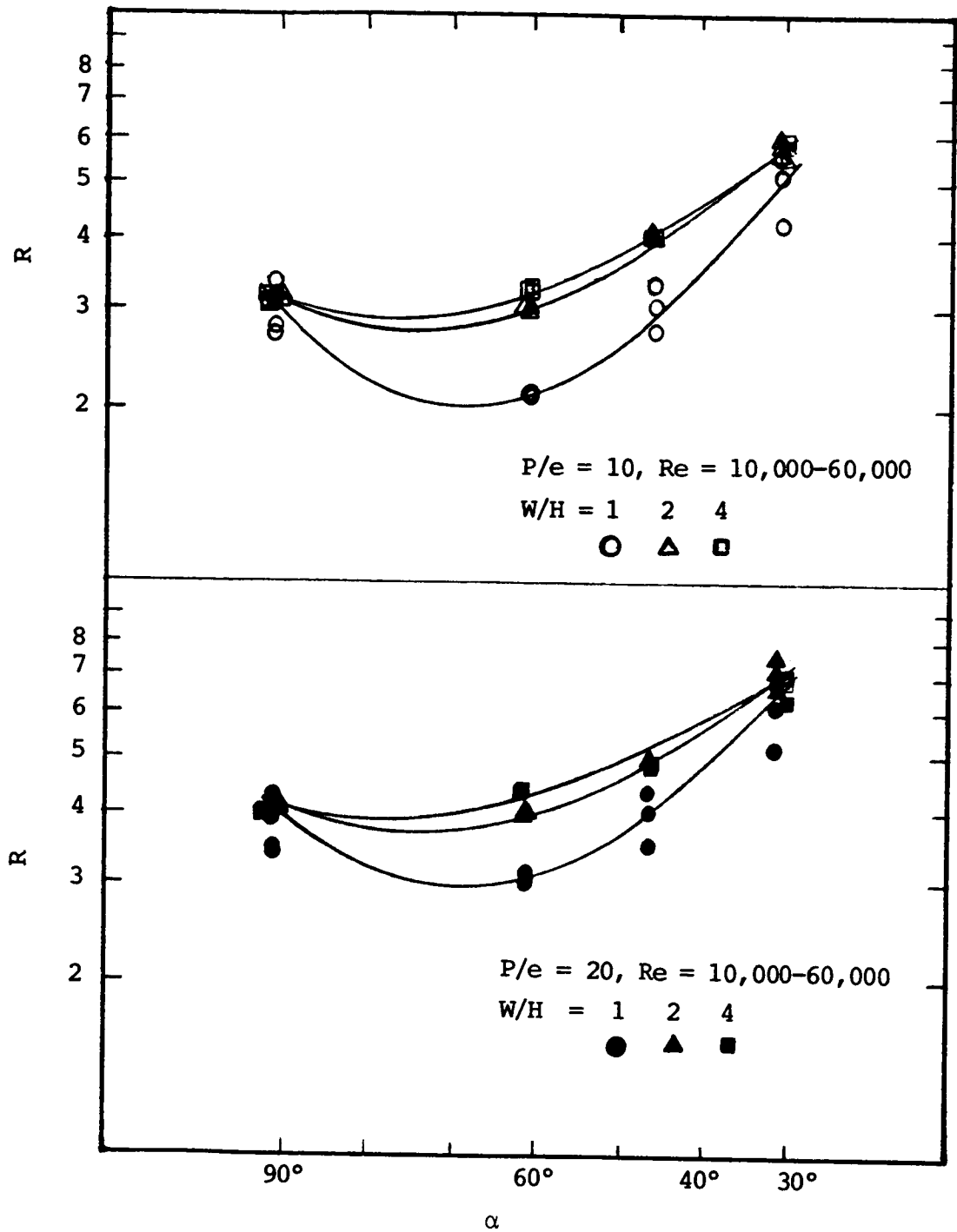


Figure 46. Friction factor vs α in each channel for different P/e .

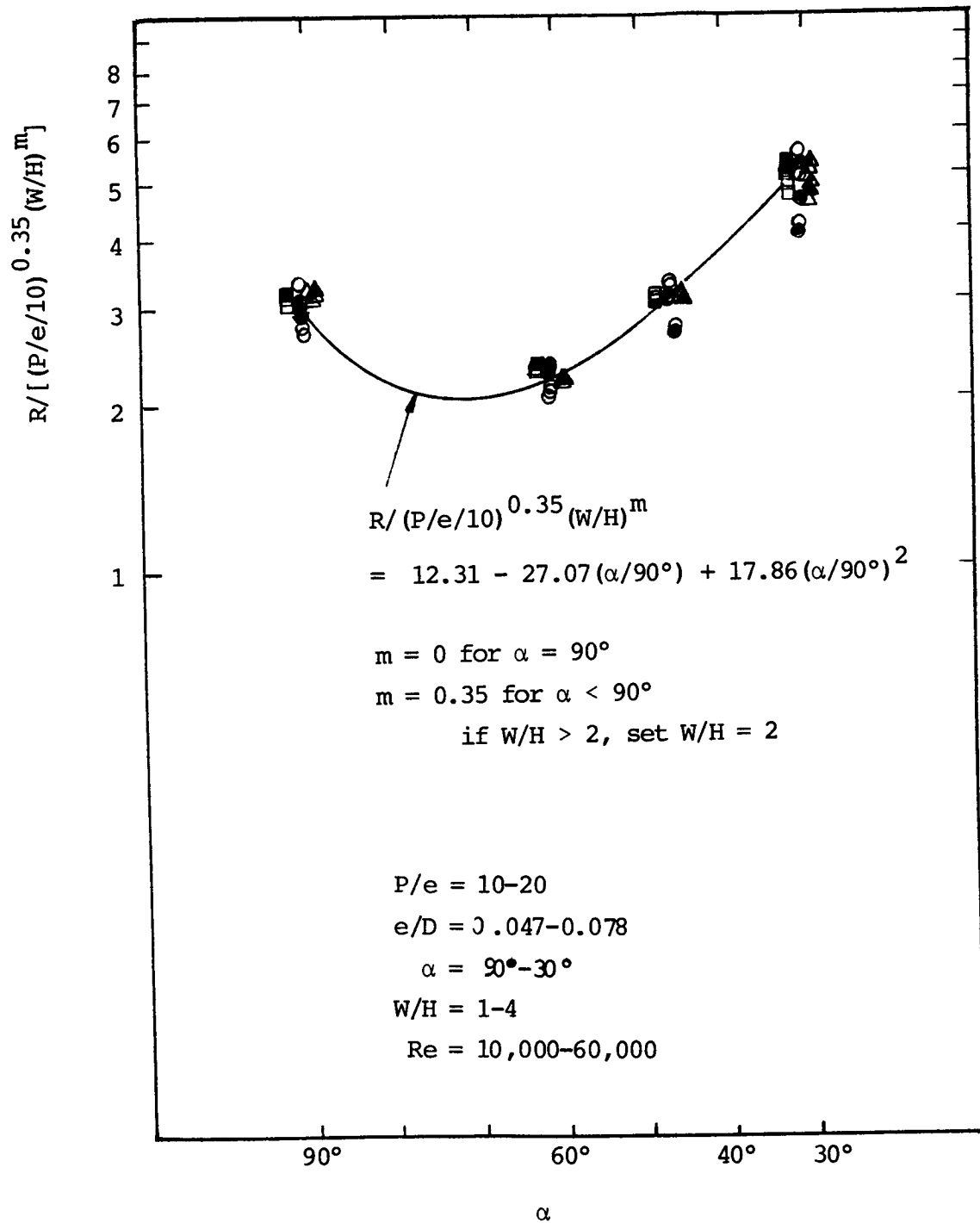


Figure 47. Final friction factor correlation

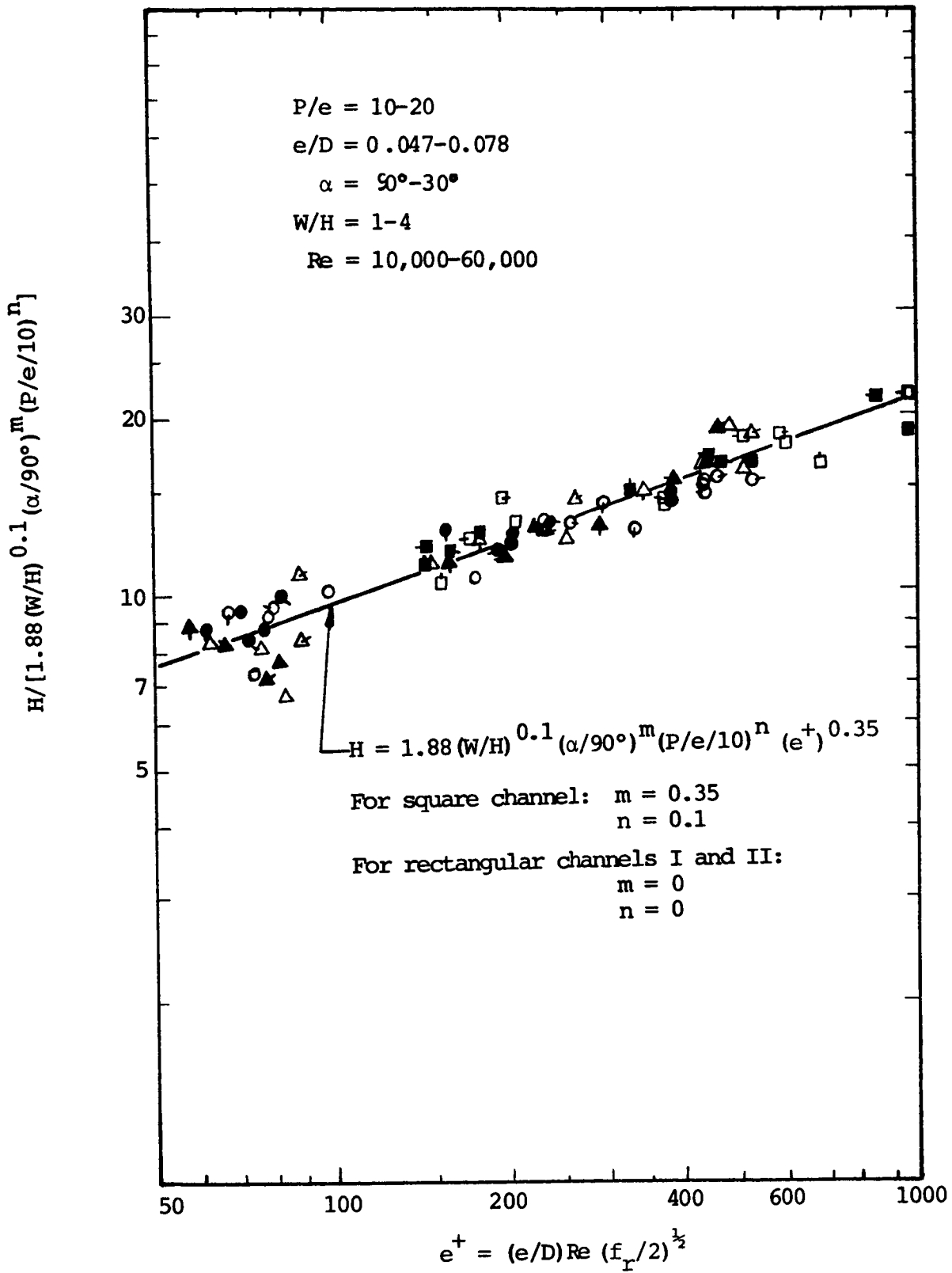


Figure 48. Average heat transfer correlation.

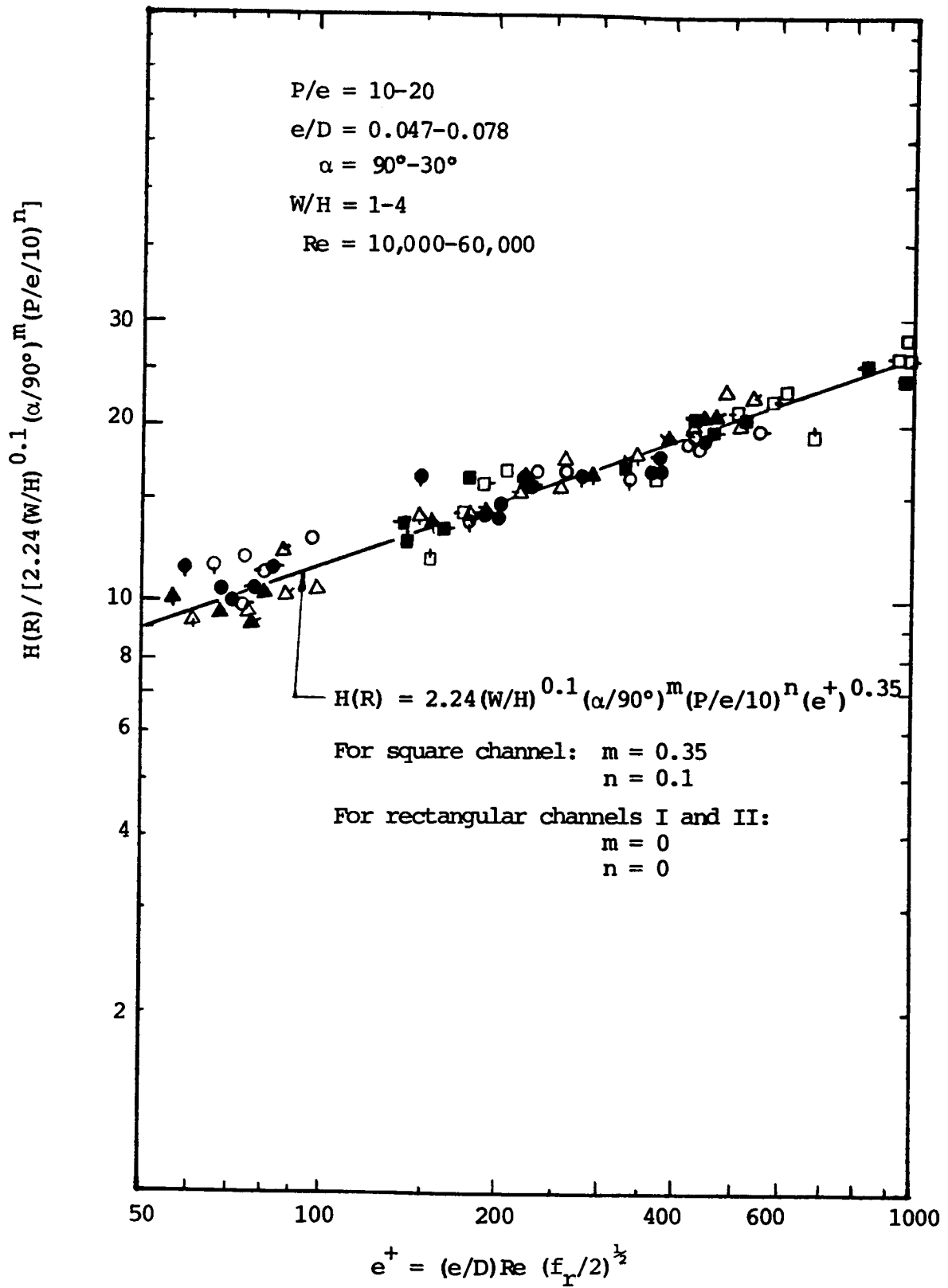


Figure 49. Ribbed side wall heat transfer correlation.

7.0 APPENDIX

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7.1 Thermocouples and Pressure Taps Locations

Test duct No. 1 (2"x2"); D =2", e/D =0.047, e=3/32"

TC No.	PT No.	x (inches)	x/D	TC No.	PT No.	x (inches)	x/D
1		0.141	0.07	33		6.141	3.071
2		0.328	0.164	34		6.329	3.164
3		0.516	0.258	35		6.516	3.258
4		0.704	0.352	36		6.704	3.352
5		0.891	0.446	37		6.891	3.446
6		1.079	0.539	38		7.078	3.539
7		1.266	0.633	39		7.266	3.633
8		1.453	0.727	40		7.454	3.727
9		1.641	0.821		3	10.828	5.414
10		1.829	0.914	41		15.141	7.570
11		2.016	1.008	42		15.328	7.664
12		2.204	1.102	43		15.516	7.758
13	1	2.391	1.196	44		15.703	7.851
14		2.579	1.289	45		15.891	7.946
15		2.766	1.383	46		16.078	8.039
16		2.954	1.477	47		16.266	8.133
17		3.141	1.570	48		16.453	8.227
18		3.328	1.664	49		16.641	8.321
19		3.516	1.758	50		16.828	8.414
20		3.704	1.852	51		17.016	8.508
21		3.891	1.945	52		17.203	8.601
22		4.079	2.039	53		17.391	8.695
23	2	4.266	2.133	54		17.578	8.789
24		4.454	2.227	55		17.766	8.883
25		4.641	2.320	56		17.953	8.977
26		4.828	2.414	57		18.141	9.571
27		5.016	2.508	58		18.328	9.164
28		5.203	2.604	59		18.516	9.258
29		5.391	2.695	60		18.703	9.352
30		5.579	2.789		4	20.203	10.102
31		5.766	2.883		5	30.515	15.258
32		5.954	2.977		6	36.140	18.07

Test duct No. 2 (4"x2"); D =8/3", e/D =0.047, e=1/8".

TC No.	PT No.	x (inches)	x/D	TC No.	PT No.	x (inches)	x/D
1		0.1875	0.07	33		8.1875	3.07
2		0.4375	0.164	34		8.4375	3.164
3		0.6875	0.258	35		8.6875	3.258
4		0.9375	0.352	36		8.9375	3.352
5		1.1875	0.445	37		9.1875	3.445
6		1.4375	0.539	38		9.4375	3.539
7		1.6875	0.633	39		9.6875	3.633
8		1.9375	0.7265	40		9.9375	3.727
9		2.1875	0.820	41		10.6875	4.008
10		2.4375	0.914	42		13.1875	4.945
11		2.6875	1.008	43	3	14.4375	5.414
12		2.9375	1.102	44		16.9375	6.351
13	1	3.1875	1.195	45		19.4375	7.289
14		3.4375	1.289	46		21.9375	8.277
15		3.6875	1.383	47		22.6875	8.508
16		3.9375	1.477	48		22.9375	8.602
17		4.1875	1.57	49		23.1875	8.695
18		4.4375	1.664	50		23.4375	8.789
19		4.6875	1.758	51		23.6875	8.883
20		4.9375	1.852	52		23.9375	8.977
21		5.1875	1.945	53		24.1875	9.070
22		5.4375	2.039	54		24.4375	9.164
23	2	5.6875	2.133	55		24.6875	9.258
24		5.9375	2.227	56		24.9375	9.352
25		6.1875	2.32	57		25.6875	9.633
26		6.4375	2.414		4	26.9375	10.102
27		6.6875	2.508	58		33.1875	12.445
28		6.9375	2.602	59		36.9375	13.852
29		7.1875	2.695	60		39.4375	14.789
30		7.4375	2.789		5	40.6875	15.258
31		7.6875	2.883		6	48.1875	18.07
32		7.9375	2.977				

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Test duct No. 3 (4"x1"); D =1.6", e/D =0.078, e=1/8.

TC No.	PT No.	x (inches)	x/D	TC No.	PT No.	x (inches)	x/D
1		0.1875	0.117	33		8.1875	5.117
2		0.4375	0.273	34		8.4375	5.273
3		0.6875	0.43	35		8.6875	5.430
4		0.9375	0.586	36		8.9375	5.586
5		1.1875	0.742	37		9.1875	5.742
6		1.4375	0.898	38		9.4375	5.898
7		1.6875	1.055	39		9.6875	6.055
8		1.9375	1.211	40		9.9375	6.211
9		2.1875	1.367	41		10.688	6.68
10		2.4375	1.523	42		13.1875	8.242
11		2.6875	1.68	43	3	14.4375	9.023
12		2.9375	1.836	44		16.9375	10.586
13	1	3.1875	1.992	45		19.4375	12.148
14		3.4375	2.148	46		21.9375	13.711
15		3.6875	2.305	47		22.6875	14.180
16		3.9375	2.461	48		22.9375	14.336
17		4.1875	2.617	49		23.1875	14.492
18		4.4375	2.773	50		23.4375	14.648
19		4.6875	2.930	51		23.6875	14.805
20		4.9375	3.086	52		23.9375	14.961
21		5.1875	3.242	53		24.1875	15.117
22		5.4375	3.398	54		24.4375	15.273
23	2	5.6875	3.555	55		24.6875	15.430
24		5.9375	3.711	56		24.9375	15.586
25		6.1875	3.867	57		25.6875	16.055
26		6.4375	4.023		4	26.9375	16.836
27		6.6875	4.18	58		33.1875	20.742
28		6.9375	4.336	59		36.9375	23.086
29		7.1875	4.492	60		39.4375	24.648
30		7.4375	4.648		5	40.6875	25.430
31		7.6875	4.805		6	48.1875	30.177
32		7.9375	4.961				

7.2 Tabulated Local Pressure Drop Data

Nomenclature:

1-4S	the smooth square channel
1-90/10	the square channel ($W/H = 2''/2''$) with $\alpha = 90^\circ$ and $P/e = 10$
2-60/20	the rectangular channel I ($W/H = 4''/2''$) with $\alpha = 60^\circ$ and $P/e = 20$
4-45/10	the rectangular channel II ($W/H = 4''/1''$) with $\alpha = 45^\circ$ and $P/e = 10$
1/2-90/10	the rectangular channel IA ($W/H = 2''/4''$) with $\alpha = 90^\circ$ and $P/e = 10$
1/4-90/20	the rectangular channel IIA ($W/H = 1''/4''$) with $\alpha = 90^\circ$ and $P/e = 20$
RU	along the upper ribbed wall
SL	along the left hand side smooth wall
f_{3-6}	average friction factor between pressure taps 3 and 6

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Tubes	Re	\dot{m} ($\frac{\text{lbm}}{\text{sec}}$)	P at Plenum (in H ₂ O)	PT locat- tion	P at test section, (in H ₂ O)						ΔP_{3-6}	f ₃₋₆
					PT1	PT2	PT3	PT4	PT5	PT6		
1 - 4a	12,200	0.0252	0.068	RU	0.018	0.018	0.016	0.012	0.008	0.003	0.013	0.0077
				SL			0.014			0.003	0.011	0.00652
	32,400	0.0666	0.470	RU	0.132	0.114	0.100	0.072	0.036	0.022	0.078	0.00659
				SL			0.098			0.024	0.074	0.00626
	64,700	0.133	1.80	RU	0.52	0.396	0.332	0.236	0.112	0.066	0.266	0.00565
				SL			0.324			0.076	0.248	0.00527
1 - 90/10	11,800	0.024	0.130	RU	0.072	0.071	0.056	0.043	0.021	0.012	0.044	0.0276
				SL			0.059			0.010	0.049	0.03074
	32,100	0.0664	0.875	RU	0.454	0.474	0.392	0.156	0.049	0.100	0.292	0.0246
				SL			0.382			0.090	0.292	0.0246
	65,900	0.1364	3.7	RU	1.75	1.96	1.62	1.22	0.670	0.424	1.196	0.0238
				SL			1.64			0.384	1.256	0.0250
1 - 90/20	12,100	0.0251	0.106	RU	0.050	0.048	0.046	0.034	0.008	0.001		0.0264
				SL			0.042			0.001		0.024
	32,000	0.0663	0.750	RU	0.400	0.366	0.344	0.256	0.112	0.074		0.0227
				SL			0.320			0.080		0.0202
	64,300	0.1334	3.05	RU	1.6	1.44	1.34	1.00	0.410	0.256	1.084	0.0225
				SL			1.242			0.304	0.938	0.0195
1 - 60/10	11,400	0.0235	0.1470	RU	0.10	0.097	0.085	0.068	0.042	0.029		0.0378
				SL			0.81			0.028		0.0358
	32,200	0.0666	1.13	RU	0.78	0.730	0.646	0.490	0.254	0.182		0.0389
				SL			0.630			0.204		0.0357
	64,500	0.1336		RU	3.05	2.9	2.5	1.876	0.910	0.668		0.0380
				SL			2.5			0.808		0.0351
1 - 60/20	13,400	0.0278	0.164	RU	0.096	0.894	0.088	0.072	0.030	0.016		0.0346
				SL			0.080			0.023		0.0274
	31,700	0.0658	0.896	RU	0.536	0.500	0.482	0.370	0.130	0.070		0.0352
				SL			0.454			0.142		0.0267
	64,600	0.134	3.75	RU	2.35	2.10	2.05	1.55	0.460	0.306		0.0359
				SL			1.95			0.666		0.0264
1 - 45/10	10,400	0.0215	0.100	RU	0.062	0.056	0.050	0.034	0.016	0.008		0.0333
				SL			0.049			0.010		0.0310
	31,700	0.0659		RU	0.562	0.490	0.414	0.298	0.136	0.09		0.0275
				SL			0.424			0.120		0.0275
	65,100	0.135	3.5	RU	2.3	1.9	1.590	1.126	0.490	0.318		0.0255
				SL			1.68			0.474		0.0242

Tubes	Re	\dot{m} ($\frac{\text{lbm}}{\text{sec}}$)	P at Plenum (in H ₂ O)	PT loca- tion	P at test section, (in H ₂ O)						ΔP_{3-6}	f_{3-6}
					PT1	PT2	PT3	PT4	PT5	PT6		
1 - 45/20	10,800	0.0225	0.106	RU	0.050	0.050	0.048	0.040	0.012	0.002		0.0335
				SL			0.046			0.010		0.0263
	31,900	0.0662	0.77	PU	0.426	0.370	0.362	0.274	0.076	0.030		0.0280
				SL			0.34			0.10		0.0200
	64,100	0.133	3.0	RU	1.7	1.4	1.388	1.50	0.250	0.136		0.0262
				SL			1.284			0.400		0.0185
1 - 30/10	10,430	0.0216	0.079	RU	0.039	0.040	0.033	0.025	0.010	0.006		0.021
				SL			0.033			0.006		0.021
	32,200	0.0666	0.676	PU	0.36	0.310	0.256	0.184	0.076	0.046		0.0175
				SL			0.264			0.076		0.0157
	67,600	0.140	2.85	RU	1.52	1.2	0.964	0.67	0.228	0.126		0.0159
				SL			1.050			0.282		0.0146
1 - 30/20	11,100	0.0228	0.072	RU	0.034	0.032	0.028	0.020	0.008	0.004		0.0171
				SL			0.027			0.004		0.0164
	32,200	0.0665	0.62	RU	0.29	0.244	0.232	0.168	0.056	0.025		0.0174
				SL			0.222			0.033		0.0158
	64,500	0.133	2.3	RU	1.13	0.83	0.796	0.574	0.112	0.032		0.0159
				SL			0.764			0.216		0.0114
2 - 48	11,500	0.0358	0.039	RU		0.013	0.012	0.010	0.010	0.006	0.006	0.00692
				SL			0.0125 +0.001			0.006		0.00750
	32,400	0.101	0.266	RU	0.069	0.069	0.067	0.051	0.032	0.023	0.044	0.00640
				SL			0.067			0.020	0.047	0.0068
	68,300	0.2132	1.107	RU	0.248	0.251	0.2410	0.182	0.063	0.069	0.172	0.00557
				SL			0.242			0.065	0.177	0.00573
2 - 90/10	10,300	0.0318	0.067	RU	0.042	0.042	0.035			0.033	0.032	
				SL			0.033			0.003	0.030	0.041
	33,000	0.101	0.62	RU	0.40	0.380	0.318			0.042	0.276	
				SL			0.302			0.032	0.270	0.0393
	64,800	0.202	2.50	RU	1.58	1.51	1.25			0.172	1.078	
				SL			1.21			0.136	1.074	0.039
2 - 90/20	10,900	0.0335	0.054	RU	0.030+	0.029+	0.028+			0.003+	0.025	
				SL			0.026			0.002	0.024	0.032
	32,500	0.101	0.498+	RU	0.286	0.268	0.252+			0.016+	0.238	0.0343
				SL			0.242			0.025		0.0316
	64,500	0.200	2.1	RU	1.2+	1.13+	1.06+			0.054+	1.006	0.0372
				SL			1.06+			0.102	0.96	0.0355

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Tubes	Re	$\frac{m}{sec}$ ($\frac{lbm}{sec}$)	P at Plenum (in H ₂ O)	PT locat- tion	P at test section, (in H ₂ O)						ΔP_{j-6}	f ₃₋₆
					PT1	PT2	PT3	PT4	PT5	PT6		
2 - 60/10	10,800	0.0334		RU								
				SL			0.050			0.017	0.033	0.0439
	45,700	0.142	1.430	RU	0.990	0.950	0.840	0.620	0.360	0.230	0.610	
				SL			0.836			0.230+	0.606	0.0448
	64,300	0.200	2.8+	RU	1.95+	1.88+	1.66+	1.22	0.700	0.446	1.214	
				SL			1.66			0.450	1.210	0.0447
2 - 60/20	10,800	0.0335		RU	0.040	0.040	0.040	0.030	0.015	0.009	0.031	0.0412
				SL			0.036			0.012	0.024	0.0319
	33,200	0.103		RU	0.37	0.366	0.354	0.272	0.1300	0.072	0.282	0.0396
				SL			0.326			0.110	0.216	0.0303
	64,300	0.1991	2.3	RU	1.43	1.34	1.350	1.030	0.500	0.266	1.084	0.04066
				SL			1.250			0.416	0.834	0.0313
2 - 45/10	9,700	0.0301	0.052	RU	0.032	0.032	0.028	0.020	0.011	0.006	0.022	
				SL			0.028			0.006	0.022	0.036
	31,300	0.0972		RU	0.356	0.336	0.296	0.214	0.128	0.074	0.222	0.0348
				SL			0.296			0.090	0.206	0.0323
	64,500	0.2005	2.15	RU	1.45	1.39	1.216	0.886	0.540	0.318	0.898	0.033
				SL			1.234			0.388	0.846	0.0311
2 - 45/20	10,100	0.0310	0.050	RU	0.034	0.032	0.026	0.019	0.015	0.010	0.016	0.0256
				SL			0.027			0.010	0.017	0.0256
	32,100	0.0995	0.490	RU	0.310	0.296	0.236	0.174	0.122	0.082	0.154	0.023
				SL			0.244			0.076	0.168	0.0252
	64,600	0.200		RU	1.90+	1.14+	0.904	0.670	0.472	0.318	0.586	0.0220
				SL			0.94			0.294	0.646	0.0239
2 - 30/10	12,000	0.0372	0.056	RU	0.029	0.027	0.023	0.015	0.008	0.002	0.021	0.0227
				SL			0.024			0.003	0.021	0.0227
	32,600	0.1011	0.432	RU	0.2170	0.210	0.184	0.133	0.072	0.033	0.151	0.0219
				SL			0.186			0.043	0.143	0.0208
	65,500	0.2034	1.690+	RU	0.80	0.766	0.680+	0.490	0.270	0.122	0.558	0.0200
				SL			0.690			0.170	0.520	0.0186
2 - 30/20	10,800	0.0334		RU	0.027	0.028	0.026	0.024	0.014	0.007	0.019	0.025
				SL			0.025			0.010	0.015	0.0200
	32,500	0.101	0.402	RU	1.83	1.80	0.180	0.136	0.076	0.040	0.14	0.0234
				SL			0.1690			0.0530	0.1160	0.0182
	65,200	0.2011	1.4650	RU	0.612	0.596	0.5950	0.4450	0.232	0.112	0.483	0.0178
				SL			0.570			0.2130	0.358	0.0132

Tubes	Re	$\frac{m}{sec}$ ($\frac{lbm}{sec}$)	P at Plenum (in H ₂ O)	PT loca- tion	P at test section, (in H ₂ O)						ΔP_{j-6}	f_{j-6}
					PT1	PT2	PT3	PT4	PT5	PT6		
4 - 4a	11,500	0.0298	0.118	RU								
				SL	0.047	0.043	0.037	0.026	0.014	0.005		0.00797
	32,800	0.0851	0.90	RU								
				SL	0.296	0.284	0.258	0.172	0.096	0.028		0.007023
	60,600	0.157	2.85	RU								
				SL	0.836	0.806	0.638	0.491	0.272	0.081	0.557	0.00496
4 - 90/10	10,900	0.0282	0.626+	RU								
				SL	0.510+	0.49+	0.408+	0.282	0.146	0.060	0.348	0.0975
	31,600	0.0815	5.3+	RU								
				SL	4.3	4.2	3.4	2.4	1.2	0.52	2.88	0.0965
	48,300	0.125	12.7+	RU								
				SL	10.5	10.0+	8.3+	5.8+	3.0+	1.25+	7.05+	0.100
4 - 90/20	11,200	0.0287	0.492	RU								
				SL	0.38+	0.374+	0.322+	0.228+	0.102+	0.04+	0.282	0.0764
	32,500	0.0839	4.2	RU								
				SL	3.3+	3.25+	2.75+	1.85+	0.9+	0.362+	2.388	0.0758
	61,900	0.160	15.6	RU								
				SL	12.50+	12.15+	10.25+	7.30+	3.50+	1.45+	8.8	0.0770
4 - 60/10	11,800	0.0302	0.716	RU								
				SL	0.610+	0.60+	0.506	0.360+	0.206	0.110+	0.396	0.0976
	32,600	0.08407	5.3	RU								
				SL	4.4+	4.3+	3.6+	2.55+	1.4+	0.75+	2.85	0.0902
	56,100	0.1449	15.9+	RU								
				SL	13.2	12.85	10.7+	7.5+	3.95	2.25		0.0897
4 - 60/20	10,990	0.0283	0.45+	RU								
				SL	0.36+	0.34+	0.26+	0.18+	0.110+	0.06+		0.0560
	34,300	0.0885	4.05+	RU								
				SL	3.25	3.1+	2.5+	1.65+	1.0+	0.55		0.0555
	66,600	0.1715	15.4	RU								
				SL	12.5+	12.05	9.7	6.3	3.8	2.1+		0.0578
4 - 45/10	11,200	0.0287		RU								
				SL			0.31			0.055		0.0697
	32,900	0.0847		RU								
				SL			2.4			0.42		0.062
	58,500	0.151		RU								
				SL			7.8			1.4		0.8629

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Tubes	Re	h ($\frac{lbm}{sec}$)	P at Plenum (in H ₂ O)	PT loca- tion	F at test section, (in H ₂ O)						ΔP_{3-6}	f ₃₋₆	
					PT1	PT2	PT3	PT4	PT5	PT6			
4 - 45/20	11,400	0.0292	0.37	RU									
				SL	0.275+	0.265+	0.23+	0.16+	0.08+	0.025+	0.205+	0.0541	
	33,100	0.0848	2.8	RU									
				SL	2.05	2.00+	1.70+	1.23+	0.63+	0.225		0.0462	
	68,100	0.1743	11.9	RU									
				SL	8.8	8.5	7.2	3.25	2.6	0.96		0.0463	
4 - 30/10	13,700	0.0353	0.54	RU									
				SL	0.37	0.36	0.3+	0.2	0.1+	0.030+		0.0482	
	34,600	0.0895	2.6	RU									
				SL	1.75	1.7	1.48	1.0+	0.56	0.21		0.0353	
	64,300	0.166	8.45	RU									
				SL	5.6	5.55	4.7	3.3	1.7	0.67		0.0325	
4 - 30/20	11,900	0.0348	0.30+	RU	0								
				SL	0.21	0.20	0.165	0.11	0.07	0.022+		0.0348	
	33,520	0.0861	1.9	RU									
				SL	1.30	1.20	1.08	0.72	0.43	0.15	0.93	0.0282	
	65,200	0.1674	6.9	RU									
				SL	4.4	4.32	3.63	2.5	1.45	0.44	3.48	0.0255	
1/2 - 90/10	9,800	0.0305	0.040	RU	0.025	0.022	0.017	0.014	0.010	0.008	0.009	0.0144	
				SL			0.018			0.008	0.0010	0.0160	
	32,700	0.102	0.392	RU	0.184	0.174	0.150	0.110	0.068	0.040	0.110	0.0157	
				SL			0.156			0.045	0.111	0.0159	
	64,100	0.199	1.450	RU	0.662	0.62	0.534	0.404	0.244	0.152	0.382	0.0143	
				SL			0.556			0.150	0.406	0.0152	
1/2 - 90/20	10,700	0.0330	0.039	RU	0.019	0.019	0.016	0.013	0.007	0.005	0.011	0.0150	
				SL			0.017			0.003	0.014	0.0191	
	33,100	0.103	0.376	RU	0.163	0.156	0.1370	0.096	0.060	0.036	0.1010	0.0142	
				SL			0.1470			0.028	0.119	0.0167	
	65,500	0.02033	1.410	RU	0.606	0.568	0.494	0.366	0.22	0.138	0.356	0.0128	
				SL			0.546			0.086	0.460	0.0165	
1/4 - 90/10	10,980	0.0281	0.130	RU									
				SL	0.065+	0.06+	0.055+	0.03+	0.015+	0.005+		0.0143	
	32,400	0.0832	1.1	RU									
				SL	0.545+	0.51+	0.42+	0.275+	0.130+	0.03+		0.0127	
	66,300	0.170	4.45	RU									
				SL	2.1+	2.0+	1.62+	1.05	0.495	0.085+		0.0120	

Tubes	Re	\dot{m} ($\frac{\text{lbm}}{\text{sec}}$)	P at Plenum (in H ₂ O)	PT loca- tion	P at test section, (in H ₂ O)						ΔP_{3-6}	f_{3-6}
					PT1	PT2	PT3	PT4	PT5	PT6		
1/4 - 90/20	11,300	0.0292	0.13*	RU	0.066	0.062	0.056	0.040	0.014	0.004		0.0136
				SL								
	33,700	0.0873	1.1	RU	0.475*	0.468*	0.418*	0.28*	0.088*	0.012*		
				SL								
	63,200	0.1623	3.7	RU	1.53	1.50*	1.30*	0.91* 0.02	0.24*	-0.02*		
				SL								

7.3 Tabulated Local and Average Heat Transfer Data

Key:

RUN NUMBER = 77 HS10-00/00 to 81 HS 20-00/00
are for the smooth square channel (W/H = 2"/2")

RUN NUMBER = 83 HR 10-90/10 to 118 HR 60-30/20
are for the rough square channel (W/H = 2"/2")

RUN NUMBER = 70 HS 10-00/00 to 72 HS 60-00/00
are for the smooth rectangular channel I (W/H = 4"/2")

RUN NUMBER = 22 HR 10-90/10 to 60 HR 60-30/20
are for the rough rectangular channel I (W/H = 4"/2")

RUN NUMBER = 62 HR 10-90/10 to 68 HR 60-90/20
are for the rough rectangular channel IA (W/H = 2"/4")

RUN NUMBER = 143 HS 10-00/00 to 145 HS 55-00/00
are for the smooth rectangular channel II (W/H = 4"/1")

RUN NUMBER = 135 HR 10-90/10 to 176 HR 30-30/20
are for the rough rectangular channel II (W/H = 4"/1")

RUN NUMBER = 179 HR 10-90/10 to 185 HR 60-90/20
are for the rough rectangular channel IIA (W/H = 1"/4")

Nomenclature:

77 HS10-00/00	run number 77, heat transfer smooth channel, Reynolds number about 10,000
83 HR10-90/10	run number 83, heat transfer rough channel, Reynolds number about 10,000, $\alpha = 90^\circ$, $P/e = 10$
b/a	the same as W/H
TW	local wall temperature, $^\circ\text{F}$
R1,R2,R3	ribbed side wall along centerline, middleline, edgeline
S1,S2,S3	smooth side wall along centerline, middleline, edgeline
QGA(R)	net heat flux to air on the ribbed side wall
QGA(S)	net heat flux to air on the smooth side wall
NU(R)A	the average Nusselt number on the ribbed side wall
NU(S)A	the average Nusselt number on the smooth side wall
NU(AV)A	the average Nusselt number between the smooth side and the ribbed side walls (weighted by area)
4S	four-sided smooth channel
4R	four-sided rough channel
F	average friction factor in two opposite ribbed walls channel
ST	average Stanton number in two opposite ribbed walls channel
H(RB)	based on ribbed side wall only, the same as H(R)

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NUMBER= 77HS10-00/00 b/a=1.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 2.000 IN
 MDOT=0.0232 LBM/SEC RE= 11199. GGE(R)= 148.7 BTU/HR-SQ FT
)= 149.0 INLET TEMP= 78.2 F TATM= 73.6 F PATM= 14.6 PSIA

AG VALUES FROM X/D= 8.5 TO X/D= 9.4:
)= 36.64 NU(S)= 36.70 NU(AV)= 36.67

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	88.4	0.0	86.2	88.6	0.0	86.4	78.2	144.3	144.7	156.7	0.0	200.1	154.2	0.0	195.8
16	92.9	0.0	89.7	93.1	0.0	90.1	78.3	142.9	143.7	108.0	0.0	138.4	107.1	0.0	134.4
26	91.4	0.0	91.5	91.6	0.0	92.0	78.4	143.4	143.8	121.3	0.0	120.4	119.8	0.0	116.3
35	90.8	0.0	92.4	91.0	0.0	93.0	78.4	143.5	143.9	127.9	0.0	113.3	126.3	0.0	108.9
45	91.0	0.0	91.8	91.2	0.0	92.0	78.5	143.5	143.8	126.4	0.0	118.9	124.8	0.0	117.4
54	92.3	0.0	91.8	92.5	0.0	92.0	78.5	143.1	143.7	114.7	0.0	119.1	113.6	0.0	117.8
63	93.2	0.0	91.3	93.4	0.0	93.0	78.6	142.8	143.4	107.9	0.0	124.1	106.9	0.0	109.9
73	94.4	0.0	93.5	94.6	0.0	93.0	78.7	142.5	143.2	99.8	0.0	105.9	99.1	0.0	110.1
82	95.7	0.0	94.1	95.9	0.0	94.0	78.7	142.1	142.8	92.3	0.0	101.9	91.7	0.0	103.1
91	96.7	0.0	95.0	96.9	0.0	94.0	78.8	141.8	142.3	87.2	0.0	96.4	86.6	0.0	103.1
101	98.8	0.0	0.0	99.0	0.0	0.0	78.8	141.1	142.6	78.0	0.0	0.0	78.0	0.0	0.0
110	98.0	0.0	0.0	98.2	0.0	0.0	78.9	141.4	142.3	81.6	0.0	0.0	81.3	0.0	0.0
120	99.5	0.0	0.0	99.7	0.0	0.0	79.0	140.9	141.7	75.6	0.0	0.0	75.3	0.0	0.0
129	99.9	0.0	0.0	100.1	0.0	0.0	79.0	140.8	141.4	74.3	0.0	0.0	73.9	0.0	0.0
138	100.8	0.0	0.0	101.0	0.0	0.0	79.1	140.5	141.1	71.3	0.0	0.0	70.9	0.0	0.0
148	101.6	0.0	0.0	101.8	0.0	0.0	79.1	140.3	141.1	68.8	0.0	0.0	68.6	0.0	0.0
157	102.2	0.0	0.0	102.1	0.0	0.0	79.2	140.1	140.8	67.1	0.0	0.0	67.7	0.0	0.0
166	102.7	0.0	0.0	103.0	0.0	0.0	79.3	140.0	140.2	65.8	0.0	0.0	65.1	0.0	0.0
176	103.2	0.0	0.0	103.0	0.0	0.0	79.3	139.8	140.2	64.5	0.0	0.0	65.2	0.0	0.0
185	103.8	0.0	0.0	103.0	0.0	0.0	79.4	139.6	140.2	63.0	0.0	0.0	65.4	0.0	0.0
195	103.8	0.0	0.0	103.8	0.0	0.0	79.5	139.6	139.9	63.1	0.0	0.0	63.3	0.0	0.0
204	104.2	0.0	0.0	104.0	0.0	0.0	79.5	139.5	139.9	62.2	0.0	0.0	62.9	0.0	0.0
213	105.1	0.0	0.0	105.0	0.0	0.0	79.6	139.2	139.6	60.0	0.0	0.0	60.4	0.0	0.0
223	106.0	0.0	0.0	105.0	0.0	0.0	79.6	139.0	139.6	58.0	0.0	0.0	60.6	0.0	0.0
232	106.3	0.0	0.0	106.0	0.0	0.0	79.7	138.9	139.3	57.5	0.0	0.0	58.3	0.0	0.0
241	106.9	0.0	0.0	106.0	0.0	0.0	79.8	138.7	139.3	56.2	0.0	0.0	58.4	0.0	0.0
251	107.2	0.0	0.0	106.0	0.0	0.0	79.8	138.6	139.3	55.7	0.0	0.0	58.5	0.0	0.0
260	107.4	0.0	0.0	107.0	0.0	0.0	79.9	138.6	139.0	55.4	0.0	0.0	56.4	0.0	0.0
270	108.0	0.0	0.0	108.0	0.0	0.0	79.9	138.4	138.7	54.2	0.0	0.0	54.4	0.0	0.0
279	108.7	0.0	0.0	108.0	0.0	0.0	80.0	138.2	138.7	52.9	0.0	0.0	54.5	0.0	0.0
288	109.3	0.0	0.0	109.0	0.0	0.0	80.1	138.0	138.4	51.9	0.0	0.0	52.6	0.0	0.0
298	109.8	0.0	0.0	109.0	0.0	0.0	80.1	137.8	138.4	51.1	0.0	0.0	52.7	0.0	0.0
307	110.3	0.0	0.0	110.0	0.0	0.0	80.2	137.7	138.1	50.3	0.0	0.0	50.9	0.0	0.0
316	110.7	0.0	0.0	110.0	0.0	0.0	80.2	137.6	138.1	49.7	0.0	0.0	51.0	0.0	0.0
326	110.6	0.0	0.0	111.0	0.0	0.0	80.3	137.6	137.8	49.9	0.0	0.0	49.3	0.0	0.0
335	111.3	0.0	0.0	111.0	0.0	0.0	80.4	137.4	137.8	48.8	0.0	0.0	49.4	0.0	0.0
345	111.6	0.0	0.0	112.0	0.0	0.0	80.4	137.3	137.5	48.4	0.0	0.0	47.8	0.0	0.0
354	112.4	0.0	0.0	112.0	0.0	0.0	80.5	137.1	137.5	47.2	0.0	0.0	47.9	0.0	0.0
363	112.4	0.0	0.0	112.0	0.0	0.0	80.5	137.1	137.5	47.3	0.0	0.0	48.0	0.0	0.0
373	112.6	0.0	0.0	112.0	0.0	0.0	80.6	137.0	137.5	47.0	0.0	0.0	48.1	0.0	0.0
7.57	121.2	0.0	0.0	121.0	0.0	0.0	83.1	134.4	134.8	38.6	0.0	0.0	38.9	0.0	0.0
7.66	122.1	0.0	0.0	122.3	0.0	0.0	83.1	134.1	134.8	37.7	0.0	0.0	37.7	0.0	0.0
7.76	121.8	0.0	0.0	122.0	0.0	0.0	83.2	134.2	134.8	38.0	0.0	0.0	38.0	0.0	0.0
7.85	122.1	0.0	0.0	122.3	0.0	0.0	83.2	134.1	134.8	37.8	0.0	0.0	37.8	0.0	0.0
7.95	122.7	0.0	0.0	122.9	0.0	0.0	83.3	134.0	134.8	37.2	0.0	0.0	37.2	0.0	0.0
8.04	122.9	0.0	0.0	123.1	0.0	0.0	83.4	133.9	134.8	37.1	0.0	0.0	37.1	0.0	0.0
8.13	123.1	0.0	0.0	123.3	0.0	0.0	83.4	133.8	134.2	36.9	0.0	0.0	36.8	0.0	0.0
8.23	123.1	0.0	0.0	123.3	0.0	0.0	83.5	133.8	134.2	37.0	0.0	0.0	36.9	0.0	0.0
8.32	123.5	0.0	0.0	123.7	0.0	0.0	83.5	133.7	134.5	36.6	0.0	0.0	36.6	0.0	0.0
8.41	123.2	0.0	0.0	123.4	0.0	0.0	83.6	133.8	134.5	37.0	0.0	0.0	37.0	0.0	0.0
8.51	123.8	122.8	121.5	124.0	123.0	121.7	83.7	133.6	134.8	36.4	37.3	38.6	36.5	37.5	38.8
8.60	123.6	122.8	120.6	123.8	123.0	121.0	83.7	133.7	134.5	36.7	37.4	39.6	36.7	37.4	39.4
8.70	123.7	123.1	120.7	123.9	123.3	121.0	83.8	133.7	134.5	36.6	37.2	39.6	36.7	37.2	39.5
8.79	123.6	123.4	121.0	123.8	122.0	121.0	83.9	133.7	134.5	36.8	37.0	39.3	36.8	38.5	39.6
8.88	124.0	123.8	122.3	124.2	125.6	128.7	83.9	133.6	134.5	36.4	36.6	38.0	36.5	39.3	32.8
8.98	123.5	123.4	121.9	123.7	123.6	122.0	84.0	133.7	134.5	37.0	37.1	38.5	37.0	37.1	38.6
9.07	123.6	123.2	122.4	123.8	123.4	122.6	84.0	133.7	134.5	36.9	37.3	38.1	37.0	37.3	38.1
9.16	123.9	123.6	122.6	124.1	123.8	122.8	84.1	133.6	134.2	36.7	37.0	37.9	36.6	36.9	37.9
9.26	124.0	124.3	122.8	124.2	124.5	122.0	84.2	133.6	134.2	36.6	36.4	37.8	36.6	36.3	38.7
9.35	124.4	124.7	123.0	124.2	124.9	123.2	84.2	133.5	134.2	36.3	36.0	37.6	36.7	36.0	37.6

AVERAGE VALUES FROM X/D= 8.5 TO X/D= 9.4 AND FROM X/D= 2.9 TO 3.7:
)= 42.89 NU(S)= 43.24 NU(AV)= 43.07

RUN NUMBER= 79HS60-00/00 b/a=1.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 2.000 IN
 PR= 71 MDOT=0.1343 LBM/SEC RE= 64472 GGE(R)= 573.8 BTU/HR-SQ FT
 GGE(S)= 604.8 INLET TEMP= 82.9 F TATM= 76.2 F PATM= 14.6 PSIA

AVERAG VALUES FROM X/D= 8.5 TO X/D= 9.4:
 NU(R)= 150.38 NU(S)= 151.39 NU(AV)= 150.89

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.07	93.9	0.0	88.8	94.8	0.0	89.8	82.9	568.5	600.5	572.8	0.0	1061.0	554.1	0.0	9
2	0.16	96.6	0.0	92.3	97.6	0.0	93.3	83.0	567.7	599.9	456.2	0.0	666.6	449.2	0.0	6
3	0.26	95.6	0.0	93.2	96.6	0.0	94.2	83.0	568.0	599.4	494.3	0.0	610.9	483.3	0.0	5
4	0.35	95.0	0.0	96.4	96.0	0.0	97.2	83.1	568.1	599.5	521.2	0.0	466.4	507.5	0.0	4
5	0.45	95.2	0.0	95.4	96.2	0.0	96.4	83.1	568.1	599.1	514.4	0.0	506.0	501.1	0.0	4
6	0.54	96.9	0.0	95.6	97.9	0.0	96.6	83.2	567.6	599.2	452.0	0.0	499.2	444.9	0.0	4
7	0.63	97.9	0.0	94.0	98.9	0.0	96.0	83.2	567.3	598.8	422.3	0.0	574.9	417.5	0.0	5
8	0.73	99.5	0.0	98.0	100.0	0.0	99.0	83.2	566.8	598.7	381.6	0.0	420.4	391.1	0.0	4
9	0.82	101.4	0.0	98.9	102.4	0.0	99.0	83.3	566.2	598.4	342.1	0.0	396.9	342.7	0.0	4
10	0.91	102.3	0.0	100.0	103.3	0.0	101.0	83.3	565.9	597.6	326.5	0.0	371.6	327.5	0.0	3
11	1.01	104.2	0.0	0.0	105.2	0.0	0.0	83.4	565.4	597.6	297.1	0.0	0.0	297.7	0.0	
12	1.10	103.4	0.0	0.0	104.4	0.0	0.0	83.4	565.6	597.6	309.8	0.0	0.0	311.7	0.0	
13	1.20	104.5	0.0	0.0	105.5	0.0	0.0	83.5	565.3	596.7	294.0	0.0	0.0	296.3	0.0	
14	1.29	105.6	0.0	0.0	106.6	0.0	0.0	83.5	565.0	596.4	279.8	0.0	0.0	282.6	0.0	
15	1.38	106.3	0.0	0.0	107.3	0.0	0.0	83.6	564.7	596.4	271.6	0.0	0.0	274.8	0.0	
16	1.48	107.0	0.0	0.0	108.0	0.0	0.0	83.6	564.5	595.5	263.9	0.0	0.0	267.0	0.0	
17	1.57	107.7	0.0	0.0	108.7	0.0	0.0	83.6	564.3	595.5	256.6	0.0	0.0	260.0	0.0	
18	1.66	108.5	0.0	0.0	109.5	0.0	0.0	83.7	564.1	595.5	248.6	0.0	0.0	252.3	0.0	
19	1.76	109.0	0.0	0.0	110.0	0.0	0.0	83.7	563.9	594.6	244.1	0.0	0.0	247.6	0.0	
20	1.85	109.3	0.0	0.0	110.0	0.0	0.0	83.8	563.8	594.6	241.6	0.0	0.0	248.0	0.0	
21	1.95	109.1	0.0	0.0	110.0	0.0	0.0	83.8	563.9	594.6	243.9	0.0	0.0	248.4	0.0	
22	2.04	109.6	0.0	0.0	111.0	0.0	0.0	83.9	563.8	594.3	239.5	0.0	0.0	239.5	0.0	
23	2.13	110.9	0.0	0.0	112.0	0.0	0.0	83.9	563.4	594.0	228.2	0.0	0.0	231.2	0.0	
24	2.23	111.5	0.0	0.0	113.0	0.0	0.0	84.0	563.2	593.7	223.5	0.0	0.0	223.5	0.0	
25	2.32	111.9	0.0	0.0	113.0	0.0	0.0	84.0	563.1	593.7	220.6	0.0	0.0	223.8	0.0	
26	2.41	112.4	0.0	0.0	115.0	0.0	0.0	84.1	562.9	593.1	217.0	0.0	0.0	209.4	0.0	
27	2.51	112.9	0.0	0.0	114.0	0.0	0.0	84.1	562.8	593.4	213.5	0.0	0.0	216.8	0.0	
28	2.60	113.1	0.0	0.0	114.0	0.0	0.0	84.1	562.7	593.4	212.3	0.0	0.0	217.1	0.0	
29	2.70	113.6	0.0	0.0	116.0	0.0	0.0	84.2	562.6	592.8	209.0	0.0	0.0	203.6	0.0	
30	2.79	114.1	0.0	0.0	116.0	0.0	0.0	84.2	562.4	592.8	205.7	0.0	0.0	203.9	0.0	
31	2.88	114.8	0.0	0.0	117.0	0.0	0.0	84.3	562.2	592.5	201.2	0.0	0.0	197.8	0.0	
32	2.98	115.2	0.0	0.0	117.0	0.0	0.0	84.3	562.0	592.5	198.2	0.0	0.0	198.0	0.0	
33	3.07	115.9	0.0	0.0	117.0	0.0	0.0	84.4	561.9	592.5	194.6	0.0	0.0	198.3	0.0	
34	3.16	116.2	0.0	0.0	119.0	0.0	0.0	84.4	561.8	591.9	193.0	0.0	0.0	186.9	0.0	
35	3.26	116.0	0.0	0.0	118.0	0.0	0.0	84.5	561.8	592.2	194.5	0.0	0.0	192.8	0.0	
36	3.35	116.9	0.0	0.0	119.0	0.0	0.0	84.5	561.6	591.9	189.3	0.0	0.0	187.3	0.0	
37	3.45	116.9	0.0	0.0	120.0	0.0	0.0	84.5	561.6	591.6	189.5	0.0	0.0	182.2	0.0	
38	3.54	117.6	0.0	0.0	120.0	0.0	0.0	84.6	561.4	591.6	185.7	0.0	0.0	182.4	0.0	
39	3.63	117.6	0.0	0.0	120.0	0.0	0.0	84.6	561.4	591.6	185.9	0.0	0.0	182.6	0.0	
40	3.73	117.9	0.0	0.0	120.0	0.0	0.0	84.7	561.3	591.6	184.4	0.0	0.0	182.8	0.0	
41	7.57	125.4	0.0	0.0	129.0	0.0	0.0	86.5	559.0	588.9	156.5	0.0	0.0	150.9	0.0	
42	7.66	126.4	0.0	0.0	130.0	0.0	0.0	86.6	558.7	588.6	152.6	0.0	0.0	147.5	0.0	
43	7.76	126.4	0.0	0.0	129.0	0.0	0.0	86.6	558.7	588.9	152.8	0.0	0.0	151.2	0.0	
44	7.85	127.4	0.0	0.0	130.0	0.0	0.0	86.6	558.4	588.6	149.1	0.0	0.0	147.7	0.0	
45	7.95	127.2	0.0	0.0	129.2	0.0	0.0	86.7	558.5	590.1	150.0	0.0	0.0	151.1	0.0	
46	8.04	127.6	0.0	0.0	129.6	0.0	0.0	86.7	558.4	589.8	148.7	0.0	0.0	149.7	0.0	
47	8.13	127.6	0.0	0.0	129.6	0.0	0.0	86.8	558.4	590.1	148.8	0.0	0.0	149.9	0.0	
48	8.23	127.9	0.0	0.0	129.9	0.0	0.0	86.8	558.3	592.2	147.8	0.0	0.0	149.6	0.0	
49	8.32	128.1	0.0	0.0	130.1	0.0	0.0	86.9	558.2	591.9	147.3	0.0	0.0	149.0	0.0	
50	8.41	127.7	0.0	0.0	129.7	0.0	0.0	86.9	558.3	591.3	148.9	0.0	0.0	150.3	0.0	
51	8.51	127.3	128.1	126.9	129.3	130.1	128.9	87.0	558.4	591.3	150.6	147.6	152.1	151.9	149.1	153
52	8.60	127.5	128.5	126.1	129.6	130.5	128.1	87.0	558.4	590.1	149.9	146.3	155.3	150.7	147.6	156
53	8.70	127.9	129.1	126.5	129.9	131.1	128.5	87.0	558.3	590.7	148.6	144.4	153.9	149.9	145.8	155
54	8.79	127.3	129.0	126.4	129.3	131.0	128.4	87.1	558.4	590.7	151.0	144.9	154.5	152.2	146.3	155
55	8.88	127.6	129.1	128.3	129.6	131.1	136.3	87.1	558.4	590.1	150.0	144.7	147.5	151.1	146.0	130
56	8.98	127.1	128.7	128.0	129.1	130.7	130.0	87.2	558.5	590.1	152.1	146.2	148.8	153.1	147.4	149
57	9.07	127.4	128.7	128.7	129.4	130.7	130.7	87.2	558.4	589.8	151.1	146.4	146.4	152.0	147.5	147
58	9.16	127.8	129.6	128.8	129.8	131.6	130.8	87.3	558.3	589.2	149.7	143.4	146.1	150.6	144.5	147
59	9.26	127.5	130.3	129.2	129.5	132.3	131.2	87.3	558.4	589.5	151.0	141.2	144.9	151.9	142.5	146
60	9.35	127.9	130.3	128.9	129.9	132.3	130.9	87.4	558.3	589.2	149.7	141.3	146.1	150.5	142.5	147

AVERAG VALUES FROM X/D= 8.5 TO X/D= 9.4 AND FROM X/D = 2.9 to 3.7:
 NU(R)= 171.00 NU(S)= 170.26 NU(AV)= 170.63

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER= SOHS50-00/00 b/a=1.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 2.000 IN
71 MDOT=0.1053 LBM/SEC RE= 50591. GGE(R)= 422.6 BTU/HR-SQ FT
S)= 433.8 INLET TEMP= 82.5 F TATM= 75.2 F PATM= 14.6 PSIA

AG VALUES FROM X/D= 8.5 TO X/D= 9.4:
)= 118.17 NU(S)= 122.47 NU(AV)= 120.32

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	92.5	0.0	88.6	92.8	0.0	87.8	82.5	417.4	429.5	458.7	0.0	753.4	460.4	0.0	899.1
0.16	95.6	0.0	91.5	95.3	0.0	90.5	82.6	416.4	429.0	350.2	0.0	511.0	370.5	0.0	592.0
0.26	94.7	0.0	92.8	94.7	0.0	93.3	82.6	416.7	428.5	377.7	0.0	448.1	387.1	0.0	439.5
0.35	94.0	0.0	95.6	94.5	0.0	96.3	82.7	416.9	428.5	402.5	0.0	352.8	396.1	0.0	344.1
0.45	94.1	0.0	94.6	94.6	0.0	94.9	82.7	416.9	428.3	400.4	0.0	383.6	393.4	0.0	384.9
0.54	95.5	0.0	94.6	95.9	0.0	95.3	82.7	416.5	428.3	357.4	0.0	384.5	356.1	0.0	374.7
0.63	96.6	0.0	93.4	96.7	0.0	95.0	82.8	416.1	428.0	329.7	0.0	429.0	336.7	0.0	383.5
0.73	97.9	0.0	96.6	97.6	0.0	97.4	82.8	415.8	427.9	301.9	0.0	330.3	316.5	0.0	322.4
0.82	99.4	0.0	97.5	99.7	0.0	97.0	82.9	415.3	427.6	274.9	0.0	310.6	277.3	0.0	331.1
0.91	100.2	0.0	98.4	100.7	0.0	98.6	82.9	415.1	426.9	262.7	0.0	293.2	262.4	0.0	298.3
1.01	102.0	0.0	0.0	101.1	0.0	0.0	82.9	414.5	427.2	238.1	0.0	0.0	257.9	0.0	0.0
1.10	101.4	0.0	0.0	101.5	0.0	0.0	83.0	414.7	426.9	246.5	0.0	0.0	253.1	0.0	0.0
1.20	102.5	0.0	0.0	102.0	0.0	0.0	83.0	414.4	426.3	232.9	0.0	0.0	246.5	0.0	0.0
1.29	103.1	0.0	0.0	103.0	0.0	0.0	83.1	414.2	426.0	226.3	0.0	0.0	233.5	0.0	0.0
1.38	103.7	0.0	0.0	103.6	0.0	0.0	83.1	414.0	426.0	220.0	0.0	0.0	227.7	0.0	0.0
1.48	104.5	0.0	0.0	103.8	0.0	0.0	83.1	413.8	425.4	212.1	0.0	0.0	225.6	0.0	0.0
1.57	105.2	0.0	0.0	105.3	0.0	0.0	83.2	413.6	425.1	205.6	0.0	0.0	210.1	0.0	0.0
1.66	105.7	0.0	0.0	107.0	0.0	0.0	83.2	413.4	424.8	201.3	0.0	0.0	195.9	0.0	0.0
1.76	106.1	0.0	0.0	106.0	0.0	0.0	83.3	413.3	424.5	198.1	0.0	0.0	204.4	0.0	0.0
1.85	106.4	0.0	0.0	106.0	0.0	0.0	83.3	413.2	424.5	195.8	0.0	0.0	204.7	0.0	0.0
1.95	106.4	0.0	0.0	107.0	0.0	0.0	83.4	413.2	424.2	196.2	0.0	0.0	196.3	0.0	0.0
2.04	106.9	0.0	0.0	107.0	0.0	0.0	83.4	413.1	424.2	192.2	0.0	0.0	196.6	0.0	0.0
2.13	107.8	0.0	0.0	108.0	0.0	0.0	83.4	412.8	423.9	185.3	0.0	0.0	188.8	0.0	0.0
2.23	108.4	0.0	0.0	110.0	0.0	0.0	83.5	412.6	423.3	181.1	0.0	0.0	174.6	0.0	0.0
2.32	108.9	0.0	0.0	110.0	0.0	0.0	83.5	412.5	423.3	177.7	0.0	0.0	174.9	0.0	0.0
2.41	109.4	0.0	0.0	111.0	0.0	0.0	83.6	412.3	423.0	174.5	0.0	0.0	168.6	0.0	0.0
2.51	109.8	0.0	0.0	110.0	0.0	0.0	83.6	412.2	423.3	172.1	0.0	0.0	175.4	0.0	0.0
2.60	109.9	0.0	0.0	110.0	0.0	0.0	83.6	412.2	423.3	171.6	0.0	0.0	175.6	0.0	0.0
2.70	110.3	0.0	0.0	112.0	0.0	0.0	83.7	412.0	422.7	169.3	0.0	0.0	163.2	0.0	0.0
2.79	111.0	0.0	0.0	112.0	0.0	0.0	83.7	411.8	422.7	165.1	0.0	0.0	163.5	0.0	0.0
2.88	111.7	0.0	0.0	112.0	0.0	0.0	83.8	411.6	422.7	161.1	0.0	0.0	163.7	0.0	0.0
2.98	111.9	0.0	0.0	113.0	0.0	0.0	83.8	411.6	422.4	160.2	0.0	0.0	158.2	0.0	0.0
3.07	112.5	0.0	0.0	113.0	0.0	0.0	83.8	411.4	422.4	157.0	0.0	0.0	158.4	0.0	0.0
3.16	112.9	0.0	0.0	114.0	0.0	0.0	83.9	411.3	422.1	155.0	0.0	0.0	153.2	0.0	0.0
3.26	112.8	0.0	0.0	114.0	0.0	0.0	83.9	411.3	422.1	153.7	0.0	0.0	153.4	0.0	0.0
3.35	113.5	0.0	0.0	115.0	0.0	0.0	84.0	411.1	421.8	152.2	0.0	0.0	148.6	0.0	0.0
3.45	113.5	0.0	0.0	115.0	0.0	0.0	84.0	411.1	421.8	152.4	0.0	0.0	148.8	0.0	0.0
3.54	114.2	0.0	0.0	115.0	0.0	0.0	84.1	410.9	421.8	148.9	0.0	0.0	149.0	0.0	0.0
3.63	114.4	0.0	0.0	115.0	0.0	0.0	84.1	410.8	421.8	148.1	0.0	0.0	149.2	0.0	0.0
3.73	114.7	0.0	0.0	115.0	0.0	0.0	84.1	410.7	421.8	146.8	0.0	0.0	149.3	0.0	0.0
7.57	121.7	0.0	0.0	123.0	0.0	0.0	85.8	408.6	419.4	124.1	0.0	0.0	122.9	0.0	0.0
7.66	122.7	0.0	0.0	124.0	0.0	0.0	85.9	408.3	419.1	120.8	0.0	0.0	119.8	0.0	0.0
7.76	122.8	0.0	0.0	124.0	0.0	0.0	85.9	408.3	419.1	120.6	0.0	0.0	119.9	0.0	0.0
7.85	123.4	0.0	0.0	124.0	0.0	0.0	85.9	408.1	419.1	118.7	0.0	0.0	120.0	0.0	0.0
7.95	123.2	0.0	0.0	124.3	0.0	0.0	86.0	408.2	420.0	119.5	0.0	0.0	119.5	0.0	0.0
8.04	123.7	0.0	0.0	123.8	0.0	0.0	86.0	408.0	420.0	118.0	0.0	0.0	121.1	0.0	0.0
8.13	124.0	0.0	0.0	125.6	0.0	0.0	86.1	407.9	419.7	117.1	0.0	0.0	115.6	0.0	0.0

8.23	124.2	0.0	0.0	123.3	0.0	0.0	86.1	407.9	422.1	116.6	0.0	0.0	123.5	0.0	0.0
8.32	124.2	0.0	0.0	123.7	0.0	0.0	86.2	407.9	421.8	116.7	0.0	0.0	122.3	0.0	0.0
8.41	123.9	0.0	0.0	122.8	0.0	0.0	86.2	408.0	421.5	117.8	0.0	0.0	125.3	0.0	0.0
8.51	123.9	124.2	123.2	122.5	124.1	123.4	86.2	408.0	421.5	117.9	117.0	120.2	126.5	121.1	123.5
8.60	124.0	124.6	122.2	123.6	123.9	122.2	86.3	407.9	420.3	117.7	115.9	123.6	122.6	121.7	127.3
8.70	124.1	124.9	122.4	124.4	124.6	123.7	86.3	407.9	420.6	117.5	115.1	123.1	120.2	119.7	122.4
8.79	123.7	124.8	122.5	123.9	124.7	122.9	86.4	408.0	420.6	119.0	115.6	122.9	121.8	119.4	125.4
8.88	124.2	125.1	124.1	123.6	125.0	126.1	86.4	407.9	420.3	117.5	114.7	117.8	123.0	118.5	115.3
8.98	123.8	125.0	123.8	124.2	125.7	124.4	86.4	408.0	420.0	118.9	115.2	118.9	121.0	116.5	120.6
9.07	123.8	124.9	124.1	123.7	124.9	125.1	86.5	408.0	420.0	119.0	115.6	118.0	123.0	119.0	118.3
9.16	124.0	125.4	124.3	123.4	125.8	125.2	86.5	407.9	419.7	118.5	114.2	117.5	123.8	116.2	118.1
9.26	124.0	126.0	125.0	124.0	126.6	125.7	86.6	407.9	419.7	118.6	112.6	115.5	122.2	114.1	116.6
9.35	124.5	126.2	124.9	124.5	126.6	126.1	86.6	407.8	419.4	117.1	112.1	115.9	120.5	114.2	115.7

AVERAG VALUES FROM X/D= 8.5 TO X/D= 9.4 AND FROM X/D = 2.9 to 3.7:
NU(R)= 135.95 NU(S)= 137.82 NU(AV)= 136.89

**ORIGINAL PAGE IS
OF POOR QUALITY**

RUN NUMBER= 81HS20-00/00 b/a=1.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 2.000 IN
 PR= 71 MDDT=0.0328 LBM/SEC RE= 15755 GGE(R)= 204.3 BTU/HR-SQ FT
 GGE(S)= 209.5 INLET TEMP= 81.7 F TATM= 74.6 F PATM= 14.6 PSIA

AVERAG VALUES FROM X/D= 8.5 TO X/D= 9.4:
 NU(R)= 51.80 NU(S)= 50.01 NU(AV)= 50.91

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.07	91.5	0.0	88.9	91.5	0.0	89.0	81.7	199.2	204.7	224.1	0.0	305.5	229.6	0.0	31
2	0.16	95.5	0.0	92.0	95.8	0.0	94.2	81.8	198.0	203.8	158.6	0.0	213.1	159.4	0.0	18
3	0.26	94.4	0.0	94.0	94.2	0.0	94.0	81.9	198.4	203.8	173.6	0.0	179.3	180.6	0.0	16
4	0.35	93.9	0.0	95.3	94.1	0.0	95.0	81.9	198.5	203.8	181.8	0.0	162.8	183.0	0.0	17
5	0.45	94.1	0.0	94.6	94.7	0.0	95.0	82.0	198.5	203.6	179.7	0.0	172.6	176.2	0.0	17
6	0.54	95.4	0.0	94.6	96.6	0.0	96.0	82.0	198.1	203.5	162.7	0.0	173.0	153.6	0.0	15
7	0.63	96.4	0.0	94.0	97.6	0.0	96.0	82.1	197.8	203.1	151.7	0.0	182.4	143.5	0.0	14
8	0.73	97.6	0.0	96.3	99.0	0.0	97.0	82.2	197.4	202.8	140.3	0.0	153.2	132.5	0.0	14
9	0.82	99.0	0.0	97.2	100.5	0.0	98.0	82.2	197.0	202.4	128.8	0.0	144.3	121.8	0.0	14
10	0.91	100.0	0.0	98.1	101.6	0.0	99.0	82.3	196.7	201.8	121.7	0.0	136.4	114.5	0.0	13
11	1.01	102.0	0.0	0.0	105.6	0.0	0.0	82.4	196.1	201.8	109.4	0.0	0.0	95.0	0.0	
12	1.10	101.3	0.0	0.0	103.1	0.0	0.0	82.4	196.3	201.8	113.9	0.0	0.0	106.9	0.0	
13	1.20	102.0	0.0	0.0	104.4	0.0	0.0	82.5	196.1	201.2	110.0	0.0	0.0	100.6	0.0	
14	1.29	103.1	0.0	0.0	104.5	0.0	0.0	82.5	195.8	200.9	104.3	0.0	0.0	100.0	0.0	
15	1.38	103.9	0.0	0.0	105.4	0.0	0.0	82.6	195.5	200.6	100.5	0.0	0.0	96.4	0.0	
16	1.48	104.6	0.0	0.0	108.5	0.0	0.0	82.7	195.3	200.0	97.5	0.0	0.0	84.7	0.0	
17	1.57	105.3	0.0	0.0	107.5	0.0	0.0	82.7	195.1	200.0	94.6	0.0	0.0	88.2	0.0	
18	1.66	105.8	0.0	0.0	107.0	0.0	0.0	82.8	194.9	199.7	92.7	0.0	0.0	90.3	0.0	
19	1.76	106.2	0.0	0.0	108.0	0.0	0.0	82.8	194.8	199.4	91.3	0.0	0.0	86.8	0.0	
20	1.85	106.8	0.0	0.0	108.0	0.0	0.0	82.9	194.6	199.4	89.2	0.0	0.0	87.0	0.0	
21	1.95	106.8	0.0	0.0	108.0	0.0	0.0	83.0	194.6	199.4	89.4	0.0	0.0	87.2	0.0	
22	2.04	107.1	0.0	0.0	109.0	0.0	0.0	83.0	194.6	199.1	88.5	0.0	0.0	83.9	0.0	
23	2.13	108.1	0.0	0.0	110.0	0.0	0.0	83.1	194.3	198.8	85.0	0.0	0.0	80.9	0.0	
24	2.23	108.9	0.0	0.0	111.0	0.0	0.0	83.1	194.0	198.5	82.4	0.0	0.0	78.0	0.0	
25	2.32	109.2	0.0	0.0	111.0	0.0	0.0	83.2	193.9	198.5	81.6	0.0	0.0	78.2	0.0	
26	2.41	109.9	0.0	0.0	112.0	0.0	0.0	83.3	193.7	198.2	79.6	0.0	0.0	75.5	0.0	
27	2.51	110.1	0.0	0.0	112.0	0.0	0.0	83.3	193.7	198.2	79.1	0.0	0.0	75.6	0.0	
28	2.60	110.3	0.0	0.0	112.0	0.0	0.0	83.4	193.6	198.2	78.7	0.0	0.0	75.8	0.0	
29	2.70	110.9	0.0	0.0	113.0	0.0	0.0	83.4	193.4	197.9	77.1	0.0	0.0	73.3	0.0	
30	2.79	111.6	0.0	0.0	114.0	0.0	0.0	83.5	193.2	197.6	75.2	0.0	0.0	70.9	0.0	
31	2.88	112.4	0.0	0.0	114.0	0.0	0.0	83.6	193.0	197.6	73.2	0.0	0.0	71.0	0.0	
32	2.98	112.7	0.0	0.0	115.0	0.0	0.0	83.6	192.9	197.3	72.6	0.0	0.0	68.8	0.0	
33	3.07	113.2	0.0	0.0	115.0	0.0	0.0	83.7	192.7	197.3	71.4	0.0	0.0	68.9	0.0	
34	3.16	113.7	0.0	0.0	116.0	0.0	0.0	83.8	192.6	197.0	70.3	0.0	0.0	66.8	0.0	
35	3.26	113.6	0.0	0.0	116.0	0.0	0.0	83.8	192.6	197.0	70.7	0.0	0.0	66.9	0.0	
36	3.35	114.3	0.0	0.0	117.0	0.0	0.0	83.9	192.4	196.7	69.1	0.0	0.0	64.9	0.0	
37	3.45	114.5	0.0	0.0	117.0	0.0	0.0	83.9	192.3	196.7	68.8	0.0	0.0	65.0	0.0	
38	3.54	115.4	0.0	0.0	117.0	0.0	0.0	84.0	192.1	196.7	66.8	0.0	0.0	65.1	0.0	
39	3.63	115.5	0.0	0.0	117.0	0.0	0.0	84.1	192.0	196.7	66.7	0.0	0.0	65.3	0.0	
40	3.73	115.6	0.0	0.0	117.0	0.0	0.0	84.1	192.0	196.7	66.6	0.0	0.0	65.4	0.0	
41	7.57	124.4	0.0	0.0	126.5	0.0	0.0	86.6	189.4	193.9	54.5	0.0	0.0	52.9	0.0	
42	7.66	125.3	0.0	0.0	127.8	0.0	0.0	86.7	189.1	194.0	53.3	0.0	0.0	51.3	0.0	
43	7.76	125.1	0.0	0.0	127.9	0.0	0.0	86.7	189.2	193.9	53.6	0.0	0.0	51.2	0.0	
44	7.85	125.4	0.0	0.0	128.8	0.0	0.0	86.8	189.1	193.7	53.3	0.0	0.0	50.1	0.0	
45	7.95	125.9	0.0	0.0	128.7	0.0	0.0	86.9	188.9	194.0	52.6	0.0	0.0	50.5	0.0	
46	8.04	126.1	0.0	0.0	128.0	0.0	0.0	86.9	188.9	194.3	52.4	0.0	0.0	51.5	0.0	
47	8.13	126.4	0.0	0.0	127.4	0.0	0.0	87.0	188.8	193.7	52.1	0.0	0.0	52.1	0.0	
48	8.23	126.5	0.0	0.0	128.4	0.0	0.0	87.0	188.7	193.4	52.0	0.0	0.0	50.8	0.0	
49	8.32	126.8	0.0	0.0	128.4	0.0	0.0	87.1	188.6	194.0	51.7	0.0	0.0	51.1	0.0	
50	8.41	126.5	0.0	0.0	129.0	0.0	0.0	87.2	188.7	193.7	52.2	0.0	0.0	50.4	0.0	
51	8.51	127.0	126.4	125.5	129.2	124.8	124.4	87.2	188.6	194.3	51.5	52.3	53.6	50.3	56.2	56.
52	8.60	126.9	126.5	124.2	128.5	124.4	123.0	87.3	188.6	194.0	51.8	52.3	55.5	51.1	56.8	59.
53	8.70	127.0	126.8	124.2	128.7	124.8	124.0	87.3	188.6	194.0	51.7	51.9	55.6	51.0	56.3	57.
54	8.79	126.8	126.8	124.3	129.5	124.0	124.0	87.4	188.6	193.7	52.0	52.0	55.6	50.0	57.5	57.
55	8.88	127.2	127.2	125.7	130.1	127.7	129.4	87.5	188.5	193.7	51.6	51.6	53.6	49.4	52.4	50.
56	8.98	126.8	126.9	125.4	129.4	127.3	125.0	87.5	188.6	193.7	52.2	52.1	54.1	50.3	53.0	56.
57	9.07	126.8	126.7	125.7	130.5	127.0	125.8	87.6	188.6	193.4	52.3	52.4	53.8	48.9	53.4	54.
58	9.16	127.2	127.2	125.9	129.5	127.5	127.1	87.6	188.5	193.4	51.8	51.8	53.5	50.2	52.7	53.
59	9.26	127.2	127.8	126.3	129.7	128.1	127.0	87.7	188.5	193.4	51.9	51.1	53.1	50.1	52.0	53.
60	9.35	127.6	128.1	126.6	130.7	129.7	129.1	87.8	188.4	193.1	51.4	50.7	52.7	48.9	50.1	50.

AVERAG VALUES FROM X/D= 8.5 TO X/D= 9.4 AND FROM X/D = 2.9 to 3.7:
 NU(R)= 60.72 NU(S)= 58.42 NU(AV)= 59.57

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER= 83HR10-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.000 IN PR= 71 MDOT=0.0203 LBM/SEC
9803. GGE(R)= 281.2 BTU/HR-SQ FT GGE(S)= 175.0 INLET TEMP= 75.6 F TATM= 71.4 F PATM= 14.6 PSIA

ID	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	95.6	0.0	92.6	87.9	0.0	85.2	75.7	273.9	170.3	152.3	0.0	179.4	154.4	0.0	197.7
16	107.2	0.0	97.7	93.2	0.0	88.5	75.8	270.4	169.0	95.4	0.0	136.7	107.7	0.0	147.7
26	103.0	0.0	99.6	92.2	0.0	93.0	75.9	271.7	169.0	111.0	0.0	126.9	114.6	0.0	109.4
35	100.6	0.0	101.6	91.1	0.0	95.0	76.0	272.4	169.3	122.6	0.0	117.8	124.0	0.0	98.7
45	96.9	0.0	101.5	91.4	0.0	96.0	76.1	273.5	169.2	145.6	0.0	119.3	122.9	0.0	94.2
54	103.3	0.0	106.9	92.6	0.0	96.0	76.2	271.6	169.0	111.0	0.0	98.0	114.0	0.0	94.6
63	102.7	0.0	102.3	93.6	0.0	97.0	76.3	271.8	168.7	114.0	0.0	115.8	107.8	0.0	90.3
73	103.4	0.0	106.1	95.0	0.0	97.0	76.4	271.6	168.4	111.4	0.0	101.3	100.3	0.0	90.6
82	106.1	0.0	106.2	96.7	0.0	98.0	76.5	270.7	167.9	101.3	0.0	101.0	92.1	0.0	86.5
91	103.0	0.0	103.0	98.2	0.0	98.0	76.6	271.7	167.3	114.0	0.0	114.0	85.9	0.0	86.6
01	112.5	0.0	0.0	100.5	0.0	0.0	76.7	268.8	167.4	83.2	0.0	0.0	77.9	0.0	0.0
10	111.8	0.0	0.0	99.9	0.0	0.0	76.9	269.0	167.1	85.1	0.0	0.0	80.1	0.0	0.0
20	110.0	0.0	0.0	101.5	0.0	0.0	77.0	269.6	166.5	90.2	0.0	0.0	75.0	0.0	0.0
29	110.5	0.0	0.0	102.0	0.0	0.0	77.1	269.4	166.2	89.1	0.0	0.0	73.8	0.0	0.0
38	107.7	0.0	0.0	102.9	0.0	0.0	77.2	270.3	165.9	97.9	0.0	0.0	71.3	0.0	0.0
48	113.5	0.0	0.0	104.6	0.0	0.0	77.3	268.5	165.6	81.9	0.0	0.0	67.0	0.0	0.0
57	114.2	0.0	0.0	105.0	0.0	0.0	77.4	268.3	165.3	80.5	0.0	0.0	66.2	0.0	0.0
66	113.2	0.0	0.0	105.0	0.0	0.0	77.5	268.6	165.0	83.1	0.0	0.0	66.3	0.0	0.0
76	113.8	0.0	0.0	107.0	0.0	0.0	77.6	268.4	164.4	81.9	0.0	0.0	61.8	0.0	0.0
85	107.8	0.0	0.0	107.0	0.0	0.0	77.7	270.2	164.4	99.2	0.0	0.0	62.0	0.0	0.0
95	116.4	0.0	0.0	107.0	0.0	0.0	77.8	267.7	164.4	76.6	0.0	0.0	62.2	0.0	0.0
04	115.2	0.0	0.0	108.0	0.0	0.0	77.9	268.0	164.1	79.4	0.0	0.0	60.2	0.0	0.0
13	115.0	0.0	0.0	109.0	0.0	0.0	78.0	268.1	163.8	80.0	0.0	0.0	58.4	0.0	0.0
23	116.0	0.0	0.0	110.0	0.0	0.0	78.1	267.8	163.5	78.0	0.0	0.0	56.6	0.0	0.0
32	111.1	0.0	0.0	110.0	0.0	0.0	78.2	269.2	163.5	90.4	0.0	0.0	56.8	0.0	0.0
41	118.2	0.0	0.0	111.0	0.0	0.0	78.4	267.1	163.2	73.9	0.0	0.0	55.1	0.0	0.0
51	117.4	0.0	0.0	111.0	0.0	0.0	78.5	267.4	163.2	75.7	0.0	0.0	55.3	0.0	0.0
60	115.9	0.0	0.0	111.0	0.0	0.0	78.6	267.8	163.2	79.1	0.0	0.0	55.5	0.0	0.0
70	116.8	0.0	0.0	112.0	0.0	0.0	78.7	267.5	162.9	77.4	0.0	0.0	53.9	0.0	0.0
79	112.7	0.0	0.0	113.0	0.0	0.0	78.8	268.8	162.6	87.3	0.0	0.0	52.4	0.0	0.0
88	120.3	0.0	0.0	113.0	0.0	0.0	78.9	266.5	162.6	70.9	0.0	0.0	52.5	0.0	0.0
98	119.1	0.0	0.0	113.0	0.0	0.0	79.0	266.8	162.6	73.3	0.0	0.0	52.7	0.0	0.0
07	118.0	0.0	0.0	113.0	0.0	0.0	79.1	267.2	162.6	75.7	0.0	0.0	52.8	0.0	0.0
16	118.6	0.0	0.0	115.0	0.0	0.0	79.2	267.0	162.0	74.7	0.0	0.0	49.8	0.0	0.0
26	112.6	0.0	0.0	114.0	0.0	0.0	79.3	268.8	162.3	88.9	0.0	0.0	51.5	0.0	0.0
35	121.2	0.0	0.0	116.0	0.0	0.0	79.4	266.2	161.7	70.2	0.0	0.0	48.7	0.0	0.0
45	119.8	0.0	0.0	116.0	0.0	0.0	79.5	266.6	161.7	72.9	0.0	0.0	48.8	0.0	0.0
54	119.2	0.0	0.0	116.0	0.0	0.0	79.6	266.8	161.7	74.2	0.0	0.0	48.9	0.0	0.0
63	119.5	0.0	0.0	116.0	0.0	0.0	79.7	266.7	161.7	73.8	0.0	0.0	49.1	0.0	0.0
73	114.0	0.0	0.0	116.0	0.0	0.0	79.8	268.4	161.7	86.5	0.0	0.0	49.2	0.0	0.0
82	124.0	0.0	0.0	123.0	0.0	0.0	84.2	265.4	159.6	72.9	0.0	0.0	45.0	0.0	0.0
91	126.2	0.0	0.0	124.1	0.0	0.0	84.3	264.7	159.6	69.1	0.0	0.0	43.8	0.0	0.0
00	124.2	0.0	0.0	123.9	0.0	0.0	84.4	265.3	159.6	72.9	0.0	0.0	44.2	0.0	0.0
09	125.0	0.0	0.0	124.1	0.0	0.0	84.5	265.1	159.6	71.5	0.0	0.0	44.0	0.0	0.0
18	120.9	0.0	0.0	123.7	0.0	0.0	84.7	266.3	159.9	80.2	0.0	0.0	44.7	0.0	0.0
27	126.6	0.0	0.0	123.8	0.0	0.0	84.8	264.6	159.9	69.0	0.0	0.0	44.7	0.0	0.0
36	126.7	0.0	0.0	124.3	0.0	0.0	84.9	264.6	159.3	69.0	0.0	0.0	44.1	0.0	0.0
45	125.2	0.0	0.0	124.3	0.0	0.0	85.0	265.0	159.3	71.9	0.0	0.0	44.2	0.0	0.0
54	125.7	0.0	0.0	123.5	0.0	0.0	85.1	264.9	159.9	71.1	0.0	0.0	45.4	0.0	0.0
63	120.6	0.0	0.0	123.2	0.0	0.0	85.2	266.4	159.9	82.1	0.0	0.0	45.8	0.0	0.0
72	126.3	125.8	126.9	123.6	122.8	118.5	85.3	264.7	160.2	70.4	71.3	69.4	45.6	46.6	52.6
81	126.4	125.6	122.7	123.6	121.9	118.0	85.4	264.7	159.9	70.4	71.8	77.4	45.7	47.8	53.5
90	125.1	124.4	120.5	123.7	123.1	119.0	85.5	265.0	159.9	73.0	74.3	82.6	45.7	46.3	52.0
99	125.2	124.8	120.6	123.6	121.0	118.0	85.6	265.0	159.9	73.0	73.7	82.6	45.9	49.2	53.8

8.88	121.9	123.2	118.9	123.9	124.3	123.9	85.7	266.0	159.9	80.1	77.3	87.4	45.6	45.2	45.7
8.98	127.3	128.4	125.4	124.5	123.4	118.0	85.8	264.4	159.6	69.5	67.7	72.8	45.0	46.3	54.0
9.07	126.9	126.1	124.8	124.6	123.2	120.5	85.9	264.5	159.6	70.3	71.7	74.1	45.0	46.6	50.3
9.16	125.7	125.1	122.7	124.0	123.6	120.7	86.0	264.9	159.6	72.7	73.9	78.7	45.8	46.3	50.1
9.26	126.3	126.3	123.2	124.1	124.3	121.0	86.1	264.7	159.6	71.8	71.8	77.8	45.8	45.5	49.9
9.35	123.8	123.9	122.2	125.1	124.7	119.9	86.3	265.4	159.3	77.0	76.8	80.4	44.7	45.2	51.5

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 U(R)A= 74.46 NU(S)A= 47.94 NU(AV)A= 61.20 ST(AV)A=0.00881 ST(AV)/ST(4S)=1.96 F/F(4S)= 3.87
 ST/ST(4S))/(F/F(4S))=0.507 (F/F(4S))/(ST/ST(4S))*3.0=0.51 (ST/ST(4S))/(F/F(4S))*{(1/3)}=1.25
 U(R)A/NU(4S)=2.39 NU(S)A/NU(4S)=1.54 e+(4R)= 75.02 R(4R)= 2.67 H(4R)= 9.10

USING ROUGH SIDE RESULTS ONLY : H(RB)= 11.90

RUN NUMBER= 84HR30-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.000 IN PR=.71 MDOF=0.0680 LBM/SEC
 RE= 32752. GGE(R)= 574.6 BTU/HR-SQ FT GGE(S)= 442.9 INLET TEMP= 79.0 F TATM= 74.4 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.07	96.7	0.0	93.2	92.3	0.0	98.8	79.1	568.0	439.0	354.7	0.0	442.5	365.8	0.0	24
2	0.16	105.1	0.0	96.3	96.5	0.0	99.4	79.1	565.4	438.3	239.9	0.0	362.8	277.7	0.0	22
3	0.26	100.8	0.0	97.4	96.0	0.0	94.2	79.2	566.7	437.6	289.1	0.0	343.2	286.9	0.0	32
4	0.35	100.4	0.0	102.1	95.9	0.0	98.7	79.3	566.8	437.6	295.7	0.0	273.6	290.3	0.0	24
5	0.45	96.6	0.0	101.4	96.5	0.0	98.8	79.4	568.0	437.1	362.8	0.0	283.8	280.6	0.0	24
6	0.54	103.2	0.0	108.3	97.6	0.0	99.8	79.4	566.0	437.1	262.2	0.0	215.9	264.9	0.0	23
7	0.63	100.6	0.0	101.7	98.7	0.0	99.0	79.5	566.8	436.7	295.9	0.0	281.2	251.0	0.0	24
8	0.73	101.5	0.0	107.6	99.9	0.0	100.8	79.6	566.5	436.5	284.6	0.0	222.6	236.2	0.0	22
9	0.82	104.3	0.0	108.0	101.4	0.0	101.6	79.7	565.7	436.2	252.7	0.0	219.7	221.3	0.0	21
10	0.91	100.6	0.0	102.7	102.4	0.0	102.9	79.7	566.8	435.3	299.0	0.0	271.6	211.2	0.0	20
11	1.01	108.3	0.0	0.0	105.2	0.0	0.0	79.8	564.5	435.5	218.0	0.0	0.0	189.1	0.0	0
12	1.10	110.0	0.0	0.0	103.2	0.0	0.0	79.9	564.0	435.5	206.1	0.0	0.0	205.4	0.0	0
13	1.20	119.0	0.0	0.0	106.2	0.0	0.0	80.0	561.3	434.3	158.2	0.0	0.0	181.8	0.0	0
14	1.29	108.2	0.0	0.0	104.3	0.0	0.0	80.0	564.5	434.0	220.5	0.0	0.0	182.0	0.0	0
15	1.38	105.1	0.0	0.0	106.9	0.0	0.0	80.1	565.4	433.7	248.9	0.0	0.0	177.8	0.0	0
16	1.48	112.1	0.0	0.0	106.5	0.0	0.0	80.2	563.3	433.4	194.1	0.0	0.0	180.9	0.0	0
17	1.57	110.8	0.0	0.0	108.0	0.0	0.0	80.3	563.7	432.8	203.0	0.0	0.0	171.6	0.0	0
18	1.66	110.1	0.0	0.0	109.0	0.0	0.0	80.3	563.9	432.5	208.3	0.0	0.0	165.9	0.0	0
19	1.76	111.1	0.0	0.0	110.0	0.0	0.0	80.4	563.6	432.2	201.9	0.0	0.0	160.6	0.0	0
20	1.85	104.1	0.0	0.0	110.0	0.0	0.0	80.5	565.7	432.2	263.4	0.0	0.0	161.0	0.0	0
21	1.95	113.9	0.0	0.0	111.0	0.0	0.0	80.6	562.8	431.9	185.6	0.0	0.0	156.0	0.0	0
22	2.04	111.1	0.0	0.0	112.0	0.0	0.0	80.6	563.6	431.6	203.4	0.0	0.0	151.3	0.0	0
23	2.13	111.6	0.0	0.0	113.0	0.0	0.0	80.7	563.5	431.3	200.5	0.0	0.0	146.8	0.0	0
24	2.23	113.2	0.0	0.0	114.0	0.0	0.0	80.8	563.0	431.0	190.9	0.0	0.0	142.6	0.0	0
25	2.32	107.5	0.0	0.0	114.0	0.0	0.0	80.9	564.7	431.0	232.9	0.0	0.0	142.9	0.0	0
26	2.41	116.2	0.0	0.0	115.0	0.0	0.0	80.9	562.1	430.7	175.1	0.0	0.0	138.9	0.0	0
27	2.51	113.0	0.0	0.0	115.0	0.0	0.0	81.0	563.1	430.7	193.4	0.0	0.0	139.2	0.0	0
28	2.60	112.6	0.0	0.0	114.0	0.0	0.0	81.1	563.2	431.0	196.3	0.0	0.0	143.8	0.0	0
29	2.70	114.1	0.0	0.0	117.0	0.0	0.0	81.2	562.7	430.1	187.6	0.0	0.0	131.8	0.0	0
30	2.79	108.8	0.0	0.0	117.0	0.0	0.0	81.2	564.3	430.1	224.8	0.0	0.0	132.1	0.0	0
31	2.88	118.5	0.0	0.0	118.0	0.0	0.0	81.3	561.4	429.8	165.8	0.0	0.0	128.6	0.0	0
32	2.98	114.7	0.0	0.0	118.0	0.0	0.0	81.4	562.6	429.8	185.4	0.0	0.0	128.9	0.0	0
33	3.07	115.1	0.0	0.0	119.0	0.0	0.0	81.5	562.4	429.5	183.5	0.0	0.0	125.6	0.0	0
34	3.16	116.5	0.0	0.0	121.0	0.0	0.0	81.5	562.0	428.9	176.4	0.0	0.0	119.3	0.0	0
35	3.26	108.8	0.0	0.0	120.0	0.0	0.0	81.6	564.3	429.2	227.8	0.0	0.0	122.7	0.0	0
36	3.35	120.1	0.0	0.0	121.0	0.0	0.0	81.7	560.9	428.9	160.2	0.0	0.0	119.7	0.0	0
37	3.45	115.7	0.0	0.0	122.0	0.0	0.0	81.8	562.3	428.6	181.8	0.0	0.0	116.9	0.0	0
38	3.54	116.2	0.0	0.0	121.0	0.0	0.0	81.8	562.1	428.9	179.5	0.0	0.0	120.1	0.0	0
39	3.63	117.5	0.0	0.0	122.0	0.0	0.0	81.9	561.7	428.6	173.2	0.0	0.0	117.3	0.0	0
40	3.73	110.2	0.0	0.0	121.0	0.0	0.0	82.0	563.9	428.9	219.3	0.0	0.0	120.6	0.0	0
41	7.57	121.8	0.0	0.0	129.0	0.0	0.0	85.1	560.4	426.5	166.6	0.0	0.0	106.0	0.0	0
42	7.66	121.1	0.0	0.0	130.0	0.0	0.0	85.2	560.6	426.2	170.2	0.0	0.0	103.7	0.0	0
43	7.76	120.9	0.0	0.0	130.0	0.0	0.0	85.2	560.7	426.2	171.5	0.0	0.0	103.9	0.0	0
44	7.85	123.4	0.0	0.0	130.0	0.0	0.0	85.3	559.9	426.2	160.4	0.0	0.0	104.0	0.0	0
45	7.95	116.7	0.0	0.0	128.3	0.0	0.0	85.4	562.0	427.4	195.7	0.0	0.0	108.7	0.0	0
46	8.04	123.8	0.0	0.0	128.5	0.0	0.0	85.5	559.8	427.4	159.2	0.0	0.0	108.3	0.0	0
47	8.13	121.3	0.0	0.0	131.0	0.0	0.0	85.5	560.6	425.9	170.9	0.0	0.0	102.1	0.0	0
48	8.23	121.7	0.0	0.0	128.2	0.0	0.0	85.6	560.5	428.9	169.3	0.0	0.0	109.7	0.0	0
49	8.32	123.7	0.0	0.0	129.9	0.0	0.0	85.7	559.9	429.2	160.6	0.0	0.0	105.7	0.0	0
50	8.41	117.0	0.0	0.0	130.5	0.0	0.0	85.8	561.9	428.9	196.1	0.0	0.0	104.5	0.0	0
51	8.51	123.3	124.4	125.8	129.4	129.7	123.8	85.8	560.0	429.2	162.9	158.3	152.7	107.4	106.6	123.1
52	8.60	121.2	122.0	119.7	129.3	129.7	124.8	85.9	560.6	428.3	173.1	169.3	180.8	107.6	106.7	120.1
53	8.70	121.5	122.6	119.5	129.6	130.1	123.8	86.0	560.5	428.3	172.0	166.8	182.3	107.0	105.7	123.4
54	8.79	122.9	123.9	120.7	131.2	131.2	122.7	86.1	560.1	428.0	165.7	161.3	176.2	103.2	103.2	127.2

55	8.88	117.7	121.1	115.3	131.3	130.3	130.8	86.2	561.7	427.4	193.9	175.0	209.8	103.1	105.5	104.2
56	8.98	124.4	126.8	123.8	129.7	128.6	123.9	86.2	559.6	427.4	159.6	150.2	162.2	107.1	109.7	123.4
57	9.07	121.4	122.2	121.0	129.9	128.5	125.6	86.3	560.5	427.1	173.9	170.0	175.9	106.6	110.3	118.3
58	9.16	121.9	122.9	121.3	131.5	129.4	125.8	86.4	560.4	426.8	171.7	167.0	174.7	103.1	107.9	117.7
59	9.26	123.4	125.2	123.3	130.1	130.1	125.0	86.5	559.9	427.1	165.0	157.3	165.4	106.4	106.5	120.1
60	9.35	119.5	120.8	120.3	130.4	129.1	123.1	86.5	561.1	426.8	185.2	178.2	180.8	105.9	109.0	126.1

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=178.80 NU(S)A=113.86 NU(AV)A=146.33 ST(AV)A=0.00630 ST(AV)/ST(4S)=1.78 F/F(4S)= 4.49
 (ST/ST(4S))/(F/F(4S))=0.397 (F/F(4S))/(ST/ST(4S))*3.0=0.79 (ST/ST(4S))/(F/F(4S))*3.0=1.08
 NU(R)A/NU(4S)=2.18 NU(S)A/NU(4S)=1.39 e+(4R)= 234.59 R(4R)= 3.10 H(4R)=13.50

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 16.51

ORIGINAL PRICE IS
OF POOR QUALITY

NUMBER= 85HR60-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.000 IN PR=.71 MDDT=0.1330 LBM/SEC
3788. GGE(R)=1024.9 BTU/HR-SQ FT GGE(S)= 750.3 INLET TEMP= 82.4 F TATM= 76.1 F PATM= 14.6 PSIA

/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	102.1	0.0	97.1	94.9	0.0	89.7	82.5	1017.1	746.0	567.2	0.0	760.8	659.2	0.0	1120.3
16	108.9	0.0	99.4	98.0	0.0	93.2	82.5	1015.1	745.3	421.6	0.0	658.8	526.0	0.0	763.9
26	102.8	0.0	100.1	97.7	0.0	97.2	82.6	1016.9	744.6	551.1	0.0	636.1	540.8	0.0	560.0
35	104.1	0.0	106.4	97.6	0.0	102.2	82.7	1016.5	744.6	519.2	0.0	468.9	546.6	0.0	418.3
45	100.4	0.0	105.2	98.4	0.0	101.4	82.7	1017.6	744.0	630.5	0.0	495.9	520.3	0.0	436.9
54	107.8	0.0	113.0	99.7	0.0	102.6	82.8	1015.4	744.2	444.6	0.0	368.1	483.0	0.0	411.8
63	103.6	0.0	104.0	101.2	0.0	102.0	82.9	1016.7	743.6	536.8	0.0	526.6	444.7	0.0	425.4
73	104.9	0.0	112.9	102.2	0.0	104.0	82.9	1016.3	743.6	506.4	0.0	371.2	423.3	0.0	386.9
82	108.8	0.0	113.4	104.6	0.0	102.5	83.0	1015.1	743.2	430.7	0.0	365.5	375.8	0.0	417.2
91	104.3	0.0	106.8	106.0	0.0	105.0	83.1	1016.5	742.3	524.0	0.0	468.8	354.8	0.0	370.8
01	112.9	0.0	0.0	106.7	0.0	0.0	83.1	1013.9	742.7	372.8	0.0	0.0	344.3	0.0	0.0
10	116.0	0.0	0.0	106.2	0.0	0.0	83.2	1013.0	742.6	338.0	0.0	0.0	354.1	0.0	0.0
20	115.0	0.0	0.0	108.5	0.0	0.0	83.3	1013.3	741.3	349.4	0.0	0.0	321.9	0.0	0.0
29	112.7	0.0	0.0	109.1	0.0	0.0	83.3	1014.0	741.2	377.8	0.0	0.0	315.1	0.0	0.0
38	109.3	0.0	0.0	112.1	0.0	0.0	83.4	1015.0	740.5	428.8	0.0	0.0	282.7	0.0	0.0
48	118.4	0.0	0.0	111.8	0.0	0.0	83.5	1012.2	739.9	317.0	0.0	0.0	285.8	0.0	0.0
57	115.6	0.0	0.0	113.2	0.0	0.0	83.5	1013.1	739.7	345.6	0.0	0.0	273.0	0.0	0.0
66	115.0	0.0	0.0	114.5	0.0	0.0	83.6	1013.3	739.5	353.0	0.0	0.0	262.1	0.0	0.0
76	116.3	0.0	0.0	113.0	0.0	0.0	83.7	1012.9	739.2	339.5	0.0	0.0	275.7	0.0	0.0
85	107.3	0.0	0.0	113.0	0.0	0.0	83.7	1015.6	739.2	471.4	0.0	0.0	276.3	0.0	0.0
95	120.2	0.0	0.0	113.5	0.0	0.0	83.8	1011.7	739.1	304.0	0.0	0.0	272.2	0.0	0.0
04	115.5	0.0	0.0	114.0	0.0	0.0	83.9	1013.1	738.9	350.3	0.0	0.0	268.2	0.0	0.0
13	116.4	0.0	0.0	115.0	0.0	0.0	84.0	1012.8	738.6	341.2	0.0	0.0	260.0	0.0	0.0
23	118.6	0.0	0.0	117.0	0.0	0.0	84.0	1012.2	738.0	319.9	0.0	0.0	244.6	0.0	0.0
32	111.4	0.0	0.0	117.0	0.0	0.0	84.1	1014.3	738.0	405.8	0.0	0.0	245.0	0.0	0.0
41	122.6	0.0	0.0	118.0	0.0	0.0	84.2	1011.0	737.7	287.3	0.0	0.0	238.2	0.0	0.0
51	117.7	0.0	0.0	118.0	0.0	0.0	84.2	1012.5	737.7	330.4	0.0	0.0	238.6	0.0	0.0
60	117.2	0.0	0.0	116.0	0.0	0.0	84.3	1012.6	738.3	336.1	0.0	0.0	254.4	0.0	0.0
70	119.3	0.0	0.0	120.0	0.0	0.0	84.4	1012.0	737.1	316.4	0.0	0.0	225.9	0.0	0.0
79	112.1	0.0	0.0	121.0	0.0	0.0	84.4	1014.1	736.8	400.3	0.0	0.0	220.0	0.0	0.0
88	125.3	0.0	0.0	122.0	0.0	0.0	84.5	1010.2	736.5	270.4	0.0	0.0	214.5	0.0	0.0
98	119.3	0.0	0.0	122.0	0.0	0.0	84.6	1012.0	736.5	318.1	0.0	0.0	214.8	0.0	0.0
07	120.0	0.0	0.0	122.0	0.0	0.0	84.6	1011.8	736.5	312.3	0.0	0.0	215.2	0.0	0.0
16	121.8	0.0	0.0	125.0	0.0	0.0	84.7	1011.2	735.6	297.6	0.0	0.0	199.3	0.0	0.0
26	111.4	0.0	0.0	123.0	0.0	0.0	84.8	1014.3	736.2	415.8	0.0	0.0	210.2	0.0	0.0
35	127.2	0.0	0.0	123.8	0.0	0.0	84.8	1009.6	736.0	260.1	0.0	0.0	206.2	0.0	0.0
45	120.3	0.0	0.0	125.0	0.0	0.0	84.9	1011.7	735.6	311.9	0.0	0.0	200.2	0.0	0.0
54	121.2	0.0	0.0	125.0	0.0	0.0	85.0	1011.4	735.6	304.6	0.0	0.0	200.5	0.0	0.0
63	123.1	0.0	0.0	126.0	0.0	0.0	85.0	1010.8	735.3	289.8	0.0	0.0	195.9	0.0	0.0
73	113.0	0.0	0.0	124.0	0.0	0.0	85.1	1013.9	735.9	396.6	0.0	0.0	206.4	0.0	0.0
82	127.9	0.0	0.0	133.0	0.0	0.0	87.9	1009.4	733.2	274.1	0.0	0.0	176.6	0.0	0.0
91	125.5	0.0	0.0	133.5	0.0	0.0	88.0	1010.1	733.1	292.3	0.0	0.0	174.8	0.0	0.0
01	125.3	0.0	0.0	132.0	0.0	0.0	88.0	1010.2	733.5	294.4	0.0	0.0	181.2	0.0	0.0
10	128.6	0.0	0.0	131.0	0.0	0.0	88.1	1009.2	733.8	270.6	0.0	0.0	185.7	0.0	0.0
20	120.0	0.0	0.0	130.7	0.0	0.0	88.2	1011.8	735.2	345.1	0.0	0.0	187.9	0.0	0.0
29	129.8	0.0	0.0	132.1	0.0	0.0	88.2	1008.8	734.6	263.5	0.0	0.0	182.0	0.0	0.0
38	125.2	0.0	0.0	131.5	0.0	0.0	88.3	1010.2	735.0	297.2	0.0	0.0	184.5	0.0	0.0
48	125.9	0.0	0.0	132.8	0.0	0.0	88.4	1010.0	736.8	292.1	0.0	0.0	180.1	0.0	0.0
57	128.7	0.0	0.0	133.0	0.0	0.0	88.5	1009.2	736.5	272.0	0.0	0.0	179.5	0.0	0.0
66	120.0	0.0	0.0	131.6	0.0	0.0	88.5	1011.8	736.2	348.7	0.0	0.0	185.4	0.0	0.0
76	129.4	129.3	129.9	131.2	131.0	124.8	88.6	1008.9	736.2	268.2	268.8	264.9	187.4	188.3	220.4
85	125.4	124.2	120.2	131.0	131.4	126.1	88.7	1010.1	735.2	298.2	308.2	347.3	188.1	186.5	213.2
95	126.0	124.8	121.0	133.8	132.0	125.5	88.7	1010.0	735.0	293.8	303.6	339.4	176.8	184.1	217.0
04	128.1	126.6	122.9	134.2	131.9	124.4	88.8	1009.3	734.7	278.4	289.5	320.9	175.3	184.7	223.9

8.88	120.8	123.3	116.1	133.5	132.0	132.2	88.9	1011.5	734.4	343.4	318.5	402.6	178.2	184.4	183.8
8.98	130.1	131.9	126.7	134.1	131.6	125.0	88.9	1008.7	734.1	265.6	254.5	289.5	176.4	186.3	220.9
9.07	125.0	124.1	121.6	134.4	131.7	127.7	89.0	1010.3	733.8	304.2	312.0	335.9	175.4	186.5	205.7
9.16	126.0	124.9	123.0	133.3	132.6	127.8	89.1	1010.0	733.7	296.4	305.5	322.6	179.9	182.8	205.5
9.26	128.7	128.1	126.0	132.5	132.3	127.2	89.1	1009.2	734.1	276.4	280.7	296.7	183.6	184.5	209.2
9.35	122.8	122.9	121.9	133.9	132.3	123.9	89.2	1010.9	733.5	326.1	325.1	335.0	177.9	184.6	229.4

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 (R)A=306.39 NU(S)A=193.11 NU(AV)A=249.75 ST(AV)A=0.00552 ST(AV)/ST(4S)=1.79 F/F(4S)= 4.83
 T/ST(4S))/(F/F(4S))=0.370 (F/F(4S))/(ST/ST(4S))*3.0=0.85 (ST/ST(4S))/(F/F(4S))*(1/3)=1.06
 (R)A/NU(4S)=2.20 NU(S)A/NU(4S)=1.38 e+(4R)= 439.60 R(4R)= 3.36 H(4R)=15.14

USING ROUGH SIDE RESULTS ONLY : H(RB)= 18.37

RUN NUMBER= B7HR10-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.000 IN PR=.71 MDDT=0.0210 LBM/SEC
 RE= 10148. GGE(R)= 266.6 BTU/HR-SQ FT GGE(S)= 156.3 INLET TEMP= 75.7 F TATM= 73.1 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	95.3	0.0	91.3	87.7	0.0	86.3	75.8	259.9	152.1	147.4	0.0	185.4	141.0	0.0
2	0.16	106.0	0.0	95.4	92.5	0.0	89.6	75.9	256.7	150.9	94.4	0.0	145.6	100.3	0.0
3	0.26	101.1	0.0	97.6	91.6	0.0	91.0	76.0	258.2	150.9	113.7	0.0	132.1	106.6	0.0
4	0.35	99.8	0.0	99.9	90.5	0.0	93.0	76.1	258.6	151.2	120.6	0.0	120.1	115.6	0.0
5	0.45	99.4	0.0	99.8	90.6	0.0	93.0	76.2	258.7	151.2	123.2	0.0	121.1	116.1	0.0
6	0.54	101.3	0.0	100.4	91.8	0.0	93.0	76.2	258.1	151.1	114.1	0.0	118.3	107.7	0.0
7	0.63	103.0	0.0	98.8	92.6	0.0	94.0	76.3	257.6	150.8	107.0	0.0	127.0	102.8	0.0
8	0.73	105.6	0.0	103.3	94.0	0.0	94.0	76.4	256.8	150.4	97.5	0.0	105.8	94.5	0.0
9	0.82	108.3	0.0	104.6	95.4	0.0	95.0	76.5	256.0	150.0	89.2	0.0	100.9	87.7	0.0
10	0.91	102.6	0.0	101.5	96.6	0.0	95.0	76.6	257.7	149.5	109.8	0.0	114.6	82.8	0.0
11	1.01	111.7	0.0	0.0	99.6	0.0	0.0	76.7	255.0	149.4	80.6	0.0	0.0	72.2	0.0
12	1.10	110.6	0.0	0.0	99.0	0.0	0.0	76.8	255.3	149.1	83.6	0.0	0.0	74.4	0.0
13	1.20	110.0	0.0	0.0	100.5	0.0	0.0	76.9	255.5	148.5	85.4	0.0	0.0	69.5	0.0
14	1.29	109.4	0.0	0.0	101.0	0.0	0.0	77.0	255.7	148.2	87.3	0.0	0.0	68.3	0.0
15	1.38	110.5	0.0	0.0	101.9	0.0	0.0	77.1	255.4	147.9	84.5	0.0	0.0	65.9	0.0
16	1.48	112.1	0.0	0.0	103.6	0.0	0.0	77.2	254.9	147.6	80.7	0.0	0.0	61.7	0.0
17	1.57	113.7	0.0	0.0	104.0	0.0	0.0	77.3	254.4	147.3	77.2	0.0	0.0	61.0	0.0
18	1.66	115.5	0.0	0.0	103.0	0.0	0.0	77.4	253.9	147.3	73.6	0.0	0.0	63.6	0.0
19	1.76	116.4	0.0	0.0	104.0	0.0	0.0	77.5	253.6	147.0	72.0	0.0	0.0	61.3	0.0
20	1.85	107.9	0.0	0.0	104.0	0.0	0.0	77.6	256.1	147.0	93.3	0.0	0.0	61.5	0.0
21	1.95	116.0	0.0	0.0	105.0	0.0	0.0	77.7	253.7	146.7	73.1	0.0	0.0	59.3	0.0
22	2.04	114.5	0.0	0.0	105.0	0.0	0.0	77.8	254.2	146.7	76.4	0.0	0.0	59.5	0.0
23	2.13	113.1	0.0	0.0	107.0	0.0	0.0	77.9	254.6	146.1	79.8	0.0	0.0	55.4	0.0
24	2.23	113.6	0.0	0.0	108.0	0.0	0.0	78.0	254.4	145.8	78.8	0.0	0.0	53.6	0.0
25	2.32	114.6	0.0	0.0	107.0	0.0	0.0	78.1	254.1	146.1	76.8	0.0	0.0	55.7	0.0
26	2.41	116.2	0.0	0.0	109.0	0.0	0.0	78.2	253.6	145.5	73.6	0.0	0.0	52.1	0.0
27	2.51	117.5	0.0	0.0	109.0	0.0	0.0	78.3	253.3	145.5	71.2	0.0	0.0	52.2	0.0
28	2.60	118.5	0.0	0.0	109.0	0.0	0.0	78.3	253.0	145.5	69.5	0.0	0.0	52.4	0.0
29	2.70	119.8	0.0	0.0	110.0	0.0	0.0	78.4	252.6	145.2	67.4	0.0	0.0	50.8	0.0
30	2.79	113.7	0.0	0.0	110.0	0.0	0.0	78.5	254.4	145.2	79.8	0.0	0.0	50.9	0.0
31	2.88	120.8	0.0	0.0	111.0	0.0	0.0	78.6	252.3	144.9	66.0	0.0	0.0	49.4	0.0
32	2.98	119.8	0.0	0.0	111.0	0.0	0.0	78.7	252.6	144.9	67.8	0.0	0.0	49.5	0.0
33	3.07	117.0	0.0	0.0	112.0	0.0	0.0	78.8	253.4	144.6	73.2	0.0	0.0	48.0	0.0
34	3.16	116.8	0.0	0.0	113.0	0.0	0.0	78.9	253.5	144.3	73.7	0.0	0.0	46.7	0.0
35	3.26	117.1	0.0	0.0	112.0	0.0	0.0	79.0	253.4	144.6	73.3	0.0	0.0	48.3	0.0
36	3.35	119.0	0.0	0.0	113.0	0.0	0.0	79.1	252.8	144.3	69.8	0.0	0.0	46.9	0.0
37	3.45	120.2	0.0	0.0	113.0	0.0	0.0	79.2	252.4	144.3	67.8	0.0	0.0	47.0	0.0
38	3.54	122.7	0.0	0.0	113.0	0.0	0.0	79.3	251.7	144.3	63.9	0.0	0.0	47.2	0.0
39	3.63	123.0	0.0	0.0	114.0	0.0	0.0	79.4	251.6	144.0	63.5	0.0	0.0	45.8	0.0
40	3.73	115.1	0.0	0.0	113.0	0.0	0.0	79.5	254.0	144.3	78.5	0.0	0.0	47.4	0.0
41	7.57	124.0	0.0	0.0	120.0	0.0	0.0	83.4	251.3	142.2	67.7	0.0	0.0	42.5	0.0
42	7.66	126.2	0.0	0.0	121.2	0.0	0.0	83.5	250.6	142.2	64.2	0.0	0.0	41.3	0.0
43	7.76	122.2	0.0	0.0	121.4	0.0	0.0	83.6	251.8	142.1	71.3	0.0	0.0	41.1	0.0
44	7.85	121.9	0.0	0.0	121.2	0.0	0.0	83.7	251.9	142.2	72.1	0.0	0.0	41.5	0.0
45	7.95	123.1	0.0	0.0	121.7	0.0	0.0	83.8	251.6	142.2	70.0	0.0	0.0	41.0	0.0
46	8.04	124.5	0.0	0.0	121.9	0.0	0.0	83.9	251.2	142.2	67.6	0.0	0.0	40.9	0.0
47	8.13	126.4	0.0	0.0	121.8	0.0	0.0	84.0	250.6	141.8	64.6	0.0	0.0	41.0	0.0
48	8.23	127.9	0.0	0.0	121.3	0.0	0.0	84.1	250.1	141.9	62.4	0.0	0.0	41.7	0.0
49	8.32	129.4	0.0	0.0	121.5	0.0	0.0	84.2	249.7	142.2	60.3	0.0	0.0	41.6	0.0
50	8.41	121.7	0.0	0.0	121.3	0.0	0.0	84.3	252.0	142.2	73.5	0.0	0.0	42.0	0.0
51	8.51	126.7	125.6	126.2	121.7	118.8	116.5	84.4	250.5	142.5	64.6	66.3	65.4	41.7	45.2
52	8.60	126.5	124.9	122.1	121.6	118.9	116.0	84.4	250.6	142.2	65.1	67.6	72.7	41.8	45.1
53	8.70	123.1	121.8	118.4	121.7	119.2	117.0	84.5	251.6	142.2	71.2	73.7	81.1	41.8	44.8
54	8.79	122.3	120.9	117.1	121.6	119.0	117.0	84.6	251.8	142.2	73.0	75.8	84.7	42.0	45.2

55	8.88	123.4	121.8	118.6	122.0	121.4	123.1	84.7	251.5	142.2	71.0	74.1	81.1	41.7	42.4
56	8.98	123.9	122.3	119.1	122.5	120.4	117.0	84.8	251.3	141.9	70.2	73.2	80.0	41.1	43.5
57	9.07	125.4	123.2	120.7	122.6	120.3	116.5	84.9	250.9	141.9	67.6	71.5	76.5	41.1	43.8
58	9.16	127.5	125.5	122.6	122.0	120.6	117.7	85.0	250.3	141.9	64.3	67.5	72.7	41.9	43.5
59	9.26	128.8	128.1	124.5	121.1	120.4	117.0	85.1	249.9	142.2	62.4	63.4	69.2	43.1	44.0
60	9.35	124.4	124.2	121.8	122.1	121.7	118.0	85.2	251.2	141.9	69.9	70.3	74.9	42.0	42.4

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 68.85 NU(S)A= 44.71 NU(AV)A= 56.78 ST(AV)A=0.00790 ST(AV)/ST(4S)=1.77 F/F(4S)= 3.20
 (ST/ST(4S))/(F/F(4S))=0.552 (F/F(4S))/(ST/ST(4S))*3.0=0.58 (ST/ST(4S))/(F/F(4S))*((1/3)=1.20
 NU(R)A/NU(4S)=2.15 NU(S)A/NU(4S)=1.40 e+(4R)= 69.30 R(4R)= 3.41 H(4R)= 9.52

BY USING ROUGHSDIE RESULTS ONLY : H(RB)= 11.88

ORIGINAL RESULTS OF POOR QUALITY

NUMBER= 88HR30-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.000 IN PR=.71 MDDT=0.0679 LBM/SEC
 2739. GGE(R)= 484.5 BTU/HR-SQ FT GGE(S)= 435.3 INLET TEMP= 78.6 F TATM= 72.3 F PATM= 14.6 PSIA

/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TRULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	93.9	0.0	89.4	92.3	0.0	97.7	78.7	478.0	430.8	345.6	0.0	490.3	348.6	0.0	248.7
16	100.8	0.0	91.6	96.3	0.0	97.4	78.7	475.9	430.1	237.6	0.0	407.3	269.5	0.0	253.8
26	96.9	0.0	93.1	95.4	0.0	92.2	78.8	477.1	429.6	290.4	0.0	367.4	284.9	0.0	352.7
35	97.6	0.0	96.7	95.1	0.0	95.7	78.9	476.9	429.6	280.4	0.0	294.6	291.8	0.0	281.5
45	97.6	0.0	97.1	95.6	0.0	95.8	78.9	476.9	429.1	281.4	0.0	289.1	283.4	0.0	280.1
54	99.3	0.0	98.1	96.8	0.0	95.8	79.0	476.4	429.2	258.5	0.0	274.7	265.5	0.0	280.7
63	100.8	0.0	96.3	97.9	0.0	95.0	79.1	475.9	428.7	241.2	0.0	304.2	251.2	0.0	296.3
73	103.2	0.0	102.1	99.3	0.0	98.8	79.1	475.2	428.5	217.5	0.0	227.9	233.7	0.0	239.9
82	105.7	0.0	103.7	101.0	0.0	98.6	79.2	474.5	428.1	197.2	0.0	213.3	216.7	0.0	242.8
91	98.9	0.0	99.6	102.1	0.0	99.9	79.3	476.5	427.2	267.3	0.0	258.1	205.9	0.0	227.8
01	105.9	0.0	0.0	104.2	0.0	0.0	79.3	474.4	427.6	196.7	0.0	0.0	189.7	0.0	0.0
10	106.4	0.0	0.0	103.2	0.0	0.0	79.4	474.2	427.3	193.4	0.0	0.0	197.6	0.0	0.0
20	105.0	0.0	0.0	105.8	0.0	0.0	79.5	474.7	426.2	204.7	0.0	0.0	177.9	0.0	0.0
29	105.4	0.0	0.0	105.8	0.0	0.0	79.5	474.5	425.9	202.0	0.0	0.0	178.8	0.0	0.0
38	106.3	0.0	0.0	106.9	0.0	0.0	79.6	474.3	425.5	195.6	0.0	0.0	171.3	0.0	0.0
48	107.4	0.0	0.0	107.5	0.0	0.0	79.7	473.9	424.9	188.2	0.0	0.0	167.8	0.0	0.0
57	108.8	0.0	0.0	108.0	0.0	0.0	79.7	473.5	424.6	179.3	0.0	0.0	165.4	0.0	0.0
66	110.3	0.0	0.0	109.0	0.0	0.0	79.8	473.1	424.3	170.7	0.0	0.0	159.9	0.0	0.0
76	111.6	0.0	0.0	110.0	0.0	0.0	79.9	472.7	424.0	164.0	0.0	0.0	154.9	0.0	0.0
85	101.6	0.0	0.0	110.0	0.0	0.0	79.9	473.7	424.0	241.7	0.0	0.0	155.2	0.0	0.0
95	108.7	0.0	0.0	111.0	0.0	0.0	80.0	473.6	423.7	181.6	0.0	0.0	150.4	0.0	0.0
1.04	106.7	0.0	0.0	112.0	0.0	0.0	80.1	474.2	423.4	195.9	0.0	0.0	145.9	0.0	0.0
1.13	107.3	0.0	0.0	113.0	0.0	0.0	80.2	474.0	423.1	192.0	0.0	0.0	141.6	0.0	0.0
2.23	108.3	0.0	0.0	114.0	0.0	0.0	80.2	473.7	422.8	185.5	0.0	0.0	137.6	0.0	0.0
2.32	109.7	0.0	0.0	114.0	0.0	0.0	80.3	473.3	422.8	176.9	0.0	0.0	137.9	0.0	0.0
2.41	111.2	0.0	0.0	115.0	0.0	0.0	80.4	472.8	422.5	168.5	0.0	0.0	134.1	0.0	0.0
2.51	112.7	0.0	0.0	115.0	0.0	0.0	80.4	472.4	422.5	160.9	0.0	0.0	134.3	0.0	0.0
2.60	114.0	0.0	0.0	114.0	0.0	0.0	80.5	472.0	422.8	154.8	0.0	0.0	138.7	0.0	0.0
2.70	115.4	0.0	0.0	117.0	0.0	0.0	80.6	471.5	421.9	148.8	0.0	0.0	127.2	0.0	0.0
2.79	106.5	0.0	0.0	117.0	0.0	0.0	80.6	474.2	421.9	201.4	0.0	0.0	127.5	0.0	0.0
2.88	113.3	0.0	0.0	117.0	0.0	0.0	80.7	472.2	421.9	159.1	0.0	0.0	127.7	0.0	0.0
2.98	110.2	0.0	0.0	118.0	0.0	0.0	80.8	473.1	421.6	176.6	0.0	0.0	124.4	0.0	0.0
3.07	110.2	0.0	0.0	118.0	0.0	0.0	80.8	473.1	421.6	177.0	0.0	0.0	124.6	0.0	0.0
3.16	110.9	0.0	0.0	120.0	0.0	0.0	80.9	472.9	421.0	173.2	0.0	0.0	118.3	0.0	0.0
3.26	112.3	0.0	0.0	119.0	0.0	0.0	81.0	472.5	421.3	165.6	0.0	0.0	121.7	0.0	0.0
3.35	114.3	0.0	0.0	121.0	0.0	0.0	81.0	471.9	420.7	155.8	0.0	0.0	115.6	0.0	0.0
3.45	115.6	0.0	0.0	121.0	0.0	0.0	81.1	471.5	420.7	150.1	0.0	0.0	115.8	0.0	0.0
3.54	117.8	0.0	0.0	120.0	0.0	0.0	81.2	470.8	421.0	141.1	0.0	0.0	119.0	0.0	0.0
3.63	118.5	0.0	0.0	121.0	0.0	0.0	81.2	470.6	420.7	138.7	0.0	0.0	116.2	0.0	0.0
3.73	107.8	0.0	0.0	120.0	0.0	0.0	81.3	473.8	421.0	196.4	0.0	0.0	119.4	0.0	0.0
7.57	116.4	0.0	0.0	129.0	0.0	0.0	84.1	471.2	418.3	159.4	0.0	0.0	101.8	0.0	0.0
7.66	115.0	0.0	0.0	129.0	0.0	0.0	84.2	471.7	418.3	167.2	0.0	0.0	101.9	0.0	0.0
7.76	114.5	0.0	0.0	129.0	0.0	0.0	84.2	471.8	418.3	170.3	0.0	0.0	102.1	0.0	0.0
7.85	116.0	0.0	0.0	129.0	0.0	0.0	84.3	471.4	418.3	162.5	0.0	0.0	102.2	0.0	0.0
7.95	117.1	0.0	0.0	128.8	0.0	0.0	84.4	471.0	419.0	157.2	0.0	0.0	103.1	0.0	0.0
8.04	118.9	0.0	0.0	129.5	0.0	0.0	84.4	470.5	418.9	149.1	0.0	0.0	101.6	0.0	0.0
8.13	120.7	0.0	0.0	130.0	0.0	0.0	84.5	470.0	418.0	141.8	0.0	0.0	100.3	0.0	0.0
8.23	122.6	0.0	0.0	129.2	0.0	0.0	84.6	469.4	420.4	134.8	0.0	0.0	102.8	0.0	0.0
8.32	124.2	0.0	0.0	129.9	0.0	0.0	84.7	468.9	421.0	129.4	0.0	0.0	101.5	0.0	0.0
8.41	113.9	0.0	0.0	129.5	0.0	0.0	84.7	472.0	421.0	176.6	0.0	0.0	102.6	0.0	0.0
8.51	117.8	118.9	120.2	129.4	128.7	123.8	84.8	470.8	421.0	155.7	150.6	145.1	103.0	104.6	117.7
8.60	115.5	116.6	115.4	128.3	128.7	125.8	84.9	471.5	420.4	167.9	162.1	168.5	105.7	104.7	112.1
8.70	114.9	116.5	114.5	129.6	129.1	125.8	84.9	471.7	420.1	171.7	163.0	174.0	102.6	103.7	112.1
8.79	115.6	117.0	114.5	131.2	130.2	123.7	85.0	471.5	419.8	168.1	160.7	174.3	99.0	101.2	118.2

8.88	117.2	118.6	116.9	130.3	130.3	132.8	85.1	471.0	419.5	159.9	153.2	161.4	101.2	101.2	95.8
8.98	118.5	119.9	118.0	129.7	128.6	124.9	85.1	470.6	419.2	153.8	147.6	156.2	102.6	105.1	114.8
9.07	120.4	121.3	119.9	129.9	128.5	124.6	85.2	470.0	418.9	145.6	142.0	147.7	102.2	105.6	115.9
9.16	122.4	124.1	121.8	129.5	129.4	124.8	85.3	469.4	419.2	137.9	131.8	140.1	103.4	103.5	115.5
9.26	123.6	126.6	123.5	129.1	129.1	124.0	85.3	469.1	419.2	133.7	124.0	134.0	104.4	104.4	118.3
9.35	116.2	118.1	116.8	129.4	129.1	123.1	85.4	471.3	418.9	166.9	157.2	163.7	103.9	104.4	121.0

ULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 U(R)A=159.74 NU(S)A=111.53 NU(AV)A=135.63 ST(AV)A=0.00584 ST(AV)/ST(4S)=1.65 F/F(4S)= 3.58
 ST/ST(4S))/(F/F(4S))=0.462 (F/F(4S))/(ST/ST(4S))*3.0=0.79 (ST/ST(4S))/(F/F(4S))*(1/3)=1.08
 U(R)A/NU(4S)=1.95 NU(S)A/NU(4S)=1.36 e+(4R)= 205.98 R(4R)= 4.00 H(4R)=13.11

Y USING ROUGH SIDE RESULTS ONLY : H(RB)= 16.16

**ORIGINAL PAGE IS
OF POOR QUALITY**

RUN NUMBER= 89HR60-90/20 E/D=0.047 F/E=20.0 ALPHA=90 HYD DIA= 2.000 IN PR=.71 MDDT=0.1320 LBM/SEC
RE= 63494. GGE(R)= 863.4 BTU/HR-SQ FT GGE(S)= 748.7 INLET TEMP= 80.6 F TATM= 73.0 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	97.4	0.0	91.1	92.4	0.0	86.7	80.6	856.1	744.1	561.6	0.0	900.0	693.9	0.0
2	0.16	104.0	0.0	93.3	95.6	0.0	90.2	80.7	854.1	743.5	403.0	0.0	745.4	548.0	0.0
3	0.26	98.1	0.0	95.1	95.3	0.0	92.1	80.8	855.9	742.8	542.7	0.0	656.3	563.3	0.0
4	0.35	99.1	0.0	101.0	95.3	0.0	96.1	80.8	855.6	742.7	514.6	0.0	466.1	565.4	0.0
5	0.45	99.4	0.0	101.2	95.9	0.0	95.4	80.9	855.5	742.2	507.9	0.0	462.8	544.1	0.0
6	0.54	101.7	0.0	101.7	97.2	0.0	95.6	81.0	854.8	742.4	452.7	0.0	452.7	503.6	0.0
7	0.63	103.5	0.0	97.8	98.7	0.0	96.0	81.0	854.3	741.8	417.4	0.0	559.1	462.0	0.0
8	0.73	106.0	0.0	105.5	99.8	0.0	99.0	81.1	853.5	741.7	376.2	0.0	383.9	434.1	0.0
9	0.82	109.3	0.0	107.3	102.5	0.0	99.0	81.1	852.5	741.3	332.5	0.0	357.9	380.7	0.0
10	0.91	101.5	0.0	102.0	103.9	0.0	101.0	81.2	854.9	740.4	462.5	0.0	451.4	359.0	0.0
11	1.01	110.3	0.0	0.0	103.1	0.0	0.0	81.3	852.2	741.2	322.3	0.0	0.0	372.4	0.0
12	1.10	111.0	0.0	0.0	103.3	0.0	0.0	81.3	852.0	740.9	315.2	0.0	0.0	369.7	0.0
13	1.20	109.0	0.0	0.0	105.5	0.0	0.0	81.4	852.6	739.7	339.0	0.0	0.0	337.3	0.0
14	1.29	108.7	0.0	0.0	107.6	0.0	0.0	81.5	852.7	739.1	343.5	0.0	0.0	310.7	0.0
15	1.38	109.7	0.0	0.0	109.2	0.0	0.0	81.5	852.4	738.8	331.9	0.0	0.0	292.4	0.0
16	1.48	110.9	0.0	0.0	110.0	0.0	0.0	81.6	852.0	737.9	318.9	0.0	0.0	285.1	0.0
17	1.57	112.5	0.0	0.0	111.7	0.0	0.0	81.6	851.6	737.6	302.8	0.0	0.0	269.5	0.0
18	1.66	114.1	0.0	0.0	113.5	0.0	0.0	81.7	851.1	737.3	288.2	0.0	0.0	254.7	0.0
19	1.76	115.5	0.0	0.0	112.0	0.0	0.0	81.8	850.7	737.0	276.6	0.0	0.0	267.4	0.0
20	1.85	103.1	0.0	0.0	112.0	0.0	0.0	81.8	854.4	737.0	440.6	0.0	0.0	267.9	0.0
21	1.95	112.3	0.0	0.0	112.0	0.0	0.0	81.9	851.6	737.0	307.2	0.0	0.0	268.5	0.0
22	2.04	109.1	0.0	0.0	113.0	0.0	0.0	82.0	852.6	736.7	344.4	0.0	0.0	260.2	0.0
23	2.13	109.7	0.0	0.0	115.0	0.0	0.0	82.0	852.4	736.1	337.6	0.0	0.0	244.7	0.0
24	2.23	111.1	0.0	0.0	119.0	0.0	0.0	82.1	852.0	734.9	321.9	0.0	0.0	218.2	0.0
25	2.32	113.1	0.0	0.0	115.0	0.0	0.0	82.1	851.4	736.1	301.5	0.0	0.0	245.6	0.0
26	2.41	115.0	0.0	0.0	118.0	0.0	0.0	82.2	850.8	735.2	284.4	0.0	0.0	225.1	0.0
27	2.51	116.8	0.0	0.0	118.0	0.0	0.0	82.3	850.3	735.2	269.9	0.0	0.0	225.5	0.0
28	2.60	118.0	0.0	0.0	116.0	0.0	0.0	82.3	849.9	735.8	261.1	0.0	0.0	239.5	0.0
29	2.70	119.9	0.0	0.0	120.0	0.0	0.0	82.4	849.3	734.6	248.1	0.0	0.0	214.0	0.0
30	2.79	108.3	0.0	0.0	121.0	0.0	0.0	82.5	852.8	734.3	361.5	0.0	0.0	208.7	0.0
31	2.88	117.0	0.0	0.0	121.0	0.0	0.0	82.5	850.2	734.3	270.1	0.0	0.0	209.0	0.0
32	2.98	112.6	0.0	0.0	122.0	0.0	0.0	82.6	851.5	734.0	310.7	0.0	0.0	204.0	0.0
33	3.07	113.0	0.0	0.0	122.0	0.0	0.0	82.6	851.4	734.0	307.2	0.0	0.0	204.3	0.0
34	3.16	114.2	0.0	0.0	125.0	0.0	0.0	82.7	851.1	733.1	295.9	0.0	0.0	189.8	0.0
35	3.26	115.3	0.0	0.0	123.0	0.0	0.0	82.8	850.7	733.7	286.4	0.0	0.0	199.7	0.0
36	3.35	118.2	0.0	0.0	124.0	0.0	0.0	82.8	849.9	733.4	263.1	0.0	0.0	195.0	0.0
37	3.45	119.6	0.0	0.0	125.0	0.0	0.0	82.9	849.4	733.1	253.3	0.0	0.0	190.6	0.0
38	3.54	122.9	0.0	0.0	124.0	0.0	0.0	83.0	848.4	733.4	232.5	0.0	0.0	195.6	0.0
39	3.63	123.9	0.0	0.0	125.0	0.0	0.0	83.0	848.1	733.1	227.1	0.0	0.0	191.1	0.0
40	3.73	109.3	0.0	0.0	124.0	0.0	0.0	83.1	852.5	733.4	355.8	0.0	0.0	196.2	0.0
41	7.57	119.4	0.0	0.0	133.0	0.0	0.0	85.6	849.5	730.7	274.2	0.0	0.0	168.1	0.0
42	7.66	117.6	0.0	0.0	133.0	0.0	0.0	85.7	850.0	730.7	290.4	0.0	0.0	168.3	0.0
43	7.76	117.4	0.0	0.0	132.0	0.0	0.0	85.8	850.1	731.0	292.8	0.0	0.0	172.3	0.0
44	7.85	119.2	0.0	0.0	132.0	0.0	0.0	85.8	849.6	731.0	277.3	0.0	0.0	172.5	0.0
45	7.95	121.0	0.0	0.0	133.0	0.0	0.0	85.9	849.0	731.9	263.4	0.0	0.0	169.1	0.0
46	8.04	123.8	0.0	0.0	132.5	0.0	0.0	85.9	848.2	731.9	244.1	0.0	0.0	171.1	0.0
47	8.13	126.0	0.0	0.0	132.0	0.0	0.0	86.0	847.5	732.3	230.8	0.0	0.0	173.3	0.0
48	8.23	128.1	0.0	0.0	132.7	0.0	0.0	86.1	846.9	734.3	219.5	0.0	0.0	171.5	0.0
49	8.32	130.2	0.0	0.0	132.9	0.0	0.0	86.1	846.3	734.0	209.1	0.0	0.0	170.8	0.0
50	8.41	116.4	0.0	0.0	131.6	0.0	0.0	86.2	850.4	733.7	306.6	0.0	0.0	176.1	0.0
51	8.51	121.6	122.0	123.1	132.2	130.0	125.8	86.3	848.8	733.4	261.5	258.6	250.9	173.9	182.7
52	8.60	117.6	118.1	115.6	131.5	130.4	127.0	86.3	850.0	732.5	295.8	291.2	316.0	176.4	181.0
53	8.70	117.4	118.0	115.4	133.8	132.0	127.4	86.4	850.1	732.5	298.3	292.7	318.9	168.2	174.8
54	8.79	118.7	118.9	115.9	134.2	131.9	125.4	86.4	849.7	732.2	286.7	285.0	314.0	166.9	175.3

55	8.88	121.3	121.3	119.2	134.5	132.0	133.1	86.5	848.9	731.6	265.5	265.5	282.6	165.8	174.9
56	8.98	122.4	122.6	119.9	135.0	130.6	127.0	86.6	848.6	731.3	257.7	256.3	277.1	164.2	180.6
57	9.07	124.6	124.1	122.4	134.3	130.6	126.7	86.6	847.9	731.3	243.0	246.3	258.0	166.8	180.8
58	9.16	127.4	127.2	124.8	133.8	130.5	124.8	86.7	847.1	731.0	226.4	227.5	241.9	168.9	181.4
59	9.26	129.2	130.7	127.0	132.5	131.2	126.2	86.8	846.6	731.6	217.0	209.6	228.8	174.1	178.9
60	9.35	118.5	120.0	118.1	133.9	131.2	123.8	86.8	849.8	731.0	291.8	278.6	295.5	169.0	179.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=272.30 NU(S)A=183.48 NU(AV)A=227.89 ST(AV)A=0.00506 ST(AV)/ST(4S)=1.64 F/F(4S)= 3.77
 (ST/ST(4S))/(F/F(4S))=0.434 (F/F(4S))/(ST/ST(4S))*3.0=0.86 (ST/ST(4S))/(F/F(4S))*3.0=1.05
 NU(R)A/NU(4S)=1.96 NU(S)A/NU(4S)=1.32 e+(4R)= 380.64 R(4R)= 4.37 H(4R)=14.85

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 17.80

ORIGINAL PAGE IS
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NUMBER= 90HR10-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.000 IN PR=.71 MDDT=0.0267 LBM/SEC
12838. GGE(R)= 314.2 BTU/HR-SQ FT GGE(S)= 196.4 INLET TEMP= 79.4 F TATM= 73.6 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	97.7	0.0	94.9	90.6	0.0	88.6	79.5	307.0	191.6	185.4	0.0	219.1	189.3	0.0	230.9
0.16	108.0	0.0	99.0	95.3	0.0	92.8	79.6	303.9	190.6	117.6	0.0	172.1	133.6	0.0	157.9
0.26	103.1	0.0	100.6	94.0	0.0	95.0	79.7	305.4	190.5	143.4	0.0	160.5	146.3	0.0	136.7
0.35	103.4	0.0	103.0	93.5	0.0	96.0	79.7	305.3	190.7	142.0	0.0	144.5	152.7	0.0	129.1
0.45	101.1	0.0	100.2	94.1	0.0	98.0	79.8	306.0	190.4	158.4	0.0	165.4	147.4	0.0	115.4
0.54	105.7	0.0	103.9	95.8	0.0	98.0	79.9	304.6	190.3	130.1	0.0	139.8	131.9	0.0	115.9
0.63	106.3	0.0	102.7	97.0	0.0	99.0	80.0	304.4	189.9	127.4	0.0	147.7	123.1	0.0	110.1
0.73	106.0	0.0	107.7	98.4	0.0	99.0	80.1	304.5	189.5	129.4	0.0	121.4	113.8	0.0	110.4
0.82	108.2	0.0	108.5	99.8	0.0	99.0	80.2	303.8	189.1	119.4	0.0	118.1	106.0	0.0	110.7
0.91	105.3	0.0	105.6	101.1	0.0	99.0	80.3	304.7	188.5	134.0	0.0	132.4	99.4	0.0	110.9
1.01	114.2	0.0	0.0	104.6	0.0	0.0	80.4	302.0	188.5	98.2	0.0	0.0	85.7	0.0	0.0
1.10	114.2	0.0	0.0	102.5	0.0	0.0	80.5	302.0	188.5	98.5	0.0	0.0	94.0	0.0	0.0
1.20	113.0	0.0	0.0	104.9	0.0	0.0	80.6	302.4	187.6	102.5	0.0	0.0	84.6	0.0	0.0
1.29	112.6	0.0	0.0	105.3	0.0	0.0	80.7	302.5	187.3	104.1	0.0	0.0	83.7	0.0	0.0
1.38	109.6	0.0	0.0	106.1	0.0	0.0	80.8	303.4	187.0	115.6	0.0	0.0	81.0	0.0	0.0
1.48	116.1	0.0	0.0	107.1	0.0	0.0	80.9	301.5	187.0	94.0	0.0	0.0	78.4	0.0	0.0
1.57	116.4	0.0	0.0	108.3	0.0	0.0	80.9	301.4	186.4	93.4	0.0	0.0	75.0	0.0	0.0
1.66	114.9	0.0	0.0	107.0	0.0	0.0	81.0	301.8	186.4	97.9	0.0	0.0	78.9	0.0	0.0
1.76	115.3	0.0	0.0	108.0	0.0	0.0	81.1	301.7	186.1	97.0	0.0	0.0	76.1	0.0	0.0
1.85	109.3	0.0	0.0	108.0	0.0	0.0	81.2	303.5	186.1	118.7	0.0	0.0	76.3	0.0	0.0
1.95	117.8	0.0	0.0	109.0	0.0	0.0	81.3	301.0	185.8	90.6	0.0	0.0	73.7	0.0	0.0
2.04	116.1	0.0	0.0	109.0	0.0	0.0	81.4	301.5	185.8	95.4	0.0	0.0	73.9	0.0	0.0
2.13	116.0	0.0	0.0	110.0	0.0	0.0	81.5	301.5	185.5	95.9	0.0	0.0	71.4	0.0	0.0
2.23	117.3	0.0	0.0	112.0	0.0	0.0	81.6	301.1	184.9	92.5	0.0	0.0	66.7	0.0	0.0
2.32	112.1	0.0	0.0	111.0	0.0	0.0	81.7	302.7	185.2	109.2	0.0	0.0	69.3	0.0	0.0
2.41	119.7	0.0	0.0	112.0	0.0	0.0	81.8	300.4	184.9	86.9	0.0	0.0	67.1	0.0	0.0
2.51	117.9	0.0	0.0	112.0	0.0	0.0	81.9	300.9	184.9	91.6	0.0	0.0	67.3	0.0	0.0
2.60	116.6	0.0	0.0	112.0	0.0	0.0	82.0	301.3	184.9	95.4	0.0	0.0	67.5	0.0	0.0
2.70	117.6	0.0	0.0	113.0	0.0	0.0	82.1	301.0	184.6	92.9	0.0	0.0	65.4	0.0	0.0
2.79	113.5	0.0	0.0	113.0	0.0	0.0	82.1	302.3	184.6	105.7	0.0	0.0	65.6	0.0	0.0
2.88	121.2	0.0	0.0	114.0	0.0	0.0	82.2	299.9	184.3	84.4	0.0	0.0	63.6	0.0	0.0
2.98	119.4	0.0	0.0	114.0	0.0	0.0	82.3	300.5	184.3	88.8	0.0	0.0	63.8	0.0	0.0
3.07	118.6	0.0	0.0	114.0	0.0	0.0	82.4	300.7	184.3	91.1	0.0	0.0	64.0	0.0	0.0
3.16	119.5	0.0	0.0	116.0	0.0	0.0	82.5	300.5	183.7	89.0	0.0	0.0	60.1	0.0	0.0
3.26	114.2	0.0	0.0	115.0	0.0	0.0	82.6	302.0	184.0	104.7	0.0	0.0	62.2	0.0	0.0
3.35	121.4	0.0	0.0	116.0	0.0	0.0	82.7	299.9	183.7	84.9	0.0	0.0	60.4	0.0	0.0
3.45	119.9	0.0	0.0	117.0	0.0	0.0	82.8	300.3	183.4	88.6	0.0	0.0	58.7	0.0	0.0
3.54	119.5	0.0	0.0	116.0	0.0	0.0	82.9	300.5	183.7	89.8	0.0	0.0	60.7	0.0	0.0
3.63	120.1	0.0	0.0	117.0	0.0	0.0	83.0	300.3	183.4	88.6	0.0	0.0	59.0	0.0	0.0
3.73	114.6	0.0	0.0	117.0	0.0	0.0	83.1	301.9	183.4	104.8	0.0	0.0	59.2	0.0	0.0
3.83	124.7	0.0	0.0	122.0	0.0	0.0	86.9	298.5	181.9	85.9	0.0	0.0	56.3	0.0	0.0
3.93	126.1	0.0	0.0	122.2	0.0	0.0	86.9	298.5	182.3	82.9	0.0	0.0	56.3	0.0	0.0
4.03	125.7	0.0	0.0	122.1	0.0	0.0	87.0	298.6	182.2	84.0	0.0	0.0	56.4	0.0	0.0
4.13	126.6	0.0	0.0	122.0	0.0	0.0	87.1	298.3	182.4	82.2	0.0	0.0	56.9	0.0	0.0
4.23	126.6	0.0	0.0	122.0	0.0	0.0	87.1	298.3	182.4	82.2	0.0	0.0	56.9	0.0	0.0
4.33	121.7	0.0	0.0	123.2	0.0	0.0	87.2	299.8	182.2	94.5	0.0	0.0	55.1	0.0	0.0
4.43	126.2	0.0	0.0	123.4	0.0	0.0	87.3	298.4	182.2	83.4	0.0	0.0	54.9	0.0	0.0
4.53	126.0	0.0	0.0	124.3	0.0	0.0	87.4	298.5	181.3	84.1	0.0	0.0	53.4	0.0	0.0
4.63	125.3	0.0	0.0	123.8	0.0	0.0	87.5	298.7	181.5	85.9	0.0	0.0	54.3	0.0	0.0
4.73	126.5	0.0	0.0	122.9	0.0	0.0	87.6	298.4	182.2	83.3	0.0	0.0	56.0	0.0	0.0
4.83	121.2	0.0	0.0	123.1	0.0	0.0	87.7	299.9	182.1	97.2	0.0	0.0	55.8	0.0	0.0
4.93	126.5	126.3	127.3	124.4	121.3	117.9	87.8	298.4	182.2	83.7	84.1	82.0	54.0	59.1	65.6
5.03	126.1	125.8	122.6	124.1	120.1	117.0	87.9	298.5	181.9	84.8	85.5	93.3	54.6	61.2	67.8
5.13	125.2	124.9	120.8	124.2	121.5	118.0	88.0	298.7	181.9	87.1	87.8	98.8	54.5	58.9	65.8
5.23	125.6	125.3	120.9	124.1	120.0	118.0	88.1	298.6	181.9	86.4	87.1	98.7	54.9	61.8	66.0

55	8.88	121.9	122.5	119.4	123.0	123.0	125.7	88.1	299.7	182.4	96.4	94.7	104.1	56.8	56.8	52.7
56	8.98	126.7	127.3	125.4	123.4	122.8	119.0	88.2	298.3	182.1	84.2	82.9	87.1	56.1	57.1	64.2
57	9.07	126.2	125.4	123.1	123.6	122.6	120.7	88.3	298.4	182.1	85.5	87.4	93.2	56.1	57.7	61.1
58	9.16	125.5	125.4	122.6	122.8	123.1	121.9	88.4	298.7	182.1	87.4	87.6	94.8	57.5	57.0	59.0
59	9.26	126.4	127.3	124.0	122.9	123.7	121.0	88.5	298.4	182.1	85.5	83.5	91.2	57.5	56.1	60.8
60	9.35	123.6	124.1	122.1	123.9	124.2	120.5	88.6	299.2	181.8	92.8	91.5	96.9	55.9	55.4	61.8

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 89.42 NU(S)A= 58.48 NU(AV)A= 73.95 ST(AV)A=0.00813 ST(AV)/ST(4S)=1.91 F/F(4S)= 4.01
 (ST/ST(4S))/(F/F(4S))=0.476 (F/F(4S))/(ST/ST(4S))*3.0=0.58 (ST/ST(4S))/(F/F(4S))*3.0=1.20
 NU(R)A/NU(4S)=2.31 NU(S)A/NU(4S)=1.51 e+(4R)= 96.88 R(4R)= 2.76 H(4R)=10.07

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 13.05

RUN NUMBER= 91HR30-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.000 IN PR= .71 MDO=0.0653 LBM/SEC
 RE= 31401. GGE(R)= 604.2 BTU/HR-SQ FT GGE(S)= 442.1 INLET TEMP= 79.9 F TATM= 74.3 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	99.5	0.0	94.9	93.2	0.0	100.1	80.0	596.7	437.9	336.0	0.0	439.4	364.7	0.0
2	0.16	108.3	0.0	98.5	98.1	0.0	101.0	80.0	594.0	437.0	231.2	0.0	354.0	265.7	0.0
3	0.26	101.8	0.0	99.7	97.4	0.0	96.0	80.1	596.0	436.4	302.4	0.0	334.8	277.2	0.0
4	0.35	103.1	0.0	104.5	97.2	0.0	100.5	80.2	595.6	436.3	286.1	0.0	269.6	281.9	0.0
5	0.45	100.8	0.0	101.2	97.5	0.0	100.7	80.3	596.3	436.0	319.6	0.0	313.5	278.5	0.0
6	0.54	106.7	0.0	105.4	98.6	0.0	100.8	80.4	594.5	436.0	248.2	0.0	261.1	262.3	0.0
7	0.63	105.4	0.0	102.3	99.8	0.0	100.0	80.4	594.9	435.5	262.1	0.0	299.2	247.1	0.0
8	0.73	104.9	0.0	109.6	101.8	0.0	102.7	80.5	595.1	435.1	268.3	0.0	225.0	224.3	0.0
9	0.82	107.4	0.0	110.2	103.3	0.0	101.6	80.6	594.3	434.8	243.8	0.0	220.7	210.9	0.0
10	0.91	103.7	0.0	105.2	104.3	0.0	102.8	80.7	595.4	434.0	284.3	0.0	266.9	202.0	0.0
11	1.01	111.9	0.0	0.0	106.9	0.0	0.0	80.8	593.0	434.1	209.3	0.0	0.0	182.5	0.0
12	1.10	113.9	0.0	0.0	106.0	0.0	0.0	80.8	592.4	433.8	196.9	0.0	0.0	189.2	0.0
13	1.20	112.0	0.0	0.0	108.1	0.0	0.0	80.9	592.9	432.9	209.6	0.0	0.0	175.0	0.0
14	1.29	111.7	0.0	0.0	108.2	0.0	0.0	81.0	593.0	432.6	212.2	0.0	0.0	174.9	0.0
15	1.38	108.2	0.0	0.0	108.9	0.0	0.0	81.1	594.1	432.3	240.6	0.0	0.0	170.9	0.0
16	1.48	116.6	0.0	0.0	108.5	0.0	0.0	81.2	591.5	432.0	183.3	0.0	0.0	173.5	0.0
17	1.57	115.3	0.0	0.0	110.0	0.0	0.0	81.3	591.9	431.4	190.9	0.0	0.0	164.8	0.0
18	1.66	113.8	0.0	0.0	110.0	0.0	0.0	81.3	592.4	431.4	200.3	0.0	0.0	165.2	0.0
19	1.76	114.6	0.0	0.0	112.0	0.0	0.0	81.4	592.1	430.8	195.8	0.0	0.0	154.6	0.0
20	1.85	107.2	0.0	0.0	112.0	0.0	0.0	81.5	594.4	430.8	253.7	0.0	0.0	155.0	0.0
21	1.95	117.7	0.0	0.0	112.0	0.0	0.0	81.6	591.2	430.8	179.6	0.0	0.0	155.4	0.0
22	2.04	114.3	0.0	0.0	113.0	0.0	0.0	81.7	592.2	430.5	199.0	0.0	0.0	150.7	0.0
23	2.13	114.9	0.0	0.0	115.0	0.0	0.0	81.7	592.1	429.9	195.8	0.0	0.0	141.8	0.0
24	2.23	116.8	0.0	0.0	116.0	0.0	0.0	81.8	591.5	429.6	185.5	0.0	0.0	137.9	0.0
25	2.32	110.5	0.0	0.0	116.0	0.0	0.0	81.9	593.4	429.6	227.5	0.0	0.0	138.2	0.0
26	2.41	119.9	0.0	0.0	117.0	0.0	0.0	82.0	590.6	429.3	170.8	0.0	0.0	134.4	0.0
27	2.51	116.1	0.0	0.0	117.0	0.0	0.0	82.1	591.7	429.3	190.6	0.0	0.0	134.7	0.0
28	2.60	115.7	0.0	0.0	116.0	0.0	0.0	82.1	591.8	429.6	193.3	0.0	0.0	139.1	0.0
29	2.70	117.5	0.0	0.0	119.0	0.0	0.0	82.2	591.3	428.7	183.7	0.0	0.0	127.8	0.0
30	2.79	111.5	0.0	0.0	119.0	0.0	0.0	82.3	593.1	428.7	222.6	0.0	0.0	128.0	0.0
31	2.88	121.7	0.0	0.0	119.0	0.0	0.0	82.4	590.0	428.7	164.4	0.0	0.0	128.3	0.0
32	2.98	118.0	0.0	0.0	120.0	0.0	0.0	82.5	591.1	428.4	182.3	0.0	0.0	125.1	0.0
33	3.07	118.4	0.0	0.0	120.0	0.0	0.0	82.5	591.0	428.4	180.6	0.0	0.0	125.3	0.0
34	3.16	119.8	0.0	0.0	122.0	0.0	0.0	82.6	590.6	427.8	174.0	0.0	0.0	119.0	0.0
35	3.26	112.4	0.0	0.0	121.0	0.0	0.0	82.7	592.8	428.1	218.6	0.0	0.0	122.4	0.0
36	3.35	122.2	0.0	0.0	122.0	0.0	0.0	82.8	589.9	427.8	163.9	0.0	0.0	119.5	0.0
37	3.45	118.7	0.0	0.0	123.0	0.0	0.0	82.9	590.9	427.5	180.6	0.0	0.0	116.6	0.0
38	3.54	119.4	0.0	0.0	122.0	0.0	0.0	82.9	590.7	427.8	177.4	0.0	0.0	119.9	0.0
39	3.63	120.7	0.0	0.0	123.0	0.0	0.0	83.0	590.3	427.5	171.5	0.0	0.0	117.1	0.0
40	3.73	112.8	0.0	0.0	122.0	0.0	0.0	83.1	592.7	427.8	218.5	0.0	0.0	120.4	0.0
41	7.57	125.2	0.0	0.0	130.0	0.0	0.0	86.4	589.0	425.4	165.3	0.0	0.0	106.3	0.0
42	7.66	123.8	0.0	0.0	130.0	0.0	0.0	86.5	589.4	425.4	172.0	0.0	0.0	106.4	0.0
43	7.76	123.6	0.0	0.0	129.5	0.0	0.0	86.6	589.4	425.6	173.3	0.0	0.0	107.9	0.0
44	7.85	126.1	0.0	0.0	129.5	0.0	0.0	86.7	588.7	425.6	162.4	0.0	0.0	108.1	0.0
45	7.95	119.4	0.0	0.0	130.2	0.0	0.0	86.7	590.7	426.0	196.8	0.0	0.0	106.7	0.0
46	8.04	126.5	0.0	0.0	130.4	0.0	0.0	86.8	588.6	426.0	161.4	0.0	0.0	106.4	0.0
47	8.13	123.6	0.0	0.0	131.0	0.0	0.0	86.9	589.4	425.1	174.7	0.0	0.0	104.9	0.0
48	8.23	123.8	0.0	0.0	130.9	0.0	0.0	87.0	589.4	427.2	174.1	0.0	0.0	105.7	0.0
49	8.32	125.8	0.0	0.0	130.5	0.0	0.0	87.1	588.8	428.1	165.3	0.0	0.0	107.1	0.0
50	8.41	119.6	0.0	0.0	131.1	0.0	0.0	87.1	590.6	427.8	197.9	0.0	0.0	105.8	0.0
51	8.51	127.0	127.8	129.5	131.0	130.3	125.6	87.2	588.4	427.8	160.8	157.7	151.3	106.2	107.9
52	8.60	124.0	125.6	123.0	131.0	130.4	126.6	87.3	589.3	426.9	174.6	167.3	179.5	106.2	107.8
53	8.70	123.8	126.3	123.1	130.3	130.8	125.7	87.4	589.4	427.2	175.9	164.6	179.4	108.2	106.9
54	8.79	125.1	127.7	124.1	130.9	130.9	125.7	87.5	589.0	427.2	170.1	159.1	174.7	106.8	106.8
55	8.88	119.7	123.2	118.2	130.1	131.0	133.4	87.6	590.6	426.9	199.6	180.0	209.4	109.1	106.7
56	8.98	126.8	128.6	126.0	129.5	130.5	126.9	87.6	588.5	426.6	163.2	156.1	166.6	110.6	108.2
57	9.07	123.6	125.3	123.2	128.8	129.3	128.6	87.7	589.4	426.6	178.4	170.4	180.4	112.8	111.4
58	9.16	123.9	126.8	124.9	130.3	130.2	128.8	87.8	589.4	426.3	177.3	164.1	172.5	108.9	109.1
59	9.26	125.7	130.1	127.6	129.0	130.9	128.9	87.9	588.8	426.6	169.1	151.4	161.0	112.6	107.6
60	9.35	121.8	124.7	123.1	130.3	131.0	131.0	88.0	590.0	426.0	189.3	174.3	182.3	109.3	107.5

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=179.51 NU(S)A=115.22 NU(AV)A=147.36 ST(AV)A=0.00662 ST(AV)/ST(4S)=1.86 F/F(4S)= 4.47
 (ST/ST(4S))/(F/F(4S))=0.415 (F/F(4S))/(ST/ST(4S))**3.0=0.70 (ST/ST(4S))/(F/F(4S))**(1/3)=1.13
 NU(R)A/NU(4S)=2.27 NU(S)A/NU(4S)=1.46 e+(4R)= 225.39 R(4R)= 3.08 H(4R)=12.48

BY USING ROUGHSIDE RESULTS ONLY : H(RB)= 15.65

ORIGINAL PAGE IS
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NUMBER= 92HR60-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.000 IN PR= 71 MDOT=0.1320 LBM/SEC
63367. GGE(R)=1021.1 BTU/HR-SQ FT GGE(S)= 758.6 INLET TEMP= 81.7 F TATM= 74.5 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	101.6	0.0	96.0	93.4	0.0	88.7	81.8	1013.0	754.2	559.8	0.0	779.9	708.9	0.0	1188.1
0.16	107.7	0.0	98.0	97.2	0.0	93.2	81.8	1011.1	753.4	428.5	0.0	685.4	537.0	0.0	729.1
0.26	100.5	0.0	98.9	96.8	0.0	96.1	81.9	1013.3	752.7	597.1	0.0	653.3	555.3	0.0	579.8
0.35	103.1	0.0	105.3	97.0	0.0	102.1	82.0	1012.5	752.6	525.2	0.0	475.7	550.1	0.0	409.2
0.45	100.9	0.0	102.0	97.7	0.0	102.4	82.0	1013.2	752.1	588.6	0.0	556.2	526.9	0.0	405.6
0.54	107.6	0.0	106.7	98.8	0.0	101.6	82.1	1011.2	752.3	434.7	0.0	450.6	492.5	0.0	423.5
0.63	104.8	0.0	101.2	100.5	0.0	102.0	82.2	1012.0	751.7	490.1	0.0	582.8	450.6	0.0	415.4
0.73	104.3	0.0	110.9	101.9	0.0	103.9	82.2	1012.1	751.5	502.8	0.0	387.0	418.0	0.0	379.3
0.82	107.7	0.0	111.7	104.6	0.0	101.0	82.3	1011.1	751.0	436.3	0.0	377.0	368.9	0.0	440.2
0.91	103.6	0.0	105.9	106.0	0.0	103.0	82.4	1012.4	750.1	522.6	0.0	471.5	347.2	0.0	399.2
1.01	112.4	0.0	0.0	107.1	0.0	0.0	82.4	1009.7	750.4	369.3	0.0	0.0	333.3	0.0	0.0
1.10	116.0	0.0	0.0	106.3	0.0	0.0	82.5	1008.6	750.4	330.0	0.0	0.0	345.2	0.0	0.0
1.20	113.0	0.0	0.0	108.5	0.0	0.0	82.6	1009.5	749.2	363.5	0.0	0.0	317.1	0.0	0.0
1.29	112.4	0.0	0.0	108.6	0.0	0.0	82.6	1009.7	749.2	371.7	0.0	0.0	316.8	0.0	0.0
1.38	108.7	0.0	0.0	111.2	0.0	0.0	82.7	1010.8	748.6	426.1	0.0	0.0	287.4	0.0	0.0
1.48	118.9	0.0	0.0	111.0	0.0	0.0	82.8	1007.8	748.0	305.6	0.0	0.0	290.5	0.0	0.0
1.57	116.0	0.0	0.0	112.7	0.0	0.0	82.9	1008.6	747.7	333.2	0.0	0.0	274.6	0.0	0.0
1.66	114.9	0.0	0.0	114.5	0.0	0.0	82.9	1009.0	747.4	345.5	0.0	0.0	259.5	0.0	0.0
1.76	116.1	0.0	0.0	113.0	0.0	0.0	83.0	1008.6	747.1	333.5	0.0	0.0	272.5	0.0	0.0
1.85	106.9	0.0	0.0	113.0	0.0	0.0	83.1	1011.4	747.1	464.4	0.0	0.0	273.1	0.0	0.0
1.95	119.7	0.0	0.0	114.0	0.0	0.0	83.1	1007.5	746.8	301.5	0.0	0.0	264.8	0.0	0.0
2.04	115.0	0.0	0.0	114.0	0.0	0.0	83.2	1008.9	746.8	347.2	0.0	0.0	265.3	0.0	0.0
2.13	116.1	0.0	0.0	115.0	0.0	0.0	83.3	1008.6	746.5	336.1	0.0	0.0	257.4	0.0	0.0
2.23	118.1	0.0	0.0	117.0	0.0	0.0	83.3	1008.0	745.9	317.2	0.0	0.0	242.4	0.0	0.0
2.32	110.8	0.0	0.0	116.0	0.0	0.0	83.4	1010.2	746.2	403.4	0.0	0.0	250.4	0.0	0.0
2.41	122.8	0.0	0.0	118.0	0.0	0.0	83.5	1006.6	745.6	280.0	0.0	0.0	236.2	0.0	0.0
2.51	117.4	0.0	0.0	118.0	0.0	0.0	83.5	1008.2	745.6	325.7	0.0	0.0	236.7	0.0	0.0
2.60	116.8	0.0	0.0	116.0	0.0	0.0	83.6	1008.4	746.2	332.3	0.0	0.0	252.0	0.0	0.0
2.70	119.0	0.0	0.0	120.0	0.0	0.0	83.7	1007.7	745.0	312.0	0.0	0.0	224.3	0.0	0.0
2.79	111.5	0.0	0.0	120.0	0.0	0.0	83.8	1010.0	745.0	397.9	0.0	0.0	224.7	0.0	0.0
2.88	124.7	0.0	0.0	121.0	0.0	0.0	83.8	1006.0	744.7	269.0	0.0	0.0	219.0	0.0	0.0
2.98	118.6	0.0	0.0	121.0	0.0	0.0	83.9	1007.9	744.7	317.4	0.0	0.0	219.3	0.0	0.0
3.07	119.5	0.0	0.0	121.0	0.0	0.0	84.0	1007.6	744.7	309.8	0.0	0.0	219.7	0.0	0.0
3.16	121.4	0.0	0.0	124.0	0.0	0.0	84.0	1007.0	743.8	294.5	0.0	0.0	203.3	0.0	0.0
3.26	111.9	0.0	0.0	123.0	0.0	0.0	84.1	1009.9	744.1	396.9	0.0	0.0	209.0	0.0	0.0
3.35	125.4	0.0	0.0	123.0	0.0	0.0	84.2	1005.8	744.1	266.5	0.0	0.0	209.3	0.0	0.0
3.45	119.5	0.0	0.0	125.0	0.0	0.0	84.2	1007.6	743.5	312.1	0.0	0.0	199.2	0.0	0.0
3.54	120.5	0.0	0.0	124.0	0.0	0.0	84.3	1007.3	743.8	304.0	0.0	0.0	204.7	0.0	0.0
3.63	122.3	0.0	0.0	125.0	0.0	0.0	84.4	1006.7	743.5	289.9	0.0	0.0	199.9	0.0	0.0
3.73	112.3	0.0	0.0	124.0	0.0	0.0	84.4	1009.7	743.8	395.8	0.0	0.0	205.3	0.0	0.0
7.57	127.6	0.0	0.0	130.0	0.0	0.0	87.3	1005.2	742.0	270.9	0.0	0.0	188.7	0.0	0.0
7.66	125.3	0.0	0.0	130.0	0.0	0.0	87.3	1005.8	742.0	288.0	0.0	0.0	189.0	0.0	0.0
7.76	125.8	0.0	0.0	129.5	0.0	0.0	87.4	1005.7	742.1	284.7	0.0	0.0	191.6	0.0	0.0
7.85	128.9	0.0	0.0	129.0	0.0	0.0	87.5	1004.8	742.3	263.6	0.0	0.0	194.2	0.0	0.0
7.95	120.0	0.0	0.0	128.6	0.0	0.0	87.5	1007.4	743.6	337.3	0.0	0.0	196.7	0.0	0.0
8.04	128.5	0.0	0.0	128.5	0.0	0.0	87.6	1004.9	743.5	267.0	0.0	0.0	197.4	0.0	0.0
8.13	124.7	0.0	0.0	128.5	0.0	0.0	87.7	1006.0	743.8	295.2	0.0	0.0	197.8	0.0	0.0
8.23	125.7	0.0	0.0	129.7	0.0	0.0	87.7	1005.7	745.6	287.9	0.0	0.0	193.1	0.0	0.0
8.32	128.7	0.0	0.0	129.9	0.0	0.0	87.8	1004.8	745.3	266.9	0.0	0.0	192.3	0.0	0.0
8.41	119.8	0.0	0.0	128.5	0.0	0.0	87.9	1007.5	745.0	342.8	0.0	0.0	199.0	0.0	0.0
8.51	128.8	128.2	128.2	129.2	128.9	123.8	88.0	1004.8	744.7	267.1	271.1	271.1	196.3	197.3	225.7
8.60	124.7	123.2	118.8	128.5	129.4	124.0	88.0	1006.0	743.8	297.8	310.5	354.9	199.4	195.3	224.3
8.70	125.5	123.8	119.5	130.8	130.0	124.4	88.1	1005.8	743.8	291.9	305.8	347.7	189.2	192.8	222.2
8.79	127.6	125.4	121.3	131.2	129.9	123.4	88.2	1005.2	743.5	276.7	293.0	329.3	187.6	193.4	229.3
8.88	119.8	120.5	114.5	131.5	130.0	126.1	88.2	1007.5	742.9	346.4	338.9	416.3	186.3	193.0	212.8
8.98	128.6	129.2	124.3	131.0	129.6	125.9	88.3	1004.9	742.9	270.6	266.6	302.9	188.7	195.1	214.1
9.07	124.4	123.0	118.8	131.3	129.6	126.7	88.4	1006.1	742.6	303.0	315.3	358.8	187.5	195.3	210.5
9.16	125.7	123.8	121.3	130.8	130.5	127.8	88.4	1005.7	742.3	292.8	308.6	332.1	190.3	191.3	204.9
9.26	128.5	127.3	125.0	129.5	130.2	126.2	88.5	1004.9	742.9	272.6	281.0	298.7	196.8	193.1	214.0
9.35	122.2	121.8	120.2	130.9	130.2	123.8	88.6	1006.8	742.3	324.8	328.7	345.3	190.4	193.2	228.4

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=304.98 NU(S)A=200.06 NU(AV)A=252.52 ST(AV)A=0.00562 ST(AV)/ST(4S)=1.81 F/F(4S)= 4.83
 (ST/ST(4S))/(F/F(4S))=0.376 (F/F(4S))/(ST/ST(4S))*3.0=0.81 (ST/ST(4S))/(F/F(4S))*3.0=1.07
 NU(R)A/NU(4S)=2.20 NU(S)A/NU(4S)=1.44 e+(4R)= 436.85 R(4R)= 3.36 H(4R)=14.71

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 18.33

RUN NUMBER= 93HR10-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.000 IN PR=.71 MDDT=0.0222 LBM/SEC
RE= 10651. GGE(R)= 258.0 BTU/HR-SQ FT GGE(S)= 150.5 INLET TEMP= 81.2 F TATM= 75.7 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.07	96.8	0.0	93.4	90.9	0.0	88.3	81.3	251.6	146.1	177.8	0.0	227.7	167.2	0.0	2
2	0.16	105.6	0.0	96.7	95.0	0.0	91.8	81.4	249.0	145.2	112.7	0.0	178.1	116.7	0.0	1
3	0.26	101.7	0.0	98.2	93.8	0.0	93.0	81.4	250.2	145.2	135.5	0.0	163.8	129.3	0.0	1
4	0.35	101.5	0.0	100.9	93.0	0.0	94.0	81.5	250.2	145.4	137.5	0.0	141.8	139.5	0.0	1
5	0.45	101.4	0.0	101.5	93.3	0.0	94.0	81.6	250.3	145.3	138.8	0.0	138.1	136.7	0.0	1
6	0.54	103.2	0.0	102.4	94.7	0.0	95.0	81.7	249.7	145.1	127.4	0.0	132.4	122.2	0.0	1
7	0.63	104.8	0.0	100.8	95.9	0.0	96.0	81.8	249.2	144.8	118.8	0.0	143.8	112.2	0.0	1
8	0.73	107.5	0.0	105.5	97.1	0.0	96.0	81.9	248.4	144.5	106.3	0.0	115.3	104.0	0.0	1
9	0.82	110.3	0.0	106.6	98.1	0.0	97.0	82.0	247.6	144.2	95.8	0.0	110.2	97.9	0.0	1
10	0.91	104.7	0.0	103.8	99.2	0.0	97.0	82.1	249.3	143.7	120.7	0.0	125.7	92.2	0.0	1
11	1.01	112.3	0.0	0.0	101.8	0.0	0.0	82.1	247.0	143.8	89.8	0.0	0.0	80.2	0.0	0
12	1.10	111.4	0.0	0.0	101.1	0.0	0.0	82.2	247.3	143.5	92.9	0.0	0.0	83.4	0.0	0
13	1.20	110.0	0.0	0.0	101.6	0.0	0.0	82.3	247.7	143.2	98.0	0.0	0.0	81.3	0.0	0
14	1.29	110.7	0.0	0.0	102.0	0.0	0.0	82.4	247.5	142.9	95.8	0.0	0.0	79.7	0.0	0
15	1.38	111.9	0.0	0.0	103.0	0.0	0.0	82.5	247.1	142.6	92.1	0.0	0.0	76.3	0.0	0
16	1.48	113.2	0.0	0.0	104.7	0.0	0.0	82.6	246.7	142.3	88.3	0.0	0.0	70.4	0.0	0
17	1.57	114.6	0.0	0.0	105.0	0.0	0.0	82.7	246.3	142.0	84.5	0.0	0.0	69.5	0.0	0
18	1.66	116.3	0.0	0.0	104.0	0.0	0.0	82.8	245.8	142.0	80.2	0.0	0.0	73.2	0.0	0
19	1.76	117.2	0.0	0.0	105.0	0.0	0.0	82.8	245.5	141.7	78.2	0.0	0.0	70.0	0.0	0
20	1.85	109.0	0.0	0.0	105.0	0.0	0.0	82.9	248.0	141.7	104.1	0.0	0.0	70.3	0.0	0
21	1.95	116.2	0.0	0.0	105.0	0.0	0.0	83.0	245.8	141.7	81.1	0.0	0.0	70.5	0.0	0
22	2.04	114.6	0.0	0.0	106.0	0.0	0.0	83.1	246.3	141.4	85.6	0.0	0.0	67.6	0.0	0
23	2.13	113.9	0.0	0.0	108.0	0.0	0.0	83.2	246.5	140.8	87.8	0.0	0.0	62.1	0.0	0
24	2.23	114.7	0.0	0.0	108.0	0.0	0.0	83.3	246.3	140.8	85.8	0.0	0.0	62.3	0.0	0
25	2.32	115.3	0.0	0.0	108.0	0.0	0.0	83.4	246.1	140.8	84.3	0.0	0.0	62.5	0.0	0
26	2.41	116.7	0.0	0.0	110.0	0.0	0.0	83.5	245.7	140.2	80.8	0.0	0.0	57.8	0.0	0
27	2.51	118.2	0.0	0.0	110.0	0.0	0.0	83.5	245.2	140.2	77.4	0.0	0.0	57.9	0.0	0
28	2.60	119.4	0.0	0.0	110.0	0.0	0.0	83.6	244.9	140.2	74.9	0.0	0.0	58.1	0.0	0
29	2.70	120.7	0.0	0.0	111.0	0.0	0.0	83.7	244.5	139.9	72.3	0.0	0.0	56.0	0.0	0
30	2.79	114.4	0.0	0.0	111.0	0.0	0.0	83.8	246.4	139.9	88.0	0.0	0.0	56.2	0.0	0
31	2.88	120.7	0.0	0.0	111.0	0.0	0.0	83.9	244.5	139.9	72.6	0.0	0.0	56.4	0.0	0
32	2.98	119.3	0.0	0.0	112.0	0.0	0.0	84.0	244.9	139.6	75.8	0.0	0.0	54.4	0.0	0
33	3.07	117.2	0.0	0.0	112.0	0.0	0.0	84.1	245.5	139.6	81.0	0.0	0.0	54.6	0.0	0
34	3.16	117.2	0.0	0.0	112.0	0.0	0.0	84.2	245.5	139.6	81.2	0.0	0.0	54.8	0.0	0
35	3.26	117.8	0.0	0.0	113.0	0.0	0.0	84.2	245.3	139.3	79.9	0.0	0.0	52.9	0.0	0
36	3.35	119.7	0.0	0.0	113.0	0.0	0.0	84.3	244.8	139.3	75.6	0.0	0.0	53.1	0.0	0
37	3.45	121.0	0.0	0.0	114.0	0.0	0.0	84.4	244.4	139.0	73.0	0.0	0.0	51.3	0.0	0
38	3.54	123.1	0.0	0.0	113.0	0.0	0.0	84.5	243.8	139.3	69.0	0.0	0.0	53.4	0.0	0
39	3.63	123.4	0.0	0.0	113.0	0.0	0.0	84.6	243.7	139.3	68.6	0.0	0.0	53.5	0.0	0
40	3.73	115.6	0.0	0.0	113.0	0.0	0.0	84.7	246.0	139.3	86.9	0.0	0.0	53.7	0.0	0
41	7.57	125.4	0.0	0.0	120.0	0.0	0.0	88.3	243.1	137.2	71.0	0.0	0.0	46.9	0.0	0
42	7.66	125.8	0.0	0.0	120.2	0.0	0.0	88.4	242.9	137.5	70.4	0.0	0.0	46.8	0.0	0
43	7.76	123.0	0.0	0.0	120.0	0.0	0.0	88.4	243.8	137.5	76.5	0.0	0.0	47.3	0.0	0
44	7.85	123.0	0.0	0.0	120.2	0.0	0.0	88.5	243.8	137.5	76.7	0.0	0.0	47.0	0.0	0
45	7.95	124.1	0.0	0.0	120.3	0.0	0.0	88.6	243.5	137.6	74.4	0.0	0.0	47.1	0.0	0
46	8.04	125.4	0.0	0.0	121.0	0.0	0.0	88.7	243.1	137.5	71.8	0.0	0.0	46.2	0.0	0
47	8.13	126.9	0.0	0.0	121.8	0.0	0.0	88.8	242.6	136.7	69.0	0.0	0.0	44.9	0.0	0
48	8.23	128.6	0.0	0.0	121.3	0.0	0.0	88.9	242.1	136.9	66.1	0.0	0.0	45.8	0.0	0
49	8.32	130.2	0.0	0.0	120.6	0.0	0.0	89.0	241.6	137.5	63.5	0.0	0.0	47.1	0.0	0
50	8.41	122.4	0.0	0.0	119.3	0.0	0.0	89.1	244.0	137.8	79.3	0.0	0.0	49.3	0.0	0
51	8.51	126.3	125.6	126.1	120.9	119.9	116.6	89.1	242.8	137.8	70.8	72.2	71.2	47.1	48.5	54.3
52	8.60	125.6	124.4	122.3	120.7	119.0	116.0	89.2	243.0	137.5	72.4	74.9	79.6	47.3	50.1	55.4
53	8.70	123.2	122.0	119.1	119.8	120.2	117.0	89.3	243.7	137.8	77.9	80.8	88.7	49.0	48.3	53.9
54	8.79	122.8	121.4	117.9	119.7	119.0	117.0	89.4	243.8	137.8	79.1	82.6	92.7	49.2	50.4	54.1
55	8.88	123.8	122.0	119.3	121.1	121.5	123.4	89.5	243.5	137.5	76.9	81.1	88.5	47.1	46.6	43.9
56	8.98	124.4	122.5	120.0	120.6	120.5	117.0	89.6	243.4	137.5	75.7	80.1	86.6	48.0	48.1	54.3
57	9.07	126.1	123.6	121.7	120.7	120.3	117.6	89.7	242.9	137.5	72.2	77.5	82.1	47.9	48.5	53.3
58	9.16	128.1	125.8	123.4	120.0	120.7	117.8	89.8	242.3	137.5	68.4	72.8	77.9	49.1	48.1	53.1
59	9.26	129.2	128.2	124.9	120.4	120.4	117.0	89.8	241.9	137.5	66.5	68.3	74.7	49.1	48.7	54.8
60	9.35	124.4	124.0	121.9	121.1	121.8	118.1	89.9	243.4	137.2	76.4	77.3	82.4	47.6	46.6	52.7

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
NU(R)A= 74.98 NU(S)A= 50.97 NU(AV)A= 62.98 ST(AV)A=0.00834 ST(AV)/ST(4S)=1.89 F/F(4S)= 3.22
(ST/ST(4S))/(F/F(4S))=0.586 (F/F(4S))/(ST/ST(4S))*3.0=0.48 (ST/ST(4S))/(F/F(4S))*1.1/3=1.28
NU(R)A/NU(4S)=2.25 NU(S)A/NU(4S)=1.53 e+(4R)= 72.53 R(4R)= 3.43 H(4R)= 8.49

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 11.28

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 94HR30-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.000 IN PR=.71 MDOT=0.0671 LBM/SEC
32180. GGE(R)= 469.2 BTU/HR-SQ FT GGE(S)= 424.0 INLET TEMP= 82.5 F TATM= 76.4 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	96.3	0.0	92.1	95.1	0.0	101.5	82.6	463.2	419.9	369.1	0.0	531.4	366.8	0.0	243.3
0.16	102.3	0.0	94.5	99.4	0.0	100.2	82.6	461.4	419.2	256.8	0.0	425.4	273.6	0.0	260.6
0.26	99.1	0.0	96.0	98.6	0.0	95.1	82.7	462.4	418.6	308.5	0.0	380.3	287.4	0.0	368.0
0.35	99.6	0.0	99.4	98.5	0.0	98.6	82.8	462.2	418.5	300.5	0.0	304.1	290.7	0.0	289.0
0.45	99.8	0.0	99.6	98.7	0.0	97.8	82.8	462.2	418.2	298.0	0.0	301.6	289.0	0.0	306.5
0.54	101.5	0.0	100.6	99.8	0.0	97.8	82.9	461.7	418.2	271.6	0.0	285.3	270.2	0.0	306.9
0.63	103.1	0.0	98.8	100.9	0.0	98.0	83.0	461.2	417.7	250.6	0.0	318.6	254.8	0.0	303.9
0.73	105.5	0.0	104.3	102.6	0.0	101.8	83.0	460.5	417.5	224.2	0.0	236.9	234.0	0.0	243.9
0.82	108.0	0.0	105.7	103.9	0.0	101.6	83.1	459.7	417.2	202.0	0.0	222.5	219.7	0.0	246.7
0.91	101.4	0.0	101.8	104.7	0.0	102.9	83.2	461.7	416.4	276.9	0.0	271.0	211.8	0.0	231.2
1.01	108.3	0.0	0.0	106.1	0.0	0.0	83.2	459.6	417.0	200.5	0.0	0.0	199.8	0.0	0.0
1.10	108.5	0.0	0.0	105.1	0.0	0.0	83.3	459.6	416.7	199.4	0.0	0.0	208.6	0.0	0.0
1.20	108.0	0.0	0.0	107.2	0.0	0.0	83.4	459.7	415.8	204.1	0.0	0.0	190.9	0.0	0.0
1.29	107.5	0.0	0.0	107.2	0.0	0.0	83.4	459.9	415.5	208.9	0.0	0.0	190.9	0.0	0.0
1.38	108.4	0.0	0.0	107.9	0.0	0.0	83.5	459.6	415.2	201.8	0.0	0.0	185.9	0.0	0.0
1.48	109.5	0.0	0.0	108.5	0.0	0.0	83.6	459.3	414.6	193.6	0.0	0.0	181.5	0.0	0.0
1.57	110.8	0.0	0.0	110.0	0.0	0.0	83.6	458.9	414.0	184.6	0.0	0.0	171.6	0.0	0.0
1.66	112.2	0.0	0.0	110.0	0.0	0.0	83.7	458.5	414.0	175.8	0.0	0.0	172.0	0.0	0.0
1.76	113.4	0.0	0.0	111.0	0.0	0.0	83.8	458.1	413.7	169.0	0.0	0.0	166.0	0.0	0.0
1.85	103.8	0.0	0.0	111.0	0.0	0.0	83.8	461.0	413.7	252.3	0.0	0.0	166.4	0.0	0.0
1.95	110.3	0.0	0.0	113.0	0.0	0.0	83.9	459.0	413.1	190.0	0.0	0.0	155.1	0.0	0.0
2.04	108.4	0.0	0.0	114.0	0.0	0.0	84.0	459.6	412.8	205.5	0.0	0.0	150.2	0.0	0.0
2.13	109.0	0.0	0.0	115.0	0.0	0.0	84.0	459.4	412.5	201.0	0.0	0.0	145.5	0.0	0.0
2.23	110.3	0.0	0.0	117.0	0.0	0.0	84.1	459.0	411.9	191.4	0.0	0.0	136.8	0.0	0.0
2.32	111.7	0.0	0.0	116.0	0.0	0.0	84.2	458.6	412.2	181.9	0.0	0.0	141.4	0.0	0.0
2.41	113.1	0.0	0.0	117.0	0.0	0.0	84.2	458.2	411.9	173.4	0.0	0.0	137.3	0.0	0.0
2.51	114.6	0.0	0.0	117.0	0.0	0.0	84.3	457.7	411.9	165.0	0.0	0.0	137.6	0.0	0.0
2.60	115.9	0.0	0.0	117.0	0.0	0.0	84.4	457.3	411.9	158.4	0.0	0.0	137.8	0.0	0.0
2.70	117.2	0.0	0.0	119.0	0.0	0.0	84.4	457.0	411.3	152.3	0.0	0.0	129.9	0.0	0.0
2.79	108.5	0.0	0.0	119.0	0.0	0.0	84.5	459.6	411.3	209.1	0.0	0.0	130.2	0.0	0.0
2.88	114.7	0.0	0.0	120.0	0.0	0.0	84.6	457.7	411.0	165.8	0.0	0.0	126.6	0.0	0.0
2.98	111.9	0.0	0.0	120.0	0.0	0.0	84.6	458.5	411.0	183.6	0.0	0.0	126.8	0.0	0.0
3.07	112.0	0.0	0.0	121.0	0.0	0.0	84.7	458.5	410.7	183.3	0.0	0.0	123.5	0.0	0.0
3.16	112.8	0.0	0.0	123.0	0.0	0.0	84.8	458.3	410.1	178.4	0.0	0.0	117.1	0.0	0.0
3.26	113.9	0.0	0.0	122.0	0.0	0.0	84.8	457.9	410.4	171.9	0.0	0.0	120.5	0.0	0.0
3.35	116.0	0.0	0.0	123.0	0.0	0.0	84.9	457.3	410.1	160.5	0.0	0.0	117.4	0.0	0.0
3.45	117.4	0.0	0.0	123.0	0.0	0.0	85.0	456.9	410.1	153.7	0.0	0.0	117.6	0.0	0.0
3.54	119.6	0.0	0.0	123.0	0.0	0.0	85.0	456.2	410.1	144.0	0.0	0.0	117.8	0.0	0.0
3.63	120.2	0.0	0.0	123.0	0.0	0.0	85.1	456.1	410.1	141.7	0.0	0.0	118.0	0.0	0.0
3.73	109.7	0.0	0.0	122.0	0.0	0.0	85.2	459.2	410.4	204.2	0.0	0.0	121.5	0.0	0.0
7.57	118.9	0.0	0.0	130.0	0.0	0.0	87.9	456.4	408.0	160.0	0.0	0.0	105.3	0.0	0.0
7.66	117.1	0.0	0.0	131.0	0.0	0.0	88.0	457.0	407.7	170.4	0.0	0.0	102.9	0.0	0.0
7.76	116.8	0.0	0.0	130.0	0.0	0.0	88.0	457.1	408.0	172.6	0.0	0.0	105.6	0.0	0.0
7.85	118.3	0.0	0.0	129.8	0.0	0.0	88.1	456.6	408.0	164.2	0.0	0.0	106.3	0.0	0.0
7.95	119.7	0.0	0.0	130.2	0.0	0.0	88.2	456.2	408.6	157.1	0.0	0.0	105.5	0.0	0.0
8.04	121.4	0.0	0.0	130.9	0.0	0.0	88.2	455.7	408.4	149.2	0.0	0.0	103.8	0.0	0.0
8.13	123.1	0.0	0.0	131.0	0.0	0.0	88.3	455.2	407.7	142.0	0.0	0.0	103.6	0.0	0.0
8.23	124.9	0.0	0.0	131.1	0.0	0.0	88.4	454.6	409.8	135.1	0.0	0.0	104.0	0.0	0.0
8.32	126.7	0.0	0.0	131.8	0.0	0.0	88.5	454.1	410.4	128.8	0.0	0.0	102.8	0.0	0.0
8.41	116.3	0.0	0.0	131.3	0.0	0.0	88.5	457.2	410.4	178.5	0.0	0.0	103.9	0.0	0.0
8.51	119.6	119.8	120.6	131.2	129.6	124.7	88.6	456.2	410.4	159.6	158.5	154.6	104.4	108.6	123.1
8.60	117.3	117.3	116.0	130.2	129.5	124.7	88.7	456.9	409.8	173.0	173.0	181.2	107.1	108.7	123.2
8.70	117.0	117.1	115.4	131.5	131.0	125.8	88.7	457.0	409.5	175.2	174.6	185.8	103.8	105.0	119.9
8.79	117.9	117.7	115.5	133.1	132.1	124.7	88.8	456.7	409.2	170.1	171.3	185.4	100.1	102.4	123.5
8.88	119.6	119.3	117.3	132.2	132.2	132.7	88.9	456.2	408.9	160.9	162.5	173.9	102.3	102.4	101.2
8.98	120.6	120.2	118.2	131.6	130.6	124.9	88.9	455.9	408.6	156.0	158.0	168.8	103.8	106.4	123.1
9.07	122.4	121.6	120.1	130.9	129.4	124.6	89.0	455.4	408.6	147.7	151.4	158.7	105.8	109.6	124.4
9.16	124.6	123.9	122.1	132.4	130.4	124.8	89.1	454.7	408.3	138.7	141.4	149.2	102.1	107.1	123.8
9.26	125.8	126.5	123.8	131.1	131.0	125.0	89.1	454.4	408.6	134.3	131.7	142.0	105.5	105.6	123.6
9.35	118.0	118.8	117.4	131.3	130.1	126.1	89.2	456.7	408.3	171.8	167.1	175.4	105.0	108.2	119.9

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=163.72 NU(S)A=112.33 NU(AV)=138.03 ST(AV)=0.00603 ST(AV)/ST(4S)=1.71 F/F(4S)= 3.57
 (ST/ST(4S))/(F/F(4S))=0.477 (F/F(4S))/(ST/ST(4S))*3.0=0.72 (ST/ST(4S))/(F/F(4S))*(1/3)=1.12
 NU(R)A/NU(4S)=2.03 NU(S)A/NU(4S)=1.39 e+(4R)= 202.74 R(4R)= 3.99 H(4R)=12.36

BY USING ROUGHSDIE RESULTS ONLY : H(RB)= 15.38

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RUN NUMBER= 95HR60-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.000 IN PR= 71 MDOF=0.1330 LBM/SEC
RE= 63780. GGE(R)= 803.5 BTU/HR-SQ FT GGE(S)= 709.9 INLET TEMP= 83.0 F TATM= 75.6 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.07	98.6	0.0	92.5	94.9	0.0	89.7	83.0	796.6	705.5	560.5	0.0	922.1	654.0	0.0	11
2	0.16	104.1	0.0	94.5	98.0	0.0	93.2	83.1	794.9	704.8	414.4	0.0	763.3	516.3	0.0	7
3	0.26	98.9	0.0	96.3	97.4	0.0	94.2	83.2	796.5	704.2	553.8	0.0	663.4	542.3	0.0	7
4	0.35	100.2	0.0	101.6	97.3	0.0	98.2	83.2	796.1	704.1	513.0	0.0	473.9	548.2	0.0	5
5	0.45	100.5	0.0	101.8	97.8	0.0	97.4	83.3	796.0	703.7	505.7	0.0	470.2	530.6	0.0	5
6	0.54	102.7	0.0	102.5	99.1	0.0	97.6	83.3	795.4	703.8	449.3	0.0	454.0	489.5	0.0	5
7	0.63	104.3	0.0	98.8	100.7	0.0	98.0	83.4	794.9	703.2	415.9	0.0	564.4	445.3	0.0	5
8	0.73	106.7	0.0	106.2	102.0	0.0	101.0	83.4	794.2	703.1	373.6	0.0	381.9	415.5	0.0	4
9	0.82	109.7	0.0	107.8	104.2	0.0	101.0	83.5	793.3	702.8	331.3	0.0	357.2	370.7	0.0	4
10	0.91	102.7	0.0	103.2	105.3	0.0	103.0	83.6	795.4	702.0	454.6	0.0	443.1	353.8	0.0	3
11	1.01	110.8	0.0	0.0	106.1	0.0	0.0	83.6	792.9	702.3	319.1	0.0	0.0	341.1	0.0	
12	1.10	111.5	0.0	0.0	106.4	0.0	0.0	83.7	792.7	702.0	311.6	0.0	0.0	338.6	0.0	
13	1.20	110.0	0.0	0.0	108.5	0.0	0.0	83.7	793.2	700.8	330.3	0.0	0.0	309.8	0.0	
14	1.29	109.4	0.0	0.0	109.6	0.0	0.0	83.8	793.4	700.5	338.8	0.0	0.0	297.2	0.0	
15	1.38	110.3	0.0	0.0	112.3	0.0	0.0	83.9	793.1	699.9	327.9	0.0	0.0	269.3	0.0	
16	1.48	111.3	0.0	0.0	111.0	0.0	0.0	83.9	792.8	699.6	316.4	0.0	0.0	282.4	0.0	
17	1.57	112.8	0.0	0.0	112.7	0.0	0.0	84.0	792.3	699.3	300.4	0.0	0.0	266.2	0.0	
18	1.66	114.2	0.0	0.0	113.5	0.0	0.0	84.0	791.9	699.3	286.9	0.0	0.0	259.6	0.0	
19	1.76	115.6	0.0	0.0	113.0	0.0	0.0	84.1	791.5	698.7	274.5	0.0	0.0	264.1	0.0	
20	1.85	104.3	0.0	0.0	113.0	0.0	0.0	84.1	794.9	698.7	431.0	0.0	0.0	264.6	0.0	
21	1.95	112.6	0.0	0.0	113.0	0.0	0.0	84.2	792.4	698.7	304.9	0.0	0.0	265.1	0.0	
22	2.04	109.7	0.0	0.0	113.0	0.0	0.0	84.3	793.3	698.7	340.7	0.0	0.0	265.6	0.0	
23	2.13	110.3	0.0	0.0	115.0	0.0	0.0	84.3	793.1	698.1	333.5	0.0	0.0	248.6	0.0	
24	2.23	111.6	0.0	0.0	118.0	0.0	0.0	84.4	792.7	697.2	318.1	0.0	0.0	226.5	0.0	
25	2.32	113.4	0.0	0.0	117.0	0.0	0.0	84.4	792.2	697.5	298.7	0.0	0.0	233.9	0.0	
26	2.41	114.9	0.0	0.0	119.0	0.0	0.0	84.5	791.7	696.9	284.3	0.0	0.0	220.6	0.0	
27	2.51	116.6	0.0	0.0	119.0	0.0	0.0	84.6	791.2	696.9	269.6	0.0	0.0	220.9	0.0	
28	2.60	118.0	0.0	0.0	117.0	0.0	0.0	84.6	790.8	697.5	258.6	0.0	0.0	235.1	0.0	
29	2.70	119.7	0.0	0.0	121.0	0.0	0.0	84.7	790.3	696.3	246.3	0.0	0.0	209.2	0.0	
30	2.79	109.0	0.0	0.0	121.0	0.0	0.0	84.7	793.5	696.3	356.8	0.0	0.0	209.5	0.0	
31	2.88	117.1	0.0	0.0	122.0	0.0	0.0	84.8	791.0	696.0	267.2	0.0	0.0	204.1	0.0	
32	2.98	112.8	0.0	0.0	122.0	0.0	0.0	84.8	792.3	696.0	309.3	0.0	0.0	204.4	0.0	
33	3.07	113.3	0.0	0.0	122.0	0.0	0.0	84.9	792.2	696.0	304.4	0.0	0.0	204.7	0.0	
34	3.16	114.1	0.0	0.0	125.0	0.0	0.0	85.0	791.9	695.1	296.6	0.0	0.0	189.4	0.0	
35	3.26	115.4	0.0	0.0	123.0	0.0	0.0	85.0	791.6	695.7	284.3	0.0	0.0	199.8	0.0	
36	3.35	118.0	0.0	0.0	125.0	0.0	0.0	85.1	790.8	695.1	262.0	0.0	0.0	189.9	0.0	
37	3.45	119.4	0.0	0.0	126.0	0.0	0.0	85.1	790.4	694.8	251.6	0.0	0.0	185.5	0.0	
38	3.54	122.1	0.0	0.0	124.0	0.0	0.0	85.2	789.5	695.4	233.3	0.0	0.0	195.5	0.0	
39	3.63	123.1	0.0	0.0	126.0	0.0	0.0	85.2	789.2	694.8	227.4	0.0	0.0	186.0	0.0	
40	3.73	109.8	0.0	0.0	125.0	0.0	0.0	85.3	793.2	695.1	353.2	0.0	0.0	191.0	0.0	
41	7.57	120.4	0.0	0.0	133.0	0.0	0.0	87.7	790.1	692.7	262.4	0.0	0.0	166.1	0.0	
42	7.66	117.3	0.0	0.0	132.5	0.0	0.0	87.7	791.0	692.9	290.7	0.0	0.0	168.2	0.0	
43	7.76	117.4	0.0	0.0	132.0	0.0	0.0	87.8	791.0	693.0	290.3	0.0	0.0	170.3	0.0	
44	7.85	119.2	0.0	0.0	131.8	0.0	0.0	87.9	790.4	693.1	273.9	0.0	0.0	171.3	0.0	
45	7.95	120.8	0.0	0.0	131.2	0.0	0.0	87.9	789.9	694.5	260.9	0.0	0.0	174.4	0.0	
46	8.04	123.4	0.0	0.0	131.1	0.0	0.0	88.0	789.2	694.4	241.9	0.0	0.0	175.0	0.0	
47	8.13	125.2	0.0	0.0	131.6	0.0	0.0	88.0	788.6	694.5	230.4	0.0	0.0	172.9	0.0	
48	8.23	127.3	0.0	0.0	132.8	0.0	0.0	88.1	788.0	696.3	218.2	0.0	0.0	169.2	0.0	
49	8.32	129.5	0.0	0.0	133.0	0.0	0.0	88.2	787.3	696.0	206.7	0.0	0.0	168.6	0.0	
50	8.41	116.9	0.0	0.0	132.1	0.0	0.0	88.2	791.1	695.6	299.3	0.0	0.0	172.0	0.0	
51	8.51	121.4	121.6	122.3	132.2	131.0	126.8	88.3	789.8	695.4	258.7	257.2	251.9	171.8	176.6	195.1
52	8.60	117.6	117.7	115.6	133.4	131.4	127.1	88.3	790.9	693.9	293.2	292.2	314.7	166.9	174.8	194.4
53	8.70	117.6	117.7	115.4	133.8	133.0	127.5	88.4	790.9	694.5	293.8	292.8	317.7	165.9	168.8	192.2
54	8.79	118.8	118.6	116.0	134.2	132.9	125.4	88.4	790.5	694.2	282.5	284.4	311.3	164.5	169.3	204.4

55	8.88	121.1	120.8	118.5	134.5	132.0	133.2	88.5	789.8	693.6	262.9	265.3	285.6	163.4	172.8	168.4
56	8.98	122.2	122.0	119.7	134.1	132.6	127.0	88.6	789.5	693.6	254.6	256.1	275.0	165.4	170.7	195.4
57	9.07	124.2	123.5	121.9	134.4	131.7	126.7	88.6	788.9	693.3	240.5	245.3	257.1	164.4	174.7	197.6
58	9.16	126.7	126.2	124.2	132.8	131.6	127.8	88.7	788.2	693.3	224.8	227.8	240.6	170.5	175.3	192.3
59	9.26	128.5	129.3	126.2	133.5	132.3	126.2	88.7	787.6	693.3	214.8	210.6	228.0	168.1	172.7	200.8
60	9.35	118.4	119.4	117.9	133.9	132.3	124.9	88.8	790.7	693.0	289.6	280.1	294.5	166.7	172.9	208.4

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=270.23 NU(S)A=180.89 NU(AV)A=225.55 ST(AV)A=0.00499 ST(AV)/ST(4S)=1.61 F/F(4S)= 3.77
 (ST/ST(4S))/(F/F(4S))=0.427 (F/F(4S))/(ST/ST(4S))**3.0=0.90 (ST/ST(4S))/(F/F(4S))**(1/3)=1.04
 NU(R)A/NU(4S)=1.94 NU(S)A/NU(4S)=1.30 e+(4R)= 382.34 R(4R)= 4.38 H(4R)=15.23

BY USING ROUGHSLIDE RESULTS ONLY : H(RB)= 18.06

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 96HR60-60/10 E/D=0.047 P/E=10.0 ALPHA=60 HYD DIA= 2.000 IN PR=.71 MDOT=0.1336 LBM/SEC
54076. GGE(R)=1160.5 BTU/HR-SQ FT GGE(S)= 985.8 INLET TEMP= 81.7 F TATM= 74.2 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
.07	102.0	0.0	97.7	95.5	0.0	88.8	81.8	1152.2	980.7	624.5	0.0	793.0	784.7	0.0	1535.4
.16	108.0	0.0	100.3	99.1	0.0	92.2	81.8	1150.4	979.9	482.4	0.0	683.6	624.1	0.0	1033.3
.26	101.1	0.0	101.1	99.0	0.0	99.2	81.9	1152.4	979.1	659.1	0.0	659.1	629.5	0.0	622.6
.35	104.2	0.0	116.2	99.4	0.0	106.2	82.0	1151.5	978.9	569.0	0.0	369.3	617.7	0.0	444.2
.45	102.2	0.0	112.8	100.7	0.0	103.4	82.1	1152.1	978.2	628.1	0.0	411.3	576.6	0.0	503.7
.54	109.1	0.0	111.6	101.6	0.0	102.6	82.2	1150.0	978.5	468.2	0.0	428.4	552.8	0.0	525.4
.63	106.4	0.0	104.7	103.9	0.0	103.0	82.3	1150.8	977.7	522.4	0.0	562.0	495.5	0.0	516.6
.73	105.6	0.0	101.3	105.0	0.0	106.0	82.3	1151.1	977.6	542.3	0.0	665.3	473.3	0.0	453.2
.82	109.8	0.0	114.9	107.6	0.0	107.0	82.4	1149.8	977.3	460.2	0.0	387.9	425.8	0.0	435.7
.91	103.0	0.0	112.8	109.8	0.0	109.0	82.5	1151.9	976.1	615.7	0.0	416.5	392.1	0.0	403.8
1.01	112.2	0.0	0.0	110.2	0.0	0.0	82.6	1149.1	976.6	425.0	0.0	0.0	387.9	0.0	0.0
1.10	115.3	0.0	0.0	109.4	0.0	0.0	82.7	1148.2	976.6	385.4	0.0	0.0	400.6	0.0	0.0
1.20	114.0	0.0	0.0	112.5	0.0	0.0	82.8	1148.6	975.1	402.5	0.0	0.0	359.1	0.0	0.0
1.29	113.8	0.0	0.0	113.6	0.0	0.0	82.8	1148.6	974.8	406.1	0.0	0.0	347.1	0.0	0.0
1.38	109.8	0.0	0.0	116.3	0.0	0.0	82.9	1149.8	974.2	468.2	0.0	0.0	319.7	0.0	0.0
1.48	118.6	0.0	0.0	116.0	0.0	0.0	83.0	1147.2	973.6	352.7	0.0	0.0	323.0	0.0	0.0
1.57	118.2	0.0	0.0	118.7	0.0	0.0	83.1	1147.3	973.0	357.6	0.0	0.0	299.1	0.0	0.0
1.66	116.8	0.0	0.0	120.5	0.0	0.0	83.2	1147.7	972.7	373.4	0.0	0.0	285.2	0.0	0.0
1.76	118.0	0.0	0.0	119.0	0.0	0.0	83.2	1147.4	972.4	361.2	0.0	0.0	297.6	0.0	0.0
1.85	105.2	0.0	0.0	119.0	0.0	0.0	83.3	1151.2	972.4	575.8	0.0	0.0	298.2	0.0	0.0
1.95	122.6	0.0	0.0	120.0	0.0	0.0	83.4	1146.0	972.1	319.9	0.0	0.0	290.6	0.0	0.0
2.04	118.7	0.0	0.0	121.0	0.0	0.0	83.5	1147.2	971.8	356.4	0.0	0.0	283.4	0.0	0.0
2.13	118.8	0.0	0.0	122.0	0.0	0.0	83.6	1147.1	971.5	356.1	0.0	0.0	276.5	0.0	0.0
2.23	120.2	0.0	0.0	124.0	0.0	0.0	83.7	1146.7	970.9	343.1	0.0	0.0	263.1	0.0	0.0
2.32	108.2	0.0	0.0	124.0	0.0	0.0	83.7	1150.3	970.9	514.1	0.0	0.0	263.7	0.0	0.0
2.41	128.1	0.0	0.0	125.0	0.0	0.0	83.8	1144.3	970.6	282.5	0.0	0.0	257.7	0.0	0.0
2.51	123.5	0.0	0.0	126.0	0.0	0.0	83.9	1145.7	970.3	316.3	0.0	0.0	251.9	0.0	0.0
2.60	119.5	0.0	0.0	122.0	0.0	0.0	84.0	1146.9	971.5	352.9	0.0	0.0	279.3	0.0	0.0
2.70	120.3	0.0	0.0	129.0	0.0	0.0	84.1	1146.7	969.4	345.8	0.0	0.0	235.8	0.0	0.0
2.79	108.6	0.0	0.0	129.0	0.0	0.0	84.2	1150.2	969.4	514.0	0.0	0.0	236.2	0.0	0.0
2.88	125.1	0.0	0.0	129.0	0.0	0.0	84.2	1145.2	969.4	306.1	0.0	0.0	236.6	0.0	0.0
2.98	123.2	0.0	0.0	129.0	0.0	0.0	84.3	1145.8	969.4	321.9	0.0	0.0	237.0	0.0	0.0
3.07	121.7	0.0	0.0	129.0	0.0	0.0	84.4	1146.3	969.4	335.6	0.0	0.0	237.4	0.0	0.0
3.16	122.1	0.0	0.0	133.0	0.0	0.0	84.5	1146.1	968.2	332.7	0.0	0.0	217.9	0.0	0.0
3.26	111.0	0.0	0.0	130.0	0.0	0.0	84.6	1149.5	969.1	474.7	0.0	0.0	232.9	0.0	0.0
3.35	123.7	0.0	0.0	131.0	0.0	0.0	84.6	1145.7	968.8	320.2	0.0	0.0	228.2	0.0	0.0
3.45	120.9	0.0	0.0	133.0	0.0	0.0	84.7	1146.5	968.2	346.0	0.0	0.0	218.9	0.0	0.0
3.54	120.4	0.0	0.0	131.0	0.0	0.0	84.8	1146.6	968.8	351.6	0.0	0.0	228.9	0.0	0.0
3.63	122.0	0.0	0.0	134.0	0.0	0.0	84.9	1146.2	967.9	337.1	0.0	0.0	215.1	0.0	0.0
3.73	112.1	0.0	0.0	132.0	0.0	0.0	85.0	1149.1	968.5	462.2	0.0	0.0	224.7	0.0	0.0
7.57	116.7	0.0	0.0	136.0	0.0	0.0	88.3	1147.8	967.3	439.3	0.0	0.0	220.3	0.0	0.0
7.66	115.5	0.0	0.0	136.0	0.0	0.0	88.4	1148.1	967.3	460.2	0.0	0.0	220.6	0.0	0.0
7.76	115.5	0.0	0.0	135.5	0.0	0.0	88.5	1148.1	967.4	461.6	0.0	0.0	223.4	0.0	0.0
7.85	118.1	0.0	0.0	135.0	0.0	0.0	88.6	1147.3	967.6	421.8	0.0	0.0	226.2	0.0	0.0
7.95	113.9	0.0	0.0	135.5	0.0	0.0	88.7	1148.6	968.7	493.9	0.0	0.0	224.5	0.0	0.0
8.04	117.1	0.0	0.0	134.6	0.0	0.0	88.8	1147.6	968.8	439.2	0.0	0.0	229.3	0.0	0.0
8.13	118.1	0.0	0.0	134.6	0.0	0.0	88.8	1147.3	969.1	425.2	0.0	0.0	229.8	0.0	0.0
8.23	117.7	0.0	0.0	134.8	0.0	0.0	88.9	1147.5	971.2	432.3	0.0	0.0	229.4	0.0	0.0
8.32	120.4	0.0	0.0	135.0	0.0	0.0	89.0	1146.6	970.9	395.9	0.0	0.0	228.7	0.0	0.0
8.41	114.6	0.0	0.0	135.1	0.0	0.0	89.1	1148.4	970.1	487.9	0.0	0.0	228.3	0.0	0.0
8.51	117.7	110.6	112.1	133.7	134.0	127.9	89.2	1147.5	970.4	435.9	580.3	542.4	235.9	234.4	271.9
8.60	120.2	113.2	115.4	134.6	134.5	123.1	89.3	1146.7	969.1	401.5	518.9	475.2	231.7	232.3	310.5
8.70	118.2	116.1	105.6	135.9	135.1	123.5	89.3	1147.3	969.4	430.7	464.5	764.3	225.8	229.7	307.6
8.79	119.4	105.7	109.9	136.3	135.0	125.4	89.4	1146.9	969.1	414.4	763.1	606.6	224.1	230.5	291.9

5	8.88	115.0	118.2	108.6	135.6	136.1	133.2	89.5	1148.3	968.8	487.8	433.4	651.2	227.8	225.3	239.9
6	8.98	114.7	111.4	110.7	137.1	135.7	128.0	89.6	1148.4	968.2	495.2	570.1	589.0	220.8	227.5	273.1
7	9.07	116.3	112.4	114.4	137.4	134.7	125.7	89.7	1147.9	967.9	466.7	546.8	502.5	219.7	232.9	291.0
8	9.16	116.2	114.5	100.2	136.8	134.6	126.8	89.7	1147.9	967.6	469.9	502.1	1189.2	222.7	233.7	282.9
9	9.26	119.6	114.1	110.0	136.5	135.3	130.2	89.8	1146.9	967.9	417.1	511.6	615.6	224.6	230.5	259.6
10	9.35	117.5	115.9	110.0	135.9	134.3	125.9	89.9	1147.5	967.9	450.2	478.0	618.4	227.9	236.1	291.3

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
NU(R)A=402.87 NU(S)A=226.92 NU(AV)A=314.90 ST(AV)A=0.00694 ST(AV)/ST(4S)=2.24 F/F(4S)= 7.16
(ST/ST(4S))/(F/F(4S))=0.313 (F/F(4S))/(ST/ST(4S))*3.0=0.63 (ST/ST(4S))/(F/F(4S))*1.13=1.16
NU(R)A/NU(4S)=2.88 NU(S)A/NU(4S)=1.62 e+(4R)= 547.14 R(4R)= 2.05 H(4R)=13.56

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 17.20

RUN NUMBER= 97HR30-60/10 E/D=0.047 P/E=10.0 ALPHA=60 HYD DIA= 2.000 IN PR=.71 MDDOT=0.0647 LBM/SEC
 RE= 31066. GGE(R)= 709.9 BTU/HR-SQ FT GGE(S)= 521.8 INLET TEMP= 80.2 F TATM= 74.4 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	102.7	0.0	98.4	95.1	0.0	100.9	80.3	701.4	517.0	343.9	0.0	425.5	382.9	0.0
2	0.16	110.9	0.0	102.9	99.6	0.0	103.9	80.4	699.0	516.2	251.7	0.0	341.1	295.7	0.0
3	0.26	104.3	0.0	102.5	99.0	0.0	99.0	80.5	701.0	515.6	323.3	0.0	349.7	305.8	0.0
4	0.35	106.9	0.0	116.2	99.3	0.0	104.5	80.6	700.2	515.4	292.2	0.0	215.9	302.5	0.0
5	0.45	105.6	0.0	113.2	100.3	0.0	102.7	80.7	700.6	514.8	308.7	0.0	236.6	288.5	0.0
6	0.54	113.1	0.0	112.6	101.4	0.0	101.7	80.8	698.3	514.8	237.2	0.0	240.9	274.0	0.0
7	0.63	109.6	0.0	107.2	102.7	0.0	102.0	80.9	699.4	514.3	267.2	0.0	291.6	258.8	0.0
8	0.73	108.6	0.0	104.5	104.5	0.0	106.7	80.9	699.7	514.0	277.9	0.0	326.3	239.7	0.0
9	0.82	111.7	0.0	116.8	106.1	0.0	107.5	81.0	698.7	513.6	250.3	0.0	214.6	225.0	0.0
10	0.91	106.0	0.0	115.2	107.9	0.0	108.8	81.1	700.4	512.6	309.4	0.0	225.8	210.6	0.0
11	1.01	114.4	0.0	0.0	109.8	0.0	0.0	81.2	697.9	512.9	231.0	0.0	0.0	196.8	0.0
12	1.10	116.6	0.0	0.0	108.0	0.0	0.0	81.3	697.3	512.9	217.0	0.0	0.0	211.1	0.0
13	1.20	116.0	0.0	0.0	112.1	0.0	0.0	81.4	697.4	511.4	221.4	0.0	0.0	183.1	0.0
14	1.29	116.0	0.0	0.0	113.2	0.0	0.0	81.5	697.4	510.8	222.0	0.0	0.0	177.2	0.0
15	1.38	112.3	0.0	0.0	113.8	0.0	0.0	81.6	698.6	510.5	249.8	0.0	0.0	173.8	0.0
16	1.48	119.4	0.0	0.0	114.5	0.0	0.0	81.7	696.4	509.9	202.7	0.0	0.0	170.6	0.0
17	1.57	119.9	0.0	0.0	115.0	0.0	0.0	81.8	696.3	509.6	200.5	0.0	0.0	168.4	0.0
18	1.66	118.8	0.0	0.0	115.0	0.0	0.0	81.9	696.6	509.6	207.1	0.0	0.0	168.9	0.0
19	1.76	119.7	0.0	0.0	118.0	0.0	0.0	82.0	696.3	508.7	202.6	0.0	0.0	155.0	0.0
20	1.85	109.3	0.0	0.0	118.0	0.0	0.0	82.1	699.5	508.7	281.9	0.0	0.0	155.4	0.0
21	1.95	123.3	0.0	0.0	119.0	0.0	0.0	82.2	695.3	508.4	185.4	0.0	0.0	151.4	0.0
22	2.04	120.6	0.0	0.0	120.0	0.0	0.0	82.3	696.1	508.1	199.2	0.0	0.0	147.7	0.0
23	2.13	120.5	0.0	0.0	121.0	0.0	0.0	82.4	696.1	507.8	200.2	0.0	0.0	144.1	0.0
24	2.23	121.6	0.0	0.0	122.0	0.0	0.0	82.5	695.8	507.5	194.9	0.0	0.0	140.7	0.0
25	2.32	111.0	0.0	0.0	123.0	0.0	0.0	82.6	698.9	507.2	269.4	0.0	0.0	137.5	0.0
26	2.41	128.8	0.0	0.0	124.0	0.0	0.0	82.7	693.6	506.9	164.7	0.0	0.0	134.4	0.0
27	2.51	125.0	0.0	0.0	124.0	0.0	0.0	82.8	694.7	506.9	180.2	0.0	0.0	134.7	0.0
28	2.60	121.8	0.0	0.0	123.0	0.0	0.0	82.9	695.7	507.2	195.7	0.0	0.0	138.4	0.0
29	2.70	122.3	0.0	0.0	126.0	0.0	0.0	83.0	695.6	506.3	193.6	0.0	0.0	128.8	0.0
30	2.79	112.5	0.0	0.0	127.0	0.0	0.0	83.1	698.5	506.0	259.7	0.0	0.0	126.1	0.0
31	2.88	125.2	0.0	0.0	127.0	0.0	0.0	83.2	694.7	506.0	180.8	0.0	0.0	126.3	0.0
32	2.98	123.7	0.0	0.0	127.0	0.0	0.0	83.3	695.1	506.0	188.1	0.0	0.0	126.6	0.0
33	3.07	123.1	0.0	0.0	127.0	0.0	0.0	83.4	695.3	506.0	191.4	0.0	0.0	126.8	0.0
34	3.16	123.9	0.0	0.0	130.0	0.0	0.0	83.5	695.1	505.1	188.0	0.0	0.0	118.7	0.0
35	3.26	114.8	0.0	0.0	129.0	0.0	0.0	83.5	697.8	505.4	244.2	0.0	0.0	121.6	0.0
36	3.35	124.4	0.0	0.0	130.0	0.0	0.0	83.6	694.9	505.1	186.5	0.0	0.0	119.1	0.0
37	3.45	123.3	0.0	0.0	130.0	0.0	0.0	83.7	695.3	505.1	192.2	0.0	0.0	119.4	0.0
38	3.54	123.0	0.0	0.0	130.0	0.0	0.0	83.8	695.3	505.1	194.1	0.0	0.0	119.6	0.0
39	3.63	124.1	0.0	0.0	130.0	0.0	0.0	83.9	695.0	505.1	189.1	0.0	0.0	119.8	0.0
40	3.73	116.3	0.0	0.0	131.0	0.0	0.0	84.0	697.4	504.8	236.2	0.0	0.0	117.4	0.0
41	7.57	123.1	0.0	0.0	135.0	0.0	0.0	88.0	695.3	503.6	215.0	0.0	0.0	116.3	0.0
42	7.66	119.7	0.0	0.0	135.0	0.0	0.0	88.1	696.3	503.6	239.0	0.0	0.0	116.5	0.0
43	7.76	119.0	0.0	0.0	134.5	0.0	0.0	88.2	696.5	503.7	245.2	0.0	0.0	118.0	0.0
44	7.85	121.2	0.0	0.0	133.8	0.0	0.0	88.3	695.9	503.9	229.3	0.0	0.0	120.1	0.0
45	7.95	116.5	0.0	0.0	134.2	0.0	0.0	88.4	697.3	504.5	268.9	0.0	0.0	119.6	0.0
46	8.04	118.8	0.0	0.0	134.4	0.0	0.0	88.5	696.6	504.5	249.1	0.0	0.0	119.2	0.0
47	8.13	121.0	0.0	0.0	132.0	0.0	0.0	88.6	695.9	504.5	232.7	0.0	0.0	126.0	0.0
48	8.23	120.4	0.0	0.0	132.9	0.0	0.0	88.7	696.1	506.3	237.8	0.0	0.0	124.2	0.0
49	8.32	122.5	0.0	0.0	132.4	0.0	0.0	88.7	695.5	507.2	223.5	0.0	0.0	125.9	0.0
50	8.41	116.7	0.0	0.0	133.0	0.0	0.0	88.8	697.2	506.9	271.4	0.0	0.0	124.4	0.0
51	8.51	119.4	113.5	112.3	132.9	131.2	124.5	88.9	696.4	506.9	247.9	307.4	323.2	124.9	129.9
52	8.60	121.8	114.5	115.2	132.9	131.3	120.6	89.0	695.7	506.0	230.2	296.1	288.2	124.9	129.8
53	8.70	120.5	116.1	108.1	133.3	131.8	120.7	89.1	696.1	506.0	240.5	279.7	397.7	124.3	128.6
54	8.79	121.6	108.8	112.4	133.9	131.9	122.6	89.2	695.8	506.0	232.9	385.2	325.4	122.8	128.6
55	8.88	117.5	118.2	110.5	133.0	132.9	130.3	89.3	697.0	505.7	268.0	261.5	356.6	125.4	125.6
56	8.98	117.4	113.2	111.4	132.5	131.4	123.8	89.4	697.0	505.4	269.9	317.5	343.5	127.1	130.4
57	9.07	119.7	114.5	113.9	131.8	131.3	122.5	89.5	696.3	505.4	249.9	301.9	309.3	129.6	131.1
58	9.16	119.0	115.7	104.1	133.3	132.2	122.7	89.6	696.5	505.1	256.7	289.2	520.7	125.3	128.4
59	9.26	121.7	114.9	110.7	132.0	132.9	125.9	89.7	695.7	505.4	235.5	299.1	358.9	129.5	126.7
60	9.35	119.9	118.3	110.3	132.3	132.0	126.0	89.8	696.3	505.1	250.5	264.5	367.8	128.8	129.7

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=223.62 NU(S)A=123.90 NU(AV)A=173.76 ST(AV)/ST(4S)=2.21 F/F(4S)= 6.03
 (ST/ST(4S))/(F/F(4S))=0.367 (F/F(4S))/(ST/ST(4S))*3.0=0.56 (ST/ST(4S))/(F/F(4S))*(1/3)=1.21
 NU(R)A/NU(4S)=2.85 NU(S)A/NU(4S)=1.58 e+(4R)= 263.18 R(4R)= 2.09 H(4R)=11.45

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 14.46

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 98HR10-60/10 E/D=0.047 P/E=10.0 ALPHA=60 HYD DIA= 2.000 IN PR= 71 MDOT=0.0188 LBM/SEC
9004. GGE(R)= 343.1 BTU/HR-SQ FT GGE(S)= 153.2 INLET TEMP= 80.6 F TATM= 74.4 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	103.1	0.0	100.8	90.9	0.0	88.1	80.7	334.5	148.5	164.0	0.0	182.8	159.2	0.0	219.5
16	116.4	0.0	106.3	94.8	0.0	91.1	80.8	330.5	147.5	102.0	0.0	142.5	115.5	0.0	157.6
26	110.9	0.0	104.9	94.2	0.0	96.0	80.9	332.2	147.5	121.8	0.0	152.3	122.3	0.0	107.6
35	110.9	0.0	114.8	93.3	0.0	98.0	81.1	332.2	147.7	122.3	0.0	108.1	132.8	0.0	95.8
45	109.5	0.0	113.8	93.7	0.0	98.0	81.2	332.6	147.5	129.0	0.0	112.0	129.3	0.0	96.4
54	114.2	0.0	112.2	95.1	0.0	98.0	81.3	331.2	147.4	110.5	0.0	117.7	117.1	0.0	97.0
63	112.3	0.0	108.3	96.2	0.0	99.0	81.4	331.7	147.0	118.0	0.0	135.5	109.0	0.0	91.9
73	111.6	0.0	107.8	97.5	0.0	100.0	81.6	332.0	146.7	121.3	0.0	138.8	101.1	0.0	87.3
82	114.4	0.0	114.0	98.7	0.0	100.0	81.7	331.1	146.3	111.0	0.0	112.4	94.5	0.0	87.7
91	110.3	0.0	113.5	99.9	0.0	100.0	81.8	332.3	145.8	128.0	0.0	115.0	88.4	0.0	87.9
01	120.6	0.0	0.0	102.2	0.0	0.0	81.9	329.3	145.9	93.4	0.0	0.0	78.9	0.0	0.0
10	120.0	0.0	0.0	101.8	0.0	0.0	82.1	329.4	145.6	95.2	0.0	0.0	81.0	0.0	0.0
20	120.0	0.0	0.0	102.4	0.0	0.0	82.2	329.4	145.3	95.5	0.0	0.0	78.9	0.0	0.0
29	119.4	0.0	0.0	103.9	0.0	0.0	82.3	329.6	144.7	97.4	0.0	0.0	73.5	0.0	0.0
38	116.5	0.0	0.0	104.8	0.0	0.0	82.4	330.5	144.4	106.3	0.0	0.0	70.7	0.0	0.0
48	122.4	0.0	0.0	105.4	0.0	0.0	82.6	328.7	144.4	90.4	0.0	0.0	69.1	0.0	0.0
57	125.3	0.0	0.0	105.9	0.0	0.0	82.7	327.8	144.1	84.3	0.0	0.0	68.0	0.0	0.0
66	123.5	0.0	0.0	106.0	0.0	0.0	82.8	328.4	143.8	88.4	0.0	0.0	67.9	0.0	0.0
76	123.8	0.0	0.0	108.0	0.0	0.0	82.9	328.3	143.2	87.9	0.0	0.0	62.5	0.0	0.0
85	116.2	0.0	0.0	109.0	0.0	0.0	83.1	330.6	142.9	109.2	0.0	0.0	60.3	0.0	0.0
95	126.2	0.0	0.0	109.0	0.0	0.0	83.2	327.6	142.9	83.3	0.0	0.0	60.6	0.0	0.0
04	125.8	0.0	0.0	110.0	0.0	0.0	83.3	327.7	142.6	84.4	0.0	0.0	58.4	0.0	0.0
13	124.9	0.0	0.0	110.0	0.0	0.0	83.4	328.0	142.6	86.5	0.0	0.0	58.7	0.0	0.0
23	125.4	0.0	0.0	111.0	0.0	0.0	83.6	327.8	142.3	85.7	0.0	0.0	56.7	0.0	0.0
32	117.2	0.0	0.0	111.0	0.0	0.0	83.7	330.3	142.3	107.7	0.0	0.0	56.9	0.0	0.0
41	129.3	0.0	0.0	112.0	0.0	0.0	83.8	326.6	142.0	78.5	0.0	0.0	55.0	0.0	0.0
51	128.9	0.0	0.0	112.0	0.0	0.0	83.9	326.8	142.0	79.4	0.0	0.0	55.3	0.0	0.0
60	126.3	0.0	0.0	113.0	0.0	0.0	84.1	327.5	141.7	84.7	0.0	0.0	53.5	0.0	0.0
70	126.2	0.0	0.0	114.0	0.0	0.0	84.2	327.6	141.4	85.2	0.0	0.0	51.8	0.0	0.0
79	119.8	0.0	0.0	114.0	0.0	0.0	84.3	329.5	141.4	101.4	0.0	0.0	52.0	0.0	0.0
88	128.4	0.0	0.0	114.0	0.0	0.0	84.4	326.9	141.4	81.2	0.0	0.0	52.2	0.0	0.0
98	130.0	0.0	0.0	115.0	0.0	0.0	84.5	326.4	141.1	78.4	0.0	0.0	50.6	0.0	0.0
07	128.2	0.0	0.0	114.0	0.0	0.0	84.7	327.0	141.4	82.0	0.0	0.0	52.6	0.0	0.0
16	128.0	0.0	0.0	116.0	0.0	0.0	84.8	327.0	140.8	82.6	0.0	0.0	49.2	0.0	0.0
26	121.6	0.0	0.0	116.0	0.0	0.0	84.9	329.0	140.8	97.9	0.0	0.0	49.4	0.0	0.0
35	127.5	0.0	0.0	116.0	0.0	0.0	85.0	327.2	140.8	84.1	0.0	0.0	49.6	0.0	0.0
45	127.4	0.0	0.0	116.0	0.0	0.0	85.2	327.2	140.8	84.5	0.0	0.0	49.8	0.0	0.0
54	126.6	0.0	0.0	117.0	0.0	0.0	85.3	327.5	140.5	86.5	0.0	0.0	48.3	0.0	0.0
63	127.4	0.0	0.0	117.0	0.0	0.0	85.4	327.2	140.5	85.0	0.0	0.0	48.5	0.0	0.0
73	123.0	0.0	0.0	117.0	0.0	0.0	85.5	328.5	140.5	95.6	0.0	0.0	48.7	0.0	0.0
82	130.3	0.0	0.0	123.0	0.0	0.0	90.6	326.3	138.7	89.0	0.0	0.0	46.3	0.0	0.0
91	128.6	0.0	0.0	124.0	0.0	0.0	90.8	326.9	138.7	93.4	0.0	0.0	45.0	0.0	0.0
00	124.7	0.0	0.0	123.8	0.0	0.0	90.9	328.0	138.7	104.8	0.0	0.0	45.5	0.0	0.0
08	125.2	0.0	0.0	123.0	0.0	0.0	91.0	327.9	139.0	103.6	0.0	0.0	46.9	0.0	0.0
17	122.0	0.0	0.0	124.5	0.0	0.0	91.1	328.8	138.7	115.1	0.0	0.0	44.9	0.0	0.0
26	124.3	0.0	0.0	122.7	0.0	0.0	91.3	328.1	139.3	107.3	0.0	0.0	47.9	0.0	0.0
35	127.9	0.0	0.0	124.2	0.0	0.0	91.4	327.1	138.4	96.7	0.0	0.0	45.5	0.0	0.0
44	125.6	0.0	0.0	125.2	0.0	0.0	91.5	327.8	138.1	103.8	0.0	0.0	44.2	0.0	0.0
53	126.6	0.0	0.0	124.4	0.0	0.0	91.6	327.5	138.7	101.1	0.0	0.0	45.7	0.0	0.0
62	122.5	0.0	0.0	123.1	0.0	0.0	91.8	328.7	139.0	115.4	0.0	0.0	47.8	0.0	0.0
71	125.0	120.4	114.0	124.4	120.6	118.4	91.9	327.9	139.0	106.8	124.1	160.0	46.1	52.2	56.6
80	128.7	119.0	117.3	123.4	119.8	114.0	92.0	326.8	139.0	96.1	130.6	139.4	47.7	53.9	68.2
89	125.9	121.0	115.6	123.5	120.0	114.0	92.1	327.7	139.0	104.7	122.4	150.6	47.7	53.7	68.5
98	125.9	117.4	119.6	122.4	119.0	115.0	92.3	327.7	139.3	105.0	140.5	129.2	49.7	56.2	66.0
07	123.6	124.4	116.9	122.8	121.1	119.4	92.4	328.4	139.3	113.4	110.6	144.4	49.4	52.3	55.6
16	123.9	118.0	115.6	123.4	120.3	117.0	92.5	328.3	139.0	112.7	138.8	153.2	48.5	53.9	61.1
26	127.4	118.6	117.2	123.4	120.1	116.5	92.6	327.2	139.0	101.4	135.8	143.5	48.6	54.5	62.8
35	125.6	120.3	113.5	122.9	120.4	116.6	92.8	327.8	139.0	107.5	128.2	170.2	49.7	54.1	62.7
44	126.5	120.8	116.6	123.0	121.2	117.0	92.9	327.5	139.0	104.9	126.3	148.7	49.8	52.8	62.1
53	125.4	126.2	113.9	123.0	121.5	119.8	93.0	327.8	139.0	109.0	106.3	168.9	50.0	52.5	55.9

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 95.96 NU(S)A= 49.31 NU(AV)A= 72.64 ST(AV)A=0.01140 ST(AV)/ST(4S)=2.49 F/F(4S)= 4.39
 (ST/ST(4S))/(F/F(4S))=0.567 (F/F(4S))/(ST/ST(4S))*3.0=0.28 (ST/ST(4S))/(F/F(4S))*(1/3)=1.52
 NU(R)A/NU(4S)=3.30 NU(S)A/NU(4S)=1.70 e+(4R)= 74.87 R(4R)= 2.18 H(4R)= 6.37

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 8.44

**ORIGINAL PAGE IS
OF POOR QUALITY**

RUN NUMBER=100HR10-60/20 E/D=0.047 P/E=20.0 ALPHA=60 HYD DIA= 2.000 IN PR= .71 MDO=0.0240 LBM/SEC
RE= 11545. GGE(R)= 326.3 BTU/HR-SQ FT GGE(S)= 180.7 INLET TEMP= 78.6 F TATM= 73.6 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.07	99.0	0.0	94.0	90.0	0.0	88.4	78.7	318.7	176.0	172.9	0.0	229.3	171.0	0.0	1
2	0.16	110.0	0.0	98.1	94.4	0.0	92.3	78.8	315.4	175.0	111.4	0.0	179.9	123.8	0.0	1
3	0.26	106.0	0.0	100.3	93.0	0.0	93.0	78.9	316.6	175.0	128.7	0.0	162.9	136.4	0.0	1
4	0.35	104.7	0.0	103.8	92.2	0.0	95.0	79.0	317.0	175.3	135.8	0.0	140.7	145.9	0.0	1
5	0.45	104.5	0.0	104.3	92.6	0.0	95.0	79.1	317.1	175.1	137.4	0.0	138.5	142.6	0.0	1
6	0.54	106.6	0.0	105.6	94.5	0.0	96.0	79.2	316.4	174.8	127.1	0.0	132.0	125.4	0.0	1
7	0.63	108.7	0.0	103.6	95.8	0.0	96.0	79.3	315.8	174.4	118.2	0.0	143.0	116.0	0.0	1
8	0.73	112.1	0.0	103.4	97.3	0.0	96.0	79.4	314.8	174.0	106.0	0.0	144.3	106.7	0.0	1
9	0.82	115.2	0.0	107.2	98.7	0.0	98.0	79.5	313.9	173.6	96.8	0.0	124.7	99.2	0.0	1
10	0.91	106.4	0.0	107.1	100.1	0.0	98.0	79.6	316.5	173.0	129.9	0.0	126.6	92.7	0.0	1
11	1.01	119.2	0.0	0.0	103.1	0.0	0.0	79.7	312.7	173.1	87.1	0.0	0.0	81.3	0.0	1
12	1.10	116.5	0.0	0.0	102.3	0.0	0.0	79.8	313.5	172.8	94.0	0.0	0.0	84.6	0.0	1
13	1.20	116.0	0.0	0.0	104.8	0.0	0.0	79.9	313.6	171.9	95.6	0.0	0.0	76.1	0.0	1
14	1.29	116.4	0.0	0.0	105.1	0.0	0.0	80.0	313.5	171.6	94.7	0.0	0.0	75.1	0.0	1
15	1.38	117.5	0.0	0.0	105.0	0.0	0.0	80.1	313.2	171.6	92.1	0.0	0.0	75.7	0.0	1
16	1.48	119.0	0.0	0.0	107.4	0.0	0.0	80.2	312.7	171.1	88.6	0.0	0.0	69.3	0.0	1
17	1.57	120.7	0.0	0.0	107.7	0.0	0.0	80.3	312.2	170.8	85.0	0.0	0.0	68.4	0.0	1
18	1.66	122.8	0.0	0.0	108.0	0.0	0.0	80.4	311.6	170.4	80.8	0.0	0.0	67.9	0.0	1
19	1.76	123.9	0.0	0.0	109.0	0.0	0.0	80.5	311.2	170.1	78.8	0.0	0.0	65.6	0.0	1
20	1.85	113.6	0.0	0.0	110.0	0.0	0.0	80.6	314.3	169.8	104.7	0.0	0.0	63.5	0.0	1
21	1.95	122.7	0.0	0.0	110.0	0.0	0.0	80.7	311.6	169.8	81.5	0.0	0.0	63.7	0.0	1
22	2.04	122.0	0.0	0.0	110.0	0.0	0.0	80.8	311.8	169.8	83.2	0.0	0.0	63.9	0.0	1
23	2.13	120.4	0.0	0.0	111.0	0.0	0.0	80.9	312.3	169.5	86.9	0.0	0.0	61.9	0.0	1
24	2.23	121.1	0.0	0.0	112.0	0.0	0.0	81.0	312.1	169.2	85.5	0.0	0.0	59.9	0.0	1
25	2.32	122.1	0.0	0.0	112.0	0.0	0.0	81.1	311.8	169.2	83.5	0.0	0.0	60.1	0.0	1
26	2.41	123.9	0.0	0.0	113.0	0.0	0.0	81.2	311.2	168.9	80.0	0.0	0.0	58.3	0.0	1
27	2.51	125.8	0.0	0.0	113.0	0.0	0.0	81.3	310.7	168.9	76.7	0.0	0.0	58.5	0.0	1
28	2.60	127.1	0.0	0.0	113.0	0.0	0.0	81.4	310.3	168.9	74.5	0.0	0.0	58.7	0.0	1
29	2.70	127.6	0.0	0.0	114.0	0.0	0.0	81.5	310.1	168.6	73.8	0.0	0.0	56.9	0.0	1
30	2.79	117.8	0.0	0.0	115.0	0.0	0.0	81.6	313.1	168.3	94.9	0.0	0.0	55.3	0.0	1
31	2.88	125.2	0.0	0.0	115.0	0.0	0.0	81.7	310.9	168.3	78.4	0.0	0.0	55.5	0.0	1
32	2.98	126.2	0.0	0.0	115.0	0.0	0.0	81.8	310.6	168.3	76.7	0.0	0.0	55.6	0.0	1
33	3.07	123.4	0.0	0.0	116.0	0.0	0.0	81.9	311.4	168.0	82.3	0.0	0.0	54.0	0.0	1
34	3.16	123.5	0.0	0.0	117.0	0.0	0.0	82.0	311.4	167.7	82.3	0.0	0.0	52.6	0.0	1
35	3.26	124.3	0.0	0.0	116.0	0.0	0.0	82.1	311.1	168.0	80.9	0.0	0.0	54.3	0.0	1
36	3.35	126.6	0.0	0.0	117.0	0.0	0.0	82.2	310.4	167.7	76.7	0.0	0.0	52.8	0.0	1
37	3.45	128.2	0.0	0.0	117.0	0.0	0.0	82.3	310.0	167.7	74.0	0.0	0.0	53.0	0.0	1
38	3.54	130.7	0.0	0.0	117.0	0.0	0.0	82.4	309.2	167.7	70.2	0.0	0.0	53.1	0.0	1
39	3.63	130.9	0.0	0.0	117.0	0.0	0.0	82.5	309.1	167.7	70.0	0.0	0.0	53.3	0.0	1
40	3.73	122.6	0.0	0.0	117.0	0.0	0.0	82.6	311.6	167.7	85.4	0.0	0.0	53.4	0.0	1
41	7.57	132.7	0.0	0.0	122.0	0.0	0.0	86.8	308.6	166.2	73.1	0.0	0.0	51.3	0.0	1
42	7.66	131.3	0.0	0.0	123.3	0.0	0.0	86.9	309.0	166.2	75.7	0.0	0.0	49.6	0.0	1
43	7.76	127.2	0.0	0.0	124.0	0.0	0.0	87.0	310.3	165.9	83.9	0.0	0.0	48.7	0.0	1
44	7.85	126.3	0.0	0.0	123.3	0.0	0.0	87.1	310.5	166.2	86.1	0.0	0.0	49.8	0.0	1
45	7.95	126.4	0.0	0.0	124.5	0.0	0.0	87.2	310.5	166.0	86.1	0.0	0.0	48.4	0.0	1
46	8.04	127.4	0.0	0.0	125.2	0.0	0.0	87.3	310.2	165.9	84.1	0.0	0.0	47.6	0.0	1
47	8.13	129.4	0.0	0.0	123.3	0.0	0.0	87.4	309.6	165.9	80.1	0.0	0.0	50.2	0.0	1
48	8.23	131.4	0.0	0.0	123.3	0.0	0.0	87.5	309.0	165.9	76.5	0.0	0.0	50.3	0.0	1
49	8.32	133.7	0.0	0.0	122.8	0.0	0.0	87.6	308.3	166.5	72.6	0.0	0.0	51.4	0.0	1
50	8.41	126.1	0.0	0.0	121.4	0.0	0.0	87.7	310.6	166.8	87.8	0.0	0.0	53.7	0.0	1
51	8.51	126.9	120.4	111.6	123.1	122.1	118.8	87.8	310.3	166.8	86.2	103.4	141.6	51.3	52.9	58.1
52	8.60	129.0	116.4	113.1	121.9	121.0	117.0	87.9	309.7	166.8	81.8	118.0	133.4	53.3	54.6	62.1
53	8.70	124.7	116.2	115.0	122.0	121.3	117.0	88.0	311.0	166.8	92.0	119.7	125.0	53.3	54.3	62.4
54	8.79	123.7	117.3	117.0	121.9	120.0	117.0	88.1	311.3	166.8	94.9	115.7	116.9	53.6	56.7	62.4
55	8.88	124.8	119.2	120.9	123.3	122.7	123.9	88.2	311.0	166.5	92.2	108.9	103.2	51.5	52.4	50.4
56	8.98	125.9	121.4	123.2	122.8	121.6	116.0	88.3	310.6	166.5	89.7	101.8	96.6	52.4	54.2	65.2
57	9.07	128.1	124.3	123.4	122.9	121.4	116.6	88.4	310.0	166.5	84.7	93.7	96.1	52.4	54.7	64.0
58	9.16	130.4	125.1	117.3	122.1	121.9	116.8	88.5	309.3	166.5	80.1	91.7	116.5	53.7	54.1	63.8
59	9.26	131.7	120.9	119.8	122.2	121.5	117.0	88.6	308.9	166.5	77.7	103.7	107.4	53.7	54.8	63.4
60	9.35	127.0	127.3	115.8	122.2	122.0	119.3	88.7	310.3	166.5	87.9	87.2	124.2	53.8	54.3	59.1

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 82.21 NU(S)A= 53.34 NU(AV)A= 67.78 ST(AV)A= 0.00829 ST(AV)/ST(4S)= 1.90 F/F(4S)= 3.49
 (ST/ST(4S))/(F/F(4S))= 0.545 (F/F(4S))/(ST/ST(4S))*3.0= 0.51 (ST/ST(4S))/(F/F(4S))*3.0= 1.25
 NU(R)A/NU(4S)= 2.32 NU(S)A/NU(4S)= 1.50 e+(4R)= 81.55 R(4R)= 3.18 H(4R)= 8.98

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 11.66

**ORIGINAL PAGE IS
OF POOR QUALITY**

UMBER=101HR30-60/20 E/D=0.047 P/E=20.0 ALPHA=60 HYD DIA= 2.000 IN PR=.71 MDDT=0.0658 LBM/SEC
1622. GGE(R)= 557.4 BTU/HR-SQ FT GGE(S)= 502.6 INLET TEMP= 80.3 F TATM= 73.6 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	97.3	0.0	92.6	94.2	0.0	100.2	80.4	550.3	497.9	357.2	0.0	494.4	395.4	0.0	276.3
16	103.5	0.0	95.5	98.8	0.0	99.1	80.4	548.5	497.1	261.5	0.0	400.4	298.0	0.0	293.2
26	99.5	0.0	96.8	98.2	0.0	94.1	80.5	549.7	496.5	318.4	0.0	371.2	309.3	0.0	402.8
35	100.1	0.0	101.4	98.2	0.0	99.5	80.6	549.5	496.4	309.8	0.0	290.4	310.9	0.0	288.0
45	100.7	0.0	101.4	98.8	0.0	98.7	80.7	549.3	495.9	301.6	0.0	291.4	300.6	0.0	302.3
54	103.0	0.0	102.7	100.1	0.0	98.8	80.8	548.6	495.9	271.1	0.0	274.8	282.3	0.0	302.6
63	105.1	0.0	99.5	101.4	0.0	97.0	80.8	548.0	495.3	248.2	0.0	322.8	264.2	0.0	336.9
73	108.2	0.0	98.2	103.1	0.0	100.7	80.9	547.0	495.1	220.4	0.0	348.0	245.5	0.0	274.9
82	111.0	0.0	105.3	104.7	0.0	103.6	81.0	546.2	494.7	200.0	0.0	247.0	229.4	0.0	240.9
91	101.1	0.0	104.9	106.3	0.0	105.8	81.1	549.2	493.7	301.4	0.0	253.3	214.9	0.0	219.3
01	112.9	0.0	0.0	108.4	0.0	0.0	81.2	545.6	494.0	188.8	0.0	0.0	198.9	0.0	0.0
10	111.7	0.0	0.0	107.1	0.0	0.0	81.3	546.0	493.8	196.9	0.0	0.0	210.0	0.0	0.0
20	111.4	0.0	0.0	110.1	0.0	0.0	81.3	546.1	492.6	199.4	0.0	0.0	187.8	0.0	0.0
29	111.3	0.0	0.0	110.2	0.0	0.0	81.4	546.1	492.3	200.6	0.0	0.0	187.8	0.0	0.0
38	112.2	0.0	0.0	111.9	0.0	0.0	81.5	545.8	491.7	195.1	0.0	0.0	177.6	0.0	0.0
48	113.4	0.0	0.0	112.5	0.0	0.0	81.6	545.5	491.1	188.1	0.0	0.0	174.2	0.0	0.0
57	115.0	0.0	0.0	114.0	0.0	0.0	81.7	545.0	490.5	179.4	0.0	0.0	166.4	0.0	0.0
66	116.8	0.0	0.0	116.0	0.0	0.0	81.7	544.5	489.9	170.4	0.0	0.0	156.9	0.0	0.0
76	117.9	0.0	0.0	117.0	0.0	0.0	81.8	544.1	489.6	165.4	0.0	0.0	152.7	0.0	0.0
85	105.0	0.0	0.0	117.0	0.0	0.0	81.9	548.0	489.6	260.3	0.0	0.0	153.0	0.0	0.0
95	115.2	0.0	0.0	118.0	0.0	0.0	82.0	544.9	489.3	179.9	0.0	0.0	149.0	0.0	0.0
2.04	112.9	0.0	0.0	118.0	0.0	0.0	82.1	545.6	489.3	194.0	0.0	0.0	149.3	0.0	0.0
2.13	112.7	0.0	0.0	119.0	0.0	0.0	82.2	545.7	489.0	195.8	0.0	0.0	145.5	0.0	0.0
2.23	114.0	0.0	0.0	121.0	0.0	0.0	82.2	545.3	488.4	188.2	0.0	0.0	138.1	0.0	0.0
2.32	116.0	0.0	0.0	121.0	0.0	0.0	82.3	544.7	488.4	177.2	0.0	0.0	138.4	0.0	0.0
2.41	117.7	0.0	0.0	122.0	0.0	0.0	82.4	544.2	488.1	168.9	0.0	0.0	135.1	0.0	0.0
2.51	119.6	0.0	0.0	122.0	0.0	0.0	82.5	543.6	488.1	160.4	0.0	0.0	135.3	0.0	0.0
2.60	121.1	0.0	0.0	121.0	0.0	0.0	82.6	543.2	488.4	154.4	0.0	0.0	139.2	0.0	0.0
2.70	121.8	0.0	0.0	124.0	0.0	0.0	82.6	543.0	487.5	151.9	0.0	0.0	129.1	0.0	0.0
2.79	108.8	0.0	0.0	125.0	0.0	0.0	82.7	546.9	487.2	229.7	0.0	0.0	126.2	0.0	0.0
2.88	118.0	0.0	0.0	125.0	0.0	0.0	82.8	544.1	487.2	169.3	0.0	0.0	126.4	0.0	0.0
2.98	117.3	0.0	0.0	125.0	0.0	0.0	82.9	544.3	487.2	173.2	0.0	0.0	126.7	0.0	0.0
3.07	116.6	0.0	0.0	125.0	0.0	0.0	83.0	544.5	487.2	177.2	0.0	0.0	126.9	0.0	0.0
3.16	117.3	0.0	0.0	128.0	0.0	0.0	83.0	544.3	486.3	173.9	0.0	0.0	118.4	0.0	0.0
3.26	118.7	0.0	0.0	127.0	0.0	0.0	83.1	543.9	486.6	167.3	0.0	0.0	121.4	0.0	0.0
3.35	121.1	0.0	0.0	128.0	0.0	0.0	83.2	543.2	486.3	156.9	0.0	0.0	118.8	0.0	0.0
3.45	122.8	0.0	0.0	128.0	0.0	0.0	83.3	542.7	486.3	150.3	0.0	0.0	119.0	0.0	0.0
3.54	125.1	0.0	0.0	128.0	0.0	0.0	83.4	542.0	486.3	142.1	0.0	0.0	119.2	0.0	0.0
3.63	125.2	0.0	0.0	129.0	0.0	0.0	83.5	541.9	486.0	142.0	0.0	0.0	116.7	0.0	0.0
3.73	114.2	0.0	0.0	128.0	0.0	0.0	83.5	545.2	486.3	194.5	0.0	0.0	119.6	0.0	0.0
7.57	120.7	0.0	0.0	133.0	0.0	0.0	86.9	543.3	484.8	174.7	0.0	0.0	114.3	0.0	0.0
7.66	118.0	0.0	0.0	133.0	0.0	0.0	87.0	544.1	484.8	190.6	0.0	0.0	114.5	0.0	0.0
7.76	116.4	0.0	0.0	133.0	0.0	0.0	87.0	544.6	484.8	201.7	0.0	0.0	114.7	0.0	0.0
7.85	117.0	0.0	0.0	132.5	0.0	0.0	87.1	544.4	485.0	198.1	0.0	0.0	116.2	0.0	0.0
7.95	117.4	0.0	0.0	133.2	0.0	0.0	87.2	544.3	485.4	195.9	0.0	0.0	114.7	0.0	0.0
8.04	118.9	0.0	0.0	134.4	0.0	0.0	87.3	543.8	485.1	187.0	0.0	0.0	111.9	0.0	0.0
8.13	120.7	0.0	0.0	132.7	0.0	0.0	87.4	543.3	484.9	177.1	0.0	0.0	116.3	0.0	0.0
8.23	122.7	0.0	0.0	132.7	0.0	0.0	87.4	542.7	487.0	167.3	0.0	0.0	117.0	0.0	0.0
8.32	124.6	0.0	0.0	131.6	0.0	0.0	87.5	542.1	488.1	158.9	0.0	0.0	120.3	0.0	0.0
8.41	115.2	0.0	0.0	132.2	0.0	0.0	87.6	544.9	487.8	214.6	0.0	0.0	118.9	0.0	0.0
8.51	115.7	109.9	108.4	133.1	134.4	126.6	87.7	544.8	487.5	211.3	266.5	285.8	116.7	113.4	136.0
8.60	117.4	108.9	111.7	132.1	133.4	124.7	87.8	544.3	486.9	199.5	279.8	247.1	119.4	115.9	143.4
8.70	115.3	110.8	114.6	132.4	133.9	123.7	87.9	544.9	486.9	215.6	257.9	221.2	118.8	114.9	147.5
8.79	115.5	113.2	116.7	134.0	134.0	123.7	87.9	544.9	486.6	214.6	234.2	205.7	114.7	114.7	147.9

8.88	116.7	116.2	121.3	133.1	134.1	131.5	88.0	544.5	486.3	206.1	209.7	177.6	117.1	114.7	121.4
8.98	117.8	119.4	123.9	132.5	132.5	123.9	88.1	544.2	486.0	198.9	188.7	165.0	118.7	118.9	147.5
9.07	119.6	122.7	117.5	131.8	131.3	121.6	88.2	543.6	486.0	187.8	170.9	201.2	120.9	122.2	158.0
9.16	122.0	116.9	105.6	132.3	132.3	121.8	88.3	542.9	486.0	174.6	205.7	339.8	119.7	119.8	157.4
9.26	123.0	109.3	108.7	131.0	133.0	124.9	88.3	542.6	486.3	169.9	280.9	289.2	123.6	118.3	144.2
9.35	115.8	115.6	107.9	132.3	133.0	125.0	88.4	544.8	485.7	215.9	217.5	303.5	120.1	118.2	144.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=182.05 NU(S)A=120.15 NU(AV)A=151.10 ST(AV)A=0.00674 ST(AV)/ST(4S)=1.89 F/F(4S)= 4.51
 ST(ST(4S))/(F/F(4S))=0.420 (F/F(4S))/(ST/ST(4S))*3.0=0.66 (ST/ST(4S))/(F/F(4S))*1/3=1.15
 NU(R)A/NU(4S)=2.29 NU(S)A/NU(4S)=1.51 e+(4R)= 227.78 R(4R)= 3.06 H(4R)=12.13

BY USING ROUGHSIDE RESULTS ONLY : H(RB)= 15.58

RUN NUMBER=102HR60-60/20 E/D=0.047 P/E=20.0 ALPHA=60 HYD DIA= 2.000 IN PR= 71 MDOT=0.1330 LBM/SEC
 RE= 63847. GGE(R)=1095.7 BTU/HR-SQ FT GGE(S)= 801.4 INLET TEMP= 81.5 F TATM= 74.6 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	
1	0.07	101.1	0.0	96.1	93.6	0.0	87.8	81.6	1087.7	797.0	610.7	0.0	820.6	728.7	0.0	
2	0.16	106.5	0.0	97.9	96.8	0.0	91.2	81.6	1086.1	796.3	479.1	0.0	732.3	574.1	0.0	
3	0.26	101.4	0.0	99.5	96.5	0.0	94.2	81.7	1087.6	795.6	605.7	0.0	670.3	590.8	0.0	
4	0.35	102.4	0.0	108.0	96.6	0.0	100.2	81.8	1087.3	795.5	578.2	0.0	454.8	589.4	0.0	
5	0.45	102.8	0.0	106.7	97.4	0.0	98.4	81.8	1087.2	794.9	569.1	0.0	479.8	561.0	0.0	
6	0.54	106.3	0.0	107.1	98.6	0.0	97.6	81.9	1086.1	795.1	488.6	0.0	473.0	523.8	0.0	
7	0.63	108.5	0.0	101.6	100.5	0.0	97.0	82.0	1085.5	794.4	449.0	0.0	607.0	471.4	0.0	
8	0.73	111.8	0.0	99.5	101.8	0.0	100.0	82.1	1084.5	794.3	399.9	0.0	682.0	442.1	0.0	
9	0.82	115.5	0.0	109.4	104.1	0.0	101.0	82.1	1083.4	794.0	356.0	0.0	435.7	397.2	0.0	
10	0.91	103.5	0.0	108.1	105.6	0.0	103.0	82.2	1087.0	793.0	559.7	0.0	460.2	372.2	0.0	
11	1.01	117.9	0.0	0.0	107.1	0.0	0.0	82.3	1082.7	793.2	333.2	0.0	0.0	349.6	0.0	
12	1.10	117.6	0.0	0.0	105.4	0.0	0.0	82.4	1082.8	793.5	336.7	0.0	0.0	378.1	0.0	
13	1.20	115.0	0.0	0.0	108.5	0.0	0.0	82.4	1083.5	792.0	364.5	0.0	0.0	333.2	0.0	
14	1.29	114.9	0.0	0.0	109.6	0.0	0.0	82.5	1083.6	791.7	366.4	0.0	0.0	320.4	0.0	
15	1.38	116.0	0.0	0.0	111.3	0.0	0.0	82.6	1083.2	791.4	355.0	0.0	0.0	302.2	0.0	
16	1.48	117.5	0.0	0.0	112.0	0.0	0.0	82.6	1082.8	790.5	340.3	0.0	0.0	295.1	0.0	
17	1.57	119.5	0.0	0.0	112.7	0.0	0.0	82.7	1082.2	790.5	322.3	0.0	0.0	288.9	0.0	
18	1.66	121.9	0.0	0.0	114.5	0.0	0.0	82.8	1081.5	790.2	302.8	0.0	0.0	273.1	0.0	
19	1.76	123.6	0.0	0.0	114.0	0.0	0.0	82.9	1081.0	789.6	290.6	0.0	0.0	277.7	0.0	
20	1.85	106.0	0.0	0.0	114.0	0.0	0.0	82.9	1086.2	789.6	515.7	0.0	0.0	278.3	0.0	
21	1.95	121.5	0.0	0.0	115.0	0.0	0.0	83.0	1081.6	789.3	307.6	0.0	0.0	270.1	0.0	
22	2.04	117.3	0.0	0.0	116.0	0.0	0.0	83.1	1082.8	789.0	346.4	0.0	0.0	262.4	0.0	
23	2.13	116.7	0.0	0.0	117.0	0.0	0.0	83.2	1083.0	788.7	353.4	0.0	0.0	255.1	0.0	
24	2.23	118.0	0.0	0.0	119.0	0.0	0.0	83.2	1082.6	788.1	340.8	0.0	0.0	241.1	0.0	
25	2.32	120.5	0.0	0.0	119.0	0.0	0.0	83.3	1081.9	788.1	318.3	0.0	0.0	241.6	0.0	
26	2.41	122.7	0.0	0.0	120.0	0.0	0.0	83.4	1081.2	787.8	300.8	0.0	0.0	235.3	0.0	
27	2.51	125.0	0.0	0.0	120.0	0.0	0.0	83.5	1080.5	787.8	284.5	0.0	0.0	235.8	0.0	
28	2.60	126.6	0.0	0.0	118.0	0.0	0.0	83.5	1080.1	788.4	274.2	0.0	0.0	250.1	0.0	
29	2.70	128.0	0.0	0.0	122.0	0.0	0.0	83.6	1079.6	787.2	265.9	0.0	0.0	224.2	0.0	
30	2.79	110.4	0.0	0.0	123.0	0.0	0.0	83.7	1084.9	786.9	443.8	0.0	0.0	218.8	0.0	
31	2.88	124.5	0.0	0.0	123.0	0.0	0.0	83.7	1080.7	786.9	289.9	0.0	0.0	219.2	0.0	
32	2.98	123.5	0.0	0.0	123.0	0.0	0.0	83.8	1081.0	786.9	297.8	0.0	0.0	219.5	0.0	
33	3.07	121.4	0.0	0.0	124.0	0.0	0.0	83.9	1081.6	786.6	315.2	0.0	0.0	214.4	0.0	
34	3.16	121.9	0.0	0.0	127.0	0.0	0.0	84.0	1081.5	785.7	311.6	0.0	0.0	199.5	0.0	
35	3.26	122.8	0.0	0.0	125.0	0.0	0.0	84.0	1081.2	786.3	304.8	0.0	0.0	209.8	0.0	
36	3.35	125.9	0.0	0.0	125.0	0.0	0.0	84.1	1080.3	786.3	282.5	0.0	0.0	210.1	0.0	
37	3.45	127.5	0.0	0.0	127.0	0.0	0.0	84.2	1079.8	785.7	272.3	0.0	0.0	200.5	0.0	
38	3.54	130.4	0.0	0.0	126.0	0.0	0.0	84.3	1078.9	786.0	255.4	0.0	0.0	205.7	0.0	
39	3.63	131.2	0.0	0.0	128.0	0.0	0.0	84.3	1078.7	785.4	251.4	0.0	0.0	196.4	0.0	
40	3.73	116.1	0.0	0.0	127.0	0.0	0.0	84.4	1083.2	785.7	373.2	0.0	0.0	201.4	0.0	
41	7.57	119.5	0.0	0.0	131.0	0.0	0.0	87.4	1082.2	784.5	366.3	0.0	0.0	195.5	0.0	
42	7.66	119.7	0.0	0.0	130.0	0.0	0.0	87.5	1082.1	784.8	364.8	0.0	0.0	200.5	0.0	
43	7.76	118.5	0.0	0.0	130.5	0.0	0.0	87.5	1082.5	784.6	379.9	0.0	0.0	198.4	0.0	
44	7.85	119.0	0.0	0.0	130.0	0.0	0.0	87.6	1082.3	784.8	374.6	0.0	0.0	201.1	0.0	
45	7.95	119.4	0.0	0.0	131.7	0.0	0.0	87.7	1082.2	785.5	370.7	0.0	0.0	194.1	0.0	
46	8.04	121.3	0.0	0.0	130.6	0.0	0.0	87.8	1081.6	785.7	350.3	0.0	0.0	199.4	0.0	
47	8.13	123.3	0.0	0.0	131.2	0.0	0.0	87.8	1081.0	785.8	331.0	0.0	0.0	197.0	0.0	
48	8.23	125.6	0.0	0.0	129.8	0.0	0.0	87.9	1080.4	788.4	311.2	0.0	0.0	204.4	0.0	
49	8.32	128.9	0.0	0.0	131.0	0.0	0.0	88.0	1079.4	787.8	286.4	0.0	0.0	198.9	0.0	
50	8.41	118.6	0.0	0.0	130.6	0.0	0.0	88.0	1082.5	787.2	384.7	0.0	0.0	200.8	0.0	
51	8.51	118.5	111.0	112.6	129.2	133.0	125.8	88.1	1082.5	787.5	386.8	513.6	480.1	208.0	190.4	226.6
52	8.60	123.0	111.6	116.9	129.6	131.4	122.1	88.2	1081.1	786.3	337.2	501.4	408.8	206.3	197.4	252.2
53	8.70	118.6	115.2	121.2	130.8	132.0	123.5	88.3	1082.5	786.6	387.3	436.2	356.7	200.6	195.1	242.2
54	8.79	117.3	119.0	124.0	130.2	131.9	122.4	88.3	1082.8	786.6	405.8	383.3	329.5	203.7	195.8	250.2
55	8.88	118.5	123.6	131.1	130.6	132.0	130.2	88.4	1082.5	786.0	390.4	333.8	275.2	202.4	195.4	204.2
56	8.98	119.9	127.5	133.9	130.1	131.7	124.0	88.5	1082.1	786.0	373.7	300.9	258.5	205.1	197.5	240.2
57	9.07	122.4	131.3	122.3	129.4	131.7	122.7	88.6	1081.3	786.0	346.6	274.4	347.7	208.9	197.8	249.2
58	9.16	126.0	121.1	105.2	128.8	131.6	123.8	88.6	1080.2	785.7	313.6	360.9	707.2	212.3	198.5	242.2
59	9.26	128.3	110.4	109.6	129.5	131.3	127.2	88.7	1079.5	785.7	295.7	539.7	560.3	209.0	200.2	221.2
60	9.35	118.6	116.6	110.0	128.9	131.3	123.9	88.8	1082.5	785.7	393.6	421.9	553.1	212.4	200.5	242.2

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=329.24 NU(S)A=207.26 NU(AV)A=268.25 ST(AV)A=0.00593 ST(AV)/ST(4S)=1.92 F/F(4S)= 5.33
 (ST/ST(4S))/(F/F(4S))=0.360 (F/F(4S))/(ST/ST(4S))**3.0=0.76 (ST/ST(4S))/(F/F(4S))**(1/3)=1.10
 NU(R)A/NU(4S)=2.36 NU(S)A/NU(4S)=1.48 e+(4R)= 464.52 R(4R)= 3.00 H(4R)=14.37

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 18.00

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER=104HR10-45/10 E/D=0.047 P/E=10.0 ALPHA=45 HYD DIA= 2.000 IN PR=.71 MDOT=0.0219 LBM/SEC
0511. GGE(R)= 253.2 BTU/HR-SQ FT GGE(S)= 171.9 INLET TEMP= 80.7 F TATM= 77.2 F PATM= 14.6 PSIA

/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	95.7	0.0	90.4	92.7	0.0	90.3	80.8	247.7	167.5	182.2	0.0	282.5	154.9	0.0	192.8
16	104.0	0.0	96.1	97.1	0.0	93.8	80.9	245.2	166.4	116.4	0.0	176.7	112.7	0.0	141.5
26	101.1	0.0	99.6	96.0	0.0	95.0	81.0	246.0	166.4	134.1	0.0	144.9	121.8	0.0	130.2
35	101.0	0.0	102.3	95.6	0.0	99.0	81.0	246.1	166.6	135.4	0.0	127.2	126.0	0.0	101.9
45	102.6	0.0	101.4	96.2	0.0	99.0	81.1	245.6	166.3	125.7	0.0	133.1	121.5	0.0	102.3
54	107.0	0.0	99.9	97.9	0.0	101.0	81.2	244.3	166.1	104.1	0.0	143.7	109.3	0.0	92.2
53	104.9	0.0	101.0	99.1	0.0	101.0	81.3	244.9	165.7	114.0	0.0	136.6	102.2	0.0	92.4
73	104.4	0.0	104.9	100.8	0.0	102.0	81.4	245.0	165.3	117.0	0.0	114.5	93.6	0.0	88.1
82	105.4	0.0	104.6	102.5	0.0	102.0	81.5	244.7	164.8	112.4	0.0	116.3	86.1	0.0	88.2
91	102.6	0.0	105.2	104.0	0.0	102.0	81.6	245.6	164.1	128.3	0.0	114.2	80.3	0.0	88.3
01	109.2	0.0	0.0	106.8	0.0	0.0	81.7	243.6	164.2	97.2	0.0	0.0	71.9	0.0	0.0
10	108.2	0.0	0.0	105.1	0.0	0.0	81.8	243.9	164.2	101.3	0.0	0.0	77.4	0.0	0.0
20	108.5	0.0	0.0	106.6	0.0	0.0	81.9	243.8	163.6	100.4	0.0	0.0	72.6	0.0	0.0
29	108.9	0.0	0.0	108.0	0.0	0.0	82.0	243.7	163.0	99.2	0.0	0.0	68.6	0.0	0.0
38	107.2	0.0	0.0	108.9	0.0	0.0	82.1	244.2	162.7	106.5	0.0	0.0	66.4	0.0	0.0
48	109.9	0.0	0.0	111.7	0.0	0.0	82.2	243.4	162.1	96.2	0.0	0.0	60.2	0.0	0.0
57	113.8	0.0	0.0	112.0	0.0	0.0	82.2	242.2	161.8	84.1	0.0	0.0	59.5	0.0	0.0
66	112.1	0.0	0.0	111.0	0.0	0.0	82.3	242.7	161.8	89.4	0.0	0.0	61.9	0.0	0.0
76	111.0	0.0	0.0	112.0	0.0	0.0	82.4	243.1	161.5	93.2	0.0	0.0	59.8	0.0	0.0
85	107.3	0.0	0.0	112.0	0.0	0.0	82.5	244.2	161.5	108.0	0.0	0.0	60.0	0.0	0.0
95	112.6	0.0	0.0	113.0	0.0	0.0	82.6	242.6	161.2	88.6	0.0	0.0	58.1	0.0	0.0
04	114.4	0.0	0.0	114.0	0.0	0.0	82.7	242.0	160.9	83.7	0.0	0.0	56.3	0.0	0.0
13	113.2	0.0	0.0	115.0	0.0	0.0	82.8	242.4	160.6	87.3	0.0	0.0	54.6	0.0	0.0
23	112.5	0.0	0.0	116.0	0.0	0.0	82.9	242.6	160.3	89.7	0.0	0.0	53.0	0.0	0.0
32	108.3	0.0	0.0	116.0	0.0	0.0	83.0	243.9	160.3	105.5	0.0	0.0	53.1	0.0	0.0
41	111.3	0.0	0.0	117.0	0.0	0.0	83.1	243.0	160.0	94.2	0.0	0.0	51.6	0.0	0.0
51	115.8	0.0	0.0	117.0	0.0	0.0	83.2	241.6	160.0	81.0	0.0	0.0	51.8	0.0	0.0
60	114.0	0.0	0.0	117.0	0.0	0.0	83.3	242.2	160.0	86.2	0.0	0.0	51.9	0.0	0.0
70	112.7	0.0	0.0	118.0	0.0	0.0	83.4	242.6	159.7	90.4	0.0	0.0	50.4	0.0	0.0
79	108.7	0.0	0.0	119.0	0.0	0.0	83.4	243.8	159.4	105.6	0.0	0.0	49.0	0.0	0.0
88	114.5	0.0	0.0	119.0	0.0	0.0	83.5	242.0	159.4	85.5	0.0	0.0	49.2	0.0	0.0
98	116.5	0.0	0.0	119.0	0.0	0.0	83.6	241.4	159.4	80.3	0.0	0.0	49.3	0.0	0.0
07	115.0	0.0	0.0	120.0	0.0	0.0	83.7	241.9	159.1	84.6	0.0	0.0	47.9	0.0	0.0
16	113.9	0.0	0.0	121.0	0.0	0.0	83.8	242.2	158.8	88.0	0.0	0.0	46.7	0.0	0.0
26	109.7	0.0	0.0	120.0	0.0	0.0	83.9	243.5	159.1	103.2	0.0	0.0	48.2	0.0	0.0
35	115.6	0.0	0.0	121.0	0.0	0.0	84.0	241.7	158.8	83.6	0.0	0.0	46.9	0.0	0.0
45	116.7	0.0	0.0	122.0	0.0	0.0	84.1	241.4	158.5	80.9	0.0	0.0	45.7	0.0	0.0
54	115.2	0.0	0.0	121.0	0.0	0.0	84.2	241.8	158.8	85.2	0.0	0.0	47.1	0.0	0.0
63	114.2	0.0	0.0	122.0	0.0	0.0	84.3	242.1	158.5	88.4	0.0	0.0	45.9	0.0	0.0
73	110.0	0.0	0.0	121.0	0.0	0.0	84.4	243.4	158.8	103.7	0.0	0.0	47.3	0.0	0.0
82	116.2	0.0	0.0	127.0	0.0	0.0	88.2	241.5	157.0	93.5	0.0	0.0	43.9	0.0	0.0
91	116.4	0.0	0.0	128.2	0.0	0.0	88.3	241.4	157.0	93.1	0.0	0.0	42.6	0.0	0.0
01	115.8	0.0	0.0	127.9	0.0	0.0	88.3	241.6	157.0	95.5	0.0	0.0	43.0	0.0	0.0
10	114.6	0.0	0.0	127.2	0.0	0.0	88.4	242.0	157.3	100.4	0.0	0.0	44.0	0.0	0.0
20	111.7	0.0	0.0	127.8	0.0	0.0	88.5	242.9	157.3	113.7	0.0	0.0	43.5	0.0	0.0
29	112.3	0.0	0.0	128.0	0.0	0.0	88.6	242.7	157.3	111.2	0.0	0.0	43.4	0.0	0.0
38	115.7	0.0	0.0	127.8	0.0	0.0	88.7	241.7	156.8	97.1	0.0	0.0	43.5	0.0	0.0
48	115.0	0.0	0.0	127.3	0.0	0.0	88.8	241.9	157.0	100.1	0.0	0.0	44.2	0.0	0.0
57	114.6	0.0	0.0	127.6	0.0	0.0	88.9	242.0	157.3	102.1	0.0	0.0	44.1	0.0	0.0
66	110.7	0.0	0.0	126.3	0.0	0.0	89.0	243.2	157.6	121.4	0.0	0.0	45.8	0.0	0.0
76	111.0	108.7	106.8	127.8	124.9	118.6	89.1	243.1	157.6	120.2	134.3	148.7	44.1	47.7	57.9
85	114.6	109.0	107.5	126.7	123.9	117.0	89.2	242.0	157.6	103.2	132.3	143.1	45.5	49.1	61.4
95	113.1	107.3	108.2	126.8	124.2	118.0	89.3	242.4	157.6	110.2	145.7	138.8	45.5	48.9	59.4
04	113.4	113.2	106.9	125.7	123.0	118.0	89.4	242.3	157.9	109.2	110.2	149.7	47.1	50.8	59.7
13	111.4	111.2	109.1	127.1	125.4	116.3	89.5	242.9	157.6	119.9	121.0	134.0	45.4	47.4	63.6
23	112.4	110.1	107.6	126.6	124.5	115.0	89.5	242.6	157.6	115.0	127.9	145.6	46.1	48.8	67.1
32	116.7	110.4	108.7	126.7	124.3	117.6	89.6	241.4	157.6	96.6	125.9	137.1	46.1	49.2	61.1
41	115.2	108.2	110.4	126.0	124.7	118.8	89.7	241.8	157.6	102.8	141.8	126.7	47.0	48.8	58.8
51	114.4	113.9	108.7	125.1	124.4	120.0	89.8	242.0	157.9	106.6	108.8	138.8	48.4	49.4	56.6
60	113.0	111.3	109.1	126.1	124.8	119.1	89.9	242.5	157.6	113.7	122.7	136.8	47.1	48.9	58.5

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 (R)A= 99.05 NU(S)A= 46.82 NU(AV)A= 72.93 ST(AV)A=0.00780 ST(AV)/ST(4S)=2.21 F/F(4S)= 3.90
 (T/ST(4S))/(F/F(4S))=0.566 (F/F(4S))/(ST/ST(4S))**3.0=0.36 (ST/ST(4S))/(F/F(4S))**(1/3)=1.40
 (R)A/NU(4S)=3.01 NU(S)A/NU(4S)=1.42 e+(4R)= 80.21 R(4R)= 2.69 H(4R)= 7.38

USING ROUGH SIDE RESULTS ONLY : H(RB)= 8.88

RUN NUMBER=105HR30-45/10 E/D=0.047 P/E=10.0 ALPHA=45 HYD DIA= 2.000 IN PR=.71 MDOT=0.0652 LBM/SEC
 RE= 31233. GGE(R)= 563.3 BTU/HR-SG FT GGE(S)= 438.3 INLET TEMP= 82.8 F TATM= 74.9 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	99.8	0.0	91.2	95.9	0.0	102.0	82.9	555.9	433.5	359.3	0.0	729.7	362.7	0.0
2	0.16	107.5	0.0	96.8	99.7	0.0	102.0	82.9	553.6	432.9	246.7	0.0	437.1	282.7	0.0
3	0.26	101.5	0.0	100.2	98.7	0.0	97.0	83.0	555.4	432.4	328.9	0.0	353.7	301.4	0.0
4	0.35	103.8	0.0	104.0	99.1	0.0	100.5	83.1	554.7	432.2	293.2	0.0	290.4	295.3	0.0
5	0.45	104.1	0.0	102.3	99.7	0.0	100.7	83.2	554.6	431.7	290.0	0.0	317.2	286.1	0.0
6	0.54	112.6	0.0	100.1	100.8	0.0	101.8	83.2	552.0	431.7	205.8	0.0	358.4	268.9	0.0
7	0.63	111.2	0.0	100.3	101.8	0.0	101.0	83.3	552.5	431.3	216.8	0.0	356.1	255.4	0.0
8	0.73	110.4	0.0	106.5	103.5	0.0	103.7	83.4	552.7	431.0	224.0	0.0	261.8	234.3	0.0
9	0.82	111.3	0.0	106.8	105.0	0.0	104.5	83.5	552.4	430.7	217.2	0.0	259.1	218.5	0.0
10	0.91	105.6	0.0	109.0	106.3	0.0	105.8	83.6	554.1	429.8	274.9	0.0	238.2	206.8	0.0
11	1.01	114.5	0.0	0.0	107.9	0.0	0.0	83.6	551.5	430.2	195.4	0.0	0.0	194.1	0.0
12	1.10	113.8	0.0	0.0	107.0	0.0	0.0	83.7	551.7	429.9	200.5	0.0	0.0	201.7	0.0
13	1.20	114.0	0.0	0.0	108.1	0.0	0.0	83.8	551.6	429.3	199.6	0.0	0.0	193.1	0.0
14	1.29	114.9	0.0	0.0	108.2	0.0	0.0	83.9	551.3	429.0	194.2	0.0	0.0	193.0	0.0
15	1.38	111.2	0.0	0.0	109.9	0.0	0.0	83.9	552.5	428.4	221.6	0.0	0.0	180.7	0.0
16	1.48	115.0	0.0	0.0	110.5	0.0	0.0	84.0	551.3	427.8	194.5	0.0	0.0	176.5	0.0
17	1.57	120.0	0.0	0.0	112.0	0.0	0.0	84.1	549.8	427.2	167.4	0.0	0.0	167.3	0.0
18	1.66	117.8	0.0	0.0	112.0	0.0	0.0	84.2	550.5	427.2	178.9	0.0	0.0	167.8	0.0
19	1.76	116.6	0.0	0.0	113.0	0.0	0.0	84.3	550.8	426.9	186.0	0.0	0.0	162.2	0.0
20	1.85	108.8	0.0	0.0	113.0	0.0	0.0	84.3	553.2	426.9	247.0	0.0	0.0	162.7	0.0
21	1.95	118.0	0.0	0.0	114.0	0.0	0.0	84.4	550.4	426.6	179.0	0.0	0.0	157.5	0.0
22	2.04	119.7	0.0	0.0	115.0	0.0	0.0	84.5	549.9	426.3	170.5	0.0	0.0	152.6	0.0
23	2.13	118.3	0.0	0.0	116.0	0.0	0.0	84.6	550.3	426.0	178.1	0.0	0.0	148.0	0.0
24	2.23	117.7	0.0	0.0	119.0	0.0	0.0	84.6	550.5	425.1	181.8	0.0	0.0	135.1	0.0
25	2.32	110.3	0.0	0.0	117.0	0.0	0.0	84.7	552.7	425.7	235.9	0.0	0.0	144.0	0.0
26	2.41	114.1	0.0	0.0	119.0	0.0	0.0	84.8	551.6	425.1	205.5	0.0	0.0	135.7	0.0
27	2.51	120.7	0.0	0.0	119.0	0.0	0.0	84.9	549.6	425.1	167.4	0.0	0.0	136.0	0.0
28	2.60	118.6	0.0	0.0	119.0	0.0	0.0	85.0	550.2	425.1	178.5	0.0	0.0	136.3	0.0
29	2.70	116.6	0.0	0.0	120.0	0.0	0.0	85.0	550.8	424.8	190.4	0.0	0.0	132.5	0.0
30	2.79	109.3	0.0	0.0	121.0	0.0	0.0	85.1	553.0	424.5	249.4	0.0	0.0	129.0	0.0
31	2.88	118.5	0.0	0.0	121.0	0.0	0.0	85.2	550.3	424.5	180.2	0.0	0.0	129.3	0.0
32	2.98	120.1	0.0	0.0	121.0	0.0	0.0	85.3	549.8	424.5	172.1	0.0	0.0	129.6	0.0
33	3.07	118.5	0.0	0.0	122.0	0.0	0.0	85.3	550.3	424.2	181.0	0.0	0.0	126.2	0.0
34	3.16	117.6	0.0	0.0	123.0	0.0	0.0	85.4	550.5	423.9	186.5	0.0	0.0	123.0	0.0
35	3.26	109.7	0.0	0.0	123.0	0.0	0.0	85.5	552.9	423.9	249.1	0.0	0.0	123.2	0.0
36	3.35	119.8	0.0	0.0	124.0	0.0	0.0	85.6	549.9	423.6	175.1	0.0	0.0	120.2	0.0
37	3.45	121.0	0.0	0.0	124.0	0.0	0.0	85.7	549.5	423.6	169.4	0.0	0.0	120.4	0.0
38	3.54	119.1	0.0	0.0	123.0	0.0	0.0	85.7	550.1	423.9	179.7	0.0	0.0	124.0	0.0
39	3.63	118.2	0.0	0.0	124.0	0.0	0.0	85.8	550.4	423.6	185.1	0.0	0.0	120.9	0.0
40	3.73	110.7	0.0	0.0	123.0	0.0	0.0	85.9	552.6	423.9	242.6	0.0	0.0	124.4	0.0
41	7.57	117.5	0.0	0.0	127.0	0.0	0.0	89.1	550.6	422.7	209.9	0.0	0.0	120.8	0.0
42	7.66	118.2	0.0	0.0	127.0	0.0	0.0	89.1	550.4	422.7	205.3	0.0	0.0	121.0	0.0
43	7.76	117.8	0.0	0.0	126.5	0.0	0.0	89.2	550.5	422.9	208.8	0.0	0.0	122.9	0.0
44	7.85	118.0	0.0	0.0	126.0	0.0	0.0	89.3	550.4	423.0	207.8	0.0	0.0	124.9	0.0
45	7.95	114.8	0.0	0.0	126.7	0.0	0.0	89.4	551.4	423.5	235.0	0.0	0.0	123.0	0.0
46	8.04	115.5	0.0	0.0	126.4	0.0	0.0	89.5	551.2	423.6	229.3	0.0	0.0	124.3	0.0
47	8.13	120.6	0.0	0.0	126.0	0.0	0.0	89.5	549.6	423.0	191.6	0.0	0.0	125.6	0.0
48	8.23	119.8	0.0	0.0	127.7	0.0	0.0	89.6	549.9	424.6	197.3	0.0	0.0	120.7	0.0
49	8.32	118.5	0.0	0.0	126.5	0.0	0.0	89.7	550.3	425.7	206.8	0.0	0.0	125.3	0.0
50	8.41	111.8	0.0	0.0	127.1	0.0	0.0	89.8	552.3	425.4	271.4	0.0	0.0	123.5	0.0
51	8.51	111.6	112.1	107.2	127.0	129.3	122.6	89.8	552.3	425.4	274.9	268.7	344.6	124.1	116.8
52	8.60	116.6	111.5	107.6	126.0	128.3	123.6	89.9	550.8	424.8	223.5	276.3	337.3	127.5	119.8
53	8.70	116.1	106.8	108.3	126.3	128.8	123.7	90.0	551.0	424.8	228.5	355.0	325.9	126.7	118.5
54	8.79	117.7	115.2	109.7	126.9	128.9	121.6	90.1	550.5	424.8	215.7	237.1	303.6	124.8	118.4

55	8.88	112.7	112.2	115.2	126.1	129.0	129.4	90.2	552.0	424.5	264.9	271.0	238.5	128.0	118.3
56	8.98	113.9	115.0	108.2	126.5	126.4	120.9	90.2	551.6	423.9	252.2	241.0	332.2	126.4	126.7
57	9.07	120.9	113.9	108.4	125.8	126.3	122.5	90.3	549.5	423.9	194.3	252.0	328.7	129.3	127.4
58	9.16	118.3	108.1	109.7	126.3	127.2	122.8	90.4	550.3	423.9	213.3	336.1	308.2	127.7	124.5
59	9.26	118.2	116.7	111.0	125.0	127.9	122.9	90.5	550.4	424.2	214.6	226.9	289.9	132.9	122.5
60	9.35	115.3	113.4	113.7	125.3	127.0	121.0	90.5	551.2	423.9	240.8	260.8	257.4	132.0	125.8

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=212.18 NU(S)A=126.03 NU(AV)A=169.10 ST(AV)A=0.00764 ST(AV)/ST(4S)=2.14 F/F(4S)= 4.47
 (ST/ST(4S))/(F/F(4S))=0.479 (F/F(4S))/(ST/ST(4S))*3.0=0.46 (ST/ST(4S))/(F/F(4S))*3.0=1.30
 NU(R)A/NU(4S)=2.69 NU(S)A/NU(4S)=1.60 e+(4R)= 224.30 R(4R)= 3.08 H(4R)= 9.72

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 12.63

ORIGINAL PAGE IS OF POOR QUALITY

NUMBER=106HR60-45/10 E/D=0.047 P/E=10.0 ALPHA=45 HYD DIA= 2.000 IN PR=.71 MDOT=0.1340 LBM/SEC
64179. GGE(R)= 856.3 BTU/HR-SQ FT GGE(S)= 873.3 INLET TEMP= 83.5 F TATM= 76.2 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	98.9	0.0	91.5	96.8	0.0	89.8	83.5	849.5	868.5	605.3	0.0	1168.7	718.0	0.0	1525.5
0.16	104.7	0.0	95.2	99.8	0.0	93.3	83.6	847.8	867.8	439.7	0.0	800.3	587.4	0.0	984.2
0.26	98.6	0.0	97.7	99.0	0.0	96.2	83.7	849.6	867.3	622.8	0.0	662.7	619.6	0.0	758.8
0.35	101.3	0.0	101.9	99.2	0.0	102.2	83.7	848.8	867.1	528.8	0.0	511.3	614.0	0.0	514.4
0.45	100.8	0.0	100.2	100.3	0.0	100.4	83.8	849.0	866.5	546.4	0.0	566.4	574.8	0.0	571.5
0.54	109.2	0.0	97.6	101.7	0.0	100.6	83.9	846.4	866.6	365.4	0.0	674.4	532.1	0.0	566.9
0.63	107.5	0.0	97.4	103.8	0.0	101.0	83.9	847.0	865.9	393.0	0.0	688.1	477.0	0.0	555.0
0.73	107.1	0.0	103.7	105.3	0.0	105.0	84.0	847.1	865.7	401.0	0.0	470.2	444.8	0.0	451.1
0.82	108.9	0.0	104.8	107.6	0.0	104.0	84.1	846.5	865.4	372.7	0.0	446.4	402.5	0.0	474.7
0.91	102.9	0.0	107.4	109.3	0.0	106.0	84.1	848.3	864.4	494.2	0.0	398.6	375.7	0.0	432.3
1.01	111.4	0.0	0.0	110.2	0.0	0.0	84.2	845.8	864.7	339.9	0.0	0.0	363.9	0.0	0.0
1.10	111.5	0.0	0.0	108.4	0.0	0.0	84.3	845.8	865.0	339.4	0.0	0.0	392.1	0.0	0.0
1.20	112.0	0.0	0.0	111.5	0.0	0.0	84.3	845.6	863.5	334.0	0.0	0.0	347.5	0.0	0.0
1.29	112.4	0.0	0.0	113.6	0.0	0.0	84.4	845.5	862.9	329.9	0.0	0.0	323.0	0.0	0.0
1.38	108.6	0.0	0.0	115.3	0.0	0.0	84.5	846.6	862.6	383.2	0.0	0.0	305.8	0.0	0.0
1.48	112.7	0.0	0.0	115.0	0.0	0.0	84.5	845.4	862.0	327.8	0.0	0.0	309.1	0.0	0.0
1.57	117.7	0.0	0.0	117.7	0.0	0.0	84.6	843.9	861.4	278.4	0.0	0.0	284.3	0.0	0.0
1.66	115.1	0.0	0.0	119.5	0.0	0.0	84.7	844.7	861.1	303.1	0.0	0.0	270.0	0.0	0.0
1.76	114.3	0.0	0.0	118.0	0.0	0.0	84.7	844.9	860.8	312.0	0.0	0.0	282.5	0.0	0.0
1.85	105.1	0.0	0.0	119.0	0.0	0.0	84.8	847.7	860.5	455.9	0.0	0.0	274.7	0.0	0.0
1.95	115.4	0.0	0.0	118.0	0.0	0.0	84.9	844.6	860.8	301.9	0.0	0.0	283.6	0.0	0.0
2.04	117.2	0.0	0.0	118.0	0.0	0.0	84.9	844.0	860.8	285.5	0.0	0.0	284.1	0.0	0.0
2.13	115.5	0.0	0.0	120.0	0.0	0.0	85.0	844.6	860.2	302.2	0.0	0.0	268.2	0.0	0.0
2.23	114.8	0.0	0.0	123.0	0.0	0.0	85.1	844.8	859.3	310.0	0.0	0.0	247.2	0.0	0.0
2.32	106.8	0.0	0.0	122.0	0.0	0.0	85.1	847.2	859.6	426.6	0.0	0.0	254.4	0.0	0.0
2.41	110.6	0.0	0.0	124.0	0.0	0.0	85.2	846.0	859.0	363.3	0.0	0.0	241.5	0.0	0.0
2.51	118.5	0.0	0.0	123.0	0.0	0.0	85.3	843.7	859.3	276.9	0.0	0.0	248.4	0.0	0.0
2.60	114.9	0.0	0.0	122.0	0.0	0.0	85.3	844.7	859.6	311.6	0.0	0.0	255.7	0.0	0.0
2.70	113.3	0.0	0.0	126.0	0.0	0.0	85.4	845.2	858.4	330.3	0.0	0.0	230.5	0.0	0.0
2.79	105.1	0.0	0.0	126.0	0.0	0.0	85.5	847.7	858.4	470.8	0.0	0.0	230.9	0.0	0.0
2.88	115.8	0.0	0.0	126.0	0.0	0.0	85.5	844.5	858.4	304.2	0.0	0.0	231.2	0.0	0.0
2.98	117.8	0.0	0.0	126.0	0.0	0.0	85.6	843.9	858.4	285.7	0.0	0.0	231.6	0.0	0.0
3.07	115.2	0.0	0.0	126.0	0.0	0.0	85.7	844.6	858.4	311.7	0.0	0.0	232.0	0.0	0.0
3.16	113.8	0.0	0.0	129.0	0.0	0.0	85.7	845.1	857.5	328.1	0.0	0.0	216.0	0.0	0.0
3.26	105.0	0.0	0.0	127.0	0.0	0.0	85.8	847.7	858.1	481.1	0.0	0.0	226.9	0.0	0.0
3.35	116.9	0.0	0.0	128.0	0.0	0.0	85.9	844.1	857.8	296.4	0.0	0.0	221.8	0.0	0.0
3.45	118.0	0.0	0.0	129.0	0.0	0.0	85.9	843.8	857.5	286.7	0.0	0.0	216.9	0.0	0.0
3.54	115.1	0.0	0.0	128.0	0.0	0.0	86.0	844.7	857.8	316.2	0.0	0.0	222.5	0.0	0.0
3.63	114.8	0.0	0.0	130.0	0.0	0.0	86.1	844.8	857.2	320.2	0.0	0.0	212.5	0.0	0.0
3.73	106.9	0.0	0.0	129.0	0.0	0.0	86.1	847.1	857.5	444.2	0.0	0.0	217.8	0.0	0.0
7.57	112.7	0.0	0.0	131.0	0.0	0.0	88.8	845.4	856.9	384.2	0.0	0.0	220.4	0.0	0.0
7.66	113.1	0.0	0.0	130.5	0.0	0.0	88.9	845.3	857.0	378.8	0.0	0.0	223.4	0.0	0.0
7.76	112.8	0.0	0.0	130.1	0.0	0.0	89.0	845.4	857.2	384.6	0.0	0.0	225.9	0.0	0.0
7.85	114.1	0.0	0.0	130.0	0.0	0.0	89.0	845.0	857.2	365.5	0.0	0.0	226.8	0.0	0.0
7.95	111.8	0.0	0.0	130.2	0.0	0.0	89.1	845.7	858.4	403.9	0.0	0.0	226.5	0.0	0.0
8.04	112.3	0.0	0.0	130.6	0.0	0.0	89.2	845.5	858.1	396.2	0.0	0.0	224.6	0.0	0.0
8.13	117.8	0.0	0.0	130.6	0.0	0.0	89.2	843.9	858.4	320.1	0.0	0.0	225.0	0.0	0.0
8.23	116.3	0.0	0.0	130.8	0.0	0.0	89.3	844.3	860.5	338.9	0.0	0.0	224.5	0.0	0.0
8.32	116.2	0.0	0.0	132.0	0.0	0.0	89.4	844.3	859.9	340.9	0.0	0.0	218.3	0.0	0.0
8.41	109.6	0.0	0.0	130.7	0.0	0.0	89.4	846.3	859.6	454.7	0.0	0.0	225.9	0.0	0.0
8.51	108.7	110.2	105.2	129.3	133.1	127.9	89.5	846.6	859.9	477.7	443.0	584.2	234.3	213.9	242.8
8.60	114.6	110.1	105.9	129.6	133.5	128.1	89.6	844.8	858.7	365.5	445.6	560.2	232.4	211.9	241.5
8.70	113.9	103.9	107.4	130.9	133.1	129.5	89.6	845.0	859.0	377.1	641.5	515.1	225.6	214.2	233.4
8.79	115.0	113.2	109.4	131.3	132.0	126.4	89.7	844.7	858.7	361.5	389.2	464.3	223.7	220.0	253.4
8.88	109.0	110.2	116.0	131.1	133.1	134.2	89.8	846.5	858.2	476.5	448.5	349.4	224.9	214.6	208.9
8.98	110.4	113.9	106.7	131.1	132.7	127.0	89.8	846.1	858.1	445.3	380.6	543.0	225.2	216.8	250.0
9.07	118.5	113.1	106.9	130.4	131.7	128.7	89.9	843.7	858.1	319.3	393.6	537.2	229.4	222.3	239.5
9.16	115.0	105.7	108.9	129.8	131.6	130.8	90.0	844.7	857.8	365.2	581.0	482.8	233.1	223.1	227.4
9.26	116.1	114.5	111.0	129.5	132.3	130.2	90.0	844.4	858.1	350.5	373.5	435.8	235.4	219.8	231.2
9.35	113.0	111.1	114.4	129.9	131.3	124.9	90.1	845.3	857.8	399.4	435.5	376.4	233.3	225.4	266.9

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=365.62 NU(S)A=226.33 NU(AV)A=295.97 ST(AV)A=0.00651 ST(AV)/ST(4S)=2.11 F/F(4S)= 4.83
 (ST/ST(4S))/(F/F(4S))=0.436 (F/F(4S))/(ST/ST(4S))**3.0=0.52 (ST/ST(4S))/(F/F(4S))**(1/3)=1.25
 NU(R)A/NU(4S)=2.61 NU(S)A/NU(4S)=1.61 e+(4R)= 442.19 R(4R)= 3.36 H(4R)=11.45

BY USING ROUGHSDIE RESULTS ONLY : H(RB)= 14.94

RUN NUMBER=108HR10-45/20 E/D=0.047 P/E=20.0 ALPHA=45 HYD DIA= 2.000 IN PR= 71 MDDT=0.0240 LBM/SEC
 RE= 11522. GGE(R)= 310.0 BTU/HR-SQ FT GGE(S)= 202.1 INLET TEMP= 80.0 F TATM= 74.0 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	98.8	0.0	95.2	91.5	0.0	89.4	80.1	302.5	197.1	177.7	0.0	220.1	189.4	0.0
2	0.16	109.0	0.0	99.8	96.4	0.0	93.2	80.2	299.5	195.9	114.3	0.0	167.9	133.2	0.0
3	0.26	104.6	0.0	101.4	95.1	0.0	95.0	80.3	300.8	195.9	136.0	0.0	156.6	145.2	0.0
4	0.35	104.4	0.0	103.9	94.5	0.0	97.0	80.4	300.9	196.1	137.7	0.0	140.7	152.6	0.0
5	0.45	104.3	0.0	103.9	94.9	0.0	97.0	80.5	300.9	195.9	138.9	0.0	141.3	149.3	0.0
6	0.54	106.4	0.0	102.5	96.7	0.0	98.0	80.6	300.3	195.7	127.9	0.0	150.6	133.2	0.0
7	0.63	108.4	0.0	102.9	98.1	0.0	99.0	80.7	299.7	195.2	118.8	0.0	148.3	123.0	0.0
8	0.73	111.5	0.0	108.2	99.8	0.0	99.0	80.8	298.7	194.8	106.9	0.0	119.8	112.4	0.0
9	0.82	114.1	0.0	107.3	101.3	0.0	99.0	80.9	298.0	194.4	98.6	0.0	124.0	104.4	0.0
10	0.91	106.5	0.0	108.2	102.8	0.0	101.0	81.0	300.2	193.7	129.3	0.0	121.2	97.5	0.0
11	1.01	116.9	0.0	0.0	106.1	0.0	0.0	81.1	297.1	193.7	91.1	0.0	0.0	85.0	0.0
12	1.10	113.7	0.0	0.0	104.3	0.0	0.0	81.2	298.1	193.7	100.7	0.0	0.0	92.2	0.0
13	1.20	114.0	0.0	0.0	105.7	0.0	0.0	81.3	298.0	193.1	100.1	0.0	0.0	86.7	0.0
14	1.29	114.5	0.0	0.0	107.1	0.0	0.0	81.4	297.8	192.5	98.8	0.0	0.0	82.1	0.0
15	1.38	115.2	0.0	0.0	109.0	0.0	0.0	81.5	297.6	191.9	97.0	0.0	0.0	76.5	0.0
16	1.48	116.5	0.0	0.0	110.9	0.0	0.0	81.6	297.2	191.6	93.5	0.0	0.0	71.9	0.0
17	1.57	117.8	0.0	0.0	111.1	0.0	0.0	81.7	296.8	191.3	90.3	0.0	0.0	71.3	0.0
18	1.66	119.6	0.0	0.0	111.0	0.0	0.0	81.8	296.3	191.0	86.0	0.0	0.0	71.8	0.0
19	1.76	120.3	0.0	0.0	112.0	0.0	0.0	81.9	296.1	190.7	84.6	0.0	0.0	69.5	0.0
20	1.85	113.7	0.0	0.0	112.0	0.0	0.0	82.0	298.1	190.7	103.2	0.0	0.0	69.8	0.0
21	1.95	120.0	0.0	0.0	113.0	0.0	0.0	82.1	296.2	190.4	85.7	0.0	0.0	67.6	0.0
22	2.04	122.0	0.0	0.0	113.0	0.0	0.0	82.2	295.6	190.4	81.5	0.0	0.0	67.8	0.0
23	2.13	120.5	0.0	0.0	114.0	0.0	0.0	82.3	296.0	190.1	85.0	0.0	0.0	65.8	0.0
24	2.23	120.3	0.0	0.0	115.0	0.0	0.0	82.4	296.1	189.8	85.7	0.0	0.0	63.9	0.0
25	2.32	120.6	0.0	0.0	116.0	0.0	0.0	82.5	296.0	189.5	85.2	0.0	0.0	62.0	0.0
26	2.41	121.8	0.0	0.0	116.0	0.0	0.0	82.6	295.6	189.5	82.7	0.0	0.0	62.2	0.0
27	2.51	122.9	0.0	0.0	116.0	0.0	0.0	82.7	295.3	189.5	80.5	0.0	0.0	62.4	0.0
28	2.60	123.7	0.0	0.0	116.0	0.0	0.0	82.9	295.1	189.5	79.1	0.0	0.0	62.6	0.0
29	2.70	123.5	0.0	0.0	116.0	0.0	0.0	83.0	295.1	189.5	79.7	0.0	0.0	62.8	0.0
30	2.79	116.7	0.0	0.0	117.0	0.0	0.0	83.1	297.2	189.2	96.7	0.0	0.0	61.0	0.0
31	2.88	123.1	0.0	0.0	118.0	0.0	0.0	83.2	295.3	188.9	80.9	0.0	0.0	59.3	0.0
32	2.98	125.8	0.0	0.0	118.0	0.0	0.0	83.3	294.4	188.9	75.7	0.0	0.0	59.5	0.0
33	3.07	123.3	0.0	0.0	119.0	0.0	0.0	83.4	295.2	188.6	80.9	0.0	0.0	57.9	0.0
34	3.16	122.4	0.0	0.0	120.0	0.0	0.0	83.5	295.5	188.3	83.0	0.0	0.0	56.4	0.0
35	3.26	122.4	0.0	0.0	120.0	0.0	0.0	83.6	295.5	188.3	83.2	0.0	0.0	56.5	0.0
36	3.35	124.3	0.0	0.0	120.0	0.0	0.0	83.7	294.9	188.3	79.4	0.0	0.0	56.7	0.0
37	3.45	125.5	0.0	0.0	120.0	0.0	0.0	83.8	294.5	188.3	77.2	0.0	0.0	56.8	0.0
38	3.54	127.2	0.0	0.0	120.0	0.0	0.0	83.9	294.0	188.3	74.2	0.0	0.0	57.0	0.0
39	3.63	126.6	0.0	0.0	121.0	0.0	0.0	84.0	294.2	188.0	75.4	0.0	0.0	55.5	0.0
40	3.73	119.4	0.0	0.0	120.0	0.0	0.0	84.1	296.4	188.3	91.7	0.0	0.0	57.3	0.0
41	7.57	125.9	0.0	0.0	126.0	0.0	0.0	88.3	294.4	186.5	85.0	0.0	0.0	53.7	0.0
42	7.66	126.2	0.0	0.0	127.8	0.0	0.0	88.4	294.3	186.3	84.5	0.0	0.0	51.3	0.0
43	7.76	123.4	0.0	0.0	127.0	0.0	0.0	88.5	295.2	186.5	91.8	0.0	0.0	52.5	0.0
44	7.85	121.9	0.0	0.0	125.3	0.0	0.0	88.6	295.6	187.1	96.3	0.0	0.0	55.2	0.0
45	7.95	122.0	0.0	0.0	127.0	0.0	0.0	88.7	295.6	186.8	96.3	0.0	0.0	53.0	0.0
46	8.04	122.9	0.0	0.0	128.7	0.0	0.0	88.8	295.3	186.3	93.9	0.0	0.0	50.7	0.0
47	8.13	124.6	0.0	0.0	127.3	0.0	0.0	88.9	294.8	186.2	89.6	0.0	0.0	52.6	0.0
48	8.23	126.3	0.0	0.0	126.3	0.0	0.0	89.0	294.3	186.5	85.6	0.0	0.0	54.2	0.0
49	8.32	128.2	0.0	0.0	125.7	0.0	0.0	89.1	293.7	187.1	81.5	0.0	0.0	55.4	0.0
50	8.41	121.1	0.0	0.0	124.4	0.0	0.0	89.2	295.9	187.4	100.6	0.0	0.0	57.7	0.0
51	8.51	120.7	113.5	113.9	126.1	125.1	120.7	89.3	296.0	187.4	102.2	132.7	130.5	55.2	56.8
52	8.60	122.9	113.4	115.4	125.9	125.0	118.0	89.4	295.3	187.1	95.6	133.5	123.2	55.6	56.9
53	8.70	119.0	115.1	117.4	126.0	125.3	118.0	89.5	296.5	187.1	109.0	125.6	115.2	55.6	56.6
54	8.79	118.6	117.3	119.4	125.9	123.0	118.0	89.6	296.6	187.1	110.9	116.1	107.9	55.9	60.7

55	8.88	119.9	120.3	122.7	126.3	125.7	124.9	89.7	296.2	187.1	106.3	104.9	97.3	55.5	56.4	5
56	8.98	121.2	122.7	116.5	125.7	124.6	118.0	89.8	295.8	187.1	102.1	97.5	120.1	56.4	58.2	7
57	9.07	123.4	121.4	117.0	125.9	124.4	118.6	89.9	295.2	187.1	95.5	101.6	118.1	56.4	58.7	7
58	9.16	125.9	117.2	115.3	125.1	124.9	119.8	90.0	294.4	187.1	88.9	117.3	126.2	57.7	58.2	6
59	9.26	126.9	123.5	112.4	124.2	125.5	121.0	90.2	294.1	187.4	86.6	95.4	143.0	59.5	57.3	6
60	9.35	123.6	119.5	112.4	125.2	127.0	121.3	90.3	295.1	187.1	95.7	109.2	144.2	57.9	55.1	6

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 89.72 NU(S)A= 56.93 NU(AV)A= 73.33 ST(AV)A=0.00899 ST(AV)/ST(4S)=2.06 F/F(4S)= 3.24
 (ST/ST(4S))/(F/F(4S))=0.636 (F/F(4S))/(ST/ST(4S))**3.0=0.37 (ST/ST(4S))/(F/F(4S))**(1/3)=1.39
 NU(R)A/NU(4S)=2.53 NU(S)A/NU(4S)=1.61 e+(4R)= 77.95 R(4R)= 3.47 H(4R)= 7.24

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 9.78

ORIGINAL PAGE IS OF POOR QUALITY

NUMBER=109HR30-45/20 E/D=0.047 P/E=20.0 ALPHA=45 HYD DIA= 2.000 IN PR=.71 MDOT=0.0653 L9M/SEC
1373. QGE(R)= 530.7 BTU/HR-SQ FT QGE(S)= 497.3 INLET TEMP= 80.6 F TATM= 74.2 F PATM= 14.6 PSIA

/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	97.1	0.0	92.6	94.8	0.0	100.0	80.7	523.8	492.6	350.1	0.0	482.1	383.7	0.0	279.2
16	104.4	0.0	96.6	99.4	0.0	101.0	80.7	521.6	491.7	242.2	0.0	361.4	289.1	0.0	266.6
26	100.3	0.0	97.5	98.7	0.0	96.0	80.8	522.9	491.1	294.9	0.0	344.4	301.2	0.0	354.5
35	100.3	0.0	101.4	98.9	0.0	100.5	80.9	522.9	491.0	296.0	0.0	280.2	299.2	0.0	274.9
45	100.7	0.0	101.2	99.4	0.0	99.7	81.0	522.7	490.5	291.1	0.0	283.9	292.6	0.0	287.9
54	102.8	0.0	97.8	100.5	0.0	99.8	81.1	522.1	490.6	263.7	0.0	342.5	276.6	0.0	288.1
63	104.8	0.0	99.1	101.8	0.0	100.0	81.1	521.5	490.0	242.0	0.0	318.8	260.2	0.0	285.3
73	107.8	0.0	105.4	103.6	0.0	102.7	81.2	520.6	489.7	215.0	0.0	236.4	239.7	0.0	250.4
82	109.7	0.0	105.1	105.4	0.0	105.6	81.3	520.0	489.3	201.0	0.0	239.8	223.3	0.0	221.4
91	100.9	0.0	106.7	106.9	0.0	106.8	81.4	522.7	488.3	293.8	0.0	226.5	210.0	0.0	210.9
01	111.5	0.0	0.0	109.9	0.0	0.0	81.5	519.5	488.4	189.8	0.0	0.0	188.4	0.0	0.0
10	109.1	0.0	0.0	108.0	0.0	0.0	81.5	520.2	488.4	207.1	0.0	0.0	202.2	0.0	0.0
20	109.0	0.0	0.0	111.1	0.0	0.0	81.6	520.2	487.2	208.4	0.0	0.0	181.2	0.0	0.0
29	109.0	0.0	0.0	111.2	0.0	0.0	81.7	520.2	486.9	209.0	0.0	0.0	181.2	0.0	0.0
38	109.5	0.0	0.0	112.9	0.0	0.0	81.8	520.1	486.3	205.8	0.0	0.0	171.6	0.0	0.0
48	110.8	0.0	0.0	113.5	0.0	0.0	81.9	519.7	485.7	196.9	0.0	0.0	168.2	0.0	0.0
57	112.4	0.0	0.0	114.0	0.0	0.0	81.9	519.2	485.4	186.9	0.0	0.0	166.0	0.0	0.0
66	114.1	0.0	0.0	116.0	0.0	0.0	82.0	518.7	484.8	177.2	0.0	0.0	156.4	0.0	0.0
76	114.7	0.0	0.0	117.0	0.0	0.0	82.1	518.5	484.5	174.3	0.0	0.0	152.1	0.0	0.0
85	105.8	0.0	0.0	117.0	0.0	0.0	82.2	521.2	484.5	241.8	0.0	0.0	152.5	0.0	0.0
95	114.3	0.0	0.0	118.0	0.0	0.0	82.3	518.7	484.2	177.4	0.0	0.0	148.4	0.0	0.0
04	114.6	0.0	0.0	119.0	0.0	0.0	82.3	518.6	483.9	176.1	0.0	0.0	144.6	0.0	0.0
13	112.8	0.0	0.0	120.0	0.0	0.0	82.4	519.1	483.6	187.2	0.0	0.0	141.0	0.0	0.0
23	113.1	0.0	0.0	121.0	0.0	0.0	82.5	519.0	483.3	185.8	0.0	0.0	137.5	0.0	0.0
32	114.8	0.0	0.0	121.0	0.0	0.0	82.6	518.5	483.3	176.2	0.0	0.0	137.8	0.0	0.0
41	116.1	0.0	0.0	122.0	0.0	0.0	82.6	518.1	483.0	169.7	0.0	0.0	134.4	0.0	0.0
51	117.5	0.0	0.0	122.0	0.0	0.0	82.7	517.7	483.0	163.1	0.0	0.0	134.7	0.0	0.0
60	119.4	0.0	0.0	122.0	0.0	0.0	82.8	517.4	483.0	159.2	0.0	0.0	134.9	0.0	0.0
70	118.1	0.0	0.0	124.0	0.0	0.0	82.9	517.5	482.4	160.9	0.0	0.0	128.5	0.0	0.0
79	108.6	0.0	0.0	124.0	0.0	0.0	83.0	520.4	482.4	222.2	0.0	0.0	128.7	0.0	0.0
88	116.8	0.0	0.0	124.0	0.0	0.0	83.0	517.9	482.4	168.0	0.0	0.0	128.9	0.0	0.0
98	117.6	0.0	0.0	125.0	0.0	0.0	83.1	517.7	482.1	164.3	0.0	0.0	126.0	0.0	0.0
07	116.0	0.0	0.0	125.0	0.0	0.0	83.2	518.1	482.1	172.9	0.0	0.0	126.2	0.0	0.0
16	116.2	0.0	0.0	127.0	0.0	0.0	83.3	518.1	481.5	172.2	0.0	0.0	120.5	0.0	0.0
26	117.0	0.0	0.0	126.0	0.0	0.0	83.4	517.8	481.8	168.4	0.0	0.0	123.6	0.0	0.0
35	118.7	0.0	0.0	127.0	0.0	0.0	83.4	517.3	481.5	160.5	0.0	0.0	120.9	0.0	0.0
45	120.1	0.0	0.0	128.0	0.0	0.0	83.5	516.9	481.2	154.6	0.0	0.0	118.3	0.0	0.0
54	121.8	0.0	0.0	127.0	0.0	0.0	83.6	516.4	481.5	147.9	0.0	0.0	121.3	0.0	0.0
63	121.1	0.0	0.0	128.0	0.0	0.0	83.7	516.6	481.2	151.0	0.0	0.0	118.7	0.0	0.0
73	111.4	0.0	0.0	129.0	0.0	0.0	83.8	519.5	481.2	205.5	0.0	0.0	118.9	0.0	0.0
82	115.4	0.0	0.0	133.0	0.0	0.0	87.0	518.3	479.7	198.7	0.0	0.0	113.5	0.0	0.0
91	115.2	0.0	0.0	132.5	0.0	0.0	87.1	518.4	479.8	200.6	0.0	0.0	114.9	0.0	0.0
01	114.8	0.0	0.0	132.1	0.0	0.0	87.2	518.5	479.9	204.1	0.0	0.0	116.2	0.0	0.0
10	115.0	0.0	0.0	131.8	0.0	0.0	87.3	518.4	480.0	203.2	0.0	0.0	117.2	0.0	0.0
20	115.4	0.0	0.0	132.0	0.0	0.0	87.3	518.3	480.6	200.8	0.0	0.0	117.0	0.0	0.0
29	116.9	0.0	0.0	131.4	0.0	0.0	87.4	517.9	480.9	190.9	0.0	0.0	118.9	0.0	0.0
38	118.4	0.0	0.0	131.5	0.0	0.0	87.5	517.4	480.1	182.0	0.0	0.0	118.6	0.0	0.0
48	120.1	0.0	0.0	132.7	0.0	0.0	87.6	516.9	481.8	172.7	0.0	0.0	115.9	0.0	0.0
57	121.0	0.0	0.0	131.5	0.0	0.0	87.7	516.6	483.0	168.4	0.0	0.0	119.6	0.0	0.0
66	111.9	0.0	0.0	132.1	0.0	0.0	87.7	519.4	482.7	233.5	0.0	0.0	118.2	0.0	0.0
76	110.6	108.7	110.8	132.0	135.3	127.6	87.8	519.8	482.7	247.8	270.4	245.7	118.6	110.4	131.8
85	114.3	109.8	112.7	131.0	135.4	125.6	87.9	518.7	482.1	213.3	257.2	227.1	121.4	110.3	138.8
95	112.3	111.8	115.2	131.3	134.8	126.7	88.0	519.3	482.1	231.8	236.7	207.1	120.8	111.7	135.2
04	113.2	113.9	117.5	132.9	134.9	125.7	88.1	519.0	481.8	224.1	218.0	191.4	116.5	111.6	139.1
88	115.0	117.1	119.4	131.1	135.0	133.4	88.1	518.4	481.8	209.5	194.3	180.0	121.8	111.6	115.5
98	116.2	119.2	107.9	131.5	133.5	124.9	88.2	518.1	481.2	201.0	181.5	285.7	120.6	115.5	142.5
07	117.8	114.8	107.0	130.8	131.3	126.6	88.3	517.6	481.2	190.4	212.0	300.4	122.9	121.4	136.5
16	119.8	107.1	107.7	131.3	133.2	127.8	88.4	517.0	481.2	178.5	299.6	290.3	121.6	116.4	132.6
26	120.7	114.6	108.8	131.0	132.9	128.9	88.5	516.7	481.2	173.9	214.5	275.6	122.7	117.4	129.0
35	115.7	110.9	110.6	130.3	133.0	131.0	88.5	518.2	481.2	207.0	251.4	254.8	125.0	117.4	122.9

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=187.14 NU(S)A=121.77 NU(AV)A=154.46 ST(AV)A=0.00695 ST(AV)/ST(4S)=1.95 F/F(4S)= 3.57
 (ST/ST(4S))/(F/F(4S))=0.546 (F/F(4S))/(ST/ST(4S))**3.0=0.48 (ST/ST(4S))/(F/F(4S))**(1/3)=1.28
 NU(R)A/NU(4S)=2.37 NU(S)A/NU(4S)=1.54 e+(4R)= 197.86 R(4R)= 3.98 H(4R)= 9.66

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 12.64

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RUN NUMBER=110HR60-45/20 E/D=0.047 P/E=20.0 ALPHA=45 HYD DIA= 2.000 IN PR=.71 MDDT=0.1340 LBM/SEC
RE= 64311. GGE(R)= 869.8 BTU/HR-SQ FT GGE(S)= 874.0 INLET TEMP= 82.0 F TATM= 75.2 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.07	98.4	0.0	93.0	94.8	0.0	88.8	82.1	862.9	869.5	578.6	0.0	864.0	748.4	0.0	14.
2	0.16	104.0	0.0	95.5	98.5	0.0	92.3	82.1	861.2	868.6	431.4	0.0	705.4	581.8	0.0	9.
3	0.26	99.6	0.0	96.9	98.2	0.0	94.2	82.2	862.5	867.9	542.8	0.0	642.4	594.3	0.0	7.
4	0.35	100.1	0.0	103.5	98.5	0.0	100.2	82.3	862.3	867.7	529.5	0.0	444.8	585.5	0.0	5.
5	0.45	100.4	0.0	102.8	99.3	0.0	99.4	82.3	862.3	867.2	522.6	0.0	461.3	559.7	0.0	5.
6	0.54	102.8	0.0	97.3	100.5	0.0	99.6	82.4	861.5	867.4	462.4	0.0	632.9	524.9	0.0	5.
7	0.63	104.7	0.0	97.9	102.5	0.0	101.0	82.4	861.0	866.7	424.0	0.0	610.6	473.8	0.0	5.
8	0.73	107.3	0.0	105.6	104.0	0.0	104.0	82.5	860.2	866.5	380.2	0.0	408.2	442.1	0.0	4.
9	0.82	109.6	0.0	105.5	106.4	0.0	105.0	82.6	859.5	866.1	348.5	0.0	410.8	398.6	0.0	4.
10	0.91	100.4	0.0	107.3	108.1	0.0	107.0	82.6	862.3	865.1	532.1	0.0	383.1	372.5	0.0	3.
11	1.01	110.7	0.0	0.0	109.2	0.0	0.0	82.7	859.2	865.4	336.3	0.0	0.0	358.1	0.0	0.
12	1.10	109.4	0.0	0.0	108.4	0.0	0.0	82.8	859.6	865.4	353.6	0.0	0.0	370.1	0.0	0.
13	1.20	108.0	0.0	0.0	111.5	0.0	0.0	82.8	860.0	863.9	374.4	0.0	0.0	330.2	0.0	0.
14	1.29	108.4	0.0	0.0	112.6	0.0	0.0	82.9	859.9	863.6	369.4	0.0	0.0	318.6	0.0	0.
15	1.38	109.1	0.0	0.0	115.3	0.0	0.0	83.0	859.6	863.0	360.3	0.0	0.0	292.4	0.0	0.
16	1.48	110.7	0.0	0.0	115.0	0.0	0.0	83.0	859.2	862.4	340.1	0.0	0.0	295.5	0.0	0.
17	1.57	112.6	0.0	0.0	116.7	0.0	0.0	83.1	858.6	862.1	318.7	0.0	0.0	281.0	0.0	0.
18	1.66	114.7	0.0	0.0	118.5	0.0	0.0	83.2	858.0	861.8	297.9	0.0	0.0	267.1	0.0	0.
19	1.76	115.5	0.0	0.0	118.0	0.0	0.0	83.2	857.7	861.2	291.0	0.0	0.0	271.2	0.0	0.
20	1.85	104.0	0.0	0.0	118.0	0.0	0.0	83.3	861.2	861.2	455.5	0.0	0.0	271.7	0.0	0.
21	1.95	115.1	0.0	0.0	119.0	0.0	0.0	83.4	857.8	860.9	295.9	0.0	0.0	264.4	0.0	0.
22	2.04	115.6	0.0	0.0	120.0	0.0	0.0	83.4	857.7	860.6	291.8	0.0	0.0	257.6	0.0	0.
23	2.13	113.3	0.0	0.0	121.0	0.0	0.0	83.5	858.4	860.3	315.2	0.0	0.0	251.0	0.0	0.
24	2.23	113.1	0.0	0.0	123.0	0.0	0.0	83.6	858.4	859.7	318.1	0.0	0.0	238.5	0.0	0.
25	2.32	114.7	0.0	0.0	122.0	0.0	0.0	83.6	858.0	860.0	302.1	0.0	0.0	245.2	0.0	0.
26	2.41	115.8	0.0	0.0	124.0	0.0	0.0	83.7	857.6	859.4	292.3	0.0	0.0	233.3	0.0	0.
27	2.51	117.3	0.0	0.0	124.0	0.0	0.0	83.8	857.2	859.4	279.6	0.0	0.0	233.6	0.0	0.
28	2.60	118.4	0.0	0.0	123.0	0.0	0.0	83.8	856.9	859.7	271.1	0.0	0.0	240.0	0.0	0.
29	2.70	118.1	0.0	0.0	126.0	0.0	0.0	83.9	856.9	858.8	274.0	0.0	0.0	223.1	0.0	0.
30	2.79	106.2	0.0	0.0	127.0	0.0	0.0	84.0	860.5	858.5	423.3	0.0	0.0	218.1	0.0	0.
31	2.88	116.9	0.0	0.0	127.0	0.0	0.0	84.0	857.3	858.5	285.2	0.0	0.0	218.4	0.0	0.
32	2.98	117.7	0.0	0.0	127.0	0.0	0.0	84.1	857.1	858.5	278.8	0.0	0.0	218.7	0.0	0.
33	3.07	115.4	0.0	0.0	128.0	0.0	0.0	84.2	857.8	858.2	300.2	0.0	0.0	214.0	0.0	0.
34	3.16	115.2	0.0	0.0	131.0	0.0	0.0	84.2	857.8	857.3	302.8	0.0	0.0	200.3	0.0	0.
35	3.26	116.1	0.0	0.0	129.0	0.0	0.0	84.3	857.5	857.9	294.7	0.0	0.0	209.7	0.0	0.
36	3.35	118.0	0.0	0.0	130.0	0.0	0.0	84.4	857.0	857.6	278.4	0.0	0.0	205.3	0.0	0.
37	3.45	119.5	0.0	0.0	131.0	0.0	0.0	84.4	856.5	857.3	266.9	0.0	0.0	201.1	0.0	0.
38	3.54	121.4	0.0	0.0	131.0	0.0	0.0	84.5	856.0	857.3	253.4	0.0	0.0	201.4	0.0	0.
39	3.63	121.2	0.0	0.0	132.0	0.0	0.0	84.6	856.0	857.0	255.2	0.0	0.0	197.3	0.0	0.
40	3.73	109.2	0.0	0.0	131.0	0.0	0.0	84.6	859.6	857.3	382.2	0.0	0.0	201.9	0.0	0.
41	7.57	111.9	0.0	0.0	134.0	0.0	0.0	87.4	858.8	856.4	380.7	0.0	0.0	199.7	0.0	0.
42	7.66	112.5	0.0	0.0	133.5	0.0	0.0	87.4	858.6	856.5	372.4	0.0	0.0	202.1	0.0	0.
43	7.76	113.3	0.0	0.0	133.3	0.0	0.0	87.5	858.4	856.6	361.7	0.0	0.0	203.3	0.0	0.
44	7.85	114.0	0.0	0.0	133.0	0.0	0.0	87.6	858.2	856.7	352.9	0.0	0.0	204.9	0.0	0.
45	7.95	114.4	0.0	0.0	133.0	0.0	0.0	87.6	858.1	858.0	348.4	0.0	0.0	205.6	0.0	0.
46	8.04	115.8	0.0	0.0	133.6	0.0	0.0	87.7	857.6	857.6	331.7	0.0	0.0	203.1	0.0	0.
47	8.13	117.2	0.0	0.0	133.6	0.0	0.0	87.8	857.2	857.9	316.5	0.0	0.0	203.4	0.0	0.
48	8.23	119.1	0.0	0.0	132.9	0.0	0.0	87.8	856.6	860.3	297.7	0.0	0.0	207.5	0.0	0.
49	8.32	120.8	0.0	0.0	134.1	0.0	0.0	87.9	856.1	859.7	282.7	0.0	0.0	202.3	0.0	0.
50	8.41	111.0	0.0	0.0	133.7	0.0	0.0	88.0	859.1	859.1	405.2	0.0	0.0	204.1	0.0	0.
51	8.51	109.5	108.3	111.8	132.3	136.1	129.9	88.0	859.5	859.4	435.0	460.7	392.8	211.0	194.3	223.0
52	8.60	115.8	110.2	114.2	133.6	136.5	128.1	88.1	857.6	857.9	336.3	421.5	356.9	204.8	192.6	233.0
53	8.70	113.1	113.0	117.2	134.9	137.1	128.5	88.2	858.4	858.2	373.9	375.4	321.1	199.5	190.5	231.1
54	8.79	113.3	115.6	119.3	134.3	136.0	127.4	88.2	858.4	858.2	371.8	340.6	300.0	202.3	195.1	237.5
55	8.88	114.9	119.2	120.7	134.6	136.1	135.3	88.3	857.9	857.6	350.2	301.4	287.5	201.1	194.8	198.2
56	8.98	116.0	120.8	106.2	134.1	135.7	132.0	88.4	857.6	857.6	336.9	287.0	522.2	203.6	196.7	213.4
57	9.07	117.7	115.2	105.0	133.4	135.7	131.7	88.4	857.1	857.6	317.9	347.6	561.7	207.0	197.0	215.2
58	9.16	120.1	104.7	106.8	133.8	135.6	131.8	88.5	856.3	857.0	294.1	573.9	508.0	205.3	197.5	214.8
59	9.26	121.7	113.5	109.2	132.5	136.3	133.2	88.6	855.9	857.6	280.3	372.5	450.2	211.8	195.0	208.5
60	9.35	115.4	109.8	111.8	133.9	135.3	127.9	88.6	857.8	857.0	347.7	439.8	401.8	205.4	199.3	236.5

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=317.10 NU(S)A=206.01 NU(AV)A=261.55 ST(AV)A=0.00574 ST(AV)/ST(4S)=1.86 F/F(4S)= 3.77
 (ST/ST(4S))/(F/F(4S))=0.492 (F/F(4S))/(ST/ST(4S))*3.0=0.59 (ST/ST(4S))/(F/F(4S))*(1/3)=1.19
 NU(R)A/NU(4S)=2.26 NU(S)A/NU(4S)=1.47 e+(4R)= 385.08 R(4R)= 4.38 H(4R)=11.87

BY USING ROUGH-SIDE RESULTS ONLY : H(RB)= 15.01

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NUMBER=112HR10-30/10 E/D=0.047 P/E=10.0 ALPHA=30 HYD DIA= 2.000 IN PR=.71 MDOOT=0.0225 LBM/SEC
10793. QGE(R)= 310.0 BTU/HR-SQ FT QGE(S)= 174.6 INLET TEMP= 80.6 F TATM= 73.5 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	100.2	0.0	97.4	92.4	0.0	89.3	80.7	302.0	169.1	170.0	0.0	198.4	158.9	0.0	214.3
16	110.6	0.0	100.9	95.9	0.0	92.9	80.8	298.9	168.1	110.1	0.0	163.2	114.3	0.0	152.1
26	105.5	0.0	103.6	95.9	0.0	96.0	80.9	300.4	168.0	134.0	0.0	145.2	123.1	0.0	122.1
35	106.2	0.0	110.4	95.0	0.0	98.0	81.0	300.2	168.3	130.7	0.0	112.1	132.1	0.0	108.6
45	107.2	0.0	111.0	95.1	0.0	98.0	81.1	299.9	168.2	126.1	0.0	110.1	131.9	0.0	109.2
54	111.7	0.0	109.8	96.5	0.0	98.0	81.2	298.5	168.1	107.4	0.0	114.5	120.1	0.0	109.7
63	112.0	0.0	105.9	97.6	0.0	98.0	81.3	298.4	167.7	106.7	0.0	133.1	113.2	0.0	110.2
73	111.4	0.0	107.0	99.1	0.0	98.0	81.4	298.6	167.3	109.2	0.0	128.0	103.5	0.0	110.6
82	110.8	0.0	106.5	100.6	0.0	99.0	81.5	298.8	166.9	111.9	0.0	131.1	95.6	0.0	104.6
91	113.0	0.0	111.1	101.9	0.0	99.0	81.6	298.1	166.4	104.2	0.0	110.9	90.1	0.0	104.9
01	120.8	0.0	0.0	105.9	0.0	0.0	81.7	295.8	166.0	83.0	0.0	0.0	75.4	0.0	0.0
10	120.0	0.0	0.0	104.1	0.0	0.0	81.8	296.0	166.0	85.0	0.0	0.0	81.6	0.0	0.0
20	111.0	0.0	0.0	105.6	0.0	0.0	81.9	298.7	165.4	112.6	0.0	0.0	76.4	0.0	0.0
29	115.9	0.0	0.0	105.1	0.0	0.0	82.0	297.3	165.4	96.2	0.0	0.0	78.7	0.0	0.0
38	113.4	0.0	0.0	107.0	0.0	0.0	82.1	298.0	164.8	104.4	0.0	0.0	72.7	0.0	0.0
48	112.3	0.0	0.0	107.7	0.0	0.0	82.2	298.3	164.8	108.7	0.0	0.0	70.8	0.0	0.0
57	119.4	0.0	0.0	108.1	0.0	0.0	82.3	296.2	164.5	87.5	0.0	0.0	70.0	0.0	0.0
66	120.2	0.0	0.0	108.0	0.0	0.0	82.4	296.0	164.2	85.8	0.0	0.0	70.3	0.0	0.0
76	118.4	0.0	0.0	110.0	0.0	0.0	82.5	296.5	163.6	90.5	0.0	0.0	65.2	0.0	0.0
85	115.5	0.0	0.0	110.0	0.0	0.0	82.6	297.4	163.6	99.1	0.0	0.0	65.4	0.0	0.0
95	117.3	0.0	0.0	111.0	0.0	0.0	82.7	296.8	163.3	94.0	0.0	0.0	63.2	0.0	0.0
04	122.5	0.0	0.0	111.0	0.0	0.0	82.8	295.3	163.3	81.5	0.0	0.0	63.5	0.0	0.0
13	123.1	0.0	0.0	112.0	0.0	0.0	82.9	295.1	163.0	80.4	0.0	0.0	61.4	0.0	0.0
23	121.2	0.0	0.0	113.0	0.0	0.0	83.0	295.7	162.7	84.8	0.0	0.0	59.4	0.0	0.0
32	115.8	0.0	0.0	113.0	0.0	0.0	83.1	297.3	162.7	99.6	0.0	0.0	59.6	0.0	0.0
41	117.4	0.0	0.0	114.0	0.0	0.0	83.2	296.8	162.4	95.0	0.0	0.0	57.8	0.0	0.0
51	124.3	0.0	0.0	114.0	0.0	0.0	83.3	294.7	162.4	78.7	0.0	0.0	57.9	0.0	0.0
60	123.5	0.0	0.0	114.0	0.0	0.0	83.4	295.0	162.4	80.5	0.0	0.0	58.1	0.0	0.0
70	121.7	0.0	0.0	115.0	0.0	0.0	83.5	295.5	162.1	84.7	0.0	0.0	56.3	0.0	0.0
79	116.9	0.0	0.0	116.0	0.0	0.0	83.6	297.0	161.8	97.6	0.0	0.0	54.7	0.0	0.0
88	119.5	0.0	0.0	116.0	0.0	0.0	83.7	296.2	161.8	90.5	0.0	0.0	54.8	0.0	0.0
98	126.2	0.0	0.0	116.0	0.0	0.0	83.8	294.2	161.8	75.9	0.0	0.0	55.0	0.0	0.0
07	126.4	0.0	0.0	116.0	0.0	0.0	83.9	294.1	161.8	75.7	0.0	0.0	55.2	0.0	0.0
16	124.6	0.0	0.0	117.0	0.0	0.0	84.0	294.7	161.5	79.4	0.0	0.0	53.6	0.0	0.0
26	118.2	0.0	0.0	118.0	0.0	0.0	84.1	296.6	161.2	95.1	0.0	0.0	52.0	0.0	0.0
35	120.3	0.0	0.0	118.0	0.0	0.0	84.2	295.9	161.2	89.7	0.0	0.0	52.2	0.0	0.0
45	126.1	0.0	0.0	118.0	0.0	0.0	84.3	294.2	161.2	77.0	0.0	0.0	52.3	0.0	0.0
54	126.7	0.0	0.0	118.0	0.0	0.0	84.4	294.0	161.2	76.0	0.0	0.0	52.5	0.0	0.0
63	125.0	0.0	0.0	119.0	0.0	0.0	84.6	294.5	160.9	79.5	0.0	0.0	51.0	0.0	0.0
73	120.6	0.0	0.0	118.0	0.0	0.0	84.7	295.9	161.2	89.9	0.0	0.0	52.8	0.0	0.0
82	125.4	0.0	0.0	126.0	0.0	0.0	88.8	294.4	158.8	87.3	0.0	0.0	46.3	0.0	0.0
91	126.5	0.0	0.0	127.3	0.0	0.0	88.9	294.1	158.8	84.9	0.0	0.0	44.9	0.0	0.0
01	130.5	0.0	0.0	127.0	0.0	0.0	89.0	292.9	158.8	76.6	0.0	0.0	45.4	0.0	0.0
10	130.3	0.0	0.0	125.3	0.0	0.0	89.1	292.9	159.4	77.1	0.0	0.0	47.8	0.0	0.0
20	129.1	0.0	0.0	126.8	0.0	0.0	89.2	293.3	159.1	79.7	0.0	0.0	45.9	0.0	0.0
29	123.1	0.0	0.0	127.3	0.0	0.0	89.3	295.1	159.0	94.7	0.0	0.0	45.4	0.0	0.0
38	130.1	0.0	0.0	127.3	0.0	0.0	89.4	293.0	158.5	78.1	0.0	0.0	45.4	0.0	0.0
48	130.1	0.0	0.0	126.3	0.0	0.0	89.5	293.0	158.8	78.3	0.0	0.0	46.8	0.0	0.0
57	128.6	0.0	0.0	127.6	0.0	0.0	89.6	293.5	158.8	81.6	0.0	0.0	45.3	0.0	0.0
66	125.7	0.0	0.0	126.3	0.0	0.0	89.8	294.3	159.1	88.6	0.0	0.0	47.1	0.0	0.0
76	121.2	115.3	117.3	127.9	124.9	121.6	89.9	295.7	159.1	102.1	125.8	116.6	45.3	49.1	54.2
85	129.1	121.0	114.9	126.7	125.0	119.0	90.0	293.3	159.1	81.1	102.3	127.3	46.8	49.2	59.3
95	128.9	122.9	113.9	126.8	125.3	119.0	90.1	293.4	159.1	81.7	96.7	133.1	46.8	48.9	59.5
04	126.6	120.9	114.5	126.7	123.0	120.0	90.2	294.1	159.1	87.3	103.5	130.7	47.1	52.4	57.7

8.88	121.8	120.0	120.8	127.1	125.5	126.5	90.3	295.5	159.1	101.4	107.5	104.7	46.7	48.8	47.6
8.98	120.4	117.0	117.7	126.6	124.5	120.0	90.4	295.9	159.1	106.6	120.2	117.1	47.4	50.4	58.1
9.07	126.4	122.7	115.7	126.7	124.3	120.6	90.5	294.1	159.1	88.5	98.7	126.0	47.4	50.8	57.1
9.16	126.9	123.0	112.9	126.1	124.7	120.8	90.6	294.0	159.1	87.5	98.0	142.3	48.5	50.4	57.0
9.26	126.2	120.2	114.4	126.2	124.4	122.0	90.7	294.2	159.1	89.5	107.7	134.0	48.5	50.9	54.9
9.35	122.6	118.5	118.7	126.2	125.8	122.1	90.8	295.3	159.1	100.3	115.1	114.3	48.6	49.1	54.9

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
NU(R)A= 87.73 NU(S)A= 50.23 NU(AV)A= 68.98 ST(AV)A=0.00902 ST(AV)/ST(4S)=2.04 F/F(4S)= 2.68
(ST/ST(4S))/(F/F(4S))=0.762 (F/F(4S))/(ST/ST(4S))*3.0=0.31 (ST/ST(4S))/(F/F(4S))*3.0=1.47
NU(R)A/NU(4S)=2.61 NU(S)A/NU(4S)=1.49 e+(4R)= 65.71 R(4R)= 4.24 H(4R)= 6.17

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 7.96

RUN NUMBER=113HR30-30/10 E/D=0.047 P/E=10.0 ALPHA=30 HYD DIA= 2.000 IN PR=.71 MDDT=0.0673 LBM/SEC
 RE= 32260. QGE(R)= 590.1 BTU/HR-SQ FT QGE(S)= 528.4 INLET TEMP= 82.0 F TATM= 75.8 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.07	99.4	0.0	95.8	96.6	0.0	102.5	82.1	583.0	523.7	368.7	0.0	465.3	394.9	0.0	2
2	0.16	107.5	0.0	100.7	101.1	0.0	102.3	82.1	580.6	522.9	251.0	0.0	343.0	302.2	0.0	2
3	0.26	102.7	0.0	101.6	100.2	0.0	97.2	82.2	582.0	522.3	311.7	0.0	329.4	317.8	0.0	3
4	0.35	103.4	0.0	108.8	100.3	0.0	101.6	82.3	581.8	522.2	302.4	0.0	240.8	317.8	0.0	2
5	0.45	102.2	0.0	109.9	100.9	0.0	101.8	82.4	582.2	521.7	322.2	0.0	232.0	309.6	0.0	2
6	0.54	108.3	0.0	109.0	102.0	0.0	101.8	82.5	580.3	521.8	246.3	0.0	239.8	292.2	0.0	2
7	0.63	109.6	0.0	104.7	103.2	0.0	100.0	82.6	579.9	521.3	235.0	0.0	287.1	276.6	0.0	3
8	0.73	108.1	0.0	104.4	105.1	0.0	103.8	82.7	580.4	521.0	249.8	0.0	292.3	254.6	0.0	2
9	0.82	107.1	0.0	102.8	106.8	0.0	105.6	82.7	580.7	520.5	261.0	0.0	317.0	237.1	0.0	2
10	0.91	106.1	0.0	112.2	108.2	0.0	106.9	82.8	581.0	519.6	273.3	0.0	216.5	224.4	0.0	2
11	1.01	118.3	0.0	0.0	110.1	0.0	0.0	82.9	577.3	520.0	178.6	0.0	0.0	209.6	0.0	0
12	1.10	114.2	0.0	0.0	109.2	0.0	0.0	83.0	578.6	519.7	202.9	0.0	0.0	217.4	0.0	0
13	1.20	113.9	0.0	0.0	112.2	0.0	0.0	83.1	578.7	518.5	205.5	0.0	0.0	194.9	0.0	0
14	1.29	113.2	0.0	0.0	112.2	0.0	0.0	83.2	578.9	518.2	210.9	0.0	0.0	195.0	0.0	0
15	1.38	109.4	0.0	0.0	112.9	0.0	0.0	83.2	580.0	517.9	242.6	0.0	0.0	191.0	0.0	0
16	1.48	107.1	0.0	0.0	113.5	0.0	0.0	83.3	580.7	517.3	267.2	0.0	0.0	187.4	0.0	0
17	1.57	116.5	0.0	0.0	115.0	0.0	0.0	83.4	577.9	516.7	191.0	0.0	0.0	178.9	0.0	0
18	1.66	116.0	0.0	0.0	116.0	0.0	0.0	83.5	578.0	516.4	194.5	0.0	0.0	173.8	0.0	0
19	1.76	113.6	0.0	0.0	117.0	0.0	0.0	83.6	578.7	516.1	210.8	0.0	0.0	168.9	0.0	0
20	1.85	110.1	0.0	0.0	117.0	0.0	0.0	83.7	579.8	516.1	239.8	0.0	0.0	169.3	0.0	0
21	1.95	112.6	0.0	0.0	118.0	0.0	0.0	83.7	579.0	515.8	219.4	0.0	0.0	164.6	0.0	0
22	2.04	119.7	0.0	0.0	118.0	0.0	0.0	83.8	576.9	515.8	175.8	0.0	0.0	165.0	0.0	0
23	2.13	119.2	0.0	0.0	119.0	0.0	0.0	83.9	577.1	515.5	178.8	0.0	0.0	160.6	0.0	0
24	2.23	116.0	0.0	0.0	122.0	0.0	0.0	84.0	578.0	514.6	197.4	0.0	0.0	148.0	0.0	0
25	2.32	109.3	0.0	0.0	121.0	0.0	0.0	84.1	580.0	514.9	251.4	0.0	0.0	152.4	0.0	0
26	2.41	111.6	0.0	0.0	122.0	0.0	0.0	84.2	579.3	514.6	230.7	0.0	0.0	148.6	0.0	0
27	2.51	121.6	0.0	0.0	122.0	0.0	0.0	84.3	576.3	514.6	168.6	0.0	0.0	148.9	0.0	0
28	2.60	119.8	0.0	0.0	121.0	0.0	0.0	84.3	576.9	514.9	177.7	0.0	0.0	153.4	0.0	0
29	2.70	116.3	0.0	0.0	124.0	0.0	0.0	84.4	577.9	514.0	198.0	0.0	0.0	141.8	0.0	0
30	2.79	109.5	0.0	0.0	125.0	0.0	0.0	84.5	580.0	513.7	253.4	0.0	0.0	138.5	0.0	0
31	2.88	113.8	0.0	0.0	125.0	0.0	0.0	84.6	578.7	513.7	216.3	0.0	0.0	138.8	0.0	0
32	2.98	124.0	0.0	0.0	125.0	0.0	0.0	84.7	575.6	513.7	159.8	0.0	0.0	139.1	0.0	0
33	3.07	123.0	0.0	0.0	125.0	0.0	0.0	84.8	575.9	513.7	164.4	0.0	0.0	139.3	0.0	0
34	3.16	118.8	0.0	0.0	127.0	0.0	0.0	84.8	577.2	513.1	185.5	0.0	0.0	132.8	0.0	0
35	3.26	111.0	0.0	0.0	126.0	0.0	0.0	84.9	579.5	513.4	242.5	0.0	0.0	136.4	0.0	0
36	3.35	113.7	0.0	0.0	127.0	0.0	0.0	85.0	578.7	513.1	220.1	0.0	0.0	133.3	0.0	0
37	3.45	122.7	0.0	0.0	127.0	0.0	0.0	85.1	576.0	513.1	167.1	0.0	0.0	133.6	0.0	0
38	3.54	122.9	0.0	0.0	127.0	0.0	0.0	85.2	576.0	513.1	166.5	0.0	0.0	133.8	0.0	0
39	3.63	119.5	0.0	0.0	127.0	0.0	0.0	85.3	577.0	513.1	183.8	0.0	0.0	134.1	0.0	0
40	3.73	112.9	0.0	0.0	127.0	0.0	0.0	85.3	579.0	513.1	229.1	0.0	0.0	134.3	0.0	0
41	7.57	120.2	0.0	0.0	132.0	0.0	0.0	88.8	576.8	511.6	199.2	0.0	0.0	128.4	0.0	0
42	7.66	120.5	0.0	0.0	132.0	0.0	0.0	88.9	576.7	511.6	197.7	0.0	0.0	128.6	0.0	0
43	7.76	124.4	0.0	0.0	131.8	0.0	0.0	89.0	575.5	511.6	176.1	0.0	0.0	129.5	0.0	0
44	7.85	120.7	0.0	0.0	131.3	0.0	0.0	89.0	576.6	511.8	197.5	0.0	0.0	131.3	0.0	0
45	7.95	120.4	0.0	0.0	132.0	0.0	0.0	89.1	576.7	512.2	199.9	0.0	0.0	129.4	0.0	0
46	8.04	116.8	0.0	0.0	132.1	0.0	0.0	89.2	577.8	512.3	227.0	0.0	0.0	129.3	0.0	0
47	8.13	125.8	0.0	0.0	132.8	0.0	0.0	89.3	575.1	511.3	170.7	0.0	0.0	127.4	0.0	0
48	8.23	124.7	0.0	0.0	132.6	0.0	0.0	89.4	575.4	513.5	176.5	0.0	0.0	128.6	0.0	0
49	8.32	121.9	0.0	0.0	132.8	0.0	0.0	89.5	576.3	514.3	192.5	0.0	0.0	128.6	0.0	0
50	8.41	120.2	0.0	0.0	133.4	0.0	0.0	89.6	576.8	514.0	203.8	0.0	0.0	127.0	0.0	0
51	8.51	113.0	107.9	110.6	133.3	133.6	127.7	89.6	578.9	514.0	268.4	343.3	299.1	127.6	126.7	146.
52	8.60	124.8	115.7	112.6	132.2	133.6	125.7	89.7	575.4	513.4	177.6	239.8	272.3	130.9	126.8	154.
53	8.70	124.6	118.2	108.7	132.5	133.0	125.8	89.8	575.4	513.4	179.1	219.4	329.7	130.2	128.6	154.
54	8.79	120.2	116.5	108.9	134.1	134.1	126.7	89.9	576.8	513.1	206.0	234.6	328.4	125.5	125.5	150.
55	8.88	113.5	114.7	112.2	133.2	134.2	134.7	90.0	578.8	512.8	266.3	253.4	281.9	128.3	125.6	124.
56	8.98	112.0	109.1	111.5	130.6	132.6	127.9	90.1	579.2	513.1	285.7	329.2	292.4	136.9	130.6	146.
57	9.07	121.5	117.2	113.6	130.9	131.4	126.6	90.1	576.4	512.8	198.9	230.5	265.9	136.2	134.5	152.
58	9.16	124.0	117.1	107.4	132.4	132.4	126.8	90.2	575.6	512.5	184.4	231.7	362.7	131.4	131.6	151.
59	9.26	120.0	116.6	109.3	131.1	133.0	127.0	90.3	576.8	512.8	210.2	237.4	328.6	136.0	129.8	151.
60	9.35	113.5	114.6	114.9	131.3	132.1	128.1	90.4	578.8	512.5	270.9	258.6	255.5	135.4	132.9	147.

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=209.13 NU(S)A=133.70 NU(AV)A=171.41 ST(AV)A=0.00750 ST(AV)/ST(4S)=2.12 F/F(4S)= 2.87
 (ST/ST(4S))/(F/F(4S))=0.738 (F/F(4S))/(ST/ST(4S))**3.0=0.30 (ST/ST(4S))/(F/F(4S))**(1/3)=1.49
 NU(R)A/NU(4S)=2.59 NU(S)A/NU(4S)=1.65 e+(4R)= 178.09 R(4R)= 5.03 H(4R)= 6.91

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 9.51

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER=114HR60-30/10 E/D=0.047 P/E=10.0 ALPHA=30 HYD DIA= 2.000 IN PR=.71 MDOT=0.1344 LBM/SEC
4317. QGE(R)=1038.9 BTU/HR-SQ FT QGE(S)= 960.9 INLET TEMP= 83.6 F TATM= 77.3 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	103.0	0.0	97.1	97.6	0.0	89.8	83.7	1031.2	956.2	583.0	0.0	838.8	750.6	0.0	1705.9
16	110.8	0.0	101.1	101.5	0.0	93.3	83.7	1028.8	955.3	415.6	0.0	647.7	588.4	0.0	1094.5
26	105.0	0.0	103.4	101.1	0.0	97.2	83.8	1030.6	954.6	531.7	0.0	575.1	603.8	0.0	780.0
35	105.7	0.0	113.1	101.2	0.0	102.2	83.9	1030.4	954.4	516.3	0.0	385.5	602.8	0.0	570.1
45	104.1	0.0	113.3	102.3	0.0	101.4	84.0	1030.8	953.8	559.5	0.0	384.0	568.6	0.0	598.1
54	110.1	0.0	112.8	103.4	0.0	102.6	84.0	1029.0	954.1	431.5	0.0	391.0	538.8	0.0	561.9
63	111.4	0.0	106.1	105.4	0.0	103.0	84.1	1028.7	953.3	411.9	0.0	511.3	489.6	0.0	551.6
73	110.1	0.0	107.6	106.9	0.0	106.0	84.2	1029.0	953.1	433.9	0.0	480.3	458.8	0.0	477.7
82	109.8	0.0	105.1	109.6	0.0	106.0	84.3	1029.1	952.7	440.3	0.0	539.6	411.1	0.0	478.9
91	108.2	0.0	118.3	111.4	0.0	108.0	84.3	1029.6	951.7	471.4	0.0	331.2	384.3	0.0	439.5
01	120.6	0.0	0.0	113.2	0.0	0.0	84.4	1025.9	951.7	309.7	0.0	0.0	361.3	0.0	0.0
10	116.3	0.0	0.0	111.4	0.0	0.0	84.5	1027.2	952.0	352.7	0.0	0.0	386.6	0.0	0.0
20	116.0	0.0	0.0	114.5	0.0	0.0	84.6	1027.3	950.5	356.9	0.0	0.0	346.9	0.0	0.0
29	116.4	0.0	0.0	116.6	0.0	0.0	84.6	1027.2	949.9	353.2	0.0	0.0	324.6	0.0	0.0
38	112.1	0.0	0.0	118.3	0.0	0.0	84.7	1028.4	949.6	410.1	0.0	0.0	308.8	0.0	0.0
48	109.1	0.0	0.0	119.0	0.0	0.0	84.8	1029.3	948.7	462.4	0.0	0.0	302.8	0.0	0.0
57	121.2	0.0	0.0	120.7	0.0	0.0	84.9	1025.7	948.4	308.2	0.0	0.0	289.0	0.0	0.0
66	119.4	0.0	0.0	121.5	0.0	0.0	85.0	1026.3	948.4	325.1	0.0	0.0	283.2	0.0	0.0
76	116.6	0.0	0.0	122.0	0.0	0.0	85.0	1027.1	947.5	355.0	0.0	0.0	279.6	0.0	0.0
85	112.6	0.0	0.0	122.0	0.0	0.0	85.1	1028.3	947.5	408.0	0.0	0.0	280.2	0.0	0.0
95	116.0	0.0	0.0	122.0	0.0	0.0	85.2	1027.3	947.5	363.6	0.0	0.0	280.7	0.0	0.0
04	124.9	0.0	0.0	123.0	0.0	0.0	85.3	1024.6	947.2	281.9	0.0	0.0	273.7	0.0	0.0
13	123.5	0.0	0.0	124.0	0.0	0.0	85.3	1025.0	946.9	292.9	0.0	0.0	267.1	0.0	0.0
23	119.9	0.0	0.0	127.0	0.0	0.0	85.4	1026.1	946.0	324.4	0.0	0.0	248.0	0.0	0.0
32	111.3	0.0	0.0	126.0	0.0	0.0	85.5	1028.7	946.3	434.5	0.0	0.0	254.7	0.0	0.0
41	114.4	0.0	0.0	128.0	0.0	0.0	85.6	1027.8	945.7	388.5	0.0	0.0	242.9	0.0	0.0
51	128.2	0.0	0.0	127.0	0.0	0.0	85.6	1023.6	946.0	262.1	0.0	0.0	249.3	0.0	0.0
60	124.3	0.0	0.0	126.0	0.0	0.0	85.7	1024.8	946.3	289.5	0.0	0.0	256.0	0.0	0.0
70	119.7	0.0	0.0	130.0	0.0	0.0	85.8	1026.2	945.1	329.8	0.0	0.0	233.0	0.0	0.0
79	111.5	0.0	0.0	131.0	0.0	0.0	85.9	1028.6	944.8	437.2	0.0	0.0	228.1	0.0	0.0
88	117.2	0.0	0.0	131.0	0.0	0.0	85.9	1026.9	944.8	357.9	0.0	0.0	228.5	0.0	0.0
98	130.8	0.0	0.0	130.0	0.0	0.0	86.0	1022.8	945.1	248.8	0.0	0.0	234.1	0.0	0.0
07	128.1	0.0	0.0	131.0	0.0	0.0	86.1	1023.6	944.8	265.4	0.0	0.0	229.2	0.0	0.0
16	122.3	0.0	0.0	134.0	0.0	0.0	86.2	1025.4	943.9	309.1	0.0	0.0	214.9	0.0	0.0
26	112.8	0.0	0.0	132.0	0.0	0.0	86.2	1028.2	944.5	421.7	0.0	0.0	224.8	0.0	0.0
35	116.8	0.0	0.0	133.0	0.0	0.0	86.3	1027.0	944.2	366.9	0.0	0.0	220.3	0.0	0.0
45	129.9	0.0	0.0	134.0	0.0	0.0	86.4	1023.1	943.9	256.0	0.0	0.0	215.9	0.0	0.0
54	128.9	0.0	0.0	134.0	0.0	0.0	86.5	1023.4	943.9	262.6	0.0	0.0	216.2	0.0	0.0
63	122.6	0.0	0.0	135.0	0.0	0.0	86.6	1025.3	943.6	309.6	0.0	0.0	212.0	0.0	0.0
73	114.3	0.0	0.0	135.0	0.0	0.0	86.6	1027.8	943.6	404.2	0.0	0.0	212.3	0.0	0.0
82	123.8	0.0	0.0	136.0	0.0	0.0	89.8	1024.9	943.3	326.0	0.0	0.0	220.9	0.0	0.0
91	122.9	0.0	0.0	135.5	0.0	0.0	89.8	1025.2	943.5	335.6	0.0	0.0	223.6	0.0	0.0
00	127.2	0.0	0.0	135.1	0.0	0.0	89.9	1023.9	943.6	297.2	0.0	0.0	226.0	0.0	0.0
09	122.9	0.0	0.0	134.8	0.0	0.0	90.0	1025.2	943.7	337.1	0.0	0.0	227.9	0.0	0.0
18	123.7	0.0	0.0	134.7	0.0	0.0	90.1	1025.0	945.0	329.7	0.0	0.0	229.1	0.0	0.0
27	121.1	0.0	0.0	136.1	0.0	0.0	90.1	1025.7	944.4	358.4	0.0	0.0	222.4	0.0	0.0
36	131.9	0.0	0.0	136.6	0.0	0.0	90.2	1022.5	944.5	265.4	0.0	0.0	220.4	0.0	0.0
45	131.7	0.0	0.0	137.9	0.0	0.0	90.3	1022.6	946.3	267.1	0.0	0.0	215.2	0.0	0.0
54	127.5	0.0	0.0	138.1	0.0	0.0	90.4	1023.8	946.0	298.2	0.0	0.0	214.5	0.0	0.0
63	124.7	0.0	0.0	137.7	0.0	0.0	90.4	1024.7	945.4	323.5	0.0	0.0	216.5	0.0	0.0
72	112.5	112.0	115.7	137.3	138.1	137.9	90.5	1028.3	945.4	505.9	517.6	441.6	218.6	215.0	215.9
81	119.4	121.1	119.5	137.6	140.5	138.1	90.6	1026.3	944.2	385.2	363.7	383.9	217.2	204.7	215.0
90	124.9	123.2	115.4	138.9	141.1	136.5	90.7	1024.6	944.5	323.6	340.5	447.9	211.8	202.6	222.9
99	129.8	123.2	122.1	139.3	141.0	135.4	90.7	1023.1	944.2	283.2	340.8	352.7	210.3	203.2	228.6

5	8.88	122.2	120.7	113.3	138.6	140.1	143.3	90.8	1025.4	943.9	353.2	371.0	493.1	213.6	207.1	194.5
6	8.98	116.7	113.7	112.9	137.1	139.7	137.0	90.9	1027.1	944.2	430.2	486.8	504.5	220.9	209.2	221.4
7	9.07	126.9	120.7	115.7	137.4	137.7	136.7	91.0	1024.0	943.9	308.0	372.2	447.5	219.7	218.3	223.1
8	9.16	126.5	118.9	107.2	135.8	139.6	135.8	91.1	1024.1	943.9	312.1	397.3	685.2	227.9	210.1	227.9
9	9.26	120.6	119.5	109.7	135.5	138.3	136.2	91.1	1025.9	944.2	376.0	390.6	596.7	229.9	216.3	226.3
0	9.35	115.1	117.6	117.5	135.9	139.3	133.9	91.2	1027.5	943.9	464.5	420.5	422.1	228.1	212.0	238.9

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=347.21 NU(S)A=220.31 NU(AV)A=283.76 ST(AV)A=0.00623 ST(AV)/ST(4S)=2.02 F/F(4S)= 2.95
 (ST/ST(4S))/(F/F(4S))=0.682 (F/F(4S))/(ST/ST(4S))*3.0=0.36 (ST/ST(4S))/(F/F(4S))*(1/3)=1.40
 NU(R)A/NU(4S)=2.47 NU(S)A/NU(4S)=1.57 e+(4R)= 333.26 R(4R)= 5.59 H(4R)= 8.44

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 11.15

RUN NUMBER=116HR10-30/20 E/D=0.047 P/E=20.0 ALPHA=30 HYD DIA= 2.000 IN PR=.71 MDDT=0.0228 LBM/SEC
 RE= 10958. GGE(R)= 262.4 BTU/HR-SQ FT GGE(S)= 205.0 INLET TEMP= 79.4 F TATM= 72.2 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.07	97.8	0.0	94.4	91.4	0.0	89.4	79.5	254.7	199.5	153.0	0.0	187.9	184.4	0.0	2
2	0.16	108.0	0.0	97.8	96.4	0.0	93.0	79.6	251.7	198.3	97.5	0.0	152.0	130.0	0.0	1
3	0.26	103.9	0.0	100.6	95.3	0.0	97.0	79.7	252.9	198.2	114.9	0.0	133.0	139.7	0.0	1
4	0.35	103.5	0.0	106.1	94.2	0.0	98.0	79.8	253.0	198.6	117.3	0.0	105.8	151.6	0.0	1
5	0.45	103.3	0.0	106.8	94.3	0.0	97.0	79.9	253.1	198.5	118.8	0.0	103.4	151.4	0.0	1
6	0.54	105.3	0.0	106.3	96.0	0.0	97.0	80.0	252.5	198.3	109.6	0.0	105.5	136.3	0.0	1
7	0.63	107.1	0.0	102.8	97.3	0.0	97.0	80.1	251.9	197.8	102.5	0.0	121.9	126.5	0.0	1
8	0.73	109.6	0.0	106.4	98.8	0.0	97.0	80.2	251.2	197.5	93.9	0.0	105.3	116.8	0.0	1
9	0.82	111.5	0.0	106.9	100.3	0.0	99.0	80.3	250.6	197.0	88.2	0.0	103.5	108.3	0.0	1
10	0.91	110.5	0.0	108.1	101.6	0.0	99.0	80.4	250.9	196.5	91.5	0.0	99.5	101.8	0.0	1
11	1.01	118.2	0.0	0.0	104.9	0.0	0.0	80.5	248.6	196.3	72.4	0.0	0.0	88.3	0.0	
12	1.10	115.0	0.0	0.0	103.2	0.0	0.0	80.6	249.6	196.3	79.6	0.0	0.0	95.5	0.0	
13	1.20	115.0	0.0	0.0	104.7	0.0	0.0	80.7	249.6	195.7	79.9	0.0	0.0	89.6	0.0	
14	1.29	115.5	0.0	0.0	105.1	0.0	0.0	80.8	249.4	195.4	78.9	0.0	0.0	88.3	0.0	
15	1.38	115.4	0.0	0.0	106.0	0.0	0.0	80.9	249.4	195.1	79.3	0.0	0.0	85.3	0.0	
16	1.48	116.0	0.0	0.0	107.8	0.0	0.0	81.0	249.3	194.8	78.1	0.0	0.0	79.8	0.0	
17	1.57	116.9	0.0	0.0	108.1	0.0	0.0	81.1	249.0	194.5	76.3	0.0	0.0	79.1	0.0	
18	1.66	118.0	0.0	0.0	108.0	0.0	0.0	81.2	248.7	194.2	74.1	0.0	0.0	79.4	0.0	
19	1.76	117.8	0.0	0.0	109.0	0.0	0.0	81.2	248.7	193.9	74.7	0.0	0.0	76.7	0.0	
20	1.85	114.4	0.0	0.0	109.0	0.0	0.0	81.3	249.7	193.9	82.9	0.0	0.0	77.0	0.0	
21	1.95	115.8	0.0	0.0	109.0	0.0	0.0	81.4	249.3	193.9	79.7	0.0	0.0	77.2	0.0	
22	2.04	120.7	0.0	0.0	110.0	0.0	0.0	81.5	247.9	193.6	69.5	0.0	0.0	74.7	0.0	
23	2.13	121.9	0.0	0.0	111.0	0.0	0.0	81.6	247.5	193.3	67.5	0.0	0.0	72.3	0.0	
24	2.23	122.1	0.0	0.0	112.2	0.0	0.0	81.7	247.4	193.0	67.3	0.0	0.0	69.5	0.0	
25	2.32	121.7	0.0	0.0	113.0	0.0	0.0	81.8	247.6	192.7	68.1	0.0	0.0	67.8	0.0	
26	2.41	122.2	0.0	0.0	113.8	0.0	0.0	81.9	247.4	192.5	67.4	0.0	0.0	66.3	0.0	
27	2.51	123.0	0.0	0.0	113.0	0.0	0.0	82.0	247.2	192.7	66.2	0.0	0.0	68.3	0.0	
28	2.60	122.8	0.0	0.0	113.0	0.0	0.0	82.1	247.2	192.7	66.6	0.0	0.0	68.5	0.0	
29	2.70	121.8	0.0	0.0	114.7	0.0	0.0	82.2	247.5	192.2	68.6	0.0	0.0	64.9	0.0	
30	2.79	116.7	0.0	0.0	115.0	0.0	0.0	82.3	249.1	192.1	79.4	0.0	0.0	64.5	0.0	
31	2.88	119.1	0.0	0.0	115.0	0.0	0.0	82.4	248.3	192.1	74.2	0.0	0.0	64.6	0.0	
32	2.98	126.0	0.0	0.0	116.0	0.0	0.0	82.5	246.3	191.8	62.1	0.0	0.0	62.8	0.0	
33	3.07	126.3	0.0	0.0	116.0	0.0	0.0	82.6	246.2	191.8	61.7	0.0	0.0	63.0	0.0	
34	3.16	125.5	0.0	0.0	117.0	0.0	0.0	82.7	246.4	191.5	63.1	0.0	0.0	61.2	0.0	
35	3.26	124.4	0.0	0.0	117.0	0.0	0.0	82.8	246.7	191.5	65.0	0.0	0.0	61.4	0.0	
36	3.35	125.3	0.0	0.0	118.0	0.0	0.0	82.9	246.5	191.2	63.7	0.0	0.0	59.7	0.0	
37	3.45	125.8	0.0	0.0	118.0	0.0	0.0	83.0	246.3	191.2	63.0	0.0	0.0	59.9	0.0	
38	3.54	126.5	0.0	0.0	118.0	0.0	0.0	83.1	246.1	191.2	62.1	0.0	0.0	60.0	0.0	
39	3.63	125.1	0.0	0.0	118.0	0.0	0.0	83.2	246.5	191.2	64.4	0.0	0.0	60.2	0.0	
40	3.73	120.6	0.0	0.0	118.0	0.0	0.0	83.3	247.9	191.2	72.8	0.0	0.0	60.3	0.0	
41	7.57	123.7	0.0	0.0	124.0	0.0	0.0	87.4	247.0	189.4	73.9	0.0	0.0	56.2	0.0	
42	7.66	124.3	0.0	0.0	125.3	0.0	0.0	87.5	246.8	189.4	72.8	0.0	0.0	54.4	0.0	
43	7.76	126.3	0.0	0.0	125.0	0.0	0.0	87.6	246.2	189.4	69.0	0.0	0.0	55.0	0.0	
44	7.85	125.5	0.0	0.0	124.3	0.0	0.0	87.7	246.4	189.7	70.7	0.0	0.0	56.3	0.0	
45	7.95	125.4	0.0	0.0	125.9	0.0	0.0	87.8	246.4	189.4	71.1	0.0	0.0	54.0	0.0	
46	8.04	125.8	0.0	0.0	127.1	0.0	0.0	87.9	246.3	189.1	70.5	0.0	0.0	52.4	0.0	
47	8.13	127.2	0.0	0.0	125.3	0.0	0.0	88.0	245.9	189.1	68.0	0.0	0.0	55.0	0.0	
48	8.23	128.3	0.0	0.0	125.3	0.0	0.0	88.1	245.6	189.1	66.2	0.0	0.0	55.1	0.0	
49	8.32	129.4	0.0	0.0	125.7	0.0	0.0	88.2	245.2	189.4	64.5	0.0	0.0	54.8	0.0	
50	8.41	125.8	0.0	0.0	125.4	0.0	0.0	88.2	246.3	189.4	71.2	0.0	0.0	55.4	0.0	
51	8.51	120.7	116.7	119.2	126.9	125.0	119.7	88.3	247.9	189.4	83.1	94.9	87.2	53.3	56.2	65.0
52	8.60	127.4	118.2	118.7	126.8	124.0	117.0	88.4	245.8	189.1	68.5	89.6	88.2	53.6	57.8	71.0
53	8.70	126.2	120.7	115.4	125.9	124.3	118.0	88.5	246.2	189.4	70.9	83.1	99.5	55.1	57.5	69.0
54	8.79	124.3	123.0	115.3	125.8	123.0	119.0	88.6	246.8	189.4	75.1	77.9	100.4	55.4	59.8	67.0
55	8.88	124.0	122.7	116.4	127.2	125.5	126.6	88.7	246.9	189.1	75.9	78.8	96.8	53.4	55.7	54.0
56	8.98	124.0	117.2	113.6	126.7	124.6	120.0	88.8	246.9	189.1	76.1	94.4	108.1	54.2	57.4	65.0
57	9.07	125.1	120.9	112.6	126.8	124.4	120.6	88.9	246.5	189.1	73.9	83.6	113.0	54.2	57.9	64.0
58	9.16	126.3	122.0	113.7	125.1	124.8	121.8	89.0	246.2	189.4	71.6	81.0	108.2	57.0	57.5	62.0
59	9.26	126.1	120.3	115.4	125.2	124.5	121.0	89.1	246.2	189.4	72.2	85.6	101.6	57.0	58.1	64.0
60	9.35	122.0	117.9	117.0	126.2	125.9	123.2	89.2	247.5	189.1	81.8	93.5	96.6	55.5	56.0	60.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 70.07 NU(S)A= 58.08 NU(AV)A= 64.07 ST(AV)A=0.00825 ST(AV)/ST(4S)=1.88 F/F(4S)= 2.27
 (ST/ST(4S))/(F/F(4S))=0.827 (F/F(4S))/(ST/ST(4S))**3.0=0.34 (ST/ST(4S))/(F/F(4S))**(1/3)=1.43
 NU(R)A/NU(4S)=2.06 NU(S)A/NU(4S)=1.71 e+(4R)= 59.90 R(4R)= 5.11 H(4R)= 6.27

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 9.57

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER=117HR30-30/20 E/D=0.047 P/E=20.0 ALPHA=30 HYD DIA= 2.000 IN PR=.71 MDDT=0.0660 LBM/SEC
31772. GGE(R)= 455.3 BTU/HR-SQ FT GGE(S)= 448.2 INLET TEMP= 79.7 F TATM= 73.8 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	97.0	0.0	92.4	93.0	0.0	99.7	79.8	448.3	443.9	286.1	0.0	390.1	368.0	0.0	245.5
0.16	105.6	0.0	96.6	97.1	0.0	100.1	79.8	445.8	443.2	190.3	0.0	292.3	282.1	0.0	240.3
0.26	101.8	0.0	97.8	96.2	0.0	95.1	79.9	446.9	442.7	224.4	0.0	274.6	298.9	0.0	320.5
0.35	101.1	0.0	104.5	96.1	0.0	98.6	80.0	447.1	442.6	232.7	0.0	200.4	302.3	0.0	261.7
0.45	101.0	0.0	105.8	96.1	0.0	97.7	80.0	447.1	442.3	234.5	0.0	190.9	302.3	0.0	274.9
0.54	103.1	0.0	105.8	97.4	0.0	97.8	80.1	446.5	442.3	213.5	0.0	191.1	281.4	0.0	275.1
0.63	104.8	0.0	102.1	98.4	0.0	97.0	80.2	446.0	441.9	199.1	0.0	223.6	267.1	0.0	288.7
0.73	107.4	0.0	107.0	100.2	0.0	99.9	80.2	445.2	441.6	180.2	0.0	182.9	243.2	0.0	246.6
0.82	108.8	0.0	107.4	101.9	0.0	100.6	80.3	444.8	441.2	171.6	0.0	180.5	224.5	0.0	239.3
0.91	105.4	0.0	108.7	102.7	0.0	101.8	80.4	445.8	440.4	195.9	0.0	173.0	216.6	0.0	225.6
1.01	114.8	0.0	0.0	104.0	0.0	0.0	80.4	443.0	441.0	141.7	0.0	0.0	206.0	0.0	0.0
1.10	110.2	0.0	0.0	104.1	0.0	0.0	80.5	444.4	440.4	164.5	0.0	0.0	205.3	0.0	0.0
1.20	111.8	0.0	0.0	106.1	0.0	0.0	80.6	443.9	439.5	156.3	0.0	0.0	188.9	0.0	0.0
1.29	112.9	0.0	0.0	105.2	0.0	0.0	80.6	443.6	439.5	151.1	0.0	0.0	196.7	0.0	0.0
1.38	112.7	0.0	0.0	107.9	0.0	0.0	80.7	443.6	438.6	152.4	0.0	0.0	177.4	0.0	0.0
1.48	113.4	0.0	0.0	107.5	0.0	0.0	80.8	443.4	438.3	149.4	0.0	0.0	180.1	0.0	0.0
1.57	114.4	0.0	0.0	108.0	0.0	0.0	80.9	443.1	438.0	145.1	0.0	0.0	177.3	0.0	0.0
1.66	115.4	0.0	0.0	109.0	0.0	0.0	80.9	442.8	437.7	141.1	0.0	0.0	171.2	0.0	0.0
1.76	115.0	0.0	0.0	110.0	0.0	0.0	81.0	442.9	437.4	143.1	0.0	0.0	165.6	0.0	0.0
1.85	109.4	0.0	0.0	110.0	0.0	0.0	81.1	444.6	437.4	172.3	0.0	0.0	166.0	0.0	0.0
1.95	111.6	0.0	0.0	111.0	0.0	0.0	81.1	444.0	437.1	160.0	0.0	0.0	160.7	0.0	0.0
2.04	117.9	0.0	0.0	111.0	0.0	0.0	81.2	442.1	437.1	132.3	0.0	0.0	161.0	0.0	0.0
2.13	117.2	0.0	0.0	112.0	0.0	0.0	81.3	442.3	436.8	135.1	0.0	0.0	156.0	0.0	0.0
2.23	116.2	0.0	0.0	114.0	0.0	0.0	81.3	442.6	436.2	139.4	0.0	0.0	146.6	0.0	0.0
2.32	117.0	0.0	0.0	114.0	0.0	0.0	81.4	442.3	436.2	136.4	0.0	0.0	146.9	0.0	0.0
2.41	117.8	0.0	0.0	115.0	0.0	0.0	81.5	442.1	435.9	133.6	0.0	0.0	142.7	0.0	0.0
2.51	119.2	0.0	0.0	115.0	0.0	0.0	81.5	441.7	435.9	128.7	0.0	0.0	143.0	0.0	0.0
2.60	119.4	0.0	0.0	114.0	0.0	0.0	81.6	441.6	436.2	128.2	0.0	0.0	147.8	0.0	0.0
2.70	118.0	0.0	0.0	116.0	0.0	0.0	81.7	442.0	435.6	133.5	0.0	0.0	139.3	0.0	0.0
2.79	109.8	0.0	0.0	116.0	0.0	0.0	81.8	444.5	435.6	173.9	0.0	0.0	139.5	0.0	0.0
2.88	113.5	0.0	0.0	117.0	0.0	0.0	81.8	443.4	435.3	153.5	0.0	0.0	135.7	0.0	0.0
2.98	123.2	0.0	0.0	117.0	0.0	0.0	81.9	440.5	435.3	116.9	0.0	0.0	136.0	0.0	0.0
3.07	122.1	0.0	0.0	117.0	0.0	0.0	82.0	440.8	435.3	120.4	0.0	0.0	136.2	0.0	0.0
3.16	120.4	0.0	0.0	119.0	0.0	0.0	82.0	441.3	434.7	126.1	0.0	0.0	128.9	0.0	0.0
3.26	119.9	0.0	0.0	118.0	0.0	0.0	82.1	441.5	435.0	128.0	0.0	0.0	132.8	0.0	0.0
3.35	121.2	0.0	0.0	119.0	0.0	0.0	82.2	441.1	434.7	123.9	0.0	0.0	129.4	0.0	0.0
3.45	122.1	0.0	0.0	120.0	0.0	0.0	82.2	440.8	434.4	121.2	0.0	0.0	126.1	0.0	0.0
3.54	123.0	0.0	0.0	120.0	0.0	0.0	82.3	440.5	434.4	118.6	0.0	0.0	126.3	0.0	0.0
3.63	120.8	0.0	0.0	120.0	0.0	0.0	82.4	441.2	434.4	125.8	0.0	0.0	126.5	0.0	0.0
3.73	112.9	0.0	0.0	120.0	0.0	0.0	82.4	443.6	434.4	159.6	0.0	0.0	126.7	0.0	0.0
7.57	118.8	0.0	0.0	125.0	0.0	0.0	85.3	441.8	432.9	143.7	0.0	0.0	118.8	0.0	0.0
7.66	118.5	0.0	0.0	125.0	0.0	0.0	85.3	441.9	432.9	145.3	0.0	0.0	119.0	0.0	0.0
7.76	121.2	0.0	0.0	124.3	0.0	0.0	85.4	441.1	433.1	134.4	0.0	0.0	121.4	0.0	0.0
7.85	120.4	0.0	0.0	124.0	0.0	0.0	85.5	441.3	433.2	137.8	0.0	0.0	122.6	0.0	0.0
7.95	120.1	0.0	0.0	127.2	0.0	0.0	85.6	441.4	432.9	139.3	0.0	0.0	113.3	0.0	0.0
8.04	121.0	0.0	0.0	127.4	0.0	0.0	85.6	441.1	432.9	135.9	0.0	0.0	112.9	0.0	0.0
8.13	122.9	0.0	0.0	123.8	0.0	0.0	85.7	440.6	433.2	129.0	0.0	0.0	123.9	0.0	0.0
8.23	124.3	0.0	0.0	127.0	0.0	0.0	85.8	440.1	434.4	124.5	0.0	0.0	114.7	0.0	0.0
8.32	124.1	0.0	0.0	129.6	0.0	0.0	85.8	440.2	434.4	125.3	0.0	0.0	108.0	0.0	0.0
8.41	119.9	0.0	0.0	129.2	0.0	0.0	85.9	441.5	434.4	141.5	0.0	0.0	109.2	0.0	0.0
8.51	110.7	114.0	121.2	129.1	129.4	122.7	86.0	444.2	434.4	195.7	172.6	137.3	109.6	108.9	128.9
8.60	120.4	117.7	118.1	128.1	129.4	120.7	86.0	441.3	433.8	139.9	151.8	149.9	112.4	108.8	136.4
8.70	120.8	121.9	110.4	128.4	128.9	120.7	86.1	441.2	433.8	138.5	134.2	197.8	111.7	110.3	136.5
8.79	119.9	123.8	111.3	129.0	129.0	121.7	86.2	441.5	433.8	142.5	127.8	191.3	110.2	110.2	133.0

5	8.88	119.7	119.1	108.5	127.1	128.1	129.5	86.2	441.5	433.8	143.7	146.3	216.0	115.5	112.9	109.1
6	8.98	119.2	109.3	107.5	125.6	126.5	122.9	86.3	441.7	433.8	146.2	209.2	226.9	120.3	117.5	129.1
7	9.07	120.2	114.5	108.9	124.8	126.4	122.6	86.4	441.4	433.8	142.1	170.9	213.4	122.8	118.1	130.5
8	9.16	121.4	112.6	111.8	126.4	127.3	122.8	86.4	441.0	433.5	137.4	183.6	189.4	118.2	115.5	129.9
9	9.26	119.1	110.6	115.2	125.0	128.0	122.9	86.5	441.7	433.8	147.6	199.6	167.6	122.6	113.9	129.6
0	9.35	112.1	111.5	117.2	125.3	127.0	122.0	86.6	443.8	433.5	189.3	193.9	157.8	121.8	116.6	133.1

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=140.85 NU(S)A=123.49 NU(AV)A=132.17 ST(AV)A=0.00587 ST(AV)/ST(4S)=1.65 F/F(4S)= 2.36
 (ST/ST(4S))/(F/F(4S))=0.700 (F/F(4S))/(ST/ST(4S))*3.0=0.52 (ST/ST(4S))/(F/F(4S))*(1/3)=1.24
 NU(R)A/NU(4S)=1.76 NU(S)A/NU(4S)=1.55 e+(4R)= 155.85 R(4R)= 6.10 H(4R)= 9.42

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 13.38

RUN NUMBER=118HR60-30/20 E/D=0.047 P/E=20.0 ALPHA=30 HYD DIA= 2.000 IN PR=.71 MDDT=0.1350 LBM/SEC
RE= 64980. GGE(R)= 850.0 BTU/HR-SQ FT GGE(S)= 760 1 INLET TEMP= 80.2 F TATM= 72.0 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.07	97.6	0.0	90.9	93.1	0.0	87.8	80.2	842.3	755.1	533.7	0.0	869.4	644.4	0.0	10
2	0.16	104.5	0.0	94.1	96.4	0.0	91.4	80.3	840.2	754.4	381.9	0.0	669.8	514.2	0.0	7
3	0.26	100.6	0.0	96.4	95.6	0.0	92.2	80.4	841.4	753.8	457.2	0.0	577.0	543.4	0.0	6
4	0.35	100.4	0.0	104.1	95.7	0.0	96.2	80.4	841.5	753.7	463.2	0.0	390.8	542.0	0.0	5
5	0.45	100.2	0.0	104.2	96.4	0.0	96.4	80.5	841.5	753.2	469.3	0.0	390.1	520.1	0.0	5
6	0.54	102.1	0.0	104.0	97.8	0.0	95.6	80.6	841.0	753.4	428.9	0.0	394.2	479.4	0.0	5
7	0.63	103.6	0.0	99.8	99.2	0.0	96.0	80.6	840.5	752.8	401.8	0.0	481.4	444.6	0.0	5
8	0.73	105.9	0.0	106.3	100.7	0.0	100.0	80.7	839.8	752.6	365.8	0.0	360.1	412.4	0.0	4
9	0.82	107.2	0.0	107.0	103.4	0.0	99.4	80.7	839.4	752.2	348.5	0.0	351.1	364.0	0.0	4
10	0.91	104.2	0.0	108.7	104.6	0.0	101.4	80.8	840.3	751.3	394.4	0.0	330.8	346.4	0.0	4
11	1.01	111.8	0.0	0.0	106.2	0.0	0.0	80.9	838.1	751.4	297.5	0.0	0.0	325.2	0.0	4
12	1.10	109.2	0.0	0.0	104.4	0.0	0.0	80.9	838.8	751.7	325.8	0.0	0.0	351.1	0.0	4
13	1.20	110.0	0.0	0.0	106.5	0.0	0.0	81.0	838.6	750.5	317.3	0.0	0.0	322.7	0.0	4
14	1.29	111.2	0.0	0.0	107.6	0.0	0.0	81.0	838.2	750.2	305.2	0.0	0.0	310.0	0.0	4
15	1.38	111.2	0.0	0.0	110.3	0.0	0.0	81.1	838.2	749.6	305.8	0.0	0.0	281.7	0.0	4
16	1.48	112.0	0.0	0.0	110.0	0.0	0.0	81.2	838.0	749.0	298.3	0.0	0.0	285.1	0.0	4
17	1.57	113.3	0.0	0.0	111.7	0.0	0.0	81.2	837.6	748.7	286.7	0.0	0.0	269.6	0.0	4
18	1.66	114.5	0.0	0.0	113.5	0.0	0.0	81.3	837.2	748.4	276.7	0.0	0.0	254.9	0.0	4
19	1.76	114.1	0.0	0.0	113.0	0.0	0.0	81.3	837.4	747.8	280.6	0.0	0.0	259.3	0.0	4
20	1.85	107.6	0.0	0.0	113.0	0.0	0.0	81.4	839.3	747.8	351.6	0.0	0.0	259.8	0.0	4
21	1.95	110.3	0.0	0.0	114.0	0.0	0.0	81.5	838.5	747.5	319.1	0.0	0.0	252.1	0.0	4
22	2.04	118.2	0.0	0.0	114.0	0.0	0.0	81.5	836.1	747.5	250.2	0.0	0.0	252.6	0.0	4
23	2.13	117.0	0.0	0.0	115.0	0.0	0.0	81.6	836.5	747.2	259.2	0.0	0.0	245.4	0.0	4
24	2.23	115.7	0.0	0.0	117.0	0.0	0.0	81.6	836.9	746.6	269.6	0.0	0.0	231.7	0.0	4
25	2.32	116.8	0.0	0.0	117.0	0.0	0.0	81.7	836.6	746.6	261.5	0.0	0.0	232.1	0.0	4
26	2.41	117.5	0.0	0.0	118.0	0.0	0.0	81.8	836.3	746.3	256.7	0.0	0.0	225.9	0.0	4
27	2.51	118.9	0.0	0.0	118.0	0.0	0.0	81.8	835.9	746.3	247.3	0.0	0.0	226.3	0.0	4
28	2.60	119.0	0.0	0.0	117.0	0.0	0.0	81.9	835.9	746.6	247.0	0.0	0.0	233.2	0.0	4
29	2.70	117.5	0.0	0.0	120.0	0.0	0.0	82.0	836.3	745.7	258.0	0.0	0.0	214.9	0.0	4
30	2.79	107.1	0.0	0.0	120.4	0.0	0.0	82.0	839.5	745.6	366.9	0.0	0.0	213.0	0.0	4
31	2.88	111.7	0.0	0.0	121.0	0.0	0.0	82.1	838.1	745.4	310.1	0.0	0.0	209.9	0.0	4
32	2.98	123.1	0.0	0.0	121.0	0.0	0.0	82.1	834.7	745.4	223.4	0.0	0.0	210.3	0.0	4
33	3.07	121.1	0.0	0.0	121.0	0.0	0.0	82.2	835.3	745.4	235.3	0.0	0.0	210.6	0.0	4
34	3.16	119.4	0.0	0.0	124.0	0.0	0.0	82.3	835.8	744.5	246.6	0.0	0.0	195.5	0.0	4
35	3.26	119.3	0.0	0.0	123.0	0.0	0.0	82.3	835.8	744.8	247.7	0.0	0.0	200.6	0.0	4
36	3.35	120.9	0.0	0.0	123.0	0.0	0.0	82.4	835.3	744.8	237.6	0.0	0.0	200.9	0.0	4
37	3.45	121.8	0.0	0.0	124.0	0.0	0.0	82.4	835.1	744.5	232.4	0.0	0.0	196.3	0.0	4
38	3.54	122.7	0.0	0.0	124.0	0.0	0.0	82.5	834.8	744.5	227.5	0.0	0.0	196.5	0.0	4
39	3.63	119.9	0.0	0.0	125.0	0.0	0.0	82.6	835.6	744.2	245.1	0.0	0.0	192.1	0.0	4
40	3.73	109.0	0.0	0.0	125.0	0.0	0.0	82.6	838.9	744.2	348.3	0.0	0.0	192.4	0.0	4
41	7.57	118.3	0.0	0.0	127.8	0.0	0.0	85.1	836.1	743.4	274.9	0.0	0.0	190.0	0.0	4
42	7.66	117.0	0.0	0.0	128.0	0.0	0.0	85.2	836.5	743.3	286.7	0.0	0.0	189.3	0.0	4
43	7.76	120.3	0.0	0.0	127.5	0.0	0.0	85.2	835.5	743.5	259.9	0.0	0.0	191.9	0.0	4
44	7.85	118.8	0.0	0.0	127.0	0.0	0.0	85.3	836.0	743.6	272.1	0.0	0.0	194.5	0.0	4
45	7.95	117.7	0.0	0.0	127.2	0.0	0.0	85.4	836.3	744.8	282.0	0.0	0.0	194.0	0.0	4
46	8.04	118.3	0.0	0.0	128.1	0.0	0.0	85.4	836.1	744.4	277.3	0.0	0.0	190.1	0.0	4
47	8.13	120.3	0.0	0.0	130.4	0.0	0.0	85.5	835.5	744.0	261.6	0.0	0.0	180.4	0.0	4
48	8.23	122.0	0.0	0.0	132.0	0.0	0.0	85.5	835.0	745.7	249.7	0.0	0.0	175.0	0.0	4
49	8.32	123.0	0.0	0.0	132.2	0.0	0.0	85.6	834.7	745.4	243.3	0.0	0.0	174.4	0.0	4
50	8.41	120.1	0.0	0.0	130.8	0.0	0.0	85.7	835.6	745.1	264.5	0.0	0.0	180.1	0.0	4
51	8.51	108.0	115.3	124.2	131.4	133.2	128.0	85.7	839.2	744.8	410.6	309.2	237.7	177.9	171.1	192.
52	8.60	121.2	119.9	119.8	130.6	133.6	125.1	85.8	835.2	743.9	257.0	266.8	267.6	180.8	169.7	206.
53	8.70	121.4	124.9	110.8	132.0	133.2	127.5	85.8	835.2	744.2	256.0	233.0	364.7	175.9	171.4	194.
54	8.79	118.7	125.6	114.9	131.3	133.0	127.4	85.9	836.0	744.2	277.7	229.5	314.1	178.4	172.0	195.
55	8.88	117.4	118.3	108.5	131.6	132.1	135.4	86.0	836.4	743.6	289.9	281.8	404.4	177.4	175.5	164.
56	8.98	117.2	107.8	107.9	131.1	131.7	130.0	86.0	836.4	743.6	292.3	418.5	416.6	179.6	177.2	184.
57	9.07	118.3	114.4	109.6	130.4	131.7	128.7	86.1	836.1	743.6	282.7	321.7	387.3	182.7	177.5	190.
58	9.16	119.6	112.1	112.6	129.8	130.6	128.8	86.2	835.7	743.3	272.1	350.7	344.1	185.4	182.0	189.
59	9.26	117.7	109.8	115.9	128.5	131.3	129.2	86.2	836.3	743.9	289.2	386.1	306.7	191.5	179.6	188.
60	9.35	109.6	110.7	117.4	128.9	131.3	126.9	86.3	838.7	743.6	391.5	373.8	293.4	189.9	179.7	199.

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
NU(R)A=278.65 NU(S)A=191.23 NU(AV)A=234.94 ST(AV)A=0.00510 ST(AV)/ST(4S)=1.66 F/F(4S)= 2.39
(ST/ST(4S))/(F/F(4S))=0.691 (F/F(4S))/(ST/ST(4S))*3.0=0.53 (ST/ST(4S))/(F/F(4S))*((1/3))=1.24
NU(R)A/NU(4S)=1.97 NU(S)A/NU(4S)=1.35 e+(4R)= 295.68 R(4R)= 6.85 H(4R)=10.27

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 12.68

**ORIGINAL PAGE IS
OF POOR QUALITY**

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OF POOR QUALITY

RUNNER= 708E10-00/00 B/A=2.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 2.667 IN
 71 MUOT=0.0334 LBM/SEC RE= 10683. GGE(R)= 150.7 BTU/HR-SQ FT
 S1= 152.9 INLET TEMP= 79.1 F TATM= 72.2 F PATM= 14.6 PSIA

AG VALUES FROM X/D= 8.5 TO X/D= 9.4:
 S1= 44.50 NU(S)= 47.01 NU(AV)= 45.34

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	100.0	0.0	97.9	98.0	0.0	98.0	79.2	144.6	144.0	101.9	0.0	113.3	112.3	0.0	112.3
0.15	104.5	0.0	105.0	102.9	0.0	102.5	79.2	143.6	142.8	83.5	0.0	81.9	88.6	0.0	90.2
0.26	101.6	0.0	104.9	100.6	0.0	100.6	79.3	144.2	143.6	95.1	0.0	82.8	99.2	0.0	99.2
0.35	98.6	0.0	100.5	96.6	0.0	97.6	79.4	144.9	144.0	110.8	0.0	100.8	123.0	0.0	116.2
0.45	97.2	0.0	100.3	95.2	0.0	95.2	79.5	145.2	143.7	120.3	0.0	102.4	134.2	0.0	134.2
0.54	97.1	0.0	100.3	95.1	0.0	95.1	79.6	145.2	143.2	121.6	0.0	102.8	135.3	0.0	135.4
0.63	97.6	0.0	100.9	95.4	0.0	95.6	79.7	145.1	143.1	118.7	0.0	100.2	133.4	0.0	131.7
0.73	98.6	0.0	101.6	101.1	0.0	100.0	79.7	144.8	142.5	111.5	0.0	97.2	97.9	0.0	103.2
0.82	100.2	0.0	102.3	102.2	0.0	101.0	79.8	144.5	142.1	104.0	0.0	94.3	93.2	0.0	98.4
0.91	101.8	0.0	101.6	103.9	0.0	93.0	79.9	144.2	141.5	96.6	0.0	97.5	86.5	0.0	158.5
1.01	103.6	0.0	0.0	104.5	0.0	0.0	80.0	143.8	141.3	89.3	0.0	0.0	84.5	0.0	0.0
1.10	105.3	0.0	0.0	104.8	0.0	0.0	80.1	143.4	141.2	83.3	0.0	0.0	83.7	0.0	0.0
1.20	107.1	0.0	0.0	105.0	0.0	0.0	80.1	143.0	141.1	77.8	0.0	0.0	83.3	0.0	0.0
1.29	108.3	0.0	0.0	106.0	0.0	0.0	80.2	142.7	140.7	74.6	0.0	0.0	80.1	0.0	0.0
1.38	108.8	0.0	0.0	107.0	0.0	0.0	80.3	142.6	140.4	73.4	0.0	0.0	77.1	0.0	0.0
1.48	110.0	0.0	0.0	107.0	0.0	0.0	80.4	142.4	140.4	70.5	0.0	0.0	77.3	0.0	0.0
1.57	111.0	0.0	0.0	109.0	0.0	0.0	80.5	142.1	140.0	68.3	0.0	0.0	74.6	0.0	0.0
1.66	111.8	0.0	0.0	110.0	0.0	0.0	80.6	142.0	139.3	66.6	0.0	0.0	69.3	0.0	0.0
1.76	112.6	0.0	0.0	110.0	0.0	0.0	80.6	141.8	139.3	65.0	0.0	0.0	69.5	0.0	0.0
1.85	114.0	0.0	0.0	111.0	0.0	0.0	80.7	141.5	138.9	62.3	0.0	0.0	67.2	0.0	0.0
1.95	114.0	0.0	0.0	112.0	0.0	0.0	80.8	141.5	138.6	62.4	0.0	0.0	65.1	0.0	0.0
2.04	114.6	0.0	0.0	112.5	0.0	0.0	80.9	141.3	138.4	61.4	0.0	0.0	64.1	0.0	0.0
2.13	115.3	0.0	0.0	113.0	0.0	0.0	81.0	141.2	138.2	60.2	0.0	0.0	63.2	0.0	0.0
2.23	116.3	0.0	0.0	114.0	0.0	0.0	81.1	141.0	137.9	58.6	0.0	0.0	61.3	0.0	0.0
2.32	116.7	0.0	0.0	114.0	0.0	0.0	81.1	140.9	137.9	58.0	0.0	0.0	61.4	0.0	0.0
2.41	117.7	0.0	0.0	115.0	0.0	0.0	81.2	140.7	137.5	56.4	0.0	0.0	59.6	0.0	0.0
2.51	118.0	0.0	0.0	115.0	0.0	0.0	81.3	140.6	137.5	56.1	0.0	0.0	59.7	0.0	0.0
2.60	119.0	0.0	0.0	115.5	0.0	0.0	81.4	140.4	137.3	54.6	0.0	0.0	58.9	0.0	0.0
2.70	119.6	0.0	0.0	115.0	0.0	0.0	81.5	140.2	137.1	53.8	0.0	0.0	58.1	0.0	0.0
2.79	120.3	0.0	0.0	116.0	0.0	0.0	81.5	140.1	137.1	53.0	0.0	0.0	58.2	0.0	0.0
2.88	120.6	0.0	0.0	118.0	0.0	0.0	81.6	140.0	136.4	52.6	0.0	0.0	54.9	0.0	0.0
2.98	121.2	0.0	0.0	118.0	0.0	0.0	81.7	139.9	136.4	51.8	0.0	0.0	55.0	0.0	0.0
3.07	121.8	0.0	0.0	118.0	0.0	0.0	81.8	139.8	136.4	51.1	0.0	0.0	55.1	0.0	0.0
3.16	122.3	0.0	0.0	118.0	0.0	0.0	81.9	139.7	136.4	50.5	0.0	0.0	55.2	0.0	0.0
3.26	122.8	0.0	0.0	119.0	0.0	0.0	82.0	139.5	136.1	50.0	0.0	0.0	53.7	0.0	0.0
3.35	123.2	0.0	0.0	119.0	0.0	0.0	82.0	139.5	136.1	49.5	0.0	0.0	53.8	0.0	0.0
3.45	123.2	0.0	0.0	119.0	0.0	0.0	82.1	139.5	136.1	49.6	0.0	0.0	53.9	0.0	0.0
3.54	122.9	0.0	0.0	119.0	0.0	0.0	82.2	139.5	136.1	50.2	0.0	0.0	54.0	0.0	0.0
3.63	124.4	0.0	0.0	120.0	0.0	0.0	82.3	139.2	135.7	48.3	0.0	0.0	52.6	0.0	0.0
3.73	124.7	0.0	0.0	120.0	0.0	0.0	82.4	139.1	135.7	48.0	0.0	0.0	52.7	0.0	0.0
4.01	124.8	0.0	0.0	121.0	0.0	0.0	82.6	139.1	135.3	48.2	0.0	0.0	51.5	0.0	0.0
4.95	129.0	0.0	0.0	122.0	0.0	0.0	83.4	138.4	135.0	45.3	0.0	0.0	51.1	0.0	0.0
5.41	128.8	0.0	0.0	123.5	0.0	0.0	83.8	138.2	134.4	44.8	0.0	0.0	49.4	0.0	0.0
6.35	130.3	0.0	0.0	125.0	0.0	0.0	84.7	137.9	133.9	44.0	0.0	0.0	48.3	0.0	0.0
7.29	131.5	0.0	0.0	127.0	0.0	0.0	85.5	137.6	133.2	43.5	0.0	0.0	46.6	0.0	0.0
8.23	132.4	0.0	0.0	127.0	0.0	0.0	86.3	137.4	133.2	43.3	0.0	0.0	47.5	0.0	0.0
8.58	132.1	129.4	125.6	127.6	127.6	127.6	86.6	137.4	133.2	43.9	46.6	49.9	47.2	47.2	47.2
9.8.60	132.2	129.4	126.7	127.7	127.7	127.7	86.6	137.3	133.2	43.7	46.6	49.7	47.1	47.1	47.1
9.8.70	132.3	129.6	126.7	127.8	127.8	127.8	86.7	137.3	133.2	43.7	46.4	49.8	47.0	47.0	47.0
9.8.79	132.4	129.4	126.5	127.9	128.9	127.9	86.8	137.3	133.5	43.7	46.8	50.2	47.1	46.0	47.1
9.8.88	132.5	129.7	127.1	128.0	128.0	128.0	86.9	137.5	132.8	43.7	46.6	49.6	46.9	46.9	46.9
9.8.98	132.6	129.7	127.6	128.0	128.0	128.0	87.0	137.4	132.8	43.7	46.6	49.1	46.9	46.9	47.0
9.9.07	125.6	129.1	126.8	128.1	128.1	128.1	87.1	138.9	133.2	52.3	47.9	50.7	47.0	47.0	47.1
9.9.16	132.8	129.9	127.6	128.2	128.2	128.2	87.1	136.9	133.2	43.4	46.4	49.0	47.0	47.0	47.0
9.9.26	132.9	130.1	127.5	128.3	128.3	128.3	87.2	137.0	133.2	43.5	46.3	49.3	47.0	47.0	47.0
9.9.35	133.0	130.0	129.5	128.4	128.4	128.4	87.3	137.2	132.8	43.5	46.6	47.1	46.8	46.8	46.8
9.9.63	133.1	0.0	0.0	128.6	0.0	0.0	87.5	137.3	132.5	43.7	0.0	0.0	46.7	0.0	0.0
9.12.45	136.1	0.0	0.0	132.0	0.0	0.0	90.0	136.6	131.4	42.8	0.0	0.0	45.2	0.0	0.0
9.13.85	137.0	0.0	0.0	133.0	0.0	0.0	91.2	136.4	131.0	42.9	0.0	0.0	45.2	0.0	0.0
9.14.79	138.0	0.0	0.0	134.0	0.0	0.0	92.1	136.2	130.7	42.6	0.0	0.0	44.8	0.0	0.0

AVERAG VALUES FROM X/D= 8.5 TO X/D= 9.4 AND FROM X/D = 2.9 to 3.7:
 NU(R)= 47.33 NU(S)= 50.55 NU(AV)= 48.41

RUN NUMBER= 71H530-00/00 b/a=2.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 2.667 IN
 PR= 71 MDOT=0 1040 LBM/SEC RE= 33293. GGE(R)= 249.0 BTU/HR-SQ FT
 GGE(S)= 344.1 INLET TEMP= 80.8 F TATM= 72.4 F PATM= 14.6 PSIA

AVERAGE VALUES FROM X/D= 8.5 TO X/D= 9.4:
 NU(R)= 85.66 NU(S)= 100.47 NU(AV)= 90.60

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.07	98.7	0.0	92.2	103.7	0.0	98.8	80.8	243.2	334.6	199.5	0.0	313.6	214.4	0.0	27.0
2	0.16	101.0	0.0	93.0	106.1	0.0	98.0	80.9	242.7	333.8	176.8	0.0	293.6	193.9	0.0	26.0
3	0.26	97.1	0.0	94.2	102.0	0.0	100.0	80.9	243.6	334.2	220.8	0.0	269.1	232.4	0.0	25.0
4	0.35	95.0	0.0	94.6	101.0	0.0	100.0	81.0	243.8	334.1	238.0	0.0	262.5	244.6	0.0	25.0
5	0.45	95.4	0.0	95.7	100.4	0.0	100.7	81.0	244.0	334.2	248.9	0.0	243.8	252.9	0.0	24.0
6	0.54	95.7	0.0	96.7	101.5	0.0	101.7	81.1	243.9	333.8	244.6	0.0	228.9	239.6	0.0	23.0
7	0.63	96.3	0.0	98.0	102.6	0.0	103.0	81.2	243.8	333.2	235.6	0.0	211.9	227.5	0.0	22.0
8	0.73	97.4	0.0	98.7	103.5	0.0	101.0	81.2	243.5	332.9	220.2	0.0	203.8	218.6	0.0	24.0
9	0.82	98.6	0.0	99.6	104.7	0.0	103.0	81.3	243.2	332.5	205.3	0.0	194.1	207.6	0.0	22.0
10	0.91	100.0	0.0	99.8	105.5	0.0	94.0	81.3	242.9	332.2	190.3	0.0	192.3	201.0	0.0	38.0
11	1.01	101.6	0.0	0.0	106.0	0.0	0.0	81.4	242.6	332.0	175.5	0.0	0.0	197.3	0.0	0.0
12	1.10	103.2	0.0	0.0	107.0	0.0	0.0	81.4	242.2	331.7	162.7	0.0	0.0	189.7	0.0	0.0
13	1.20	104.8	0.0	0.0	108.0	0.0	0.0	81.5	241.9	331.3	153.1	0.0	0.0	182.7	0.0	0.0
14	1.29	105.4	0.0	0.0	109.0	0.0	0.0	81.5	241.8	330.9	148.1	0.0	0.0	176.2	0.0	0.0
15	1.38	105.9	0.0	0.0	110.0	0.0	0.0	81.6	241.6	330.6	145.3	0.0	0.0	170.2	0.0	0.0
16	1.48	106.6	0.0	0.0	111.0	0.0	0.0	81.6	241.5	330.2	141.5	0.0	0.0	164.5	0.0	0.0
17	1.57	107.4	0.0	0.0	112.0	0.0	0.0	81.7	241.3	329.9	137.2	0.0	0.0	159.1	0.0	0.0
18	1.66	108.1	0.0	0.0	113.0	0.0	0.0	81.7	241.2	329.5	133.8	0.0	0.0	154.1	0.0	0.0
19	1.76	108.7	0.0	0.0	114.0	0.0	0.0	81.8	241.0	329.1	131.0	0.0	0.0	149.4	0.0	0.0
20	1.85	109.7	0.0	0.0	115.0	0.0	0.0	81.8	240.8	328.8	126.4	0.0	0.0	145.0	0.0	0.0
21	1.95	109.6	0.0	0.0	115.0	0.0	0.0	81.9	240.8	328.8	127.1	0.0	0.0	145.2	0.0	0.0
22	2.04	110.0	0.0	0.0	116.0	0.0	0.0	81.9	240.7	328.4	125.5	0.0	0.0	141.0	0.0	0.0
23	2.13	110.6	0.0	0.0	117.0	0.0	0.0	82.0	240.6	328.1	123.0	0.0	0.0	137.0	0.0	0.0
24	2.23	111.3	0.0	0.0	118.0	0.0	0.0	82.0	240.5	327.7	120.2	0.0	0.0	133.3	0.0	0.0
25	2.32	112.0	0.0	0.0	118.0	0.0	0.0	82.1	240.3	327.7	117.5	0.0	0.0	133.4	0.0	0.0
26	2.41	112.5	0.0	0.0	119.0	0.0	0.0	82.2	240.2	327.3	115.7	0.0	0.0	129.9	0.0	0.0
27	2.51	113.0	0.0	0.0	119.0	0.0	0.0	82.2	240.1	327.3	113.9	0.0	0.0	130.0	0.0	0.0
28	2.60	113.5	0.0	0.0	119.5	0.0	0.0	82.3	240.0	327.2	112.3	0.0	0.0	128.4	0.0	0.0
29	2.70	114.0	0.0	0.0	120.0	0.0	0.0	82.3	239.9	327.0	110.6	0.0	0.0	126.8	0.0	0.0
30	2.79	114.7	0.0	0.0	120.0	0.0	0.0	82.4	239.7	327.0	108.3	0.0	0.0	126.9	0.0	0.0
31	2.88	115.0	0.0	0.0	122.0	0.0	0.0	82.4	239.6	326.3	107.5	0.0	0.0	120.4	0.0	0.0
32	2.98	115.4	0.0	0.0	122.0	0.0	0.0	82.5	239.6	326.3	106.3	0.0	0.0	120.6	0.0	0.0
33	3.07	116.0	0.0	0.0	122.0	0.0	0.0	82.5	239.4	326.3	104.5	0.0	0.0	120.7	0.0	0.0
34	3.16	116.2	0.0	0.0	123.0	0.0	0.0	82.6	239.4	325.9	104.0	0.0	0.0	117.8	0.0	0.0
35	3.26	116.7	0.0	0.0	124.0	0.0	0.0	82.6	239.3	325.5	102.6	0.0	0.0	114.9	0.0	0.0
36	3.35	116.9	0.0	0.0	124.0	0.0	0.0	82.7	239.2	325.5	102.1	0.0	0.0	115.1	0.0	0.0
37	3.45	117.0	0.0	0.0	123.0	0.0	0.0	82.7	239.2	325.9	101.9	0.0	0.0	118.2	0.0	0.0
38	3.54	117.3	0.0	0.0	124.0	0.0	0.0	82.8	239.1	325.5	101.2	0.0	0.0	115.3	0.0	0.0
39	3.63	118.1	0.0	0.0	124.0	0.0	0.0	82.8	239.0	325.5	98.9	0.0	0.0	115.5	0.0	0.0
40	3.73	118.3	0.0	0.0	125.0	0.0	0.0	82.9	238.9	325.2	98.5	0.0	0.0	112.7	0.0	0.0
41	4.01	118.8	0.0	0.0	125.5	0.0	0.0	83.0	238.8	325.0	97.5	0.0	0.0	111.7	0.0	0.0
42	4.95	120.8	0.0	0.0	127.0	0.0	0.0	83.6	238.4	324.5	93.4	0.0	0.0	109.0	0.0	0.0
43	5.41	122.0	0.0	0.0	128.0	0.0	0.0	83.8	238.1	324.1	90.9	0.0	0.0	107.0	0.0	0.0
44	6.35	123.0	0.0	0.0	130.0	0.0	0.0	84.4	237.9	323.4	89.7	0.0	0.0	103.2	0.0	0.0
45	7.29	124.9	0.0	0.0	131.0	0.0	0.0	84.9	237.5	323.0	86.4	0.0	0.0	101.9	0.0	0.0
46	8.23	125.8	0.0	0.0	132.0	0.0	0.0	85.4	237.3	322.7	85.4	0.0	0.0	100.7	0.0	0.0
47	8.58	126.2	123.7	123.3	132.1	132.1	131.1	85.6	237.2	322.3	85.0	90.5	91.5	100.8	100.8	103.0
48	8.60	126.3	124.2	123.8	132.2	132.2	130.8	85.6	237.1	322.3	84.7	89.3	90.3	100.6	100.6	103.7
49	8.70	126.4	123.9	123.3	132.3	132.3	131.3	85.7	237.1	322.3	84.6	90.2	91.6	100.5	100.5	102.7
50	8.79	126.5	124.0	122.5	132.3	132.3	131.3	85.7	237.1	323.4	84.5	90.0	93.7	100.9	100.9	103.1
51	8.88	126.7	123.9	124.1	132.4	132.4	131.4	85.8	237.1	321.6	84.2	90.4	89.9	100.2	100.2	102.4
52	8.98	126.7	124.7	125.6	132.5	132.5	131.5	85.8	237.2	322.3	84.3	88.7	86.7	100.3	100.3	102.5
53	9.07	121.8	123.3	122.6	132.6	132.6	131.6	85.9	238.1	323.0	96.3	92.5	94.2	100.5	100.5	102.7
54	9.16	126.8	124.1	123.4	132.7	132.7	131.7	85.9	236.1	323.0	84.0	89.9	91.6	100.4	100.4	102.5
55	9.26	126.9	125.0	124.3	132.8	132.8	131.8	86.0	237.5	323.0	84.3	88.5	90.1	100.2	100.2	102.4
56	9.35	126.9	123.5	124.8	132.8	132.8	131.8	86.0	238.0	323.0	84.6	92.3	89.2	100.3	100.3	102.5
57	9.63	127.4	0.0	0.0	133.0	0.0	0.0	86.2	236.9	322.3	83.5	0.0	0.0	100.0	0.0	0.0
58	12.45	129.7	0.0	0.0	135.0	0.0	0.0	87.8	236.4	321.6	81.7	0.0	0.0	98.6	0.0	0.0
59	13.85	130.9	0.0	0.0	136.0	0.0	0.0	88.6	236.1	321.2	80.7	0.0	0.0	98.0	0.0	0.0
60	14.79	132.0	0.0	0.0	137.0	0.0	0.0	89.1	235.9	320.9	79.5	0.0	0.0	96.8	0.0	0.0

AVERAGE VALUES FROM X/D= 8.5 TO X/D= 9.4 AND FROM X/D= 2.9 to 3.7:
 NU(R)= 94.20 NU(S)= 108.79 NU(AV)= 99.06

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 721860-00/00 b/a=2.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 2.667 IN
 1 MDOT=0 2010 LBM/SEC RE= 64358. GGE(R)= 481.1 BTU/HR-SQ FT
 2 = 571.5 INLET TEMP= 90.8 F TATM= 72.9 F PATM= 14.6 PSIA

3 VALUES FROM X/D= 8.5 TO X/D= 9.4:
 4 = 153.64 NU(S)= 161.41 NU(AV)= 156.23

XD	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	104.0	0.0	91.7	107.3	0.0	106.8	80.8	474.2	561.6	299.9	0.0	639.5	310.8	0.0	316.8
16	105.2	0.0	95.7	108.4	0.0	108.0	80.9	474.0	561.3	285.5	0.0	468.7	298.8	0.0	303.2
26	100.9	0.0	96.9	104.4	0.0	104.0	80.9	474.9	561.4	348.5	0.0	435.8	350.4	0.0	356.5
35	99.4	0.0	97.2	102.5	0.0	102.5	81.0	475.2	561.6	378.0	0.0	429.4	382.3	0.0	382.3
45	98.3	0.0	98.2	101.1	0.0	99.7	81.0	475.5	561.4	403.4	0.0	405.8	409.8	0.0	435.9
54	98.3	0.0	99.4	101.5	0.0	100.3	81.1	475.5	561.2	404.6	0.0	380.3	402.7	0.0	427.8
63	98.8	0.0	100.8	102.0	0.0	102.0	81.1	475.4	561.0	394.2	0.0	354.1	393.8	0.0	393.8
73	100.4	0.0	101.4	102.1	0.0	101.6	81.2	475.0	561.0	362.1	0.0	344.2	392.8	0.0	402.5
82	101.9	0.0	102.4	105.3	0.0	103.0	81.2	474.7	559.8	336.4	0.0	328.5	340.7	0.0	376.7
91	103.5	0.0	102.6	107.7	0.0	95.6	81.3	474.3	559.0	312.7	0.0	325.9	309.9	0.0	572.0
01	105.6	0.0	0.0	108.1	0.0	0.0	81.3	473.9	558.8	286.0	0.0	0.0	305.7	0.0	0.0
10	107.4	0.0	0.0	109.0	0.0	0.0	81.4	473.5	558.5	266.5	0.0	0.0	296.1	0.0	0.0
20	109.0	0.0	0.0	111.0	0.0	0.0	81.4	473.1	557.8	251.3	0.0	0.0	276.2	0.0	0.0
29	109.8	0.0	0.0	111.5	0.0	0.0	81.5	472.9	557.6	244.5	0.0	0.0	272.0	0.0	0.0
38	110.1	0.0	0.0	112.5	0.0	0.0	81.6	472.9	557.3	242.3	0.0	0.0	263.4	0.0	0.0
48	111.1	0.0	0.0	113.5	0.0	0.0	81.6	472.7	556.9	234.4	0.0	0.0	255.4	0.0	0.0
57	111.9	0.0	0.0	114.5	0.0	0.0	81.7	472.5	556.5	228.5	0.0	0.0	247.8	0.0	0.0
66	112.8	0.0	0.0	115.5	0.0	0.0	81.7	472.3	556.2	222.2	0.0	0.0	240.7	0.0	0.0
76	113.5	0.0	0.0	116.8	0.0	0.0	81.8	472.1	555.7	217.5	0.0	0.0	231.9	0.0	0.0
85	114.4	0.0	0.0	118.0	0.0	0.0	81.8	471.9	555.3	211.7	0.0	0.0	224.4	0.0	0.0
95	114.5	0.0	0.0	118.0	0.0	0.0	81.9	471.9	555.3	211.4	0.0	0.0	224.7	0.0	0.0
04	114.7	0.0	0.0	119.0	0.0	0.0	81.9	471.9	554.9	210.4	0.0	0.0	218.7	0.0	0.0
13	115.4	0.0	0.0	120.1	0.0	0.0	82.0	471.7	554.5	206.2	0.0	0.0	212.6	0.0	0.0
23	116.1	0.0	0.0	121.0	0.0	0.0	82.0	471.6	554.2	202.2	0.0	0.0	207.8	0.0	0.0
32	117.0	0.0	0.0	121.0	0.0	0.0	82.1	471.4	554.2	197.2	0.0	0.0	208.0	0.0	0.0
41	117.5	0.0	0.0	122.0	0.0	0.0	82.1	471.3	553.8	194.6	0.0	0.0	202.9	0.0	0.0
51	118.0	0.0	0.0	122.0	0.0	0.0	82.2	471.1	553.8	192.1	0.0	0.0	203.2	0.0	0.0
60	118.6	0.0	0.0	122.5	0.0	0.0	82.2	471.0	553.7	189.2	0.0	0.0	200.8	0.0	0.0
70	118.9	0.0	0.0	123.0	0.0	0.0	82.3	470.9	553.5	187.8	0.0	0.0	198.5	0.0	0.0
79	119.3	0.0	0.0	123.0	0.0	0.0	82.3	470.7	553.5	183.5	0.0	0.0	198.8	0.0	0.0
88	119.9	0.0	0.0	124.0	0.0	0.0	82.4	470.7	553.1	183.2	0.0	0.0	194.1	0.0	0.0
98	120.3	0.0	0.0	125.0	0.0	0.0	82.4	470.6	552.8	181.5	0.0	0.0	189.6	0.0	0.0
07	121.2	0.0	0.0	124.0	0.0	0.0	82.5	470.4	553.1	177.4	0.0	0.0	194.5	0.0	0.0
16	121.2	0.0	0.0	126.0	0.0	0.0	82.5	470.4	552.4	177.6	0.0	0.0	185.6	0.0	0.0
26	121.9	0.0	0.0	126.0	0.0	0.0	82.6	470.3	552.4	174.6	0.0	0.0	185.8	0.0	0.0
35	122.1	0.0	0.0	126.0	0.0	0.0	82.6	470.2	552.4	174.0	0.0	0.0	186.0	0.0	0.0
45	122.0	0.0	0.0	126.0	0.0	0.0	82.7	470.3	552.4	174.6	0.0	0.0	186.2	0.0	0.0
54	122.0	0.0	0.0	126.0	0.0	0.0	82.7	470.3	552.4	174.8	0.0	0.0	186.4	0.0	0.0
63	123.1	0.0	0.0	127.0	0.0	0.0	82.8	470.0	552.0	170.2	0.0	0.0	182.2	0.0	0.0
73	123.4	0.0	0.0	127.0	0.0	0.0	82.8	470.0	552.0	169.1	0.0	0.0	182.4	0.0	0.0
81	123.8	0.0	0.0	127.5	0.0	0.0	83.0	469.9	551.9	168.0	0.0	0.0	180.9	0.0	0.0
95	125.5	0.0	0.0	129.0	0.0	0.0	83.5	469.5	551.3	163.0	0.0	0.0	176.7	0.0	0.0
04	126.9	0.0	0.0	130.0	0.0	0.0	83.7	469.2	551.0	158.5	0.0	0.0	173.6	0.0	0.0
13	127.5	0.0	0.0	132.0	0.0	0.0	84.2	469.1	550.2	158.0	0.0	0.0	167.8	0.0	0.0
22	129.6	0.0	0.0	133.0	0.0	0.0	84.8	468.6	549.9	152.1	0.0	0.0	165.9	0.0	0.0
31	130.7	0.0	0.0	134.0	0.0	0.0	85.3	468.4	549.5	149.9	0.0	0.0	164.0	0.0	0.0
40	131.0	129.0	128.2	134.3	136.2	135.2	85.5	468.3	548.9	149.5	156.4	159.3	163.4	157.3	160.4
50	131.1	130.0	129.4	134.3	136.3	135.3	85.5	468.0	548.8	149.1	152.8	154.9	163.4	156.9	160.1
60	131.2	129.7	128.9	134.4	136.4	135.4	85.5	468.2	549.2	149.0	154.0	156.9	163.3	156.9	160.0
70	131.3	129.9	127.7	139.5	135.5	135.5	85.6	468.1	548.8	148.8	153.5	161.5	147.9	159.7	159.7
80	131.4	129.7	130.2	134.5	136.6	135.6	85.6	468.3	547.9	148.7	154.4	152.7	162.9	156.2	159.3
90	131.5	130.8	131.4	134.7	136.7	135.7	85.7	468.6	549.9	148.6	150.9	148.9	163.0	156.6	159.7
00	120.3	128.0	126.1	134.8	136.8	135.8	85.7	470.6	550.4	197.8	161.8	169.4	163.0	156.6	159.7
10	131.7	129.2	128.0	134.9	136.9	135.9	85.8	468.1	549.9	148.1	156.6	161.1	162.6	156.3	159.4
20	131.8	128.4	128.6	135.0	137.9	136.0	85.8	470.2	549.9	148.6	160.5	159.7	162.4	153.4	159.2
30	131.9	126.1	128.5	135.1	137.1	136.1	85.9	470.0	549.5	148.3	169.8	160.2	162.2	155.8	158.9
40	132.0	0.0	0.0	135.3	0.0	0.0	86.0	469.1	549.0	148.2	0.0	0.0	161.8	0.0	0.0
50	135.0	0.0	0.0	138.0	0.0	0.0	87.6	467.4	548.1	142.7	0.0	0.0	157.4	0.0	0.0
60	136.7	0.0	0.0	139.9	0.0	0.0	88.3	467.0	547.4	139.7	0.0	0.0	153.5	0.0	0.0
70	138.0	0.0	0.0	141.1	0.0	0.0	88.8	466.7	547.0	137.2	0.0	0.0	151.3	0.0	0.0

AVERAGE VALUES FROM X/D= 8.5 TO X/D= 9.4 AND FROM X/D = 2.9 to 3.7:
 GGE(R)= 164.67 NU(S)= 174.35 NU(AV)= 167.90

**ORIGINAL PAGE IS
OF POOR QUALITY**

RUN NUMBER= 22HR10-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.667 IN PR=.71 MDDT=0.0321 LBM/SEC
RE= 10111. GGE(R)= 343.8 BTU/HR-SQ FT GGE(S)= 186.5 INLET TEMP= 83.6 F TATM= 79.5 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	124.5	0.0	119.4	111.5	0.0	110.2	83.7	333.9	175.3	119.4	0.0	136.5	91.9	0.0
2	0.16	135.0	0.0	135.5	118.9	0.0	117.3	83.9	331.6	173.2	94.6	0.0	93.6	72.2	0.0
3	0.26	128.8	0.0	133.0	115.5	0.0	112.5	84.1	332.9	174.5	108.4	0.0	99.1	81.0	0.0
4	0.35	123.0	0.0	126.6	111.3	0.0	109.6	84.2	334.2	174.9	125.6	0.0	114.9	94.1	0.0
5	0.45	115.2	0.0	123.9	108.0	0.0	108.8	84.4	335.9	175.3	158.9	0.0	123.9	108.0	0.0
6	0.54	120.0	0.0	133.4	106.5	0.0	108.7	84.6	334.9	175.4	137.6	0.0	99.9	116.4	0.0
7	0.63	120.5	0.0	136.5	106.0	0.0	108.8	84.7	334.8	175.6	136.3	0.0	94.1	120.1	0.0
8	0.73	123.0	0.0	133.0	110.5	0.0	112.5	84.9	334.2	175.4	127.7	0.0	101.1	99.7	0.0
9	0.82	126.8	0.0	131.0	112.5	0.0	112.2	85.1	333.4	174.7	116.2	0.0	105.6	92.7	0.0
10	0.91	124.4	0.0	124.0	113.9	0.0	101.7	85.3	333.9	174.2	124.0	0.0	125.3	88.4	0.0
11	1.01	127.6	0.0	0.0	114.0	0.0	0.0	85.4	333.2	174.1	114.9	0.0	0.0	88.6	0.0
12	1.10	132.3	0.0	0.0	114.0	0.0	0.0	85.6	332.2	174.1	103.4	0.0	0.0	89.1	0.0
13	1.20	128.8	0.0	0.0	114.5	0.0	0.0	85.8	332.9	173.9	112.4	0.0	0.0	87.9	0.0
14	1.29	129.7	0.0	0.0	115.5	0.0	0.0	85.9	332.7	173.6	110.4	0.0	0.0	85.3	0.0
15	1.38	125.4	0.0	0.0	117.0	0.0	0.0	86.1	333.7	173.0	123.3	0.0	0.0	81.3	0.0
16	1.48	129.0	0.0	0.0	117.5	0.0	0.0	86.3	332.9	172.9	113.1	0.0	0.0	80.4	0.0
17	1.57	134.8	0.0	0.0	118.8	0.0	0.0	86.4	331.6	172.4	99.5	0.0	0.0	77.3	0.0
18	1.66	131.8	0.0	0.0	119.4	0.0	0.0	86.6	332.3	172.2	106.7	0.0	0.0	76.2	0.0
19	1.76	132.9	0.0	0.0	120.2	0.0	0.0	86.8	332.0	171.9	104.4	0.0	0.0	74.6	0.0
20	1.85	130.4	0.0	0.0	121.0	0.0	0.0	87.0	332.6	171.6	111.0	0.0	0.0	73.1	0.0
21	1.95	132.7	0.0	0.0	121.0	0.0	0.0	87.1	332.1	171.6	105.6	0.0	0.0	73.4	0.0
22	2.04	136.1	0.0	0.0	122.0	0.0	0.0	87.3	331.3	171.2	98.4	0.0	0.0	71.5	0.0
23	2.13	133.5	0.0	0.0	122.4	0.0	0.0	87.5	331.9	171.1	104.5	0.0	0.0	71.0	0.0
24	2.23	135.3	0.0	0.0	124.3	0.0	0.0	87.6	331.5	170.4	100.7	0.0	0.0	67.3	0.0
25	2.32	131.8	0.0	0.0	122.7	0.0	0.0	87.8	332.3	171.0	109.4	0.0	0.0	70.9	0.0
26	2.41	135.1	0.0	0.0	123.5	0.0	0.0	88.0	331.6	170.7	101.8	0.0	0.0	69.6	0.0
27	2.51	135.5	0.0	0.0	124.4	0.0	0.0	88.1	331.5	170.4	101.3	0.0	0.0	68.0	0.0
28	2.60	136.1	0.0	0.0	124.0	0.0	0.0	88.3	331.3	170.5	100.3	0.0	0.0	69.1	0.0
29	2.70	137.3	0.0	0.0	125.0	0.0	0.0	88.5	331.1	170.2	98.1	0.0	0.0	67.4	0.0
30	2.79	133.2	0.0	0.0	125.1	0.0	0.0	88.6	332.0	170.1	107.8	0.0	0.0	67.5	0.0
31	2.88	135.7	0.0	0.0	126.6	0.0	0.0	88.8	331.4	169.6	102.2	0.0	0.0	64.9	0.0
32	2.98	140.3	0.0	0.0	127.5	0.0	0.0	89.0	330.4	169.3	93.1	0.0	0.0	63.5	0.0
33	3.07	137.8	0.0	0.0	126.6	0.0	0.0	89.2	331.0	169.6	98.3	0.0	0.0	65.4	0.0
34	3.16	139.0	0.0	0.0	127.0	0.0	0.0	89.3	330.7	169.4	96.2	0.0	0.0	65.0	0.0
35	3.26	136.0	0.0	0.0	128.0	0.0	0.0	89.5	331.4	169.1	102.9	0.0	0.0	63.4	0.0
36	3.35	138.7	0.0	0.0	127.5	0.0	0.0	89.7	330.8	169.3	97.4	0.0	0.0	64.6	0.0
37	3.45	138.0	0.0	0.0	127.0	0.0	0.0	89.8	330.9	169.4	99.2	0.0	0.0	65.8	0.0
38	3.54	137.4	0.0	0.0	127.0	0.0	0.0	90.0	331.1	169.4	100.8	0.0	0.0	66.1	0.0
39	3.63	139.9	0.0	0.0	127.5	0.0	0.0	90.2	330.5	169.3	95.9	0.0	0.0	65.4	0.0
40	3.73	136.6	0.0	0.0	128.0	0.0	0.0	90.3	331.2	169.1	103.3	0.0	0.0	64.8	0.0
41	4.01	138.1	0.0	0.0	128.0	0.0	0.0	90.9	330.9	169.1	100.9	0.0	0.0	65.6	0.0
42	4.95	140.6	0.0	0.0	128.6	0.0	0.0	92.5	330.3	168.9	98.8	0.0	0.0	67.3	0.0
43	5.41	140.3	0.0	0.0	129.0	0.0	0.0	93.4	330.4	168.7	101.1	0.0	0.0	68.0	0.0
44	6.35	141.2	0.0	0.0	130.5	0.0	0.0	95.1	330.2	168.2	102.5	0.0	0.0	68.0	0.0
45	7.29	142.2	0.0	0.0	132.0	0.0	0.0	96.8	330.0	167.6	103.7	0.0	0.0	67.9	0.0
46	8.23	142.9	0.0	0.0	132.0	0.0	0.0	98.5	329.8	167.6	105.7	0.0	0.0	71.2	0.0
47	8.58	142.0	143.0	138.9	133.6	130.6	128.1	99.1	330.0	167.3	109.4	107.0	118.0	69.1	75.7
48	8.60	145.4	145.0	142.9	133.2	130.3	128.6	99.2	329.1	167.5	101.1	102.1	107.0	70.0	76.6
49	8.70	142.8	141.5	140.1	133.3	131.1	129.6	99.3	329.7	167.5	107.7	111.1	114.9	70.2	75.0
50	8.79	144.0	141.0	141.5	133.4	130.8	130.5	99.5	329.5	167.8	105.1	112.8	111.5	70.3	76.2
51	8.88	143.0	141.5	140.0	132.5	130.9	130.3	99.7	329.9	167.5	108.2	112.0	116.2	72.5	76.1
52	8.98	143.4	141.6	139.7	133.5	131.9	128.7	99.8	329.8	167.1	107.6	112.2	117.5	70.5	73.9
53	9.07	147.4	143.0	138.3	133.2	131.0	130.6	100.0	328.9	167.6	98.5	108.6	122.0	71.6	76.7
54	9.16	142.5	141.7	140.5	133.4	132.1	129.0	100.2	329.5	167.5	110.5	112.6	116.0	71.5	74.4

55	9.26	142.8	141.2	140.8	133.7	130.6	131.2	100.4	329.6	167.5	110.2	114.5	115.6	71.2	78.6
56	9.35	142.3	140.5	140.8	133.4	132.3	129.5	100.5	329.9	167.3	112.0	117.1	116.2	72.2	74.6
57	9.63	144.7	0.0	0.0	133.6	0.0	0.0	101.0	329.4	166.9	106.9	0.0	0.0	72.6	0.0
58	12.45	148.6	0.0	0.0	138.5	0.0	0.0	106.1	328.6	165.3	108.8	0.0	0.0	71.8	0.0
59	13.85	150.2	0.0	0.0	140.0	0.0	0.0	108.7	328.2	164.8	110.7	0.0	0.0	73.6	0.0
60	14.79	150.0	0.0	0.0	140.0	0.0	0.0	110.4	328.3	164.8	115.7	0.0	0.0	77.6	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=102.97 NU(S)A= 67.90 NU(AV)A= 91.28 ST(AV)A=0.01268 ST(AV)/ST(4S)=2.84 F/F(4S)= 5.03
 (ST/ST(4S))/(F/F(4S))=0.564 (F/F(4S))/(ST/ST(4S))*3.0=0.22 (ST/ST(4S))/(F/F(4S))*((1/3)=1.66
 NU(R)A/NU(4S)=3.22 NU(S)A/NU(4S)=2.12 e+(4R)= 79.03 R(4R)= 3.28 H(4R)= 7.27

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 9.00

AVERAGE VALUES WITH SL: H(4R)= 7.28

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 23HR30-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.667 IN PR=.71 MDOT=0.0596 LBM/SEC
LBB69. GGE(R)= 416.2 BTU/HR-SQ FT GGE(S)= 220.0 INLET TEMP= 84.2 F TATM= 80.4 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	118.6	0.0	111.4	109.4	0.0	104.9	84.3	407.8	210.6	173.1	0.0	219.1	121.9	0.0	148.8
16	125.9	0.0	118.5	112.1	0.0	104.9	84.4	406.2	209.6	142.5	0.0	173.5	110.0	0.0	149.1
26	119.5	0.0	117.2	107.1	0.0	106.0	84.5	407.6	210.8	169.6	0.0	181.5	135.6	0.0	142.8
35	117.1	0.0	117.3	106.3	0.0	103.0	84.6	408.1	210.8	182.9	0.0	181.8	141.9	0.0	167.0
45	111.4	0.0	116.9	107.1	0.0	104.0	84.7	409.4	210.4	223.5	0.0	185.2	136.8	0.0	159.3
54	116.1	0.0	128.9	107.3	0.0	106.0	84.8	408.4	210.4	190.1	0.0	134.9	136.2	0.0	144.5
63	116.1	0.0	131.8	106.9	0.0	108.0	85.0	408.4	210.4	190.8	0.0	126.8	139.6	0.0	132.7
73	118.4	0.0	129.1	107.7	0.0	108.2	85.1	407.8	210.2	178.0	0.0	134.8	135.1	0.0	132.2
82	121.8	0.0	127.8	109.6	0.0	108.4	85.2	407.1	209.5	161.7	0.0	138.9	124.8	0.0	131.2
91	119.6	0.0	121.8	110.0	0.0	105.0	85.3	407.6	209.3	172.8	0.0	162.4	123.2	0.0	154.5
1.01	122.0	0.0	0.0	110.0	0.0	0.0	85.4	407.1	209.3	161.7	0.0	0.0	123.8	0.0	0.0
1.10	124.0	0.0	0.0	110.5	0.0	0.0	85.5	406.6	209.2	153.6	0.0	0.0	121.7	0.0	0.0
1.20	122.3	0.0	0.0	111.6	0.0	0.0	85.6	407.0	208.8	161.3	0.0	0.0	116.8	0.0	0.0
1.29	124.3	0.0	0.0	112.6	0.0	0.0	85.7	406.5	208.4	153.2	0.0	0.0	112.8	0.0	0.0
1.38	121.4	0.0	0.0	113.0	0.0	0.0	85.9	407.2	208.3	166.5	0.0	0.0	111.5	0.0	0.0
1.48	124.5	0.0	0.0	114.0	0.0	0.0	86.0	406.5	207.9	153.3	0.0	0.0	107.7	0.0	0.0
1.57	127.6	0.0	0.0	115.0	0.0	0.0	86.1	405.8	207.5	142.0	0.0	0.0	104.2	0.0	0.0
1.66	125.9	0.0	0.0	115.6	0.0	0.0	86.2	406.2	207.3	148.6	0.0	0.0	102.4	0.0	0.0
1.76	127.7	0.0	0.0	116.3	0.0	0.0	86.3	405.8	207.1	142.3	0.0	0.0	100.2	0.0	0.0
1.85	125.2	0.0	0.0	117.5	0.0	0.0	86.4	406.4	206.6	152.1	0.0	0.0	96.5	0.0	0.0
1.95	127.0	0.0	0.0	117.3	0.0	0.0	86.5	406.0	206.7	145.6	0.0	0.0	97.5	0.0	0.0
2.04	128.5	0.0	0.0	118.0	0.0	0.0	86.6	405.6	206.5	140.6	0.0	0.0	95.5	0.0	0.0
2.13	127.3	0.0	0.0	119.0	0.0	0.0	86.8	405.9	206.1	145.2	0.0	0.0	92.7	0.0	0.0
2.23	129.5	0.0	0.0	119.6	0.0	0.0	86.9	405.4	205.9	137.9	0.0	0.0	91.2	0.0	0.0
2.32	127.0	0.0	0.0	120.0	0.0	0.0	87.0	406.0	205.7	147.1	0.0	0.0	90.4	0.0	0.0
2.41	130.0	0.0	0.0	121.0	0.0	0.0	87.1	405.3	205.4	137.0	0.0	0.0	87.8	0.0	0.0
2.51	130.0	0.0	0.0	120.6	0.0	0.0	87.2	405.3	205.5	137.3	0.0	0.0	89.2	0.0	0.0
2.60	129.5	0.0	0.0	121.0	0.0	0.0	87.3	405.4	205.4	139.3	0.0	0.0	88.4	0.0	0.0
2.70	131.2	0.0	0.0	121.5	0.0	0.0	87.4	405.0	205.2	134.1	0.0	0.0	87.3	0.0	0.0
2.79	127.7	0.0	0.0	122.2	0.0	0.0	87.6	405.8	204.9	146.4	0.0	0.0	85.7	0.0	0.0
2.88	130.6	0.0	0.0	122.4	0.0	0.0	87.7	405.2	204.9	136.7	0.0	0.0	85.4	0.0	0.0
2.98	132.5	0.0	0.0	123.5	0.0	0.0	87.8	404.7	204.5	131.1	0.0	0.0	82.9	0.0	0.0
3.07	131.4	0.0	0.0	123.0	0.0	0.0	87.9	405.0	204.7	134.8	0.0	0.0	84.4	0.0	0.0
3.16	133.0	0.0	0.0	124.0	0.0	0.0	88.0	404.6	204.3	130.2	0.0	0.0	82.2	0.0	0.0
3.26	130.5	0.0	0.0	124.0	0.0	0.0	88.1	405.2	204.3	138.4	0.0	0.0	82.4	0.0	0.0
3.35	133.5	0.0	0.0	124.4	0.0	0.0	88.2	404.5	204.1	129.3	0.0	0.0	81.7	0.0	0.0
3.45	132.0	0.0	0.0	123.2	0.0	0.0	88.3	404.9	204.6	134.2	0.0	0.0	84.9	0.0	0.0
3.54	131.6	0.0	0.0	124.4	0.0	0.0	88.5	404.9	204.1	135.8	0.0	0.0	82.2	0.0	0.0
3.63	134.0	0.0	0.0	124.4	0.0	0.0	88.6	404.4	204.1	128.7	0.0	0.0	82.4	0.0	0.0
3.73	131.0	0.0	0.0	124.5	0.0	0.0	88.7	405.1	204.1	138.4	0.0	0.0	82.4	0.0	0.0
4.01	131.1	0.0	0.0	124.5	0.0	0.0	89.0	405.1	204.1	139.1	0.0	0.0	83.1	0.0	0.0
4.95	133.0	0.0	0.0	124.6	0.0	0.0	90.1	404.6	204.1	136.2	0.0	0.0	85.4	0.0	0.0
5.41	133.4	0.0	0.0	126.0	0.0	0.0	90.7	404.5	203.6	136.6	0.0	0.0	83.1	0.0	0.0
6.35	134.3	0.0	0.0	128.0	0.0	0.0	91.8	404.3	202.9	137.0	0.0	0.0	80.7	0.0	0.0
7.29	135.6	0.0	0.0	128.4	0.0	0.0	93.0	404.1	202.7	136.1	0.0	0.0	82.1	0.0	0.0
8.23	136.0	0.0	0.0	128.5	0.0	0.0	94.1	404.0	202.7	138.2	0.0	0.0	84.4	0.0	0.0
8.58	137.1	138.3	133.5	128.5	126.5	123.5	94.5	403.8	202.5	135.9	132.1	148.4	85.4	90.7	100.1
8.60	138.1	137.7	136.4	128.9	126.5	124.7	94.5	403.5	202.3	132.6	133.9	138.0	84.2	90.5	96.1
8.70	136.6	135.3	134.6	129.4	127.6	125.2	94.6	403.8	202.2	137.9	142.3	144.8	83.3	87.9	94.9
8.79	138.4	136.4	136.3	129.5	125.6	125.3	94.8	403.4	202.8	132.4	138.7	139.1	83.6	94.0	95.1
8.88	136.9	136.6	134.5	128.5	127.3	124.8	94.9	403.8	202.1	137.5	138.5	145.9	86.0	89.3	96.7
8.98	137.0	136.2	133.5	129.7	127.2	123.3	95.0	403.8	202.1	137.6	140.2	150.1	83.3	89.9	102.2
9.07	137.3	133.7	129.2	129.9	128.3	124.9	95.1	403.7	202.5	136.9	149.7	169.4	83.3	87.2	97.2
9.16	134.8	133.4	132.0	130.3	129.0	125.5	95.2	403.7	202.4	146.0	151.3	157.0	82.6	85.8	95.7

5	9.26	139.4	136.4	135.7	130.5	127.2	125.5	95.3	403.5	202.3	131.0	140.5	143.0	82.2	90.8	96.1
6	9.35	139.4	136.0	135.0	131.0	128.7	124.5	95.4	403.8	202.1	131.4	142.4	146.0	81.2	86.9	99.6
7	9.63	137.0	0.0	0.0	130.0	0.0	0.0	95.8	403.8	202.1	140.0	0.0	0.0	84.4	0.0	0.0
B	12.45	140.5	0.0	0.0	132.5	0.0	0.0	99.2	403.0	201.2	138.6	0.0	0.0	85.8	0.0	0.0
9	13.85	142.0	0.0	0.0	136.0	0.0	0.0	100.8	402.7	200.0	138.7	0.0	0.0	80.7	0.0	0.0
0	14.79	142.5	0.0	0.0	137.0	0.0	0.0	102.0	402.5	199.6	140.6	0.0	0.0	80.7	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=134.83 NU(S)A= 83.30 NU(AV)A=117.65 ST(AV)A=0.00877 ST(AV)/ST(4S)=2.22 F/F(4S)= 5.92
 (ST/ST(4S))/(F/F(4S))=0.375 (F/F(4S))/(ST/ST(4S))*3.0=0.54 (ST/ST(4S))/(F/F(4S))*{(1/3)}=1.23
 NU(R)A/NU(4S)=2.56 NU(S)A/NU(4S)=1.58 e+(4R)= 148.46 R(4R)= 3.24 H(4R)=12.36

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 14.05

AVERAGE VALUES WITH SL: H(4R)= 12.48

RUN NUMBER= 24HR&O-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.667 IN PR= 71 MDOT=0.1925 LBM/SEC
 RE= 60898. GGE(R)= 922.7 BTU/HR-SQ FT GGE(S)= 417.7 INLET TEMP= 87.4 F TATM= 80.4 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	
1	0.07	124.4	0.0	110.7	112.2	0.0	112.3	87.5	913.0	408.7	358.1	0.0	569.2	239.0	0.0	
2	0.16	133.4	0.0	114.0	115.2	0.0	111.4	87.5	911.1	407.7	287.8	0.0	498.8	213.4	0.0	
3	0.26	126.4	0.0	120.1	110.2	0.0	107.8	87.6	912.6	408.2	340.8	0.0	407.0	261.6	0.0	
4	0.35	124.1	0.0	121.0	108.9	0.0	107.4	87.7	913.1	408.2	363.3	0.0	397.1	278.8	0.0	
5	0.45	117.3	0.0	119.6	105.6	0.0	100.6	87.8	914.6	408.7	448.6	0.0	416.1	332.0	0.0	
6	0.54	122.7	0.0	134.4	106.2	0.0	104.0	87.8	913.4	408.4	379.5	0.0	284.1	322.3	0.0	
7	0.63	120.8	0.0	135.7	108.1	0.0	104.6	87.9	913.8	407.8	402.5	0.0	277.0	292.7	0.0	
8	0.73	123.2	0.0	135.1	108.8	0.0	106.6	88.0	913.3	407.5	375.7	0.0	280.7	283.7	0.0	
9	0.82	126.8	0.0	134.4	107.7	0.0	107.1	88.1	912.5	407.9	341.2	0.0	285.2	301.0	0.0	
10	0.91	124.3	0.0	131.2	108.3	0.0	106.0	88.2	913.1	407.7	365.7	0.0	307.0	293.0	0.0	
11	1.01	127.4	0.0	0.0	108.0	0.0	0.0	88.2	912.4	407.8	337.2	0.0	0.0	298.7	0.0	
12	1.10	126.4	0.0	0.0	110.0	0.0	0.0	88.3	912.6	407.1	346.7	0.0	0.0	271.7	0.0	
13	1.20	125.9	0.0	0.0	111.6	0.0	0.0	88.4	912.7	406.5	352.1	0.0	0.0	253.5	0.0	
14	1.29	128.7	0.0	0.0	112.5	0.0	0.0	88.5	912.1	406.2	328.0	0.0	0.0	244.6	0.0	
15	1.38	125.9	0.0	0.0	112.8	0.0	0.0	88.6	912.7	406.1	353.5	0.0	0.0	242.2	0.0	
16	1.48	130.2	0.0	0.0	114.0	0.0	0.0	88.6	911.8	405.6	317.2	0.0	0.0	231.2	0.0	
17	1.57	130.6	0.0	0.0	115.0	0.0	0.0	88.7	911.7	405.3	314.7	0.0	0.0	222.9	0.0	
18	1.66	129.4	0.0	0.0	115.3	0.0	0.0	88.8	911.9	405.2	324.7	0.0	0.0	221.0	0.0	
19	1.76	132.1	0.0	0.0	116.0	0.0	0.0	88.9	911.3	404.9	304.7	0.0	0.0	215.7	0.0	
20	1.85	129.0	0.0	0.0	117.5	0.0	0.0	88.9	912.0	404.4	329.1	0.0	0.0	204.7	0.0	
21	1.95	131.1	0.0	0.0	118.0	0.0	0.0	89.0	911.6	404.2	313.1	0.0	0.0	201.6	0.0	
22	2.04	131.3	0.0	0.0	118.0	0.0	0.0	89.1	911.5	404.2	312.1	0.0	0.0	202.1	0.0	
23	2.13	130.9	0.0	0.0	118.0	0.0	0.0	89.2	911.6	404.2	315.7	0.0	0.0	202.6	0.0	
24	2.23	134.3	0.0	0.0	120.1	0.0	0.0	89.3	910.9	403.4	292.2	0.0	0.0	189.0	0.0	
25	2.32	131.8	0.0	0.0	118.1	0.0	0.0	89.3	911.4	404.2	310.0	0.0	0.0	203.0	0.0	
26	2.41	136.0	0.0	0.0	120.0	0.0	0.0	89.4	910.5	403.5	282.3	0.0	0.0	190.5	0.0	
27	2.51	134.0	0.0	0.0	120.2	0.0	0.0	89.5	910.9	403.4	295.6	0.0	0.0	189.7	0.0	
28	2.60	133.4	0.0	0.0	120.5	0.0	0.0	89.6	911.1	403.3	300.1	0.0	0.0	188.3	0.0	
29	2.70	136.1	0.0	0.0	120.7	0.0	0.0	89.6	910.5	403.2	283.0	0.0	0.0	187.5	0.0	
30	2.79	131.3	0.0	0.0	120.5	0.0	0.0	89.7	911.5	403.3	316.5	0.0	0.0	189.2	0.0	
31	2.88	136.4	0.0	0.0	121.8	0.0	0.0	89.8	910.4	402.8	282.0	0.0	0.0	181.7	0.0	
32	2.98	135.7	0.0	0.0	121.6	0.0	0.0	89.9	910.5	402.9	286.8	0.0	0.0	183.3	0.0	
33	3.07	135.5	0.0	0.0	121.9	0.0	0.0	90.0	910.6	402.8	288.6	0.0	0.0	182.0	0.0	
34	3.16	137.9	0.0	0.0	122.0	0.0	0.0	90.0	910.1	402.8	274.4	0.0	0.0	181.8	0.0	
35	3.26	133.9	0.0	0.0	123.0	0.0	0.0	90.1	910.9	402.4	300.2	0.0	0.0	176.5	0.0	
36	3.35	139.8	0.0	0.0	123.0	0.0	0.0	90.2	909.6	402.4	264.5	0.0	0.0	176.9	0.0	
37	3.45	137.0	0.0	0.0	123.0	0.0	0.0	90.3	910.3	402.4	281.0	0.0	0.0	177.3	0.0	
38	3.54	135.6	0.0	0.0	123.0	0.0	0.0	90.4	910.6	402.4	290.2	0.0	0.0	177.7	0.0	
39	3.63	138.9	0.0	0.0	122.6	0.0	0.0	90.4	909.8	402.5	270.7	0.0	0.0	180.4	0.0	
40	3.73	134.2	0.0	0.0	122.7	0.0	0.0	90.5	910.9	402.5	300.6	0.0	0.0	180.3	0.0	
41	4.01	134.3	0.0	0.0	123.0	0.0	0.0	90.7	910.9	402.4	301.4	0.0	0.0	179.8	0.0	
42	4.95	136.1	0.0	0.0	123.7	0.0	0.0	91.5	910.5	402.1	294.0	0.0	0.0	179.9	0.0	
43	5.41	136.6	0.0	0.0	125.5	0.0	0.0	91.9	910.3	401.5	293.1	0.0	0.0	172.0	0.0	
44	6.35	137.0	0.0	0.0	126.5	0.0	0.0	92.7	910.3	401.1	295.2	0.0	0.0	170.5	0.0	
45	7.29	138.1	0.0	0.0	127.5	0.0	0.0	93.5	910.0	400.8	292.6	0.0	0.0	169.0	0.0	
46	8.23	138.9	0.0	0.0	127.8	0.0	0.0	94.3	909.8	400.7	292.1	0.0	0.0	171.2	0.0	
47	8.58	142.6	145.6	137.0	127.3	126.2	121.2	94.6	909.0	400.4	271.1	255.1	306.8	175.3	181.3	214
48	8.60	140.2	139.7	139.0	128.4	126.9	123.8	94.6	909.3	399.9	285.7	288.6	293.2	169.4	177.3	194
49	8.70	139.3	135.9	137.1	128.4	126.4	123.8	94.6	909.7	400.2	291.6	315.8	306.9	169.7	180.4	194
50	8.79	141.5	140.3	138.9	129.3	127.4	125.4	94.7	909.2	401.3	278.2	285.7	294.7	166.2	175.8	187
51	8.88	138.6	139.1	135.4	128.2	125.6	125.9	94.8	910.0	399.2	297.6	294.2	321.0	171.1	185.5	183
52	8.98	138.5	140.2	134.2	128.6	128.6	124.6	94.9	910.3	401.0	298.8	287.6	331.5	170.2	170.2	193
53	9.07	133.1	130.8	124.8	129.1	130.6	126.6	95.0	911.1	401.3	342.0	363.9	437.1	168.2	161.2	181
54	9.16	136.7	131.9	127.3	128.8	130.5	128.5	95.0	910.3	401.0	312.8	353.5	403.9	170.0	161.9	171
55	9.26	150.0	137.6	135.0	129.4	131.5	125.9	95.1	909.4	400.8	237.2	306.4	326.3	167.3	157.5	186
56	9.35	148.6	138.8	130.0	128.5	129.0	123.5	95.2	909.6	400.8	243.6	298.5	374.0	172.0	169.7	202
57	9.63	143.5	0.0	0.0	129.0	0.0	0.0	95.4	909.8	400.2	271.0	0.0	0.0	170.5	0.0	0.
58	12.45	142.7	0.0	0.0	129.0	0.0	0.0	97.8	909.0	400.2	288.3	0.0	0.0	182.7	0.0	0.
59	13.85	144.0	0.0	0.0	134.0	0.0	0.0	98.9	908.7	398.4	286.9	0.0	0.0	161.7	0.0	0.
60	14.79	144.0	0.0	0.0	135.0	0.0	0.0	99.7	908.7	398.1	291.6	0.0	0.0	160.3	0.0	0.

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=284.87 NU(S)A=174.87 NU(AV)A=248.20 ST(AV)A=0.00573 ST(AV)/ST(4S)=1.84 F/F(4S)= 7.87
 (ST/ST(4S))/(F/F(4S))=0.233 (F/F(4S))/(ST/ST(4S))*3.0=1.27 (ST/ST(4S))/(F/F(4S))*3.0=0.92
 NU(R)A/NU(4S)=2.11 NU(S)A/NU(4S)=1.30 e+(4R)= 483.05 R(4R)= 3.20 H(4R)=21.38

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 23.06

AVERAGE VALUES WITH SL: H(4R)= 21.58

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER= 26HR30-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.667 IN PR=.71 MDOOT=0.1010 LBM/SEC
 21117. QGE(R)= 617.9 BTU/HR-SQ FT QGE(S)= 374.1 INLET TEMP= 81.6 F TATM= 73.6 F PATM= 14.6 PSIA

(/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	119.5	0.0	105.8	108.2	0.0	103.8	81.7	607.8	363.4	235.1	0.0	368.5	200.2	0.0	240.0
16	127.3	0.0	107.1	112.0	0.0	99.1	81.8	606.0	362.0	194.7	0.0	350.1	175.1	0.0	306.2
26	119.6	0.0	110.6	107.4	0.0	101.0	81.9	607.7	362.6	235.6	0.0	309.5	207.6	0.0	277.4
35	115.0	0.0	111.9	104.6	0.0	102.0	82.0	608.7	363.2	269.6	0.0	297.6	235.2	0.0	265.4
45	108.4	0.0	109.8	105.0	0.0	101.6	82.1	610.2	362.9	339.1	0.0	322.0	231.8	0.0	271.5
54	113.6	0.0	124.3	104.8	0.0	104.6	82.2	609.1	363.0	283.5	0.0	211.4	234.9	0.0	236.8
63	112.2	0.0	125.8	103.8	0.0	104.9	82.3	609.4	363.2	297.9	0.0	204.7	246.9	0.0	234.6
73	115.2	0.0	124.7	105.1	0.0	105.0	82.4	608.7	362.7	271.2	0.0	210.3	233.6	0.0	234.6
82	119.5	0.0	123.9	107.3	0.0	106.0	82.5	607.8	361.9	240.0	0.0	214.5	213.3	0.0	225.1
91	116.2	0.0	116.8	108.6	0.0	102.0	82.6	608.5	361.5	264.6	0.0	260.0	203.2	0.0	272.4
01	119.0	0.0	0.0	108.1	0.0	0.0	82.7	607.9	361.7	244.7	0.0	0.0	208.1	0.0	0.0
10	119.5	0.0	0.0	109.0	0.0	0.0	82.8	607.8	361.3	242.0	0.0	0.0	201.6	0.0	0.0
20	118.4	0.0	0.0	109.0	0.0	0.0	82.9	608.0	361.3	250.2	0.0	0.0	202.4	0.0	0.0
29	120.7	0.0	0.0	110.5	0.0	0.0	83.0	607.5	360.8	235.4	0.0	0.0	191.8	0.0	0.0
38	117.5	0.0	0.0	112.0	0.0	0.0	83.1	608.2	360.3	258.3	0.0	0.0	182.2	0.0	0.0
48	121.9	0.0	0.0	113.0	0.0	0.0	83.2	607.2	359.9	229.2	0.0	0.0	176.5	0.0	0.0
57	123.4	0.0	0.0	114.5	0.0	0.0	83.4	606.9	359.4	221.1	0.0	0.0	168.3	0.0	0.0
1.66	122.1	0.0	0.0	115.0	0.0	0.0	83.5	607.2	359.2	229.2	0.0	0.0	166.1	0.0	0.0
1.76	124.1	0.0	0.0	115.5	0.0	0.0	83.6	606.7	359.0	218.3	0.0	0.0	163.9	0.0	0.0
1.85	121.0	0.0	0.0	116.5	0.0	0.0	83.7	607.4	358.6	237.2	0.0	0.0	159.3	0.0	0.0
1.95	123.2	0.0	0.0	117.0	0.0	0.0	83.8	606.9	358.5	224.4	0.0	0.0	157.3	0.0	0.0
2.04	123.7	0.0	0.0	118.0	0.0	0.0	83.9	606.8	358.1	222.1	0.0	0.0	152.9	0.0	0.0
2.13	123.1	0.0	0.0	119.0	0.0	0.0	84.0	607.0	357.7	226.1	0.0	0.0	148.9	0.0	0.0
2.23	126.1	0.0	0.0	119.5	0.0	0.0	84.1	606.3	357.6	210.2	0.0	0.0	147.1	0.0	0.0
2.32	123.1	0.0	0.0	119.5	0.0	0.0	84.2	607.0	357.6	227.2	0.0	0.0	147.5	0.0	0.0
2.41	126.7	0.0	0.0	119.8	0.0	0.0	84.3	606.2	357.4	208.2	0.0	0.0	146.6	0.0	0.0
2.51	126.0	0.0	0.0	120.5	0.0	0.0	84.4	606.3	357.2	212.2	0.0	0.0	144.1	0.0	0.0
2.60	125.4	0.0	0.0	121.0	0.0	0.0	84.5	606.5	357.0	215.9	0.0	0.0	142.4	0.0	0.0
2.70	127.7	0.0	0.0	121.5	0.0	0.0	84.6	605.9	356.8	204.7	0.0	0.0	140.8	0.0	0.0
2.79	123.6	0.0	0.0	121.5	0.0	0.0	84.7	606.9	356.8	227.1	0.0	0.0	141.2	0.0	0.0
2.88	126.8	0.0	0.0	122.0	0.0	0.0	84.8	606.1	356.7	210.1	0.0	0.0	139.6	0.0	0.0
2.98	127.6	0.0	0.0	123.0	0.0	0.0	84.9	606.0	356.3	206.6	0.0	0.0	136.1	0.0	0.0
3.07	127.1	0.0	0.0	123.0	0.0	0.0	85.0	606.1	356.3	209.6	0.0	0.0	136.5	0.0	0.0
3.16	129.3	0.0	0.0	123.5	0.0	0.0	85.1	605.6	356.1	199.4	0.0	0.0	135.0	0.0	0.0
3.26	125.8	0.0	0.0	123.6	0.0	0.0	85.2	606.4	356.1	217.4	0.0	0.0	135.0	0.0	0.0
3.35	129.9	0.0	0.0	123.8	0.0	0.0	85.3	605.5	356.0	197.6	0.0	0.0	134.6	0.0	0.0
3.45	128.0	0.0	0.0	123.8	0.0	0.0	85.4	605.9	356.0	207.0	0.0	0.0	134.9	0.0	0.0
3.54	127.1	0.0	0.0	124.0	0.0	0.0	85.5	606.1	355.9	212.0	0.0	0.0	134.5	0.0	0.0
3.63	130.3	0.0	0.0	124.8	0.0	0.0	85.7	605.4	355.6	197.0	0.0	0.0	132.0	0.0	0.0
3.73	126.4	0.0	0.0	124.4	0.0	0.0	85.8	606.2	355.8	216.7	0.0	0.0	133.8	0.0	0.0
4.01	126.8	0.0	0.0	123.5	0.0	0.0	86.1	606.1	356.1	216.1	0.0	0.0	138.2	0.0	0.0
4.95	128.7	0.0	0.0	124.0	0.0	0.0	87.1	605.7	355.9	211.2	0.0	0.0	139.9	0.0	0.0
5.41	129.3	0.0	0.0	125.5	0.0	0.0	87.6	605.6	355.4	210.6	0.0	0.0	136.0	0.0	0.0
6.35	129.5	0.0	0.0	127.5	0.0	0.0	88.7	605.6	354.7	214.6	0.0	0.0	132.1	0.0	0.0
7.29	130.3	0.0	0.0	128.5	0.0	0.0	89.7	605.4	354.3	215.4	0.0	0.0	131.9	0.0	0.0
8.23	131.0	0.0	0.0	129.0	0.0	0.0	90.8	605.2	354.1	216.9	0.0	0.0	133.5	0.0	0.0
8.58	132.5	134.8	128.2	128.9	125.1	120.2	91.2	605.0	353.8	210.9	199.7	235.3	135.0	150.1	175.4
8.60	132.9	131.6	130.5	128.7	125.7	123.2	91.2	604.7	354.0	208.8	215.6	221.6	135.8	147.6	159.3
8.70	131.8	129.4	129.3	129.3	126.8	123.8	91.3	605.0	353.8	215.1	228.7	229.3	134.0	143.4	156.8
8.79	134.0	131.6	131.7	129.2	125.0	124.1	91.4	604.5	354.9	204.3	216.5	216.0	135.1	152.3	156.2
8.88	132.5	131.4	129.1	129.4	126.1	122.4	91.5	604.9	353.1	212.4	218.3	231.6	134.2	146.9	164.8
8.98	132.1	131.7	128.9	129.3	125.6	122.0	91.6	605.1	353.8	215.2	217.3	233.6	135.1	150.1	167.7
9.07	132.1	126.7	123.7	129.5	128.0	124.3	91.7	605.0	354.5	215.6	248.9	272.2	134.9	140.7	156.4
9.16	127.7	127.2	128.3	130.1	129.4	125.6	91.8	605.1	354.3	242.3	246.1	238.7	133.0	135.5	150.8

9.26	135.7	131.3	131.1	129.7	127.5	123.6	91.9	604.7	354.5	198.6	220.9	222.1	134.9	143.4	161.2
9.35	136.1	130.4	131.5	129.3	128.3	122.6	92.0	605.0	354.6	197.3	226.8	220.5	136.7	140.5	167.0
9.63	131.6	0.0	0.0	130.2	0.0	0.0	92.3	605.1	353.7	221.6	0.0	0.0	134.3	0.0	0.0
12.45	134.4	0.0	0.0	133.0	0.0	0.0	95.5	604.5	352.7	222.2	0.0	0.0	134.5	0.0	0.0
13.85	135.4	0.0	0.0	135.0	0.0	0.0	97.1	604.3	352.0	224.8	0.0	0.0	132.3	0.0	0.0
14.79	135.0	0.0	0.0	135.6	0.0	0.0	98.1	604.3	351.8	233.3	0.0	0.0	133.6	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=209.70 NU(S)A=135.04 NU(AV)A=184.81 ST(AV)A=0.00809 ST(AV)/ST(4S)=2.28 F/F(4S)= 6.76
 (ST/ST(4S))/(F/F(4S))=0.338 (F/F(4S))/(ST/ST(4S))**3.0=0.57 (ST/ST(4S))/(F/F(4S))**(1/3)=1.21
 NU(R)A/NU(4S)=2.60 NU(S)A/NU(4S)=1.67 e+(4R)= 253.67 R(4R)= 3.22 H(4R)=13.60

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 15.70

AVERAGE VALUES WITH SL: H(4R)= 13.64

ORIGINAL PAGE IS
OF POOR QUALITY

RUN NUMBER= 27HR60-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.667 IN PR= 71 MDDT=0.2020 LBM/SEC
RE= 64193. GGE(R)=1053.6 BTU/HR-SQ FT GGE(S)= 675.8 INLET TEMP= 83.0 F TATM= 74.5 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	119.7	0.0	101.3	111.4	0.0	112.8	83.1	1043.6	665.0	415.8	0.0	835.4	342.7	0.0
2	0.16	126.5	0.0	104.9	115.2	0.0	107.5	83.2	1042.1	663.7	350.9	0.0	699.5	302.4	0.0
3	0.26	119.9	0.0	112.3	110.4	0.0	104.0	83.3	1043.6	664.1	415.5	0.0	524.2	357.0	0.0
4	0.35	117.6	0.0	112.1	108.1	0.0	102.5	83.3	1044.1	664.4	444.6	0.0	529.7	391.6	0.0
5	0.45	111.7	0.0	109.8	107.3	0.0	98.4	83.4	1045.4	663.9	539.5	0.0	578.4	405.8	0.0
6	0.54	117.6	0.0	124.9	105.4	0.0	101.6	83.5	1044.1	664.6	446.9	0.0	368.1	443.2	0.0
7	0.63	114.2	0.0	124.2	104.8	0.0	102.5	83.6	1044.8	664.8	498.2	0.0	375.5	457.8	0.0
8	0.73	117.2	0.0	124.4	106.7	0.0	105.4	83.7	1044.2	664.2	454.6	0.0	374.2	421.3	0.0
9	0.82	121.8	0.0	125.2	109.5	0.0	106.8	83.8	1043.1	663.2	400.2	0.0	367.4	376.3	0.0
10	0.91	119.5	0.0	125.6	110.3	0.0	104.3	83.9	1043.7	662.9	427.3	0.0	364.8	366.0	0.0
11	1.01	123.3	0.0	0.0	110.3	0.0	0.0	84.0	1042.8	662.9	386.6	0.0	0.0	367.2	0.0
12	1.10	122.1	0.0	0.0	111.6	0.0	0.0	84.1	1043.1	662.4	399.8	0.0	0.0	350.8	0.0
13	1.20	120.9	0.0	0.0	113.4	0.0	0.0	84.2	1043.3	661.7	413.9	0.0	0.0	329.9	0.0
14	1.29	123.3	0.0	0.0	115.2	0.0	0.0	84.3	1042.8	661.1	389.2	0.0	0.0	311.3	0.0
15	1.38	120.6	0.0	0.0	116.0	0.0	0.0	84.4	1043.4	660.8	419.3	0.0	0.0	304.2	0.0
16	1.48	125.5	0.0	0.0	118.0	0.0	0.0	84.5	1042.3	660.1	369.8	0.0	0.0	286.5	0.0
17	1.57	125.1	0.0	0.0	118.5	0.0	0.0	84.5	1042.4	659.9	374.3	0.0	0.0	283.0	0.0
18	1.66	123.9	0.0	0.0	119.5	0.0	0.0	84.6	1042.7	659.6	386.6	0.0	0.0	275.4	0.0
19	1.76	126.6	0.0	0.0	120.5	0.0	0.0	84.7	1042.1	659.2	362.3	0.0	0.0	268.2	0.0
20	1.85	123.5	0.0	0.0	122.8	0.0	0.0	84.8	1042.8	658.4	392.4	0.0	0.0	252.3	0.0
21	1.95	125.9	0.0	0.0	122.0	0.0	0.0	84.9	1042.2	658.7	370.0	0.0	0.0	258.4	0.0
22	2.04	125.6	0.0	0.0	123.0	0.0	0.0	85.0	1042.3	658.3	373.6	0.0	0.0	252.1	0.0
23	2.13	124.9	0.0	0.0	124.4	0.0	0.0	85.1	1042.5	657.8	381.0	0.0	0.0	243.5	0.0
24	2.23	128.3	0.0	0.0	125.7	0.0	0.0	85.2	1041.7	657.3	351.5	0.0	0.0	236.0	0.0
25	2.32	126.0	0.0	0.0	123.0	0.0	0.0	85.3	1042.2	658.3	372.3	0.0	0.0	253.8	0.0
26	2.41	131.0	0.0	0.0	125.0	0.0	0.0	85.4	1041.1	657.6	331.8	0.0	0.0	241.3	0.0
27	2.51	130.0	0.0	0.0	125.6	0.0	0.0	85.5	1041.3	657.4	340.0	0.0	0.0	238.1	0.0
28	2.60	127.3	0.0	0.0	125.0	0.0	0.0	85.6	1041.9	657.6	362.9	0.0	0.0	242.4	0.0
29	2.70	130.0	0.0	0.0	125.1	0.0	0.0	85.7	1041.3	657.5	341.3	0.0	0.0	242.3	0.0
30	2.79	125.4	0.0	0.0	124.9	0.0	0.0	85.7	1042.4	657.6	382.0	0.0	0.0	244.1	0.0
31	2.88	131.0	0.0	0.0	126.6	0.0	0.0	85.8	1041.1	657.0	334.9	0.0	0.0	234.2	0.0
32	2.98	129.5	0.0	0.0	126.0	0.0	0.0	85.9	1041.5	656.5	347.3	0.0	0.0	226.7	0.0
33	3.07	129.3	0.0	0.0	126.5	0.0	0.0	86.0	1041.5	657.0	349.6	0.0	0.0	235.8	0.0
34	3.16	131.8	0.0	0.0	127.7	0.0	0.0	86.1	1040.9	656.6	330.9	0.0	0.0	229.3	0.0
35	3.26	127.8	0.0	0.0	128.5	0.0	0.0	86.2	1041.8	656.3	363.7	0.0	0.0	225.3	0.0
36	3.35	134.5	0.0	0.0	128.5	0.0	0.0	86.3	1040.4	656.3	313.4	0.0	0.0	225.8	0.0
37	3.45	130.0	0.0	0.0	127.4	0.0	0.0	86.4	1041.3	656.7	346.7	0.0	0.0	232.5	0.0
38	3.54	129.3	0.0	0.0	129.0	0.0	0.0	86.5	1041.5	656.1	353.1	0.0	0.0	224.0	0.0
39	3.63	132.9	0.0	0.0	129.0	0.0	0.0	86.6	1040.7	656.1	326.0	0.0	0.0	224.5	0.0
40	3.73	128.1	0.0	0.0	128.4	0.0	0.0	86.7	1041.8	656.3	364.9	0.0	0.0	228.2	0.0
41	4.01	128.0	0.0	0.0	128.0	0.0	0.0	87.0	1041.8	656.5	368.0	0.0	0.0	231.9	0.0
42	4.95	129.7	0.0	0.0	128.5	0.0	0.0	87.9	1041.4	656.3	360.5	0.0	0.0	233.9	0.0
43	5.41	130.2	0.0	0.0	130.0	0.0	0.0	88.3	1041.3	655.8	359.9	0.0	0.0	227.7	0.0
44	6.35	130.4	0.0	0.0	133.3	0.0	0.0	89.3	1041.3	654.6	365.7	0.0	0.0	214.7	0.0
45	7.29	131.7	0.0	0.0	134.6	0.0	0.0	90.2	1041.0	654.1	361.7	0.0	0.0	212.5	0.0
46	8.23	132.0	0.0	0.0	134.0	0.0	0.0	91.1	1040.9	654.3	366.7	0.0	0.0	219.8	0.0
47	8.58	135.8	140.1	131.6	133.3	131.0	122.8	91.5	1040.1	654.1	337.7	307.8	373.0	225.1	238.2
48	8.60	133.7	132.5	132.5	133.8	131.3	126.3	91.5	1040.3	653.8	354.7	365.1	365.1	222.4	236.4
49	8.70	132.7	126.8	130.4	136.0	131.2	126.2	91.6	1040.7	653.4	364.2	425.2	385.8	211.7	237.3
50	8.79	136.4	133.4	132.0	135.7	129.7	128.3	91.7	1039.8	653.0	334.5	358.6	371.0	214.1	247.8
51	8.88	135.0	133.2	130.8	132.6	131.1	127.5	91.8	1040.3	653.4	346.2	361.2	383.4	230.2	239.0
52	8.98	137.7	136.1	132.1	134.9	133.7	127.5	91.9	1040.1	654.6	326.4	338.2	371.8	218.8	225.1
53	9.07	134.2	127.4	123.7	137.1	135.8	130.1	91.9	1040.4	654.4	354.2	422.1	471.3	208.5	214.7
54	9.16	133.1	127.8	128.4	135.9	136.1	131.7	92.0	1040.7	654.3	364.5	418.5	411.6	214.6	213.6
55	9.26	145.4	132.9	132.8	137.5	134.3	129.4	92.1	1040.1	653.8	280.8	366.8	367.7	207.2	223.0
56	9.35	142.9	132.5	133.0	136.9	132.3	126.6	92.2	1040.5	653.7	293.3	371.4	366.8	210.4	234.5
57	9.63	137.4	0.0	0.0	136.5	0.0	0.0	92.5	1040.8	653.4	333.2	0.0	0.0	213.4	0.0
58	12.45	135.2	0.0	0.0	139.0	0.0	0.0	95.3	1040.2	652.5	372.7	0.0	0.0	213.5	0.0
59	13.85	136.5	0.0	0.0	141.8	0.0	0.0	96.7	1039.9	651.5	372.6	0.0	0.0	206.0	0.0
60	14.79	137.0	0.0	0.0	142.0	0.0	0.0	97.6	1039.8	651.5	376.0	0.0	0.0	209.1	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=339.44 NU(S)A=222.45 NU(AV)A=300.44 ST(AV)A=0.00658 ST(AV)/ST(4S)=2.13 F/F(4S)= 7.97
 (ST/ST(4S))/(F/F(4S))=0.268 (F/F(4S))/(ST/ST(4S))*3.0=0.82 (ST/ST(4S))/(F/F(4S))*3.0=1.07
 NU(R)A/NU(4S)=2.42 NU(S)A/NU(4S)=1.58 e+(4R)= 509.16 R(4R)= 3.20 H(4R)=17.66

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 20.10

AVERAGE VALUES WITH SL: H(4R)= 17.74

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER= 29HR10-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.667 IN PR= 71 MDDT=0.0365 LBM/SEC
11576. GGE(R)= 252.9 BTU/HR-SQ FT GGE(S)= 179.6 INLET TEMP= 82.6 F TATM= 78.0 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	109.7	0.0	105.6	101.4	0.0	103.7	82.7	246.0	171.6	133.0	0.0	156.8	134.0	0.0	119.4
0.16	116.5	0.0	112.4	107.2	0.0	108.4	82.8	244.5	170.1	105.9	0.0	120.6	101.8	0.0	97.1
0.26	111.6	0.0	109.7	105.8	0.0	105.8	82.9	245.6	170.6	125.0	0.0	133.9	108.8	0.0	108.8
0.35	108.8	0.0	109.4	101.9	0.0	102.6	83.0	246.2	170.8	139.5	0.0	136.3	132.4	0.0	127.7
0.45	107.9	0.0	112.0	99.6	0.0	101.1	83.2	246.4	170.8	145.3	0.0	124.6	151.7	0.0	139.2
0.54	108.3	0.0	113.1	99.2	0.0	101.3	83.3	246.3	170.4	143.6	0.0	120.5	156.4	0.0	138.2
0.63	109.6	0.0	114.1	100.2	0.0	100.3	83.4	246.0	170.1	136.9	0.0	116.8	147.8	0.0	146.5
0.73	112.3	0.0	115.1	104.9	0.0	105.5	83.5	245.4	169.9	124.3	0.0	113.3	115.8	0.0	112.7
0.82	115.2	0.0	115.9	105.7	0.0	106.0	83.6	244.8	169.6	113.0	0.0	110.6	112.0	0.0	110.5
0.91	112.8	0.0	112.0	107.1	0.0	98.0	83.7	245.3	169.1	123.0	0.0	126.5	105.5	0.0	172.9
1.01	114.6	0.0	0.0	107.0	0.0	0.0	83.9	244.9	169.2	116.1	0.0	0.0	106.5	0.0	0.0
1.10	117.8	0.0	0.0	107.5	0.0	0.0	84.0	244.2	169.0	105.2	0.0	0.0	104.7	0.0	0.0
1.20	114.6	0.0	0.0	109.0	0.0	0.0	84.1	244.9	168.4	116.9	0.0	0.0	98.5	0.0	0.0
1.29	114.9	0.0	0.0	110.6	0.0	0.0	84.2	244.8	167.9	116.2	0.0	0.0	92.6	0.0	0.0
1.38	115.9	0.0	0.0	111.7	0.0	0.0	84.3	244.6	167.5	112.8	0.0	0.0	89.1	0.0	0.0
1.48	118.1	0.0	0.0	113.0	0.0	0.0	84.4	244.1	167.0	105.6	0.0	0.0	85.1	0.0	0.0
1.57	120.3	0.0	0.0	113.5	0.0	0.0	84.6	243.6	166.8	99.2	0.0	0.0	83.9	0.0	0.0
1.66	122.2	0.0	0.0	114.0	0.0	0.0	84.7	243.2	166.6	94.3	0.0	0.0	82.7	0.0	0.0
1.76	123.8	0.0	0.0	115.0	0.0	0.0	84.8	242.9	166.3	90.6	0.0	0.0	80.1	0.0	0.0
1.85	119.8	0.0	0.0	116.0	0.0	0.0	84.9	243.7	165.9	101.6	0.0	0.0	77.6	0.0	0.0
1.95	119.2	0.0	0.0	116.0	0.0	0.0	85.0	243.9	165.9	103.8	0.0	0.0	77.9	0.0	0.0
2.04	121.2	0.0	0.0	118.0	0.0	0.0	85.1	243.4	165.2	98.2	0.0	0.0	73.1	0.0	0.0
2.13	118.1	0.0	0.0	119.0	0.0	0.0	85.3	244.1	164.8	108.1	0.0	0.0	71.0	0.0	0.0
2.23	118.4	0.0	0.0	120.0	0.0	0.0	85.4	244.1	164.5	107.4	0.0	0.0	69.1	0.0	0.0
2.32	119.9	0.0	0.0	119.7	0.0	0.0	85.5	243.7	164.6	103.0	0.0	0.0	69.9	0.0	0.0
2.41	122.0	0.0	0.0	120.6	0.0	0.0	85.6	243.3	164.3	97.1	0.0	0.0	68.2	0.0	0.0
2.51	124.0	0.0	0.0	121.0	0.0	0.0	85.7	242.8	164.1	92.2	0.0	0.0	67.6	0.0	0.0
2.60	126.2	0.0	0.0	121.0	0.0	0.0	85.8	242.3	164.1	87.2	0.0	0.0	67.8	0.0	0.0
2.70	128.3	0.0	0.0	121.0	0.0	0.0	86.0	241.9	164.1	83.0	0.0	0.0	68.0	0.0	0.0
2.79	122.6	0.0	0.0	121.6	0.0	0.0	86.1	243.1	163.9	96.7	0.0	0.0	67.0	0.0	0.0
2.88	122.6	0.0	0.0	122.6	0.0	0.0	86.2	243.1	163.5	97.0	0.0	0.0	65.2	0.0	0.0
2.98	125.3	0.0	0.0	122.6	0.0	0.0	86.3	242.5	163.5	90.3	0.0	0.0	65.4	0.0	0.0
3.07	121.7	0.0	0.0	123.0	0.0	0.0	86.4	243.3	163.4	100.1	0.0	0.0	64.8	0.0	0.0
3.16	121.6	0.0	0.0	124.4	0.0	0.0	86.5	243.4	162.9	100.7	0.0	0.0	62.4	0.0	0.0
3.26	123.0	0.0	0.0	123.8	0.0	0.0	86.7	243.0	163.1	97.0	0.0	0.0	63.7	0.0	0.0
3.35	124.7	0.0	0.0	124.1	0.0	0.0	86.8	242.7	163.0	92.8	0.0	0.0	63.3	0.0	0.0
3.45	125.0	0.0	0.0	124.6	0.0	0.0	86.9	242.6	162.8	92.3	0.0	0.0	62.6	0.0	0.0
3.54	127.3	0.0	0.0	124.0	0.0	0.0	87.0	242.1	163.0	87.1	0.0	0.0	63.9	0.0	0.0
3.63	130.7	0.0	0.0	124.2	0.0	0.0	87.1	241.4	163.0	80.3	0.0	0.0	63.7	0.0	0.0
3.73	125.8	0.0	0.0	124.2	0.0	0.0	87.2	242.4	163.0	91.1	0.0	0.0	63.9	0.0	0.0
4.01	122.3	0.0	0.0	124.5	0.0	0.0	87.6	243.2	162.9	101.5	0.0	0.0	63.9	0.0	0.0
4.95	124.8	0.0	0.0	125.0	0.0	0.0	88.8	242.6	162.7	97.3	0.0	0.0	64.9	0.0	0.0
5.41	130.8	0.0	0.0	127.5	0.0	0.0	89.3	241.3	161.8	84.1	0.0	0.0	61.2	0.0	0.0
6.35	131.4	0.0	0.0	128.5	0.0	0.0	90.5	241.2	161.4	85.0	0.0	0.0	61.3	0.0	0.0
7.29	131.9	0.0	0.0	129.3	0.0	0.0	91.7	241.1	161.1	86.3	0.0	0.0	61.6	0.0	0.0
8.23	130.0	0.0	0.0	129.5	0.0	0.0	92.8	241.5	161.1	93.4	0.0	0.0	63.1	0.0	0.0
8.58	128.8	130.2	126.2	130.4	125.8	123.4	93.3	241.7	160.9	97.8	94.0	105.4	62.2	71.0	76.6
8.60	130.6	131.2	129.3	130.6	126.8	125.9	93.3	241.2	160.9	92.7	91.4	96.2	62.0	69.1	70.8
8.70	126.8	126.9	125.3	130.8	127.9	126.8	93.4	242.0	160.9	104.0	103.8	109.0	61.8	67.1	69.1
8.79	126.8	125.6	124.3	131.7	128.6	128.3	93.5	242.1	161.0	104.6	108.4	112.9	60.6	66.0	66.4
8.88	128.5	126.7	126.5	131.8	129.1	128.7	93.7	241.9	160.2	99.6	105.0	105.7	60.3	64.9	65.5
8.98	130.2	127.7	127.1	131.0	129.8	126.2	93.8	241.5	160.5	95.1	102.1	104.0	61.9	63.9	70.9
9.07	130.9	128.9	128.3	131.2	128.2	127.4	93.9	241.3	160.9	93.5	99.1	100.6	61.9	67.3	68.8
9.16	132.7	132.4	131.1	131.3	128.3	126.1	94.0	240.4	160.9	89.0	89.8	92.9	61.9	67.3	72.0

55	9.26	134.3	132.5	131.5	131.4	130.1	126.8	94.1	240.2	160.9	85.8	89.7	92.1	61.9	64.2	70.6
56	9.35	132.0	130.3	132.0	130.4	126.9	126.2	94.2	241.0	160.9	91.6	95.8	91.5	63.7	70.6	72.2
57	9.63	128.7	0.0	0.0	131.1	0.0	0.0	94.6	241.8	160.3	101.6	0.0	0.0	63.0	0.0	0.0
58	12.45	131.6	0.0	0.0	133.0	0.0	0.0	98.1	241.2	159.8	102.5	0.0	0.0	65.2	0.0	0.0
59	13.85	137.3	0.0	0.0	136.5	0.0	0.0	99.9	239.9	158.5	91.0	0.0	0.0	61.4	0.0	0.0
60	14.79	137.5	0.0	0.0	136.6	0.0	0.0	101.0	239.9	158.5	93.2	0.0	0.0	63.1	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 94.12 NU(S)A= 62.86 NU(AV)A= 83.70 ST(AV)A=0.01016 ST(AV)/ST(4S)=2.34 F/F(4S)= 4.17
 (ST/ST(4S))/(F/F(4S))=0.560 (F/F(4S))/(ST/ST(4S))*3.0=0.33 (ST/ST(4S))/(F/F(4S))*3.0=1.45
 NU(R)A/NU(4S)=2.64 NU(S)A/NU(4S)=1.76 e+(4R)= 80.43 R(4R)= 4.03 H(4R)= 8.67

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 10.30

AVERAGE VALUES WITH SL: H(4R)= 8.72

RUN NUMBER= 30HR30-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.667 IN PR=.71 MDOT=0.1005 LBM/SEC
 RE= 31853. GGE(R)= 454.6 BTU/HR-SQ FT GGE(S)= 358.0 INLET TEMP= 85.7 F TATM= 79.0 F PATM= 14.6 PSIA

ND	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	
1	0.07	112.2	0.0	104.2	108.0	0.0	103.9	85.8	447.3	349.3	245.8	0.0	352.5	228.4	0.0	
2	0.16	118.7	0.0	104.9	108.5	0.0	104.1	85.8	445.8	349.1	197.1	0.0	339.9	224.0	0.0	
3	0.26	113.9	0.0	106.9	105.7	0.0	106.0	85.9	446.9	349.1	232.1	0.0	309.5	256.3	0.0	
4	0.35	112.3	0.0	109.0	104.6	0.0	107.0	86.0	447.2	349.1	247.1	0.0	282.5	273.2	0.0	
5	0.45	110.9	0.0	111.0	105.6	0.0	108.8	86.1	447.5	348.6	262.0	0.0	260.9	259.7	0.0	
6	0.54	110.7	0.0	112.1	106.0	0.0	109.3	86.2	447.6	348.4	265.0	0.0	250.7	255.4	0.0	
7	0.63	111.5	0.0	113.9	105.7	0.0	108.9	86.3	447.4	348.4	257.3	0.0	235.0	260.1	0.0	
8	0.73	113.5	0.0	115.6	107.4	0.0	107.0	86.3	447.0	347.8	238.9	0.0	221.7	239.7	0.0	
9	0.82	116.4	0.0	117.5	110.0	0.0	107.4	86.4	446.3	346.8	216.1	0.0	208.5	213.5	0.0	
10	0.91	113.5	0.0	114.4	111.3	0.0	104.0	86.5	447.0	346.4	240.3	0.0	232.5	202.7	0.0	
11	1.01	114.2	0.0	0.0	110.2	0.0	0.0	86.6	446.8	346.8	234.8	0.0	0.0	213.1	0.0	
12	1.10	114.2	0.0	0.0	112.6	0.0	0.0	86.7	446.8	345.9	235.5	0.0	0.0	193.5	0.0	
13	1.20	113.3	0.0	0.0	113.8	0.0	0.0	86.8	447.0	345.5	244.3	0.0	0.0	185.3	0.0	
14	1.29	114.7	0.0	0.0	114.0	0.0	0.0	86.8	446.7	345.4	232.5	0.0	0.0	184.4	0.0	
15	1.38	116.6	0.0	0.0	116.0	0.0	0.0	86.9	446.3	344.7	218.1	0.0	0.0	171.9	0.0	
16	1.48	119.0	0.0	0.0	116.5	0.0	0.0	87.0	445.8	344.5	202.0	0.0	0.0	169.3	0.0	
17	1.57	121.4	0.0	0.0	117.9	0.0	0.0	87.1	445.2	344.0	188.1	0.0	0.0	161.8	0.0	
18	1.66	123.7	0.0	0.0	118.4	0.0	0.0	87.2	444.7	343.8	176.5	0.0	0.0	159.6	0.0	
19	1.76	125.9	0.0	0.0	119.4	0.0	0.0	87.2	444.2	343.5	166.6	0.0	0.0	154.8	0.0	
20	1.85	119.1	0.0	0.0	120.4	0.0	0.0	87.3	445.7	343.1	203.3	0.0	0.0	150.4	0.0	
21	1.95	117.5	0.0	0.0	121.1	0.0	0.0	87.4	446.1	342.8	214.9	0.0	0.0	147.5	0.0	
22	2.04	118.1	0.0	0.0	122.0	0.0	0.0	87.5	446.0	342.5	211.1	0.0	0.0	143.8	0.0	
23	2.13	117.1	0.0	0.0	123.0	0.0	0.0	87.6	446.2	342.2	219.0	0.0	0.0	139.9	0.0	
24	2.23	118.1	0.0	0.0	124.7	0.0	0.0	87.7	446.0	341.5	212.2	0.0	0.0	133.6	0.0	
25	2.32	120.3	0.0	0.0	123.9	0.0	0.0	87.7	445.5	341.8	198.2	0.0	0.0	136.9	0.0	
26	2.41	122.4	0.0	0.0	124.6	0.0	0.0	87.8	445.0	341.6	186.4	0.0	0.0	134.5	0.0	
27	2.51	125.0	0.0	0.0	124.5	0.0	0.0	87.9	444.4	341.6	173.5	0.0	0.0	135.2	0.0	
28	2.60	127.2	0.0	0.0	124.5	0.0	0.0	88.0	444.0	341.6	163.9	0.0	0.0	135.5	0.0	
29	2.70	129.7	0.0	0.0	124.6	0.0	0.0	88.1	443.4	341.6	154.2	0.0	0.0	135.4	0.0	
30	2.79	121.4	0.0	0.0	124.6	0.0	0.0	88.2	445.2	341.6	193.8	0.0	0.0	135.7	0.0	
31	2.88	121.2	0.0	0.0	126.0	0.0	0.0	88.2	445.3	341.1	195.5	0.0	0.0	130.7	0.0	
32	2.98	121.3	0.0	0.0	127.0	0.0	0.0	88.3	445.3	340.7	195.4	0.0	0.0	127.5	0.0	
33	3.07	120.3	0.0	0.0	127.3	0.0	0.0	88.4	445.5	340.6	202.1	0.0	0.0	126.7	0.0	
34	3.16	120.8	0.0	0.0	127.7	0.0	0.0	88.5	445.4	340.5	199.4	0.0	0.0	125.6	0.0	
35	3.26	123.2	0.0	0.0	128.8	0.0	0.0	88.6	444.8	340.1	185.8	0.0	0.0	122.3	0.0	
36	3.35	125.2	0.0	0.0	128.8	0.0	0.0	88.7	444.4	340.1	175.8	0.0	0.0	122.5	0.0	
37	3.45	126.0	0.0	0.0	128.1	0.0	0.0	88.7	444.2	340.3	172.4	0.0	0.0	125.0	0.0	
38	3.54	128.5	0.0	0.0	128.4	0.0	0.0	88.8	443.7	340.2	161.6	0.0	0.0	124.3	0.0	
39	3.63	131.9	0.0	0.0	128.5	0.0	0.0	88.9	442.9	340.2	148.9	0.0	0.0	124.2	0.0	
40	3.73	123.9	0.0	0.0	127.6	0.0	0.0	89.0	444.7	340.5	184.1	0.0	0.0	127.4	0.0	
41	4.01	120.1	0.0	0.0	128.0	0.0	0.0	89.2	445.5	340.4	208.5	0.0	0.0	126.8	0.0	
42	4.95	121.9	0.0	0.0	128.8	0.0	0.0	90.1	445.1	340.1	201.7	0.0	0.0	126.6	0.0	
43	5.41	130.8	0.0	0.0	130.0	0.0	0.0	90.5	443.2	339.6	158.4	0.0	0.0	123.9	0.0	
44	6.35	131.6	0.0	0.0	132.7	0.0	0.0	91.3	443.0	338.7	158.3	0.0	0.0	117.8	0.0	
45	7.29	132.1	0.0	0.0	133.0	0.0	0.0	92.1	442.9	338.6	159.3	0.0	0.0	119.1	0.0	
46	8.23	128.0	0.0	0.0	133.5	0.0	0.0	92.9	443.8	338.4	181.8	0.0	0.0	119.8	0.0	
47	8.58	127.1	128.7	123.5	133.5	128.1	122.4	93.3	444.0	338.1	188.4	179.9	210.8	120.5	139.1	166.0
48	8.60	126.4	126.4	125.0	133.7	129.0	125.5	93.3	444.1	338.0	192.4	192.4	200.9	119.9	135.7	150.0
49	8.70	125.1	124.3	123.3	134.1	131.7	127.9	93.4	444.4	337.9	200.9	206.1	213.0	118.9	126.4	140.0
50	8.79	126.1	125.1	123.2	134.5	131.8	128.9	93.4	444.2	338.8	195.1	201.3	214.2	118.4	126.6	137.0
51	8.88	128.0	126.7	125.8	133.5	131.8	127.3	93.5	443.8	337.5	184.7	191.9	197.3	121.1	126.4	143.0
52	8.98	130.9	128.2	127.2	133.1	131.2	126.5	93.6	443.3	338.3	170.6	183.8	189.3	122.8	129.2	147.0
53	9.07	131.8	129.9	128.8	134.2	131.4	127.0	93.7	442.9	338.7	166.7	175.5	181.0	119.8	128.9	145.0
54	9.16	131.1	133.8	131.7	134.6	131.6	126.6	93.8	442.2	338.6	170.0	158.5	167.2	118.9	128.3	147.0
55	9.26	139.2	134.1	132.6	134.7	132.6	126.7	93.9	441.8	338.6	139.7	157.4	163.5	118.8	125.3	148.0
56	9.35	135.4	129.4	133.0	135.5	131.7	125.0	93.9	443.1	338.3	153.2	179.1	162.6	116.6	128.4	156.3
57	9.63	125.8	0.0	0.0	135.0	0.0	0.0	94.2	444.3	337.8	201.4	0.0	0.0	118.6	0.0	0.0
58	12.45	128.1	0.0	0.0	133.0	0.0	0.0	96.7	443.8	338.6	201.5	0.0	0.0	133.0	0.0	0.0
59	13.85	136.5	0.0	0.0	140.0	0.0	0.0	97.9	441.9	336.0	163.1	0.0	0.0	113.7	0.0	0.0
60	14.79	137.0	0.0	0.0	141.0	0.0	0.0	98.7	441.8	335.7	164.2	0.0	0.0	113.0	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=179.14 NU(S)A=122.60 NU(A)A=160.29 ST(AV)A=0.00708 ST(AV)/ST(4S)=1.99 F/F(4S)= 5.40
 (ST/ST(4S))/(F/F(4S))=0.369 (F/F(4S))/(ST/ST(4S))*3.0=0.68 (ST/ST(4S))/(F/F(4S))*3.0=1.14
 NU(R)A/NU(4S)=2.23 NU(S)A/NU(4S)=1.53 e+(4R)= 223.66 R(4R)= 3.97 H(4R)=14.28

BY USING ROUGHSDIE RESULTS ONLY : H(RB)= 16.28

AVERAGE VALUES WITH SL: H(4R)= 14.38

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 31HR60-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.667 IN PR=.71 MDOT=0.1994 LBM/SEC
63228. GGE(R)= 735.8 BTU/HR-SQ FT GGE(S)= 511.7 INLET TEMP= 86.6 F TATM= 78.8 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	114.7	0.0	150.0	109.0	0.0	109.1	86.6	727.9	503.3	376.5	0.0	166.7	327.0	0.0	325.0
0.16	119.6	0.0	103.1	109.0	0.0	108.4	86.7	726.8	503.4	320.7	0.0	643.6	328.0	0.0	336.9
0.26	115.0	0.0	106.6	105.3	0.0	106.4	86.8	727.8	503.3	374.2	0.0	532.8	393.4	0.0	371.6
0.35	113.5	0.0	107.7	104.2	0.0	105.0	86.8	728.2	503.3	396.3	0.0	506.5	421.5	0.0	403.1
0.45	111.5	0.0	110.3	104.0	0.0	102.5	86.9	728.6	502.6	429.8	0.0	451.9	426.7	0.0	467.7
0.54	111.5	0.0	111.1	103.4	0.0	103.5	87.0	728.6	502.8	430.9	0.0	438.1	444.1	0.0	441.5
0.63	112.4	0.0	113.2	103.2	0.0	102.6	87.0	728.4	502.9	416.6	0.0	403.9	451.5	0.0	468.9
0.73	114.5	0.0	115.6	105.1	0.0	104.4	87.1	727.9	502.2	385.4	0.0	370.5	404.9	0.0	421.3
0.82	117.5	0.0	118.2	107.7	0.0	104.5	87.2	727.3	501.3	347.8	0.0	339.9	354.2	0.0	419.6
0.91	114.8	0.0	114.9	108.9	0.0	103.4	87.2	727.9	500.9	382.9	0.0	381.6	335.3	0.0	449.5
1.01	116.7	0.0	0.0	108.0	0.0	0.0	87.3	727.5	501.2	358.8	0.0	0.0	351.2	0.0	0.0
1.10	115.8	0.0	0.0	110.3	0.0	0.0	87.4	727.7	500.4	371.1	0.0	0.0	316.4	0.0	0.0
1.20	114.4	0.0	0.0	112.0	0.0	0.0	87.4	728.0	499.7	391.4	0.0	0.0	294.9	0.0	0.0
1.29	115.5	0.0	0.0	113.0	0.0	0.0	87.5	727.7	499.4	376.8	0.0	0.0	283.9	0.0	0.0
1.38	117.3	0.0	0.0	114.3	0.0	0.0	87.6	727.3	498.9	354.6	0.0	0.0	270.5	0.0	0.0
1.48	119.7	0.0	0.0	115.6	0.0	0.0	87.6	726.8	498.4	328.5	0.0	0.0	258.3	0.0	0.0
1.57	122.3	0.0	0.0	116.6	0.0	0.0	87.7	726.2	498.1	304.1	0.0	0.0	249.7	0.0	0.0
1.66	124.6	0.0	0.0	116.6	0.0	0.0	87.8	725.7	498.1	285.5	0.0	0.0	250.3	0.0	0.0
1.76	126.9	0.0	0.0	117.3	0.0	0.0	87.8	725.2	497.8	268.9	0.0	0.0	244.8	0.0	0.0
1.85	120.0	0.0	0.0	118.3	0.0	0.0	87.9	726.7	497.5	327.9	0.0	0.0	237.0	0.0	0.0
1.95	118.3	0.0	0.0	119.0	0.0	0.0	88.0	727.1	497.2	347.2	0.0	0.0	232.1	0.0	0.0
2.04	118.2	0.0	0.0	120.0	0.0	0.0	88.0	727.1	496.9	349.1	0.0	0.0	225.1	0.0	0.0
2.13	116.9	0.0	0.0	120.8	0.0	0.0	88.1	727.4	496.6	365.8	0.0	0.0	219.9	0.0	0.0
2.23	117.9	0.0	0.0	121.4	0.0	0.0	88.2	727.2	496.4	354.1	0.0	0.0	216.2	0.0	0.0
2.32	120.7	0.0	0.0	121.0	0.0	0.0	88.2	726.6	496.5	324.0	0.0	0.0	219.4	0.0	0.0
2.41	122.8	0.0	0.0	121.4	0.0	0.0	88.3	726.1	496.4	304.7	0.0	0.0	217.1	0.0	0.0
2.51	125.0	0.0	0.0	121.8	0.0	0.0	88.4	725.6	496.2	286.7	0.0	0.0	214.8	0.0	0.0
2.60	127.8	0.0	0.0	121.0	0.0	0.0	88.4	725.0	496.5	266.5	0.0	0.0	220.6	0.0	0.0
2.70	130.5	0.0	0.0	121.4	0.0	0.0	88.5	724.4	496.4	249.6	0.0	0.0	218.3	0.0	0.0
2.79	121.4	0.0	0.0	122.2	0.0	0.0	88.6	726.4	496.1	320.1	0.0	0.0	213.4	0.0	0.0
2.88	122.0	0.0	0.0	122.8	0.0	0.0	88.6	726.3	495.9	314.9	0.0	0.0	210.0	0.0	0.0
2.98	121.1	0.0	0.0	123.7	0.0	0.0	88.7	726.5	495.5	324.4	0.0	0.0	204.8	0.0	0.0
3.07	119.9	0.0	0.0	123.8	0.0	0.0	88.8	726.8	495.5	337.6	0.0	0.0	204.6	0.0	0.0
3.16	120.5	0.0	0.0	124.4	0.0	0.0	88.8	726.6	495.3	331.9	0.0	0.0	201.4	0.0	0.0
3.26	123.2	0.0	0.0	124.8	0.0	0.0	89.0	726.0	495.1	306.1	0.0	0.0	199.4	0.0	0.0
3.35	125.3	0.0	0.0	124.7	0.0	0.0	89.0	725.6	495.2	288.7	0.0	0.0	200.4	0.0	0.0
3.45	128.0	0.0	0.0	124.0	0.0	0.0	89.0	725.0	495.4	269.0	0.0	0.0	204.8	0.0	0.0
3.54	129.2	0.0	0.0	124.4	0.0	0.0	89.1	724.7	495.3	261.2	0.0	0.0	202.8	0.0	0.0
3.63	132.7	0.0	0.0	124.5	0.0	0.0	89.2	723.9	495.2	240.4	0.0	0.0	202.6	0.0	0.0
3.73	123.4	0.0	0.0	124.4	0.0	0.0	89.2	726.0	495.3	307.1	0.0	0.0	203.5	0.0	0.0
4.01	118.9	0.0	0.0	124.5	0.0	0.0	89.4	727.0	495.2	356.5	0.0	0.0	204.0	0.0	0.0
4.95	120.4	0.0	0.0	125.0	0.0	0.0	90.1	726.7	495.1	346.1	0.0	0.0	204.7	0.0	0.0
5.41	130.6	0.0	0.0	126.0	0.0	0.0	90.4	724.4	494.7	260.1	0.0	0.0	200.6	0.0	0.0
6.35	131.4	0.0	0.0	127.5	0.0	0.0	91.1	724.2	494.2	258.9	0.0	0.0	195.6	0.0	0.0
7.29	131.8	0.0	0.0	128.5	0.0	0.0	91.8	724.1	493.8	260.3	0.0	0.0	193.5	0.0	0.0
8.23	127.0	0.0	0.0	129.5	0.0	0.0	92.4	725.2	493.4	301.6	0.0	0.0	191.4	0.0	0.0
8.58	126.4	129.1	122.8	128.7	125.3	120.2	92.7	725.4	493.3	309.2	286.2	346.1	196.7	217.3	257.5
8.60	124.1	124.8	123.2	129.3	126.8	123.3	92.7	725.6	492.9	331.8	324.8	341.8	193.4	207.7	231.5
8.70	123.1	121.9	121.1	129.4	127.4	122.7	92.8	726.0	493.3	343.8	358.0	368.1	193.4	204.6	236.7
8.79	124.8	123.4	121.5	128.8	127.1	124.5	92.8	725.6	494.9	326.0	341.0	363.6	197.4	207.6	224.8
8.88	127.7	125.3	124.6	128.9	127.6	125.9	92.9	725.1	492.3	299.3	321.5	328.6	196.6	203.7	214.0
8.98	132.2	127.5	126.5	128.2	128.5	124.7	93.0	724.5	494.5	265.4	301.3	310.3	201.7	200.0	224.1
9.07	132.0	129.7	128.1	130.2	130.7	125.2	93.0	724.1	494.3	266.9	283.6	296.5	190.8	188.3	220.4
9.16	134.7	133.2	130.8	130.4	129.8	126.6	93.1	723.5	493.8	249.7	259.1	275.6	190.3	193.0	211.4
9.26	146.8	133.5	132.5	131.5	132.7	125.0	93.2	722.9	493.4	193.4	257.3	263.9	185.0	179.0	222.8
9.35	139.4	128.5	133.0	131.1	128.1	122.6	93.2	724.4	493.3	225.5	294.9	261.5	187.1	203.3	241.4
9.63	128.7	0.0	0.0	131.0	0.0	0.0	93.4	725.8	492.9	295.2	0.0	0.0	188.3	0.0	0.0
12.45	126.1	0.0	0.0	128.5	0.0	0.0	95.4	725.4	493.8	338.3	0.0	0.0	213.6	0.0	0.0
13.85	135.5	0.0	0.0	135.0	0.0	0.0	96.4	723.3	491.5	264.4	0.0	0.0	182.0	0.0	0.0
14.79	136.0	0.0	0.0	135.8	0.0	0.0	97.1	723.2	491.2	265.2	0.0	0.0	181.0	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=289.61 NU(S)A=198.33 NU(AV)A=259.19 ST(AV)A=0.00577 ST(AV)/ST(4S)=1.86 F/F(4S)= 6.35
 (ST/ST(4S))/(F/F(4S))=0.293 (F/F(4S))/(ST/ST(4S))**3.0=0.98 (ST/ST(4S))/(F/F(4S))**(1/3)=1.01
 NU(R)A/NU(4S)=2.09 NU(S)A/NU(4S)=1.43 e+(4R)= 446.32 R(4R)= 3.93 H(4R)=18.54

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 20.71

AVERAGE VALUES WITH SL: H(4R)= 18.72

RUN NUMBER= 37HR10-60/10 E/D=0.047 P/E=10.0 ALPHA=60 HYD DIA= 2.667 IN PR= .71 MDOT=0.0334 LBM/SEC
 RE= 10590. GGE(R)= 363.0 BTU/HR-SQ FT GGE(S)= 109.5 INLET TEMP= 80.8 F TATM= 75.4 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	117.1	0.0	111.7	96.3	0.0	99.3	80.9	353.8	102.3	143.2	0.0	168.3	97.4	0.0
2	0.16	134.7	0.0	125.9	100.8	0.0	104.6	81.0	349.9	101.2	95.5	0.0	114.2	75.2	0.0
3	0.26	131.3	0.0	123.8	100.6	0.0	103.1	81.2	350.7	101.3	102.4	0.0	120.5	76.6	0.0
4	0.35	123.8	0.0	112.4	96.7	0.0	100.1	81.3	352.3	101.7	121.4	0.0	166.0	96.8	0.0
5	0.45	116.0	0.0	124.8	93.1	0.0	99.2	81.5	354.0	102.1	150.0	0.0	119.6	128.3	0.0
6	0.54	117.5	0.0	128.5	92.7	0.0	98.1	81.6	353.7	101.8	144.2	0.0	110.4	133.9	0.0
7	0.63	117.7	0.0	127.8	94.3	0.0	97.0	81.8	353.6	101.2	143.9	0.0	112.3	117.7	0.0
8	0.73	118.9	0.0	126.2	98.7	0.0	101.4	81.9	353.4	101.1	139.7	0.0	116.7	88.0	0.0
9	0.82	122.6	0.0	115.6	98.7	0.0	102.0	82.0	352.6	101.1	127.1	0.0	153.6	88.7	0.0
10	0.91	113.9	0.0	123.5	99.4	0.0	150.0	82.2	354.5	100.8	163.4	0.0	125.4	85.6	0.0
11	1.01	128.6	0.0	0.0	100.0	0.0	0.0	82.3	351.2	100.6	110.9	0.0	0.0	83.2	0.0
12	1.10	132.0	0.0	0.0	100.8	0.0	0.0	82.5	350.5	100.3	103.4	0.0	0.0	80.0	0.0
13	1.20	127.1	0.0	0.0	102.0	0.0	0.0	82.6	351.6	99.9	115.4	0.0	0.0	75.3	0.0
14	1.29	127.0	0.0	0.0	102.2	0.0	0.0	82.8	351.6	99.8	116.0	0.0	0.0	75.0	0.0
15	1.38	122.5	0.0	0.0	103.0	0.0	0.0	82.9	352.6	99.5	130.0	0.0	0.0	72.3	0.0
16	1.48	127.0	0.0	0.0	104.0	0.0	0.0	83.0	351.6	99.2	116.7	0.0	0.0	69.1	0.0
17	1.57	137.4	0.0	0.0	105.9	0.0	0.0	83.2	349.3	98.5	94.0	0.0	0.0	63.3	0.0
18	1.66	132.0	0.0	0.0	106.7	0.0	0.0	83.3	350.5	98.2	105.1	0.0	0.0	61.3	0.0
19	1.76	131.3	0.0	0.0	107.1	0.0	0.0	83.5	350.7	98.1	106.9	0.0	0.0	60.5	0.0
20	1.85	126.7	0.0	0.0	108.2	0.0	0.0	83.6	351.7	97.7	119.0	0.0	0.0	57.9	0.0
21	1.95	131.8	0.0	0.0	108.0	0.0	0.0	83.8	350.5	97.7	106.4	0.0	0.0	58.8	0.0
22	2.04	139.3	0.0	0.0	109.5	0.0	0.0	83.9	348.9	97.2	91.8	0.0	0.0	55.3	0.0
23	2.13	135.0	0.0	0.0	110.0	0.0	0.0	84.0	349.8	97.0	100.0	0.0	0.0	54.5	0.0
24	2.23	134.5	0.0	0.0	111.2	0.0	0.0	84.2	350.0	96.6	101.3	0.0	0.0	52.1	0.0
25	2.32	129.6	0.0	0.0	111.2	0.0	0.0	84.3	351.0	96.6	112.9	0.0	0.0	52.3	0.0
26	2.41	133.4	0.0	0.0	112.2	0.0	0.0	84.5	350.2	96.2	104.2	0.0	0.0	50.5	0.0
27	2.51	135.0	0.0	0.0	113.0	0.0	0.0	84.6	349.8	95.9	101.1	0.0	0.0	49.2	0.0
28	2.60	137.8	0.0	0.0	113.5	0.0	0.0	84.8	349.2	95.8	95.8	0.0	0.0	48.5	0.0
29	2.70	137.9	0.0	0.0	114.0	0.0	0.0	84.9	349.2	95.6	95.9	0.0	0.0	47.8	0.0
30	2.79	135.5	0.0	0.0	114.7	0.0	0.0	85.0	349.7	95.3	100.8	0.0	0.0	46.8	0.0
31	2.88	137.9	0.0	0.0	115.7	0.0	0.0	85.2	349.2	95.0	96.3	0.0	0.0	45.3	0.0
32	2.98	144.0	0.0	0.0	116.5	0.0	0.0	85.3	347.9	94.7	86.2	0.0	0.0	44.2	0.0
33	3.07	139.3	0.0	0.0	116.8	0.0	0.0	85.5	348.9	94.6	94.2	0.0	0.0	43.9	0.0
34	3.16	138.5	0.0	0.0	117.5	0.0	0.0	85.6	349.1	94.3	95.9	0.0	0.0	43.0	0.0
35	3.26	134.5	0.0	0.0	118.0	0.0	0.0	85.8	350.0	94.1	104.3	0.0	0.0	42.4	0.0
36	3.35	133.0	0.0	0.0	118.3	0.0	0.0	85.9	350.3	94.0	108.0	0.0	0.0	42.2	0.0
37	3.45	135.0	0.0	0.0	118.8	0.0	0.0	86.0	349.8	93.9	103.8	0.0	0.0	41.6	0.0
38	3.54	137.2	0.0	0.0	119.2	0.0	0.0	86.2	349.4	93.7	99.4	0.0	0.0	41.2	0.0
39	3.63	139.2	0.0	0.0	120.0	0.0	0.0	86.3	348.9	93.4	95.8	0.0	0.0	40.3	0.0
40	3.73	136.6	0.0	0.0	120.0	0.0	0.0	86.5	349.5	93.4	101.2	0.0	0.0	40.4	0.0
41	4.01	137.9	0.0	0.0	123.0	0.0	0.0	86.9	349.2	92.3	99.3	0.0	0.0	37.1	0.0
42	4.95	140.4	0.0	0.0	123.9	0.0	0.0	88.3	348.7	92.0	96.9	0.0	0.0	37.4	0.0
43	5.41	139.4	0.0	0.0	127.0	0.0	0.0	89.0	348.9	90.9	100.1	0.0	0.0	34.6	0.0
44	6.35	139.7	0.0	0.0	129.0	0.0	0.0	90.5	348.8	90.2	102.1	0.0	0.0	33.7	0.0
45	7.29	138.6	0.0	0.0	130.0	0.0	0.0	91.9	349.0	89.8	107.5	0.0	0.0	33.9	0.0
46	8.23	138.0	0.0	0.0	130.0	0.0	0.0	93.3	349.2	89.8	112.1	0.0	0.0	35.1	0.0
47	8.58	137.1	146.7	155.9	131.2	129.6	130.6	93.8	349.3	89.6	115.8	94.8	80.7	34.4	35.9
48	8.60	141.3	146.4	153.5	131.4	128.8	130.7	93.9	348.3	89.6	105.3	95.1	83.8	34.2	36.8
49	8.70	138.0	136.9	150.4	130.7	129.3	131.8	94.0	349.0	89.9	113.7	116.7	88.7	35.1	36.5
50	8.79	139.0	152.9	135.7	132.9	130.7	131.9	94.2	348.8	89.5	111.5	85.1	120.3	33.1	34.9
51	8.88	139.7	149.5	156.3	131.2	129.5	132.6	94.3	348.9	89.4	110.1	90.6	80.6	34.7	36.4
52	8.98	132.7	147.0	155.9	130.5	129.7	131.0	94.4	350.4	89.6	131.2	95.5	81.7	35.6	36.4
53	9.07	143.1	146.1	152.8	130.6	129.6	132.6	94.6	348.1	90.0	102.8	96.8	85.6	35.8	36.8
54	9.16	137.0	134.6	153.7	130.8	130.4	132.2	94.7	348.9	90.0	118.1	125.3	84.7	35.7	36.1
55	9.26	136.3	151.6	148.8	131.3	130.2	132.8	94.9	349.2	89.8	120.6	88.1	92.7	35.3	36.4
56	9.35	135.3	148.7	149.0	130.9	129.4	131.9	95.0	349.7	89.6	124.2	93.2	92.7	35.8	37.3
57	9.63	138.0	0.0	0.0	130.6	0.0	0.0	95.4	349.2	89.5	117.3	0.0	0.0	36.4	0.0
58	12.45	138.5	0.0	0.0	132.0	0.0	0.0	99.7	349.1	89.1	127.8	0.0	0.0	39.2	0.0
59	13.85	140.7	0.0	0.0	133.0	0.0	0.0	101.8	348.6	88.7	127.0	0.0	0.0	40.3	0.0
60	14.79	141.0	0.0	0.0	133.0	0.0	0.0	103.3	348.5	88.7	130.5	0.0	0.0	42.2	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=106.92 NU(S)A= 38.71 NU(AV)A= 84.19 ST(AV)A=0.01117 ST(AV)/ST(4S)=2.52 F/F(4S)= 5.61
 (ST/ST(4S))/(F/F(4S))=0.450 (F/F(4S))/(ST/ST(4S))*3.0=0.35 (ST/ST(4S))/(F/F(4S))*((1/3))=1.42
 NU(R)A/NU(4S)=3.22 NU(S)A/NU(4S)=1.17 e+(4R)= 87.18 R(4R)= 2.98 H(4R)= 9.41

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 9.71

AVERAGE VALUES WITH SL: H(4R)= 8.21

ORIGINAL PAGE IS OF POOR QUALITY

NUMBER= 38HR30-60/10 E/D=0.047 P/E=10.0 ALPHA=60 HYD DIA= 2.667 IN PR=.71 MDDT=0.1010 LBM/SEC
32130. GGE(R)= 640.4 BTU/HR-SQ FT GGE(S)= 205.9 INLET TEMP= 82.2 F TATM= 75.4 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
.07	109.3	0.0	104.7	97.5	0.0	94.8	82.3	632.9	199.7	342.2	0.0	412.4	191.3	0.0	232.4
.16	124.5	0.0	109.3	99.1	0.0	94.1	82.4	629.6	199.1	218.3	0.0	341.5	173.6	0.0	248.5
.26	117.7	0.0	110.4	95.9	0.0	96.0	82.5	631.1	199.2	261.6	0.0	329.9	216.0	0.0	214.9
.35	114.6	0.0	104.7	94.4	0.0	96.0	82.5	631.8	199.4	287.9	0.0	416.6	246.3	0.0	216.5
.45	110.2	0.0	118.2	96.1	0.0	98.1	82.6	632.7	198.6	335.3	0.0	259.9	215.7	0.0	187.1
.54	114.1	0.0	122.8	96.6	0.0	99.4	82.7	631.9	198.4	294.2	0.0	230.3	209.2	0.0	173.8
.63	112.3	0.0	125.7	95.8	0.0	100.3	82.8	632.3	198.6	313.2	0.0	215.3	223.5	0.0	165.6
.73	114.1	0.0	126.4	96.0	0.0	98.4	82.9	631.9	198.5	295.8	0.0	212.1	221.5	0.0	187.2
.82	119.1	0.0	113.7	98.6	0.0	99.9	83.0	630.8	197.6	255.1	0.0	300.0	185.0	0.0	170.7
.91	108.8	0.0	124.1	100.4	0.0	99.0	83.1	633.0	196.9	359.5	0.0	225.4	166.2	0.0	180.8
1.01	124.0	0.0	0.0	98.3	0.0	0.0	83.2	629.7	197.7	225.2	0.0	0.0	191.0	0.0	0.0
1.10	122.0	0.0	0.0	100.0	0.0	0.0	83.3	630.1	197.0	237.5	0.0	0.0	172.1	0.0	0.0
1.20	119.5	0.0	0.0	101.8	0.0	0.0	83.4	630.7	196.4	254.7	0.0	0.0	155.6	0.0	0.0
1.29	121.4	0.0	0.0	101.4	0.0	0.0	83.5	630.3	196.5	242.4	0.0	0.0	159.9	0.0	0.0
1.38	118.3	0.0	0.0	102.2	0.0	0.0	83.6	630.9	196.3	264.9	0.0	0.0	153.6	0.0	0.0
1.48	122.9	0.0	0.0	103.0	0.0	0.0	83.7	629.9	196.0	234.1	0.0	0.0	147.8	0.0	0.0
1.57	129.6	0.0	0.0	103.8	0.0	0.0	83.8	628.5	195.7	199.8	0.0	0.0	142.3	0.0	0.0
1.66	124.6	0.0	0.0	105.0	0.0	0.0	83.8	629.6	195.2	225.2	0.0	0.0	134.6	0.0	0.0
1.76	125.4	0.0	0.0	105.5	0.0	0.0	83.9	629.4	195.1	221.2	0.0	0.0	131.9	0.0	0.0
1.85	120.0	0.0	0.0	107.2	0.0	0.0	84.0	630.6	194.5	255.5	0.0	0.0	122.3	0.0	0.0
1.95	127.1	0.0	0.0	107.2	0.0	0.0	84.1	629.0	194.5	213.3	0.0	0.0	122.8	0.0	0.0
2.04	132.1	0.0	0.0	108.8	0.0	0.0	84.2	627.9	193.9	191.0	0.0	0.0	114.9	0.0	0.0
2.13	127.8	0.0	0.0	108.8	0.0	0.0	84.3	628.9	193.9	210.6	0.0	0.0	115.3	0.0	0.0
2.23	128.7	0.0	0.0	109.8	0.0	0.0	84.4	628.7	193.5	206.7	0.0	0.0	111.0	0.0	0.0
2.32	124.1	0.0	0.0	110.5	0.0	0.0	84.5	629.7	193.3	231.5	0.0	0.0	108.2	0.0	0.0
2.41	128.5	0.0	0.0	111.8	0.0	0.0	84.6	628.7	192.8	208.5	0.0	0.0	103.2	0.0	0.0
2.51	133.0	0.0	0.0	111.8	0.0	0.0	84.7	627.7	192.8	189.1	0.0	0.0	103.5	0.0	0.0
2.60	130.6	0.0	0.0	112.0	0.0	0.0	84.8	628.2	192.7	199.5	0.0	0.0	103.0	0.0	0.0
2.70	132.1	0.0	0.0	113.0	0.0	0.0	84.9	627.9	192.4	193.5	0.0	0.0	99.5	0.0	0.0
2.79	130.4	0.0	0.0	113.5	0.0	0.0	85.0	628.3	192.2	201.2	0.0	0.0	98.0	0.0	0.0
2.88	135.3	0.0	0.0	114.2	0.0	0.0	85.1	627.2	191.9	181.6	0.0	0.0	95.8	0.0	0.0
2.98	137.8	0.0	0.0	115.0	0.0	0.0	85.2	626.7	191.6	173.1	0.0	0.0	93.4	0.0	0.0
3.07	133.1	0.0	0.0	115.5	0.0	0.0	85.2	627.7	191.5	190.7	0.0	0.0	92.0	0.0	0.0
3.16	133.4	0.0	0.0	116.3	0.0	0.0	85.3	627.6	191.1	189.9	0.0	0.0	89.2	0.0	0.0
3.26	129.5	0.0	0.0	117.2	0.0	0.0	85.4	628.5	190.9	207.3	0.0	0.0	87.3	0.0	0.0
3.35	128.1	0.0	0.0	117.6	0.0	0.0	85.5	628.8	190.7	214.7	0.0	0.0	86.4	0.0	0.0
3.45	138.0	0.0	0.0	118.4	0.0	0.0	85.6	626.6	190.4	173.8	0.0	0.0	84.4	0.0	0.0
3.54	133.0	0.0	0.0	119.0	0.0	0.0	85.7	627.7	190.2	192.9	0.0	0.0	83.0	0.0	0.0
3.63	135.2	0.0	0.0	119.0	0.0	0.0	85.8	627.2	190.2	184.5	0.0	0.0	83.2	0.0	0.0
3.73	132.1	0.0	0.0	119.5	0.0	0.0	85.9	627.9	190.0	197.4	0.0	0.0	82.1	0.0	0.0
4.01	132.5	0.0	0.0	124.8	0.0	0.0	86.2	627.8	188.1	196.8	0.0	0.0	70.7	0.0	0.0
4.95	134.4	0.0	0.0	125.0	0.0	0.0	87.1	627.4	188.0	192.3	0.0	0.0	71.9	0.0	0.0
5.41	133.9	0.0	0.0	127.0	0.0	0.0	87.6	627.5	187.3	196.2	0.0	0.0	68.8	0.0	0.0
6.35	131.5	0.0	0.0	128.5	0.0	0.0	88.5	628.0	186.8	211.3	0.0	0.0	67.5	0.0	0.0
7.29	130.0	0.0	0.0	129.2	0.0	0.0	89.4	628.4	186.5	223.7	0.0	0.0	67.7	0.0	0.0
8.23	131.0	0.0	0.0	129.0	0.0	0.0	90.4	628.2	186.6	222.9	0.0	0.0	69.6	0.0	0.0
8.58	131.8	138.4	153.0	127.6	122.9	122.1	90.7	628.0	186.8	220.3	189.8	145.3	72.9	83.5	85.7
8.60	133.1	139.9	150.2	127.2	122.2	122.7	90.7	627.6	187.0	213.4	184.0	152.1	73.8	85.5	84.3
8.70	129.8	127.1	147.5	126.3	122.3	122.8	90.8	628.4	187.3	232.3	249.6	159.8	76.0	85.7	84.4
8.79	131.7	146.5	125.7	127.2	124.3	124.2	90.9	628.0	188.0	221.8	162.8	260.1	74.6	81.3	81.3
8.88	132.4	140.1	152.9	126.5	123.4	122.9	91.0	627.8	186.6	218.5	184.2	146.1	75.8	82.9	84.4
8.98	123.5	138.8	152.5	126.6	122.7	122.5	91.1	629.9	187.3	280.2	190.2	147.8	76.0	85.5	86.0
9.07	130.1	138.6	148.4	128.3	123.6	124.9	91.2	628.4	187.4	232.6	190.9	158.2	72.6	83.3	80.0
9.16	124.4	123.4	149.9	128.1	123.1	124.6	91.3	628.7	187.5	273.0	281.9	154.5	73.3	79.8	80.9

5	9.26	132.2	144.8	145.1	128.5	129.0	122.8	91.4	628.4	187.4	221.5	169.3	168.4	72.6	71.7	85.9
5	9.35	132.3	138.4	145.0	128.7	125.2	121.6	91.5	628.8	187.3	221.4	192.9	169.1	72.4	79.9	89.6
7	9.63	128.5	0.0	0.0	127.0	0.0	0.0	91.7	628.7	187.3	246.2	0.0	0.0	76.5	0.0	0.0
8	12.45	130.1	0.0	0.0	125.0	0.0	0.0	94.5	628.4	188.0	253.1	0.0	0.0	88.4	0.0	0.0
9	13.85	133.0	0.0	0.0	128.0	0.0	0.0	95.9	627.7	187.0	242.0	0.0	0.0	83.3	0.0	0.0
0	14.79	133.0	0.0	0.0	129.0	0.0	0.0	96.9	627.7	186.6	247.9	0.0	0.0	82.9	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=212.05 NU(S)A= 80.85 NU(AV)A=168.32 ST(AV)A=0.00737 ST(AV)/ST(4S)=2.08 F/F(4S)= 7.43
 (ST/ST(4S))/(F/F(4S))=0.279 (F/F(4S))/(ST/ST(4S))*3.0=0.83 (ST/ST(4S))/(F/F(4S))*(1/3)=1.06
 NU(R)A/NU(4S)=2.63 NU(S)A/NU(4S)=1.00 e+(4R)= 266.86 R(4R)= 2.93 H(4R)=16.43

BY USING ROUGHSIDE RESULTS ONLY : H(RB)= 16.43

AVERAGE VALUES WITH SL: H(4R)= 14.29

RUN NUMBER= 39HR60-60/10 E/D=0.047 P/E=10.0 ALPHA=60 HYD DIA= 2.667 IN PR= 71 MDOT=0.2030 LBM/SEC
 RE= 64538. QGE(R)=1099.2 BTU/HR-SQ FT QGE(S)= 435.9 INLET TEMP= 83.2 F TATM= 76.1 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU
1	0.07	110.7	0.0	101.6	100.5	0.0	103.6	83.3	1091.6	429.6	580.5	0.0	868.6	363.1	0.0	30
2	0.16	123.2	0.0	106.0	104.2	0.0	105.1	83.4	1088.9	428.3	398.6	0.0	701.3	299.3	0.0	28
3	0.26	116.8	0.0	109.2	99.4	0.0	102.0	83.4	1090.3	428.7	476.6	0.0	617.2	391.4	0.0	30
4	0.35	114.5	0.0	103.5	97.8	0.0	100.5	83.5	1090.8	428.8	513.5	0.0	796.2	437.7	0.0	36
5	0.45	110.3	0.0	117.3	97.6	0.0	96.8	83.6	1091.7	428.1	596.4	0.0	472.5	446.2	0.0	47
6	0.54	115.3	0.0	119.8	99.4	0.0	98.6	83.7	1090.6	427.5	503.1	0.0	440.4	396.8	0.0	41
7	0.63	111.9	0.0	123.7	99.3	0.0	100.0	83.8	1091.3	427.5	565.7	0.0	398.5	401.5	0.0	36
8	0.73	115.0	0.0	127.5	98.0	0.0	100.2	83.9	1090.7	428.0	510.6	0.0	364.3	441.3	0.0	38
9	0.82	121.4	0.0	115.8	100.1	0.0	102.4	84.0	1089.2	427.2	423.9	0.0	498.4	385.5	0.0	33
10	0.91	109.8	0.0	128.7	102.8	0.0	100.3	84.0	1091.8	426.3	617.5	0.0	356.2	331.0	0.0	38
11	1.01	127.1	0.0	0.0	102.5	0.0	0.0	84.1	1088.0	426.4	368.8	0.0	0.0	338.0	0.0	0.0
12	1.10	122.7	0.0	0.0	103.5	0.0	0.0	84.2	1089.0	426.0	412.1	0.0	0.0	321.7	0.0	0.0
13	1.20	120.5	0.0	0.0	105.0	0.0	0.0	84.3	1089.4	425.5	438.3	0.0	0.0	299.3	0.0	0.0
14	1.29	123.4	0.0	0.0	105.6	0.0	0.0	84.4	1088.8	425.2	406.4	0.0	0.0	291.9	0.0	0.0
15	1.38	121.0	0.0	0.0	107.8	0.0	0.0	84.5	1089.3	424.5	434.2	0.0	0.0	264.9	0.0	0.0
16	1.48	126.4	0.0	0.0	108.2	0.0	0.0	84.6	1088.1	424.3	378.6	0.0	0.0	261.2	0.0	0.0
17	1.57	129.9	0.0	0.0	109.5	0.0	0.0	84.6	1087.4	423.8	349.7	0.0	0.0	248.2	0.0	0.0
18	1.66	125.6	0.0	0.0	110.6	0.0	0.0	84.7	1088.3	423.4	387.5	0.0	0.0	238.2	0.0	0.0
19	1.76	127.1	0.0	0.0	111.6	0.0	0.0	84.8	1088.0	423.1	374.4	0.0	0.0	229.8	0.0	0.0
20	1.85	122.0	0.0	0.0	112.2	0.0	0.0	84.9	1089.1	422.9	427.1	0.0	0.0	225.4	0.0	0.0
21	1.95	130.0	0.0	0.0	113.0	0.0	0.0	85.0	1087.4	422.6	351.4	0.0	0.0	219.4	0.0	0.0
22	2.04	132.3	0.0	0.0	113.5	0.0	0.0	85.1	1086.8	422.4	334.7	0.0	0.0	216.1	0.0	0.0
23	2.13	128.7	0.0	0.0	114.9	0.0	0.0	85.2	1087.6	421.9	363.3	0.0	0.0	206.3	0.0	0.0
24	2.23	130.3	0.0	0.0	118.2	0.0	0.0	85.2	1087.3	420.7	350.9	0.0	0.0	185.6	0.0	0.0
25	2.32	125.6	0.0	0.0	114.4	0.0	0.0	85.3	1088.3	422.1	392.9	0.0	0.0	211.1	0.0	0.0
26	2.41	131.3	0.0	0.0	117.8	0.0	0.0	85.4	1087.1	420.9	344.4	0.0	0.0	188.9	0.0	0.0
27	2.51	131.5	0.0	0.0	118.3	0.0	0.0	85.5	1087.0	420.7	343.5	0.0	0.0	186.4	0.0	0.0
28	2.60	131.8	0.0	0.0	119.0	0.0	0.0	85.6	1087.0	420.4	341.8	0.0	0.0	182.9	0.0	0.0
29	2.70	133.5	0.0	0.0	120.0	0.0	0.0	85.7	1086.6	420.1	330.1	0.0	0.0	177.8	0.0	0.0
30	2.79	131.3	0.0	0.0	119.8	0.0	0.0	85.8	1087.1	420.1	346.8	0.0	0.0	179.3	0.0	0.0
31	2.88	139.8	0.0	0.0	121.2	0.0	0.0	85.8	1085.2	419.6	292.2	0.0	0.0	172.4	0.0	0.0
32	2.98	139.1	0.0	0.0	122.4	0.0	0.0	85.9	1085.4	419.2	296.5	0.0	0.0	167.0	0.0	0.0
33	3.07	134.4	0.0	0.0	122.8	0.0	0.0	86.0	1086.4	419.1	326.1	0.0	0.0	165.4	0.0	0.0
34	3.16	135.0	0.0	0.0	123.5	0.0	0.0	86.1	1086.3	418.8	322.6	0.0	0.0	162.6	0.0	0.0
35	3.26	130.6	0.0	0.0	124.8	0.0	0.0	86.2	1087.2	418.3	355.4	0.0	0.0	157.3	0.0	0.0
36	3.35	131.2	0.0	0.0	125.5	0.0	0.0	86.3	1087.1	418.1	351.3	0.0	0.0	154.7	0.0	0.0
37	3.45	133.0	0.0	0.0	125.5	0.0	0.0	86.4	1086.7	418.1	338.2	0.0	0.0	155.0	0.0	0.0
38	3.54	134.9	0.0	0.0	125.8	0.0	0.0	86.4	1086.3	418.0	325.4	0.0	0.0	154.1	0.0	0.0
39	3.63	137.3	0.0	0.0	126.8	0.0	0.0	86.5	1085.7	417.6	310.3	0.0	0.0	150.5	0.0	0.0
40	3.73	133.2	0.0	0.0	127.0	0.0	0.0	86.6	1086.7	417.5	338.5	0.0	0.0	150.0	0.0	0.0
41	4.01	133.6	0.0	0.0	130.0	0.0	0.0	86.9	1086.6	416.5	337.3	0.0	0.0	140.1	0.0	0.0
42	4.95	135.0	0.0	0.0	131.8	0.0	0.0	87.7	1086.3	415.8	332.8	0.0	0.0	136.7	0.0	0.0
43	5.41	135.4	0.0	0.0	133.0	0.0	0.0	88.2	1086.2	415.4	332.8	0.0	0.0	134.1	0.0	0.0
44	6.35	130.8	0.0	0.0	134.8	0.0	0.0	89.0	1087.2	414.7	376.1	0.0	0.0	130.9	0.0	0.0
45	7.29	130.3	0.0	0.0	134.8	0.0	0.0	89.9	1087.3	414.7	388.2	0.0	0.0	133.2	0.0	0.0
46	8.23	134.0	0.0	0.0	133.0	0.0	0.0	90.7	1086.5	415.4	362.0	0.0	0.0	141.7	0.0	0.0
47	8.58	136.1	140.5	149.8	131.5	126.2	121.2	91.1	1086.0	415.5	347.4	316.5	266.3	148.0	170.3	198.6
48	8.60	134.4	141.7	146.1	130.5	124.5	123.3	91.1	1086.1	415.7	361.2	309.1	284.4	151.9	179.2	185.4
49	8.70	131.1	126.5	149.8	131.4	124.4	122.8	91.2	1087.0	415.7	392.1	443.1	267.0	148.8	180.2	189.3
50	8.79	133.4	148.9	124.0	131.5	126.5	126.5	91.3	1086.5	417.2	371.2	271.4	477.8	149.2	170.4	170.4
51	8.88	134.2	140.8	155.1	129.9	126.1	126.1	91.3	1086.5	415.1	365.0	316.3	245.4	155.0	171.9	171.9
52	8.98	126.0	140.7	154.8	130.8	128.9	126.2	91.4	1088.7	416.8	453.2	318.1	247.3	152.4	160.1	172.5
53	9.07	133.8	141.2	149.8	132.8	130.3	127.1	91.5	1086.5	416.6	369.8	314.8	268.3	145.2	154.6	168.5
54	9.16	129.2	122.0	151.5	133.4	130.9	126.7	91.6	1087.5	415.9	416.2	514.8	261.3	143.2	152.2	170.5

55	9.26	141.5	146.2	146.4	132.5	134.3	126.0	91.7	1086.9	416.3	313.8	286.9	285.9	146.7	140.5	174.5
56	9.35	138.4	138.1	146.0	133.3	129.1	124.6	91.8	1087.5	415.7	335.3	337.7	288.5	144.0	160.2	182.1
57	9.63	134.1	0.0	0.0	130.5	0.0	0.0	92.0	1087.5	416.3	371.6	0.0	0.0	155.6	0.0	0.0
58	12.45	131.4	0.0	0.0	129.0	0.0	0.0	94.6	1087.0	416.8	423.1	0.0	0.0	173.6	0.0	0.0
59	13.85	134.2	0.0	0.0	133.3	0.0	0.0	95.9	1086.4	415.3	405.3	0.0	0.0	158.7	0.0	0.0
60	14.79	135.0	0.0	0.0	134.5	0.0	0.0	96.7	1086.3	414.8	405.3	0.0	0.0	156.9	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=349.08 NU(S)A=153.68 NU(AV)A=283.95 ST(AV)A=0.00619 ST(AV)/ST(4S)=2.01 F/F(4S)= 8.78
 (ST/ST(4S))/(F/F(4S))=0.229 (F/F(4S))/(ST/ST(4S))*3.0=1.09 (ST/ST(4S))/(F/F(4S))*1/3)=0.97
 NU(R)A/NU(4S)=2.47 NU(S)A/NU(4S)=1.09 e+(4R)= 538.03 R(4R)= 2.91 H(4R)=20.32

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 20.72

AVERAGE VALUES WITH SL: H(4R)= 18.23

ORIGINAL PAGE IS OF POOR QUALITY

NUMBER= 42HR10-60/20 E/D=0.047 P/E=20.0 ALPHA=60 HYD DIA= 2.667 IN PR=71 MDOT=0.0346 LBM/SEC
11017 GGE(R)= 306.7 BTU/HR-SQ FT GGE(S)= 141.5 INLET TEMP= 78.8 F TATM= 72.3 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	106.4	0.0	102.0	96.2	0.0	97.1	78.9	299.2	133.3	159.8	0.0	190.3	113.0	0.0	107.8
16	119.0	0.0	112.0	101.3	0.0	103.6	79.0	296.4	132.0	108.9	0.0	132.1	87.2	0.0	78.8
26	115.0	0.0	110.2	99.7	0.0	101.7	79.2	297.3	132.6	121.8	0.0	140.7	94.9	0.0	86.5
35	110.6	0.0	102.3	95.7	0.0	98.6	79.3	298.3	132.9	139.9	0.0	190.3	119.0	0.0	101.1
45	108.6	0.0	112.9	92.4	0.0	97.1	79.4	298.7	133.3	150.3	0.0	131.0	150.4	0.0	110.3
54	108.2	0.0	116.5	92.2	0.0	96.2	79.5	298.8	132.9	153.0	0.0	118.7	154.3	0.0	117.0
63	109.0	0.0	116.6	93.7	0.0	96.0	79.7	298.6	132.3	149.4	0.0	118.7	138.6	0.0	118.9
73	111.8	0.0	117.2	97.8	0.0	100.0	79.8	298.0	132.3	136.6	0.0	116.9	107.9	0.0	96.1
82	114.7	0.0	117.8	98.7	0.0	100.0	79.9	297.4	132.0	125.4	0.0	115.2	103.2	0.0	96.5
91	106.0	0.0	114.2	99.7	0.0	92.5	80.1	299.3	131.7	169.2	0.0	128.6	98.3	0.0	155.2
01	117.6	0.0	0.0	100.3	0.0	0.0	80.2	296.7	131.4	116.3	0.0	0.0	95.8	0.0	0.0
10	118.7	0.0	0.0	100.8	0.0	0.0	80.3	296.5	131.3	113.2	0.0	0.0	93.9	0.0	0.0
20	114.4	0.0	0.0	102.0	0.0	0.0	80.4	297.4	130.8	128.4	0.0	0.0	89.0	0.0	0.0
29	114.3	0.0	0.0	102.0	0.0	0.0	80.6	297.4	130.8	129.2	0.0	0.0	89.5	0.0	0.0
38	115.3	0.0	0.0	103.8	0.0	0.0	80.7	297.2	130.2	125.9	0.0	0.0	82.6	0.0	0.0
48	118.0	0.0	0.0	104.1	0.0	0.0	80.8	296.6	130.1	116.9	0.0	0.0	81.9	0.0	0.0
57	120.6	0.0	0.0	105.0	0.0	0.0	81.0	296.1	129.7	109.4	0.0	0.0	79.0	0.0	0.0
66	123.0	0.0	0.0	105.9	0.0	0.0	81.1	295.5	129.4	103.2	0.0	0.0	76.4	0.0	0.0
76	124.7	0.0	0.0	107.5	0.0	0.0	81.2	295.2	128.8	99.4	0.0	0.0	71.8	0.0	0.0
85	118.5	0.0	0.0	107.8	0.0	0.0	81.3	296.5	128.7	116.8	0.0	0.0	71.2	0.0	0.0
95	121.9	0.0	0.0	108.9	0.0	0.0	81.5	295.8	128.3	107.1	0.0	0.0	68.5	0.0	0.0
04	129.4	0.0	0.0	109.0	0.0	0.0	81.6	294.1	128.3	90.0	0.0	0.0	68.5	0.0	0.0
13	123.7	0.0	0.0	109.6	0.0	0.0	81.7	295.4	128.1	102.9	0.0	0.0	67.2	0.0	0.0
23	121.5	0.0	0.0	111.8	0.0	0.0	81.9	295.9	127.3	109.1	0.0	0.0	62.2	0.0	0.0
32	121.8	0.0	0.0	110.2	0.0	0.0	82.0	295.8	127.9	108.6	0.0	0.0	66.3	0.0	0.0
41	123.3	0.0	0.0	111.2	0.0	0.0	82.1	295.5	127.5	104.9	0.0	0.0	64.1	0.0	0.0
51	125.0	0.0	0.0	112.5	0.0	0.0	82.2	295.1	127.0	100.9	0.0	0.0	61.4	0.0	0.0
60	127.2	0.0	0.0	113.0	0.0	0.0	82.4	294.6	126.9	96.0	0.0	0.0	60.5	0.0	0.0
70	129.6	0.0	0.0	113.5	0.0	0.0	82.5	294.1	126.7	91.2	0.0	0.0	59.7	0.0	0.0
79	126.0	0.0	0.0	114.0	0.0	0.0	82.6	294.9	126.5	99.3	0.0	0.0	58.9	0.0	0.0
88	126.9	0.0	0.0	115.6	0.0	0.0	82.8	294.7	125.9	97.5	0.0	0.0	56.0	0.0	0.0
98	131.4	0.0	0.0	115.8	0.0	0.0	82.9	293.7	125.9	88.4	0.0	0.0	55.8	0.0	0.0
07	125.9	0.0	0.0	115.3	0.0	0.0	83.0	294.9	126.0	100.4	0.0	0.0	57.0	0.0	0.0
16	124.0	0.0	0.0	115.6	0.0	0.0	83.1	295.3	125.9	105.5	0.0	0.0	56.6	0.0	0.0
26	125.0	0.0	0.0	116.6	0.0	0.0	83.3	295.1	125.6	103.2	0.0	0.0	55.0	0.0	0.0
35	126.1	0.0	0.0	117.0	0.0	0.0	83.4	294.8	125.4	100.7	0.0	0.0	54.5	0.0	0.0
45	126.7	0.0	0.0	117.7	0.0	0.0	83.5	294.7	125.2	99.6	0.0	0.0	53.4	0.0	0.0
54	128.0	0.0	0.0	118.3	0.0	0.0	83.7	294.4	125.0	96.8	0.0	0.0	52.6	0.0	0.0
63	131.7	0.0	0.0	118.0	0.0	0.0	83.8	293.6	125.1	89.3	0.0	0.0	53.3	0.0	0.0
73	128.5	0.0	0.0	119.0	0.0	0.0	83.9	294.3	124.7	96.2	0.0	0.0	51.8	0.0	0.0
82	125.2	0.0	0.0	120.0	0.0	0.0	84.3	295.0	124.3	105.1	0.0	0.0	50.7	0.0	0.0
95	128.6	0.0	0.0	121.2	0.0	0.0	85.6	294.3	123.9	99.5	0.0	0.0	50.6	0.0	0.0
04	131.9	0.0	0.0	125.0	0.0	0.0	86.2	293.6	122.5	93.3	0.0	0.0	45.9	0.0	0.0
13	132.9	0.0	0.0	127.0	0.0	0.0	87.5	293.3	121.8	93.7	0.0	0.0	44.7	0.0	0.0
23	132.1	0.0	0.0	130.3	0.0	0.0	88.8	293.5	120.6	98.0	0.0	0.0	42.0	0.0	0.0
32	131.0	0.0	0.0	132.0	0.0	0.0	90.1	293.8	120.0	103.6	0.0	0.0	41.3	0.0	0.0
41	129.7	138.5	139.7	133.6	128.8	128.4	90.6	294.0	119.7	108.4	88.5	86.3	40.1	45.1	45.6
51	132.2	138.5	142.1	132.7	129.0	128.6	90.6	293.3	120.0	101.8	88.3	82.1	41.1	45.1	45.6
60	127.0	129.4	141.8	131.6	128.4	128.8	90.8	294.4	120.5	117.2	109.8	83.1	42.5	46.1	45.6
70	126.2	142.1	128.5	133.4	128.8	129.6	90.9	294.7	120.2	120.3	82.9	112.9	40.8	45.7	44.7
80	127.7	137.4	142.7	132.0	127.8	129.3	91.0	294.5	120.0	115.6	91.5	82.1	42.2	47.0	45.1
90	130.0	133.2	139.7	131.8	129.0	130.1	91.1	294.0	120.1	109.0	100.7	87.2	42.5	45.7	44.4
07	129.9	132.4	137.1	132.7	129.1	131.4	91.3	294.0	120.2	109.6	102.9	92.4	41.7	45.7	43.1
16	132.9	135.7	139.5	133.2	129.7	130.5	91.4	292.8	120.0	101.5	95.2	87.6	41.3	45.1	44.2

9.26	134.4	135.3	137.8	133.3	130.1	131.4	91.5	292.7	120.0	98.4	96.3	91.1	41.3	44.8	43.3
9.35	132.0	136.6	138.0	133.4	130.4	130.5	91.7	293.5	119.7	104.7	94.0	91.1	41.2	44.4	44.3
9.63	128.0	0.0	0.0	133.6	0.0	0.0	92.0	294.4	119.3	117.8	0.0	0.0	41.3	0.0	0.0
12.45	128.0	0.0	0.0	135.0	0.0	0.0	95.9	294.4	118.9	131.1	0.0	0.0	43.5	0.0	0.0
13.85	134.2	0.0	0.0	138.0	0.0	0.0	97.8	293.1	117.9	114.8	0.0	0.0	41.8	0.0	0.0
14.79	134.8	0.0	0.0	138.0	0.0	0.0	99.1	292.9	117.9	116.8	0.0	0.0	43.1	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
U(R)A=103.20 NU(S)A= 48.04 NU(AV)A= 84.81 ST(AV)A=0.01082 ST(AV)/ST(4S)=2.46 F/F(4S)= 4.12
ST/ST(4S))/(F/F(4S))=0.598 (F/F(4S))/(ST/ST(4S))**3.0=0.28 (ST/ST(4S))/(F/F(4S))**(1/3)=1.54
U(R)A/NU(4S)=3.01 NU(S)A/NU(4S)=1.40 e+(4R)= 76.48 R(4R)= 4.03 H(4R)= 7.89

RY USING ROUGH SIDE RESULTS ONLY : H(RB)= 8.58

AVERAGE VALUES WITH SL: H(4R)= 7.11

RUN NUMBER= 43HR30-60/20 E/D=0.047 P/E=20.0 ALPHA=60 HYD DIA= 2.667 IN PR=.71 MDOT=0.1022 LBM/SEC
 RE= 32628. GGE(R)= 541.1 BTU/HR-SQ FT GGE(S)= 281.2 INLET TEMP= 80.2 F TATM= 73.0 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	102.9	0.0	99.3	98.8	0.0	97.3	80.3	534.6	273.7	346.2	0.0	411.7	216.5	0.0
2	0.16	116.2	0.0	103.5	102.0	0.0	95.0	80.3	531.6	272.6	217.4	0.0	336.6	184.6	0.0
3	0.26	110.7	0.0	104.4	98.0	0.0	97.0	80.4	532.8	272.9	258.1	0.0	325.9	228.3	0.0
4	0.35	107.6	0.0	99.4	96.4	0.0	98.0	80.5	533.5	273.1	288.7	0.0	414.2	252.3	0.0
5	0.45	105.9	0.0	111.0	96.4	0.0	100.2	80.6	533.9	272.9	309.3	0.0	257.4	253.4	0.0
6	0.54	106.3	0.0	114.3	97.7	0.0	102.0	80.7	533.8	272.5	305.4	0.0	232.7	234.8	0.0
7	0.63	107.6	0.0	117.1	98.2	0.0	102.2	80.8	533.5	272.2	291.4	0.0	215.2	228.8	0.0
8	0.73	110.3	0.0	119.3	97.7	0.0	101.1	80.9	532.9	272.3	265.2	0.0	203.1	236.9	0.0
9	0.82	114.0	0.0	120.2	99.2	0.0	102.0	80.9	532.1	271.8	235.8	0.0	198.5	218.1	0.0
10	0.91	102.9	0.0	115.7	100.8	0.0	98.2	81.0	534.6	271.2	358.0	0.0	225.8	200.9	0.0
11	1.01	115.0	0.0	0.0	101.4	0.0	0.0	81.1	531.9	271.0	229.8	0.0	0.0	195.6	0.0
12	1.10	112.4	0.0	0.0	102.5	0.0	0.0	81.2	532.5	270.6	249.9	0.0	0.0	186.0	0.0
13	1.20	110.2	0.0	0.0	102.6	0.0	0.0	81.3	533.0	270.6	269.8	0.0	0.0	185.8	0.0
14	1.29	111.3	0.0	0.0	103.5	0.0	0.0	81.4	532.7	270.2	260.5	0.0	0.0	178.8	0.0
15	1.38	113.5	0.0	0.0	105.0	0.0	0.0	81.5	532.2	269.7	243.1	0.0	0.0	167.7	0.0
16	1.48	116.6	0.0	0.0	105.8	0.0	0.0	81.5	531.5	269.4	221.9	0.0	0.0	162.5	0.0
17	1.57	119.6	0.0	0.0	107.0	0.0	0.0	81.6	530.9	269.0	204.5	0.0	0.0	155.1	0.0
18	1.66	122.4	0.0	0.0	107.0	0.0	0.0	81.7	530.3	269.0	190.6	0.0	0.0	155.6	0.0
19	1.76	124.5	0.0	0.0	107.5	0.0	0.0	81.8	529.8	268.8	181.5	0.0	0.0	153.0	0.0
20	1.85	115.3	0.0	0.0	109.4	0.0	0.0	81.9	531.8	268.1	232.7	0.0	0.0	142.5	0.0
21	1.95	118.4	0.0	0.0	109.8	0.0	0.0	82.0	531.2	268.0	213.2	0.0	0.0	140.8	0.0
22	2.04	122.6	0.0	0.0	110.0	0.0	0.0	82.1	530.2	267.9	191.2	0.0	0.0	140.2	0.0
23	2.13	118.5	0.0	0.0	111.0	0.0	0.0	82.1	531.1	267.5	213.5	0.0	0.0	135.5	0.0
24	2.23	117.9	0.0	0.0	112.0	0.0	0.0	82.2	531.3	267.2	217.7	0.0	0.0	131.2	0.0
25	2.32	119.5	0.0	0.0	112.0	0.0	0.0	82.3	530.9	267.2	208.6	0.0	0.0	131.5	0.0
26	2.41	121.0	0.0	0.0	113.5	0.0	0.0	82.4	530.6	266.6	200.8	0.0	0.0	125.3	0.0
27	2.51	123.0	0.0	0.0	113.2	0.0	0.0	82.5	530.1	266.8	191.1	0.0	0.0	126.9	0.0
28	2.60	125.7	0.0	0.0	114.0	0.0	0.0	82.6	529.5	266.5	179.3	0.0	0.0	123.8	0.0
29	2.70	128.3	0.0	0.0	114.4	0.0	0.0	82.7	529.0	266.3	169.2	0.0	0.0	122.5	0.0
30	2.79	123.2	0.0	0.0	115.6	0.0	0.0	82.7	530.1	265.9	191.3	0.0	0.0	118.2	0.0
31	2.88	124.0	0.0	0.0	116.8	0.0	0.0	82.8	529.9	265.5	187.9	0.0	0.0	114.1	0.0
32	2.98	124.3	0.0	0.0	116.4	0.0	0.0	82.9	529.9	265.6	186.9	0.0	0.0	115.8	0.0
33	3.07	120.7	0.0	0.0	116.3	0.0	0.0	83.0	530.6	265.6	205.4	0.0	0.0	116.4	0.0
34	3.16	120.6	0.0	0.0	117.4	0.0	0.0	83.1	530.7	265.2	206.4	0.0	0.0	112.8	0.0
35	3.26	122.7	0.0	0.0	117.8	0.0	0.0	83.2	530.2	265.1	195.7	0.0	0.0	111.7	0.0
36	3.35	124.6	0.0	0.0	118.9	0.0	0.0	83.3	529.8	264.7	186.9	0.0	0.0	108.3	0.0
37	3.45	125.2	0.0	0.0	119.0	0.0	0.0	83.3	529.7	264.7	184.6	0.0	0.0	108.3	0.0
38	3.54	127.4	0.0	0.0	120.0	0.0	0.0	83.4	529.2	264.3	175.5	0.0	0.0	105.4	0.0
39	3.63	131.1	0.0	0.0	120.0	0.0	0.0	83.5	528.4	264.3	161.9	0.0	0.0	105.6	0.0
40	3.73	125.5	0.0	0.0	120.0	0.0	0.0	83.6	529.6	264.3	184.3	0.0	0.0	105.9	0.0
41	4.01	119.9	0.0	0.0	123.0	0.0	0.0	83.9	530.8	263.2	214.6	0.0	0.0	98.0	0.0
42	4.95	121.9	0.0	0.0	124.8	0.0	0.0	84.7	530.4	262.6	207.5	0.0	0.0	95.3	0.0
43	5.41	130.4	0.0	0.0	127.0	0.0	0.0	85.1	528.5	261.8	169.8	0.0	0.0	90.9	0.0
44	6.35	131.1	0.0	0.0	132.2	0.0	0.0	86.0	528.4	259.9	170.1	0.0	0.0	81.7	0.0
45	7.29	129.8	0.0	0.0	133.0	0.0	0.0	86.8	528.6	259.6	178.5	0.0	0.0	81.6	0.0
46	8.23	114.0	0.0	0.0	134.0	0.0	0.0	87.7	532.1	259.3	293.0	0.0	0.0	81.1	0.0
47	8.58	124.9	137.3	140.5	133.9	128.7	125.5	88.0	529.8	259.0	208.0	155.6	146.1	81.7	92.1
48	8.60	123.1	136.5	144.4	134.0	129.2	125.8	88.0	530.1	259.0	218.8	158.3	136.1	81.5	91.0
49	8.70	120.1	122.4	142.0	132.9	129.3	125.3	88.1	530.8	259.4	240.2	224.1	142.6	83.8	91.1
50	8.79	120.9	136.6	121.2	133.1	129.7	125.3	88.2	530.6	260.4	234.8	158.7	232.7	84.0	90.9
51	8.88	122.5	129.9	140.9	133.5	128.4	126.3	88.3	530.3	258.5	224.3	184.4	145.8	82.8	93.2
52	8.98	126.0	128.2	136.4	133.3	127.9	126.4	88.4	529.6	259.3	203.7	192.4	159.6	83.5	94.9
53	9.07	125.3	127.8	132.8	134.4	129.6	128.2	88.5	529.6	259.7	208.0	194.8	172.8	81.8	91.3
54	9.16	126.8	132.3	136.8	134.7	131.0	127.8	88.5	528.4	259.6	199.9	174.7	158.4	81.4	88.5
55	9.26	133.0	131.7	135.7	133.8	133.2	129.0	88.6	528.4	260.0	172.4	177.5	162.4	83.3	84.3
56	9.35	131.3	134.0	136.0	134.8	130.8	127.5	88.7	529.3	259.6	179.7	169.0	161.9	81.5	89.3
57	9.63	119.7	0.0	0.0	134.5	0.0	0.0	89.0	530.9	259.1	249.7	0.0	0.0	82.3	0.0
58	12.45	119.8	0.0	0.0	133.0	0.0	0.0	91.5	530.8	259.6	270.3	0.0	0.0	90.1	0.0
59	13.85	130.5	0.0	0.0	136.0	0.0	0.0	92.8	528.5	258.5	201.5	0.0	0.0	86.0	0.0
60	14.79	131.0	0.0	0.0	135.9	0.0	0.0	93.7	528.4	258.6	203.0	0.0	0.0	87.8	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=198.27 NU(S)A= 96.49 NU(AV)A=164.34 ST(AV)A=0.00708 ST(AV)/ST(4S)=2.00 F/F(4S)= 5.43
 (ST/ST(4S))/(F/F(4S))=0.369 (F/F(4S))/(ST/ST(4S))*3.0=0.67 (ST/ST(4S))/(F/F(4S))*(1/3)=1.14
 NU(R)A/NU(4S)=2.43 NU(S)A/NU(4S)=1.18 e+(4R)= 229.13 R(4R)= 3.96 H(4R)=14.25

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 14.86

AVERAGE VALUES WITH SL: H(4R)= 13.19

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER= 44HR60-60/20 E/D=0.047 P/E=20.0 ALPHA=60 HYD DIA= 2.667 IN PR=.71 MDDT=0.2065 LBM/SEC
5939. GGE(R)= 925.2 BTU/HR-SQ FT GGE(S)= 270.1 INLET TEMP= 81.6 F TATM= 73.2 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	104.9	0.0	97.4	99.3	0.0	100.7	81.6	918.3	263.3	577.7	0.0	852.8	218.5	0.0	201.9
16	116.0	0.0	100.6	103.3	0.0	102.1	81.7	915.8	261.9	390.7	0.0	709.3	177.6	0.0	188.3
26	110.4	0.0	104.2	97.5	0.0	99.6	81.8	917.0	262.6	468.6	0.0	598.2	244.6	0.0	215.5
35	108.1	0.0	99.1	95.8	0.0	97.7	81.8	917.5	262.7	511.1	0.0	777.7	276.3	0.0	242.9
45	106.8	0.0	111.1	94.2	0.0	95.1	81.9	917.8	262.6	539.2	0.0	459.8	312.4	0.0	291.1
54	108.0	0.0	113.1	95.9	0.0	97.3	82.0	917.6	261.9	515.5	0.0	431.0	275.1	0.0	250.0
63	110.1	0.0	116.4	98.1	0.0	98.0	82.0	917.1	261.2	477.9	0.0	390.2	237.8	0.0	239.3
73	113.4	0.0	120.3	97.7	0.0	98.6	82.1	916.4	261.3	428.1	0.0	350.7	245.0	0.0	231.6
82	117.6	0.0	122.4	97.5	0.0	98.7	82.2	915.5	261.4	377.7	0.0	332.6	249.3	0.0	231.2
91	104.8	0.0	118.8	99.0	0.0	98.2	82.2	918.3	260.8	594.9	0.0	367.1	227.4	0.0	238.8
01	119.6	0.0	0.0	100.2	0.0	0.0	82.3	915.0	260.4	358.5	0.0	0.0	212.7	0.0	0.0
10	115.4	0.0	0.0	101.8	0.0	0.0	82.4	915.9	259.8	405.2	0.0	0.0	193.4	0.0	0.0
20	113.1	0.0	0.0	102.3	0.0	0.0	82.4	916.4	259.6	436.6	0.0	0.0	191.0	0.0	0.0
29	114.4	0.0	0.0	103.0	0.0	0.0	82.5	916.2	259.4	419.6	0.0	0.0	184.9	0.0	0.0
38	116.8	0.0	0.0	104.2	0.0	0.0	82.6	915.6	259.0	390.7	0.0	0.0	174.9	0.0	0.0
48	120.0	0.0	0.0	105.5	0.0	0.0	82.6	914.9	258.5	357.6	0.0	0.0	165.1	0.0	0.0
57	123.3	0.0	0.0	106.3	0.0	0.0	82.7	914.2	258.2	328.8	0.0	0.0	159.8	0.0	0.0
66	126.4	0.0	0.0	106.3	0.0	0.0	82.8	913.5	258.2	305.7	0.0	0.0	160.2	0.0	0.0
76	128.6	0.0	0.0	108.0	0.0	0.0	82.8	913.0	257.6	291.3	0.0	0.0	149.4	0.0	0.0
85	118.8	0.0	0.0	108.8	0.0	0.0	82.9	915.2	257.3	372.1	0.0	0.0	145.0	0.0	0.0
95	122.0	0.0	0.0	108.5	0.0	0.0	83.0	914.5	257.4	341.9	0.0	0.0	147.1	0.0	0.0
04	124.3	0.0	0.0	109.0	0.0	0.0	83.0	914.0	257.2	323.2	0.0	0.0	144.6	0.0	0.0
13	120.5	0.0	0.0	110.4	0.0	0.0	83.1	914.8	256.7	356.9	0.0	0.0	137.2	0.0	0.0
23	119.8	0.0	0.0	111.2	0.0	0.0	83.2	915.0	256.4	364.4	0.0	0.0	133.5	0.0	0.0
32	122.1	0.0	0.0	111.5	0.0	0.0	83.2	914.5	256.3	343.2	0.0	0.0	132.3	0.0	0.0
41	123.9	0.0	0.0	113.0	0.0	0.0	83.3	914.1	255.8	328.4	0.0	0.0	125.6	0.0	0.0
51	127.0	0.0	0.0	113.2	0.0	0.0	83.4	913.4	255.7	305.3	0.0	0.0	125.0	0.0	0.0
60	129.2	0.0	0.0	114.0	0.0	0.0	83.4	912.9	255.4	290.9	0.0	0.0	121.8	0.0	0.0
70	132.1	0.0	0.0	114.0	0.0	0.0	83.5	912.3	255.4	273.7	0.0	0.0	122.1	0.0	0.0
79	126.0	0.0	0.0	114.1	0.0	0.0	83.6	913.6	255.4	313.9	0.0	0.0	121.9	0.0	0.0
88	127.7	0.0	0.0	114.6	0.0	0.0	83.6	913.2	255.2	302.1	0.0	0.0	120.1	0.0	0.0
98	125.1	0.0	0.0	115.7	0.0	0.0	83.7	913.8	254.8	321.7	0.0	0.0	116.0	0.0	0.0
07	122.3	0.0	0.0	115.2	0.0	0.0	83.8	914.4	255.0	345.8	0.0	0.0	118.2	0.0	0.0
16	122.4	0.0	0.0	116.0	0.0	0.0	83.8	914.4	254.7	345.5	0.0	0.0	115.4	0.0	0.0
26	125.5	0.0	0.0	117.0	0.0	0.0	83.9	913.7	254.4	320.0	0.0	0.0	111.9	0.0	0.0
35	127.8	0.0	0.0	118.0	0.0	0.0	83.9	913.2	254.0	303.5	0.0	0.0	108.7	0.0	0.0
45	128.3	0.0	0.0	118.0	0.0	0.0	84.0	913.1	254.0	300.4	0.0	0.0	108.9	0.0	0.0
54	131.5	0.0	0.0	119.0	0.0	0.0	84.1	912.4	253.6	280.3	0.0	0.0	105.8	0.0	0.0
63	135.6	0.0	0.0	118.7	0.0	0.0	84.1	911.5	253.7	258.1	0.0	0.0	107.0	0.0	0.0
73	128.4	0.0	0.0	119.3	0.0	0.0	84.2	913.1	253.5	301.0	0.0	0.0	105.2	0.0	0.0
82	120.7	0.0	0.0	123.5	0.0	0.0	84.4	914.8	252.0	367.1	0.0	0.0	93.9	0.0	0.0
91	122.4	0.0	0.0	124.0	0.0	0.0	85.1	914.4	251.8	356.3	0.0	0.0	94.1	0.0	0.0
00	134.1	0.0	0.0	127.0	0.0	0.0	85.4	911.8	250.8	272.2	0.0	0.0	87.6	0.0	0.0
09	133.6	0.0	0.0	130.1	0.0	0.0	86.1	911.9	249.6	278.5	0.0	0.0	82.3	0.0	0.0
18	131.6	0.0	0.0	132.0	0.0	0.0	86.7	912.4	249.0	294.8	0.0	0.0	79.7	0.0	0.0
27	129.0	0.0	0.0	132.0	0.0	0.0	87.4	912.9	249.0	317.8	0.0	0.0	80.8	0.0	0.0
36	127.9	140.9	143.5	131.7	129.0	123.7	87.6	913.2	248.6	328.4	248.3	236.7	81.7	87.0	99.9
45	123.1	139.3	148.7	131.4	129.3	123.8	87.6	914.0	248.6	373.5	256.2	216.8	82.3	86.4	99.5
54	120.1	121.7	146.6	131.2	128.2	122.4	87.7	914.8	249.0	409.0	389.6	224.9	82.9	89.1	104.0
63	121.3	138.0	119.9	130.6	127.5	125.0	87.8	914.5	250.8	395.0	263.6	412.1	84.8	91.3	97.6
72	124.0	130.2	143.8	130.7	125.6	126.2	87.8	914.1	247.9	365.8	312.4	236.5	83.7	95.1	93.6
81	129.1	129.8	139.3	130.2	128.7	125.8	87.9	913.3	250.2	320.5	315.6	257.2	85.5	88.7	95.6
90	126.9	129.8	134.3	131.2	130.9	127.9	88.0	913.4	250.5	339.6	316.0	285.4	83.9	84.4	90.8
99	131.4	134.1	138.2	130.9	130.0	127.8	88.0	912.4	250.0	304.5	286.7	263.2	84.3	86.2	91.0

5	9.26	142.4	133.9	137.8	132.1	134.7	128.1	88.1	912.2	249.7	242.9	288.2	265.6	82.2	77.5	90.4
6	9.35	138.5	136.8	138.0	132.3	129.7	126.6	88.2	912.9	249.2	262.3	271.6	265.1	81.7	86.9	93.7
7	9.63	125.1	0.0	0.0	131.2	0.0	0.0	88.3	914.9	249.2	360.0	0.0	0.0	84.2	0.0	0.0
8	12.45	120.2	0.0	0.0	128.0	0.0	0.0	90.3	914.9	250.4	441.6	0.0	0.0	95.8	0.0	0.0
9	13.85	133.4	0.0	0.0	132.0	0.0	0.0	91.3	912.0	249.0	312.0	0.0	0.0	88.1	0.0	0.0
0	14.79	134.0	0.0	0.0	132.8	0.0	0.0	92.0	911.8	248.7	312.0	0.0	0.0	87.6	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=321.00 NU(S)A= 97.53 NU(AV)A=246.51 ST(AV)A=0.00526 ST(AV)/ST(4S)=1.71 F/F(4S)= 6.41
 (ST/ST(4S))/(F/F(4S))=0.267 (F/F(4S))/(ST/ST(4S))*3.0=1.28 (ST/ST(4S))/(F/F(4S))*3.0=0.92
 NU(R)A/NU(4S)=2.24 NU(S)A/NU(4S)=0.68 e+(4R)= 465.58 R(4R)= 3.93 H(4R)=21.04

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 19.33

AVERAGE VALUES WITH SL: H(4R)= 19.75

RUN NUMBER= 46HR10-45/10 E/D=0.047 P/E=10.0 ALPHA=45 HYD DIA= 2.667 IN PR= 71 MDO=0.0341 LBM/SEC
 RE= 10832. GGE(R)= 291.3 BTU/HR-SQ FT GGE(S)= 104.0 INLET TEMP= 81.7 F TATM= 77.4 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	105.9	0.0	107.9	98.5	0.0	98.6	81.8	285.0	96.7	172.9	0.0	159.6	84.6	0.0
2	0.16	121.6	0.0	119.4	102.2	0.0	104.4	81.9	281.6	95.9	103.7	0.0	109.8	69.0	0.0
3	0.26	118.8	0.0	121.2	100.6	0.0	102.5	82.0	282.2	96.5	112.1	0.0	105.3	75.8	0.0
4	0.35	114.9	0.0	116.8	97.5	0.0	99.3	82.1	283.1	96.6	126.2	0.0	119.3	91.8	0.0
5	0.45	110.4	0.0	116.3	95.4	0.0	98.2	82.2	284.1	96.5	147.4	0.0	121.9	107.4	0.0
6	0.54	112.1	0.0	110.6	93.5	0.0	97.4	82.4	283.7	96.7	139.3	0.0	146.7	127.3	0.0
7	0.63	113.6	0.0	114.4	93.5	0.0	98.1	82.5	283.3	96.7	132.9	0.0	129.6	128.6	0.0
8	0.73	113.7	0.0	121.6	98.7	0.0	102.1	82.6	283.3	96.3	133.0	0.0	106.0	87.2	0.0
9	0.82	116.4	0.0	122.2	99.7	0.0	181.5	82.7	282.7	95.9	122.5	0.0	104.5	82.4	0.0
10	0.91	114.9	0.0	118.8	101.5	0.0	99.0	82.8	283.1	95.3	128.8	0.0	114.8	74.4	0.0
11	1.01	114.1	0.0	0.0	100.8	0.0	0.0	82.9	283.2	95.5	132.6	0.0	0.0	78.0	0.0
12	1.10	125.7	0.0	0.0	102.0	0.0	0.0	83.0	280.7	95.1	96.0	0.0	0.0	73.2	0.0
13	1.20	124.2	0.0	0.0	102.8	0.0	0.0	83.1	281.0	94.8	99.9	0.0	0.0	70.4	0.0
14	1.29	123.5	0.0	0.0	104.0	0.0	0.0	83.3	281.2	94.4	101.9	0.0	0.0	66.4	0.0
15	1.38	119.7	0.0	0.0	105.6	0.0	0.0	83.4	282.0	93.8	113.2	0.0	0.0	61.6	0.0
16	1.48	116.3	0.0	0.0	106.0	0.0	0.0	83.5	282.8	93.7	125.7	0.0	0.0	60.7	0.0
17	1.57	130.1	0.0	0.0	108.1	0.0	0.0	83.6	279.7	92.9	87.7	0.0	0.0	55.3	0.0
18	1.66	127.4	0.0	0.0	108.2	0.0	0.0	83.7	280.3	92.9	93.5	0.0	0.0	55.3	0.0
19	1.76	126.3	0.0	0.0	109.4	0.0	0.0	83.8	280.6	92.4	96.3	0.0	0.0	52.7	0.0
20	1.85	120.3	0.0	0.0	110.8	0.0	0.0	83.9	281.9	91.9	113.0	0.0	0.0	49.9	0.0
21	1.95	130.2	0.0	0.0	112.5	0.0	0.0	84.1	279.7	91.3	88.3	0.0	0.0	46.8	0.0
22	2.04	133.7	0.0	0.0	113.5	0.0	0.0	84.2	278.9	91.0	82.0	0.0	0.0	45.2	0.0
23	2.13	131.0	0.0	0.0	115.0	0.0	0.0	84.3	279.5	90.4	87.1	0.0	0.0	42.9	0.0
24	2.23	129.9	0.0	0.0	116.0	0.0	0.0	84.4	279.8	90.1	89.5	0.0	0.0	41.5	0.0
25	2.32	125.8	0.0	0.0	116.0	0.0	0.0	84.5	280.7	90.1	99.0	0.0	0.0	41.6	0.0
26	2.41	121.2	0.0	0.0	117.5	0.0	0.0	84.6	281.7	89.5	112.1	0.0	0.0	39.6	0.0
27	2.51	127.0	0.0	0.0	118.5	0.0	0.0	84.7	280.4	89.2	96.5	0.0	0.0	38.4	0.0
28	2.60	133.3	0.0	0.0	119.0	0.0	0.0	84.8	279.0	89.0	83.8	0.0	0.0	37.9	0.0
29	2.70	131.2	0.0	0.0	120.0	0.0	0.0	85.0	279.5	88.6	87.9	0.0	0.0	36.8	0.0
30	2.79	126.3	0.0	0.0	121.0	0.0	0.0	85.1	280.6	88.3	99.0	0.0	0.0	35.7	0.0
31	2.88	124.8	0.0	0.0	122.0	0.0	0.0	85.2	280.9	87.9	103.1	0.0	0.0	34.7	0.0
32	2.98	137.1	0.0	0.0	123.0	0.0	0.0	85.3	278.2	87.5	78.1	0.0	0.0	33.8	0.0
33	3.07	135.7	0.0	0.0	123.5	0.0	0.0	85.4	278.5	87.4	80.5	0.0	0.0	33.3	0.0
34	3.16	133.5	0.0	0.0	124.0	0.0	0.0	85.5	279.0	87.2	84.5	0.0	0.0	32.9	0.0
35	3.26	128.9	0.0	0.0	124.5	0.0	0.0	85.6	280.0	87.0	94.1	0.0	0.0	32.5	0.0
36	3.35	127.4	0.0	0.0	125.0	0.0	0.0	85.8	280.3	86.8	97.8	0.0	0.0	32.1	0.0
37	3.45	130.0	0.0	0.0	125.3	0.0	0.0	85.9	279.7	86.7	92.1	0.0	0.0	31.9	0.0
38	3.54	135.1	0.0	0.0	125.8	0.0	0.0	86.0	278.6	86.5	82.4	0.0	0.0	31.6	0.0
39	3.63	134.9	0.0	0.0	125.8	0.0	0.0	86.1	278.7	86.5	82.9	0.0	0.0	31.6	0.0
40	3.73	132.4	0.0	0.0	126.0	0.0	0.0	86.2	279.2	86.5	87.8	0.0	0.0	31.5	0.0
41	4.01	135.6	0.0	0.0	127.0	0.0	0.0	86.5	278.5	86.1	82.4	0.0	0.0	30.9	0.0
42	4.95	135.6	0.0	0.0	129.0	0.0	0.0	87.7	278.5	85.4	84.2	0.0	0.0	29.9	0.0
43	5.41	134.4	0.0	0.0	130.0	0.0	0.0	88.2	278.8	85.0	87.4	0.0	0.0	29.5	0.0
44	6.35	135.1	0.0	0.0	131.5	0.0	0.0	89.4	278.6	84.5	88.0	0.0	0.0	29.0	0.0
45	7.29	134.2	0.0	0.0	132.4	0.0	0.0	90.5	278.8	84.2	92.0	0.0	0.0	29.0	0.0
46	8.23	120.2	0.0	0.0	132.3	0.0	0.0	91.6	281.9	84.2	142.1	0.0	0.0	29.8	0.0
47	8.58	130.9	143.4	136.5	133.0	129.1	130.1	92.1	279.5	84.2	103.5	78.3	90.5	29.6	32.7
48	8.60	135.8	140.9	135.8	132.9	128.7	129.5	92.1	278.3	84.2	91.6	82.0	91.6	29.7	33.1
49	8.70	132.9	140.4	148.0	132.8	128.3	130.8	92.2	278.9	84.3	98.6	83.2	71.9	29.9	33.6
50	8.79	131.7	135.6	147.4	133.9	126.9	130.4	92.3	279.2	84.3	102.0	92.8	72.9	29.1	35.0
51	8.88	129.1	133.9	146.5	132.5	127.0	130.6	92.4	280.0	84.1	109.8	97.1	74.4	30.2	35.0
52	8.98	125.7	142.4	137.4	131.8	128.0	130.0	92.5	280.7	84.4	121.7	80.9	89.9	30.9	34.2
53	9.07	134.4	140.0	136.0	132.3	127.7	132.4	92.7	278.8	84.6	96.0	84.6	92.4	30.7	34.7
54	9.16	131.4	140.2	149.6	132.6	128.2	129.2	92.8	278.9	84.5	103.8	84.5	70.5	30.5	34.3

55	9.26	129.9	135.5	147.8	132.9	132.7	130.6	92.9	279.5	84.5	108.5	94.2	73.1	30.3	30.5	32.0
56	9.35	129.1	133.3	148.0	132.2	127.9	131.4	93.0	279.9	84.4	111.3	99.7	73.1	30.9	34.7	31.0
57	9.63	133.3	0.0	0.0	131.6	0.0	0.0	93.3	279.0	84.3	100.2	0.0	0.0	31.6	0.0	0.0
58	12.45	136.4	0.0	0.0	131.8	0.0	0.0	96.7	278.3	84.4	100.2	0.0	0.0	34.4	0.0	0.0
59	13.85	138.0	0.0	0.0	133.0	0.0	0.0	98.4	278.0	83.9	100.0	0.0	0.0	34.6	0.0	0.0
60	14.79	139.0	0.0	0.0	134.8	0.0	0.0	99.6	277.8	83.3	100.1	0.0	0.0	33.6	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 96.50 NU(S)A= 31.39 NU(AV)A= 74.79 ST(AV)A=0.00971 ST(AV)/ST(4S)=2.20 F/F(4S)= 4.10
 (ST/ST(4S))/(F/F(4S))=0.538 (F/F(4S))/(ST/ST(4S))*3.0=0.36 (ST/ST(4S))/(F/F(4S))*1/3=1.38
 NU(R)A/NU(4S)=2.85 NU(S)A/NU(4S)=0.93 e+(4R)= 75.15 R(4R)= 4.04 H(4R)= 9.31

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 9.15

AVERAGE VALUES WITH SL: H(4R)= 8.46

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 47HR30-45/10 E/D=0.047 P/E=10.0 ALPHA=45 HYD DIA= 2.667 IN PR=.71 MDOT=0.1020 LBM/SEC
2357. GGE(R)= 581.2 BTU/HR-SQ FT GGE(S)= 197.2 INLET TEMP= 84.9 F TATM= 78.1 F PATM= 14.6 PSIA

/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	104.6	0.0	105.3	101.0	0.0	96.2	85.0	575.4	190.7	426.3	0.0	411.7	173.4	0.0	246.3
16	120.5	0.0	109.3	104.3	0.0	95.1	85.0	571.9	189.5	234.7	0.0	343.0	143.5	0.0	275.4
26	114.4	0.0	113.4	99.9	0.0	97.0	85.1	573.3	190.0	284.9	0.0	295.0	186.6	0.0	232.8
35	113.2	0.0	114.1	98.2	0.0	97.0	85.2	573.5	190.2	298.1	0.0	288.8	213.4	0.0	234.7
45	109.9	0.0	117.7	98.0	0.0	99.7	85.3	574.2	190.1	339.4	0.0	257.7	217.9	0.0	192.6
54	113.4	0.0	112.4	99.2	0.0	100.6	85.4	573.5	189.7	297.6	0.0	308.6	199.8	0.0	181.0
63	113.8	0.0	117.9	99.4	0.0	101.9	85.5	573.4	189.5	294.2	0.0	257.0	197.7	0.0	167.2
73	114.4	0.0	126.8	99.1	0.0	101.0	85.6	573.3	189.6	288.9	0.0	202.0	203.4	0.0	178.4
82	118.6	0.0	128.2	100.0	0.0	102.0	85.6	572.3	189.3	252.3	0.0	195.4	191.5	0.0	168.1
91	116.5	0.0	123.7	101.7	0.0	102.0	85.7	572.8	188.7	270.4	0.0	219.2	171.6	0.0	168.4
01	114.3	0.0	0.0	101.6	0.0	0.0	85.8	573.3	188.7	292.3	0.0	0.0	173.6	0.0	0.0
10	125.4	0.0	0.0	101.8	0.0	0.0	85.9	570.8	188.6	209.9	0.0	0.0	172.2	0.0	0.0
20	122.8	0.0	0.0	102.8	0.0	0.0	86.0	571.4	188.3	225.4	0.0	0.0	162.5	0.0	0.0
29	123.2	0.0	0.0	104.0	0.0	0.0	86.1	571.3	187.8	223.4	0.0	0.0	152.1	0.0	0.0
38	120.2	0.0	0.0	105.5	0.0	0.0	86.1	572.0	187.3	243.9	0.0	0.0	140.5	0.0	0.0
48	114.9	0.0	0.0	106.6	0.0	0.0	86.2	573.1	186.9	290.2	0.0	0.0	133.2	0.0	0.0
57	131.7	0.0	0.0	106.4	0.0	0.0	86.3	569.4	187.0	182.1	0.0	0.0	135.1	0.0	0.0
66	126.9	0.0	0.0	107.3	0.0	0.0	86.4	570.5	186.6	204.5	0.0	0.0	129.6	0.0	0.0
76	126.5	0.0	0.0	109.4	0.0	0.0	86.5	570.6	185.9	206.9	0.0	0.0	117.7	0.0	0.0
85	119.7	0.0	0.0	110.4	0.0	0.0	86.6	572.1	185.5	250.6	0.0	0.0	113.0	0.0	0.0
95	133.2	0.0	0.0	111.0	0.0	0.0	86.7	569.1	185.3	177.4	0.0	0.0	110.4	0.0	0.0
04	135.2	0.0	0.0	112.0	0.0	0.0	86.7	568.7	184.9	170.2	0.0	0.0	106.2	0.0	0.0
13	130.6	0.0	0.0	113.0	0.0	0.0	86.8	569.7	184.6	188.8	0.0	0.0	102.3	0.0	0.0
23	130.0	0.0	0.0	114.5	0.0	0.0	86.9	569.8	184.0	191.8	0.0	0.0	96.7	0.0	0.0
32	125.8	0.0	0.0	114.1	0.0	0.0	87.0	570.7	184.2	213.3	0.0	0.0	98.5	0.0	0.0
41	119.5	0.0	0.0	115.5	0.0	0.0	87.1	572.1	183.7	255.8	0.0	0.0	93.7	0.0	0.0
51	125.0	0.0	0.0	116.0	0.0	0.0	87.2	570.9	183.5	218.7	0.0	0.0	92.2	0.0	0.0
60	133.2	0.0	0.0	116.5	0.0	0.0	87.2	569.1	183.3	179.5	0.0	0.0	90.8	0.0	0.0
70	131.5	0.0	0.0	117.3	0.0	0.0	87.3	569.5	183.0	186.8	0.0	0.0	88.5	0.0	0.0
79	125.6	0.0	0.0	118.5	0.0	0.0	87.4	570.8	182.6	216.6	0.0	0.0	85.1	0.0	0.0
88	125.1	0.0	0.0	119.0	0.0	0.0	87.5	570.9	182.4	220.0	0.0	0.0	83.9	0.0	0.0
98	140.8	0.0	0.0	120.0	0.0	0.0	87.6	567.4	182.1	154.5	0.0	0.0	81.4	0.0	0.0
07	136.2	0.0	0.0	121.0	0.0	0.0	87.7	568.5	181.7	169.7	0.0	0.0	79.0	0.0	0.0
16	133.6	0.0	0.0	121.6	0.0	0.0	87.7	569.0	181.5	179.7	0.0	0.0	77.7	0.0	0.0
26	127.9	0.0	0.0	122.0	0.0	0.0	87.8	570.3	181.3	206.1	0.0	0.0	76.9	0.0	0.0
35	128.3	0.0	0.0	123.0	0.0	0.0	87.9	570.2	181.0	204.4	0.0	0.0	74.7	0.0	0.0
45	133.0	0.0	0.0	123.0	0.0	0.0	88.0	569.2	181.0	183.1	0.0	0.0	74.9	0.0	0.0
54	136.6	0.0	0.0	124.0	0.0	0.0	88.1	568.4	180.6	169.6	0.0	0.0	72.8	0.0	0.0
63	135.4	0.0	0.0	124.4	0.0	0.0	88.2	568.6	180.5	174.3	0.0	0.0	72.1	0.0	0.0
73	131.4	0.0	0.0	124.8	0.0	0.0	88.3	569.5	180.3	191.0	0.0	0.0	71.4	0.0	0.0
81	135.4	0.0	0.0	125.0	0.0	0.0	88.5	568.6	180.3	175.4	0.0	0.0	71.5	0.0	0.0
95	135.2	0.0	0.0	126.6	0.0	0.0	89.4	568.7	179.7	179.2	0.0	0.0	69.7	0.0	0.0
41	133.8	0.0	0.0	127.0	0.0	0.0	89.8	569.0	179.5	186.6	0.0	0.0	69.6	0.0	0.0
635	133.9	0.0	0.0	128.8	0.0	0.0	90.6	569.0	178.9	189.5	0.0	0.0	67.5	0.0	0.0
729	133.4	0.0	0.0	128.3	0.0	0.0	91.5	569.1	179.1	195.4	0.0	0.0	70.0	0.0	0.0
823	133.0	0.0	0.0	127.0	0.0	0.0	92.3	569.2	179.5	201.1	0.0	0.0	74.4	0.0	0.0
858	133.5	144.7	135.9	125.9	122.9	119.1	92.6	569.1	179.6	200.1	157.0	189.0	77.5	85.2	97.4
860	137.9	139.3	136.3	126.2	121.2	118.8	92.6	568.0	179.5	180.3	174.9	187.0	76.8	90.3	98.6
870	133.0	136.8	151.0	125.1	120.3	119.8	92.7	569.2	180.0	203.1	185.5	140.3	79.8	93.7	95.6
879	131.2	132.7	143.4	127.0	121.3	123.2	92.8	569.5	180.3	213.1	205.1	161.7	75.7	91.1	85.2
888	126.6	132.8	145.2	126.3	121.6	122.6	92.9	570.6	178.9	243.2	205.4	156.7	77.0	89.5	86.6
898	124.4	143.3	137.1	125.5	121.9	119.5	93.0	571.2	179.9	261.2	163.0	185.9	79.4	89.2	97.5
907	135.8	137.8	134.9	126.6	122.6	119.1	93.1	568.5	180.3	191.0	182.5	195.2	77.3	87.7	99.6
916	127.5	137.4	153.2	126.7	122.3	119.9	93.2	569.5	180.3	237.9	184.8	136.2	77.3	88.9	96.9

9.26	133.3	133.2	147.8	126.5	128.7	121.4	93.2	569.6	180.3	203.9	204.6	149.9	77.7	73.1	92.0
9.35	133.3	131.9	148.0	127.1	123.9	123.0	93.3	570.0	180.1	204.8	212.1	149.6	76.4	84.4	87.2
9.63	133.5	0.0	0.0	125.5	0.0	0.0	93.6	569.1	180.1	204.5	0.0	0.0	80.9	0.0	0.0
12.45	137.4	0.0	0.0	125.5	0.0	0.0	96.1	568.2	180.1	196.6	0.0	0.0	87.5	0.0	0.0
13.85	138.3	0.0	0.0	128.5	0.0	0.0	97.4	568.0	179.0	197.9	0.0	0.0	82.0	0.0	0.0
14.79	139.0	0.0	0.0	130.0	0.0	0.0	98.2	567.8	178.5	198.3	0.0	0.0	80.0	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 U(R)A=199.55 NU(S)A= 76.98 NU(AV)A=158.70 ST(AV)A=0.00690 ST(AV)/ST(4S)=1.95 F/F(4S)= 5.21
 ST/ST(4S)/(F/F(4S))=0.374 (F/F(4S))/(ST/ST(4S))*3.0=0.70 (ST/ST(4S))/(F/F(4S))*((1/3))=1.12
 U(R)A/NU(4S)=2.46 NU(S)A/NU(4S)=0.95 e+(4R)= 222.54 R(4R)= 4.10 H(4R)=14.44

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 14.24

AVERAGE VALUES WITH SL: H(4R)= 12.93

RUN NUMBER= 48HR60-45/10 E/D=0.047 P/E=10.0 ALPHA=45 HYD DIA= 2.667 IN PR= 71 MDDT=0.2013 LBM/SEC
RE= 63893. GGE(R)= 979.3 BTU/HR-SQ FT GGE(S)= 410.6 INLET TEMP= 85.0 F TATM= 76.8 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	104.6	0.0	102.6	103.3	0.0	104.0	85.1	973.2	403.5	724.4	0.0	807.0	322.6	0.0
2	0.16	119.4	0.0	107.4	105.8	0.0	104.5	85.1	969.9	402.7	411.7	0.0	633.6	284.1	0.0
3	0.26	111.9	0.0	111.9	101.9	0.0	103.0	85.2	971.5	402.8	529.5	0.0	529.5	351.5	0.0
4	0.35	112.3	0.0	112.9	100.5	0.0	101.5	85.3	971.5	402.8	523.0	0.0	511.7	385.4	0.0
5	0.45	110.1	0.0	117.4	97.8	0.0	99.0	85.4	971.9	403.0	571.4	0.0	441.2	471.4	0.0
6	0.54	115.2	0.0	112.1	99.2	0.0	100.0	85.4	970.8	402.5	474.4	0.0	529.5	425.5	0.0
7	0.63	114.9	0.0	119.5	101.8	0.0	101.0	85.5	970.9	401.6	480.4	0.0	415.4	358.7	0.0
8	0.73	115.4	0.0	129.1	100.0	0.0	103.0	85.6	970.8	402.2	473.5	0.0	324.4	406.1	0.0
9	0.82	120.1	0.0	130.9	102.9	0.0	105.3	85.7	969.7	401.2	409.4	0.0	311.7	338.6	0.0
10	0.91	117.8	0.0	126.7	103.0	0.0	103.9	85.8	970.3	401.1	440.0	0.0	344.4	338.1	0.0
11	1.01	116.2	0.0	0.0	105.3	0.0	0.0	85.8	970.6	400.3	464.4	0.0	0.0	298.8	0.0
12	1.10	127.1	0.0	0.0	106.4	0.0	0.0	85.9	968.2	399.9	341.5	0.0	0.0	283.6	0.0
13	1.20	123.7	0.0	0.0	107.0	0.0	0.0	86.0	969.0	399.7	373.2	0.0	0.0	276.4	0.0
14	1.29	125.0	0.0	0.0	108.0	0.0	0.0	86.1	968.7	399.3	361.4	0.0	0.0	264.5	0.0
15	1.38	122.2	0.0	0.0	109.0	0.0	0.0	86.1	969.3	399.0	390.4	0.0	0.0	253.5	0.0
16	1.48	115.7	0.0	0.0	110.8	0.0	0.0	86.2	970.7	398.3	478.2	0.0	0.0	234.4	0.0
17	1.57	133.8	0.0	0.0	112.0	0.0	0.0	86.3	966.7	397.9	295.5	0.0	0.0	224.8	0.0
18	1.66	128.5	0.0	0.0	112.8	0.0	0.0	86.4	967.9	397.6	333.6	0.0	0.0	218.5	0.0
19	1.76	128.4	0.0	0.0	113.8	0.0	0.0	86.5	967.9	397.2	335.0	0.0	0.0	210.9	0.0
20	1.85	120.1	0.0	0.0	115.0	0.0	0.0	86.5	969.7	396.8	419.3	0.0	0.0	202.3	0.0
21	1.95	136.9	0.0	0.0	116.0	0.0	0.0	86.6	966.0	396.5	278.8	0.0	0.0	195.8	0.0
22	2.04	136.8	0.0	0.0	117.0	0.0	0.0	86.7	966.1	396.1	279.7	0.0	0.0	189.6	0.0
23	2.13	132.3	0.0	0.0	117.7	0.0	0.0	86.8	967.1	395.8	308.1	0.0	0.0	185.7	0.0
24	2.23	132.0	0.0	0.0	120.0	0.0	0.0	86.9	967.1	395.0	310.7	0.0	0.0	172.8	0.0
25	2.32	127.2	0.0	0.0	117.7	0.0	0.0	86.9	968.2	395.8	348.7	0.0	0.0	186.6	0.0
26	2.41	119.5	0.0	0.0	120.0	0.0	0.0	87.0	969.9	395.0	432.8	0.0	0.0	173.6	0.0
27	2.51	120.0	0.0	0.0	121.6	0.0	0.0	87.1	969.8	394.4	427.2	0.0	0.0	165.7	0.0
28	2.60	135.0	0.0	0.0	122.0	0.0	0.0	87.2	966.5	394.3	292.9	0.0	0.0	164.1	0.0
29	2.70	133.4	0.0	0.0	122.8	0.0	0.0	87.2	966.8	394.0	303.6	0.0	0.0	160.6	0.0
30	2.79	126.0	0.0	0.0	123.0	0.0	0.0	87.3	968.4	393.9	362.9	0.0	0.0	160.0	0.0
31	2.88	126.5	0.0	0.0	125.0	0.0	0.0	87.4	968.3	393.2	358.9	0.0	0.0	151.5	0.0
32	2.98	145.3	0.0	0.0	126.0	0.0	0.0	87.5	964.2	392.9	241.6	0.0	0.0	147.8	0.0
33	3.07	138.8	0.0	0.0	126.0	0.0	0.0	87.6	965.6	392.9	273.0	0.0	0.0	148.0	0.0
34	3.16	135.4	0.0	0.0	127.0	0.0	0.0	87.6	966.4	392.5	293.0	0.0	0.0	144.4	0.0
35	3.26	128.4	0.0	0.0	127.3	0.0	0.0	87.7	967.9	392.4	344.5	0.0	0.0	143.5	0.0
36	3.35	130.5	0.0	0.0	128.4	0.0	0.0	87.8	967.5	392.0	328.0	0.0	0.0	139.8	0.0
37	3.45	135.0	0.0	0.0	129.0	0.0	0.0	87.9	966.5	391.8	296.9	0.0	0.0	137.9	0.0
38	3.54	139.9	0.0	0.0	129.0	0.0	0.0	87.9	965.4	391.8	269.0	0.0	0.0	138.2	0.0
39	3.63	137.4	0.0	0.0	129.5	0.0	0.0	88.0	965.9	391.6	283.2	0.0	0.0	136.7	0.0
40	3.73	131.8	0.0	0.0	130.0	0.0	0.0	88.1	967.2	391.4	320.3	0.0	0.0	135.2	0.0
41	4.01	137.7	0.0	0.0	131.0	0.0	0.0	88.3	965.9	391.1	283.1	0.0	0.0	132.6	0.0
42	4.95	137.4	0.0	0.0	132.0	0.0	0.0	89.1	965.9	390.7	289.1	0.0	0.0	131.6	0.0
43	5.41	136.3	0.0	0.0	132.0	0.0	0.0	89.5	966.2	390.7	298.2	0.0	0.0	132.8	0.0
44	6.35	136.0	0.0	0.0	132.8	0.0	0.0	90.3	966.2	390.4	304.8	0.0	0.0	132.4	0.0
45	7.29	135.5	0.0	0.0	132.2	0.0	0.0	91.1	966.4	390.6	313.2	0.0	0.0	136.8	0.0
46	8.23	136.0	0.0	0.0	131.0	0.0	0.0	91.8	966.2	391.1	314.8	0.0	0.0	143.7	0.0
47	8.58	137.5	147.9	137.5	129.7	126.2	120.6	92.1	965.9	391.1	306.2	249.1	306.2	149.7	165.1
48	8.60	141.3	139.5	139.6	128.3	124.3	121.1	92.2	964.8	391.4	282.3	293.0	292.4	155.7	175.1
49	8.70	134.8	133.1	153.4	128.1	122.4	120.3	92.2	966.4	391.9	326.4	340.0	227.2	157.1	186.7
50	8.79	132.6	132.4	138.7	129.5	124.5	125.2	92.3	966.9	392.9	345.0	346.7	299.6	151.9	175.5
51	8.88	127.8	134.0	143.8	127.3	124.6	126.1	92.4	968.1	390.9	393.0	334.4	270.7	160.8	174.4
52	8.98	127.3	146.1	137.3	129.7	127.7	124.7	92.5	968.6	392.1	399.7	259.5	310.5	151.4	160.0
53	9.07	141.0	139.5	137.0	131.8	128.3	123.3	92.5	965.1	392.0	286.2	295.4	312.0	143.6	157.6
54	9.16	134.3	137.6	155.8	130.5	126.9	124.2	92.6	966.6	391.9	333.2	308.8	219.8	148.7	164.4
55	9.26	142.7	133.2	148.2	130.8	131.9	125.0	92.7	966.9	391.8	277.6	343.0	250.3	147.8	143.4
56	9.35	138.6	133.4	148.5	130.1	126.6	125.5	92.8	967.6	391.8	303.0	342.2	249.4	150.8	166.5
57	9.63	140.2	0.0	0.0	129.0	0.0	0.0	93.0	966.4	391.8	294.2	0.0	0.0	156.3	0.0
58	12.45	139.6	0.0	0.0	129.5	0.0	0.0	95.3	965.5	391.6	312.1	0.0	0.0	164.0	0.0
59	13.85	140.3	0.0	0.0	132.0	0.0	0.0	96.5	965.3	390.7	314.8	0.0	0.0	157.2	0.0
60	14.79	141.0	0.0	0.0	133.5	0.0	0.0	97.3	965.1	390.2	314.9	0.0	0.0	153.7	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
NU(R)A=313.05 NU(S)A=147.02 NU(AV)A=257.71 ST(AV)A=0.00567 ST(AV)/ST(4S)=1.84 F/F(4S)= 5.98
(ST/ST(4S))/(F/F(4S))=0.307 (F/F(4S))/(ST/ST(4S))*3.0=0.97 (ST/ST(4S))/(F/F(4S))*3.0=1.01
NU(R)A/NU(4S)=2.24 NU(S)A/NU(4S)=1.05 e+(4R)= 436.30 R(4R)= 4.15 H(4R)=18.25

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 18.47

AVERAGE VALUES WITH SL: H(4R)= 16.73

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 50HR10-45/20 E/D=0.047 P/E=20.0 ALPHA=45 HYD DIA= 2.667 IN PR=.71 MDDT=0.0340 LBM/SEC
10859. GGE(R)= 270.8 BTU/HR-SQ FT GGE(S)= 94.6 INLET TEMP= 78.6 F TATM= 72.6 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	111.8	0.0	105.9	92.8	0.0	93.6	78.7	262.1	87.7	116.3	0.0	141.6	91.2	0.0	86.2
16	119.9	0.0	115.0	97.1	0.0	98.1	78.8	260.4	86.7	93.1	0.0	105.7	69.4	0.0	66.1
26	115.5	0.0	114.5	95.6	0.0	96.0	78.9	261.3	87.3	104.9	0.0	107.8	76.5	0.0	74.7
35	110.1	0.0	110.4	91.3	0.0	93.1	79.0	262.5	87.7	124.0	0.0	122.8	104.7	0.0	91.4
45	105.7	0.0	112.1	88.7	0.0	91.8	79.1	263.5	87.8	145.4	0.0	117.2	134.8	0.0	101.7
54	107.1	0.0	112.4	88.5	0.0	90.7	79.2	263.2	87.4	138.5	0.0	116.4	137.3	0.0	112.0
63	107.7	0.0	113.7	89.9	0.0	90.5	79.3	263.0	86.9	136.0	0.0	112.3	119.8	0.0	113.4
73	108.0	0.0	115.1	94.1	0.0	94.5	79.4	263.0	86.9	135.0	0.0	108.1	86.7	0.0	84.4
82	110.4	0.0	116.3	95.5	0.0	95.1	79.5	262.5	86.4	124.7	0.0	104.7	79.2	0.0	81.3
91	113.0	0.0	113.5	95.7	0.0	93.4	79.6	261.9	86.3	115.1	0.0	113.4	78.7	0.0	91.8
01	116.1	0.0	0.0	96.0	0.0	0.0	79.7	261.2	86.2	105.3	0.0	0.0	77.6	0.0	0.0
10	118.8	0.0	0.0	97.0	0.0	0.0	79.8	260.6	85.8	98.1	0.0	0.0	73.2	0.0	0.0
20	122.0	0.0	0.0	98.0	0.0	0.0	79.9	259.9	85.5	90.6	0.0	0.0	69.3	0.0	0.0
1.29	124.6	0.0	0.0	98.3	0.0	0.0	80.0	259.3	85.4	85.3	0.0	0.0	68.5	0.0	0.0
1.38	119.4	0.0	0.0	99.8	0.0	0.0	80.1	260.5	84.8	97.2	0.0	0.0	63.2	0.0	0.0
1.48	114.3	0.0	0.0	100.1	0.0	0.0	80.2	261.6	84.7	112.5	0.0	0.0	62.5	0.0	0.0
1.57	129.3	0.0	0.0	101.5	0.0	0.0	80.3	258.3	84.2	77.3	0.0	0.0	58.3	0.0	0.0
1.66	126.3	0.0	0.0	101.8	0.0	0.0	80.4	259.0	84.1	82.7	0.0	0.0	57.7	0.0	0.0
1.76	123.1	0.0	0.0	103.6	0.0	0.0	80.5	259.7	83.4	89.4	0.0	0.0	53.0	0.0	0.0
1.85	122.8	0.0	0.0	104.6	0.0	0.0	80.6	259.7	83.1	90.2	0.0	0.0	50.8	0.0	0.0
1.95	122.7	0.0	0.0	105.3	0.0	0.0	80.7	259.7	82.8	90.7	0.0	0.0	49.4	0.0	0.0
2.04	123.8	0.0	0.0	106.0	0.0	0.0	80.8	259.5	82.6	88.5	0.0	0.0	48.1	0.0	0.0
2.13	125.5	0.0	0.0	106.4	0.0	0.0	80.9	259.1	82.4	85.2	0.0	0.0	47.4	0.0	0.0
2.23	127.2	0.0	0.0	108.0	0.0	0.0	81.0	258.8	81.9	82.1	0.0	0.0	44.5	0.0	0.0
2.32	123.1	0.0	0.0	107.3	0.0	0.0	81.1	259.7	82.1	90.6	0.0	0.0	46.0	0.0	0.0
2.41	118.6	0.0	0.0	108.0	0.0	0.0	81.2	260.7	81.9	102.1	0.0	0.0	44.8	0.0	0.0
2.51	125.0	0.0	0.0	110.4	0.0	0.0	81.3	259.2	81.0	86.9	0.0	0.0	40.8	0.0	0.0
2.60	127.7	0.0	0.0	111.0	0.0	0.0	81.4	258.6	80.8	81.8	0.0	0.0	40.0	0.0	0.0
2.70	125.5	0.0	0.0	111.8	0.0	0.0	81.6	259.1	80.5	86.3	0.0	0.0	38.9	0.0	0.0
2.79	125.8	0.0	0.0	112.0	0.0	0.0	81.7	259.1	80.4	85.8	0.0	0.0	38.8	0.0	0.0
2.88	127.0	0.0	0.0	113.0	0.0	0.0	81.8	258.8	80.1	83.7	0.0	0.0	37.5	0.0	0.0
2.98	128.4	0.0	0.0	113.5	0.0	0.0	81.9	258.5	79.9	81.2	0.0	0.0	36.9	0.0	0.0
3.07	130.4	0.0	0.0	113.4	0.0	0.0	82.0	258.1	79.9	77.9	0.0	0.0	37.2	0.0	0.0
3.16	131.7	0.0	0.0	114.4	0.0	0.0	82.1	257.8	79.6	75.9	0.0	0.0	36.0	0.0	0.0
3.26	127.0	0.0	0.0	115.0	0.0	0.0	82.2	258.8	79.3	84.4	0.0	0.0	35.3	0.0	0.0
3.35	125.8	0.0	0.0	115.0	0.0	0.0	82.3	259.1	79.3	87.0	0.0	0.0	35.4	0.0	0.0
3.45	128.0	0.0	0.0	116.0	0.0	0.0	82.4	258.6	79.0	82.8	0.0	0.0	34.3	0.0	0.0
3.54	131.7	0.0	0.0	116.2	0.0	0.0	82.5	257.8	78.9	76.5	0.0	0.0	34.2	0.0	0.0
3.63	129.8	0.0	0.0	116.8	0.0	0.0	82.6	258.2	78.7	79.9	0.0	0.0	33.6	0.0	0.0
3.73	129.2	0.0	0.0	117.0	0.0	0.0	82.7	258.3	78.6	81.1	0.0	0.0	33.5	0.0	0.0
4.01	131.2	0.0	0.0	121.0	0.0	0.0	83.0	257.9	77.2	78.1	0.0	0.0	29.6	0.0	0.0
4.95	132.4	0.0	0.0	122.0	0.0	0.0	84.0	257.6	76.8	77.6	0.0	0.0	29.5	0.0	0.0
5.41	132.3	0.0	0.0	124.6	0.0	0.0	84.5	257.6	75.9	78.5	0.0	0.0	27.6	0.0	0.0
6.35	132.7	0.0	0.0	128.0	0.0	0.0	85.6	257.5	74.7	79.4	0.0	0.0	25.6	0.0	0.0
7.29	131.2	0.0	0.0	127.5	0.0	0.0	86.6	257.9	74.8	83.9	0.0	0.0	26.5	0.0	0.0
8.23	130.8	0.0	0.0	127.5	0.0	0.0	87.6	258.0	74.8	86.5	0.0	0.0	27.2	0.0	0.0
8.58	127.4	141.8	134.4	127.9	124.6	124.6	88.0	258.6	74.9	95.0	69.6	80.7	27.2	29.6	29.6
8.60	129.9	138.2	134.1	127.9	123.7	125.2	88.0	258.0	74.9	89.2	74.4	81.0	27.2	30.4	29.1
8.70	131.3	135.7	144.9	128.5	123.5	125.0	88.1	257.7	74.8	86.4	78.4	65.7	26.8	30.6	29.3
8.79	133.8	133.6	143.5	129.7	124.4	126.5	88.2	257.2	74.7	81.7	82.0	67.3	26.1	29.9	28.3
8.88	131.1	135.0	143.1	127.8	124.0	128.1	88.3	257.9	74.7	87.2	80.0	68.1	27.4	30.3	27.2
8.98	126.5	136.3	141.4	127.4	124.2	127.0	88.4	259.0	74.9	98.4	78.3	70.7	27.8	30.3	28.0
9.07	133.5	136.9	139.9	127.6	124.6	127.7	88.5	257.4	75.2	82.8	77.0	72.5	27.8	30.1	27.8
9.16	128.3	139.7	142.8	128.2	124.8	126.7	88.6	258.0	75.0	94.1	73.1	68.9	27.4	30.0	28.5
9.26	125.7	134.8	142.9	128.3	128.4	126.8	88.7	258.8	75.0	101.3	81.2	69.1	27.4	27.3	28.5
9.35	126.6	132.5	143.0	127.6	124.8	126.5	88.8	258.8	74.9	99.1	85.7	69.1	27.9	30.1	28.8
9.63	132.3	0.0	0.0	126.4	0.0	0.0	89.1	257.6	75.1	86.3	0.0	0.0	29.1	0.0	0.0
12.45	133.4	0.0	0.0	127.5	0.0	0.0	92.2	257.4	74.8	89.9	0.0	0.0	30.5	0.0	0.0
13.85	131.2	0.0	0.0	129.0	0.0	0.0	93.8	257.9	74.3	98.8	0.0	0.0	30.2	0.0	0.0
14.79	132.0	0.0	0.0	129.5	0.0	0.0	94.8	257.7	74.1	99.2	0.0	0.0	30.6	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 86.27 NU(S)A= 31.34 NU(AV)A= 67.96 ST(AV)A= 0.00880 ST(AV)/ST(4S)= 2.00 F/F(4S)= 3.27
 (ST/ST(4S))/(F/F(4S))= 0.611 (F/F(4S))/(ST/ST(4S))*3.0= 0.41 (ST/ST(4S))/(F/F(4S))* (1/3)= 1.35
 NU(R)A/NU(4S)= 2.55 NU(S)A/NU(4S)= 0.92 e+(4R)= 66.52 R(4R)= 4.94 H(4R)= 9.21

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 9.02

AVERAGE VALUES WITH SL: H(4R)= 8.28

RUN NUMBER= 51HR30-45/20 E/D=0.047 P/E=20.0 ALPHA=45 HYD DIA= 2.667 IN PR= 71 MDOT=0.1010 LBM/SEC
 RE= 32218. GGE(R)= 506.5 BTU/HR-SQ FT GGE(S)= 289.1 INLET TEMP= 81.0 F TATM= 74.0 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	
1	0.07	110.4	0.0	98.9	101.5	0.0	96.6	81.1	498.4	280.9	248.8	0.0	409.2	200.9	0.0	
2	0.16	116.1	0.0	101.3	104.1	0.0	95.1	81.1	497.2	279.9	208.2	0.0	361.2	178.3	0.0	
3	0.26	111.4	0.0	104.7	100.4	0.0	97.0	81.2	498.2	280.2	241.7	0.0	310.7	213.6	0.0	
4	0.35	109.5	0.0	106.4	98.8	0.0	98.0	81.3	498.6	280.4	258.9	0.0	290.9	235.0	0.0	
5	0.45	105.4	0.0	108.5	97.4	0.0	101.1	81.4	499.5	280.8	304.5	0.0	269.7	256.9	0.0	
6	0.54	106.4	0.0	109.5	98.6	0.0	100.7	81.5	499.3	280.3	293.2	0.0	260.7	239.8	0.0	
7	0.63	105.9	0.0	111.6	99.6	0.0	101.3	81.6	499.4	279.8	300.2	0.0	243.2	227.0	0.0	
8	0.73	106.2	0.0	113.5	99.0	0.0	99.8	81.6	499.4	280.1	297.5	0.0	229.3	236.0	0.0	
9	0.82	109.0	0.0	115.5	101.8	0.0	100.4	81.7	498.8	279.0	267.5	0.0	216.0	203.3	0.0	
10	0.91	111.7	0.0	113.6	101.8	0.0	98.0	81.8	498.2	279.0	243.7	0.0	229.2	204.1	0.0	
11	1.01	115.1	0.0	0.0	102.7	0.0	0.0	81.9	497.4	278.7	219.0	0.0	0.0	195.9	0.0	
12	1.10	117.9	0.0	0.0	103.0	0.0	0.0	82.0	496.8	278.6	202.2	0.0	0.0	193.7	0.0	
13	1.20	121.4	0.0	0.0	105.1	0.0	0.0	82.1	496.0	277.9	184.3	0.0	0.0	176.3	0.0	
14	1.29	124.6	0.0	0.0	105.0	0.0	0.0	82.1	495.3	277.9	170.5	0.0	0.0	177.7	0.0	
15	1.38	117.4	0.0	0.0	107.2	0.0	0.0	82.2	496.9	277.1	206.4	0.0	0.0	162.1	0.0	
16	1.48	108.9	0.0	0.0	108.2	0.0	0.0	82.3	498.8	276.7	274.1	0.0	0.0	156.2	0.0	
17	1.57	123.9	0.0	0.0	108.8	0.0	0.0	82.4	495.5	276.5	174.4	0.0	0.0	153.0	0.0	
18	1.66	119.8	0.0	0.0	109.4	0.0	0.0	82.5	496.4	276.3	194.3	0.0	0.0	149.9	0.0	
19	1.76	118.1	0.0	0.0	110.2	0.0	0.0	82.6	496.7	276.0	204.1	0.0	0.0	145.8	0.0	
20	1.85	118.5	0.0	0.0	111.5	0.0	0.0	82.6	496.7	275.6	202.3	0.0	0.0	139.4	0.0	
21	1.95	119.0	0.0	0.0	112.8	0.0	0.0	82.7	496.6	275.1	199.9	0.0	0.0	133.6	0.0	
22	2.04	120.6	0.0	0.0	114.0	0.0	0.0	82.8	496.2	274.7	191.7	0.0	0.0	128.6	0.0	
23	2.13	122.9	0.0	0.0	115.0	0.0	0.0	82.9	495.7	274.3	180.9	0.0	0.0	124.7	0.0	
24	2.23	125.2	0.0	0.0	116.2	0.0	0.0	83.0	495.2	273.9	171.2	0.0	0.0	120.3	0.0	
25	2.32	119.7	0.0	0.0	115.5	0.0	0.0	83.1	496.4	274.1	197.7	0.0	0.0	123.3	0.0	
26	2.41	112.3	0.0	0.0	117.0	0.0	0.0	83.1	498.0	273.6	249.2	0.0	0.0	117.9	0.0	
27	2.51	120.0	0.0	0.0	118.0	0.0	0.0	83.2	496.3	273.2	196.9	0.0	0.0	114.6	0.0	
28	2.60	122.1	0.0	0.0	118.5	0.0	0.0	83.3	495.9	273.0	186.5	0.0	0.0	113.2	0.0	
29	2.70	121.4	0.0	0.0	119.4	0.0	0.0	83.4	496.0	272.7	190.3	0.0	0.0	110.5	0.0	
30	2.79	123.0	0.0	0.0	119.2	0.0	0.0	83.5	495.7	272.8	182.9	0.0	0.0	111.3	0.0	
31	2.88	124.6	0.0	0.0	121.0	0.0	0.0	83.6	495.3	272.1	176.0	0.0	0.0	106.0	0.0	
32	2.98	126.4	0.0	0.0	122.0	0.0	0.0	83.6	494.9	271.8	168.7	0.0	0.0	103.3	0.0	
33	3.07	128.8	0.0	0.0	122.0	0.0	0.0	83.7	494.4	271.8	159.9	0.0	0.0	103.5	0.0	
34	3.16	130.2	0.0	0.0	123.0	0.0	0.0	83.8	494.1	271.4	155.2	0.0	0.0	100.9	0.0	
35	3.26	123.9	0.0	0.0	124.0	0.0	0.0	83.9	495.5	271.1	180.5	0.0	0.0	98.5	0.0	
36	3.35	122.0	0.0	0.0	124.5	0.0	0.0	84.0	495.9	270.9	190.0	0.0	0.0	97.4	0.0	
37	3.45	124.0	0.0	0.0	125.0	0.0	0.0	84.0	495.5	270.7	180.7	0.0	0.0	96.3	0.0	
38	3.54	126.2	0.0	0.0	125.5	0.0	0.0	84.1	495.0	270.5	171.4	0.0	0.0	95.3	0.0	
39	3.63	124.8	0.0	0.0	126.6	0.0	0.0	84.2	495.3	270.1	177.8	0.0	0.0	92.8	0.0	
40	3.73	125.8	0.0	0.0	126.5	0.0	0.0	84.3	495.1	270.2	173.7	0.0	0.0	93.2	0.0	
41	4.01	129.7	0.0	0.0	130.0	0.0	0.0	84.5	494.2	268.9	159.3	0.0	0.0	86.1	0.0	
42	4.95	130.9	0.0	0.0	131.5	0.0	0.0	85.4	493.9	268.4	157.8	0.0	0.0	84.6	0.0	
43	5.41	124.1	0.0	0.0	133.0	0.0	0.0	85.8	495.4	267.8	187.9	0.0	0.0	82.4	0.0	
44	6.35	123.5	0.0	0.0	134.0	0.0	0.0	86.6	495.6	267.5	195.0	0.0	0.0	81.9	0.0	
45	7.29	123.6	0.0	0.0	134.2	0.0	0.0	87.5	495.5	267.4	198.6	0.0	0.0	82.9	0.0	
46	8.23	124.0	0.0	0.0	133.0	0.0	0.0	88.3	495.5	267.8	200.7	0.0	0.0	86.7	0.0	
47	8.58	124.9	134.8	131.3	131.1	124.1	120.5	88.6	495.3	268.2	197.4	155.1	167.8	91.2	109.2	12
48	8.60	127.6	128.9	129.7	132.0	122.7	119.8	88.6	494.6	267.9	183.4	177.6	174.1	89.2	113.6	12
49	8.70	128.8	128.4	140.4	131.3	122.8	121.3	88.7	494.4	268.2	178.3	180.1	138.3	91.0	113.6	11
50	8.79	130.6	128.3	133.9	132.2	124.3	124.8	88.8	494.0	268.9	170.8	180.7	158.3	89.5	109.6	10
51	8.88	126.1	130.5	135.5	130.5	124.9	124.4	88.9	495.0	267.8	192.2	171.9	153.4	93.0	107.4	10
52	8.98	119.9	132.6	136.6	130.7	125.5	122.9	88.9	496.5	268.5	232.0	164.4	150.6	92.9	106.0	11
53	9.07	126.7	132.6	135.3	131.5	127.6	124.0	89.0	494.9	268.9	189.9	164.1	154.6	91.4	100.8	11
54	9.16	119.6	135.0	139.8	132.6	127.6	122.1	89.1	495.5	268.5	234.6	156.1	141.3	89.1	100.7	11
55	9.26	123.9	129.5	141.3	131.7	130.3	122.3	89.2	496.0	268.9	206.3	177.8	137.5	91.3	94.5	117
56	9.35	127.5	125.5	142.0	131.7	127.2	120.8	89.3	495.6	268.9	187.5	197.7	135.8	91.5	102.3	123
57	9.63	128.7	0.0	0.0	130.8	0.0	0.0	89.5	494.4	268.6	182.3	0.0	0.0	94.0	0.0	C
58	12.45	131.2	0.0	0.0	128.0	0.0	0.0	92.0	493.9	269.6	181.3	0.0	0.0	107.8	0.0	C
59	13.85	125.9	0.0	0.0	132.0	0.0	0.0	93.3	495.0	268.2	217.7	0.0	0.0	99.4	0.0	C
60	14.79	126.0	0.0	0.0	133.0	0.0	0.0	94.1	495.0	267.8	222.4	0.0	0.0	98.7	0.0	C

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=185.31 NU(S)A= 94.87 NU(AV)A=155.16 ST(AV)A=0.00677 ST(AV)/ST(4S)=1.91 F/F(4S)= 4.17
 (ST/ST(4S))/(F/F(4S))=0.458 (F/F(4S))/(ST/ST(4S))*3.0=0.60 (ST/ST(4S))/(F/F(4S))*1.13=1.19
 NU(R)A/NU(4S)=2.29 NU(S)A/NU(4S)=1.17 e+(4R)= 196.68 R(4R)= 4.97 H(4R)=12.85

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 13.43

AVERAGE VALUES WITH SL: H(4R)= 11.91

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 52HR60-45/20 E/D=0.047 P/E=20.0 ALPHA=45 HYD DIA= 2.667 IN PR= 71 MDDT=0.2020 LBM/SEC
54355. GGE(R)= 835.3 BTU/HR-SQ FT GGE(S)= 500.7 INLET TEMP= 82.8 F TATM= 75.2 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
.07	113.5	0.0	96.1	105.0	0.0	102.7	82.9	826.9	492.5	393.9	0.0	911.3	324.6	0.0	362.2
.16	117.7	0.0	101.7	106.5	0.0	103.1	82.9	826.0	492.0	346.7	0.0	642.2	304.6	0.0	355.9
.26	114.2	0.0	104.7	101.9	0.0	101.0	83.0	826.7	492.3	386.7	0.0	556.0	380.1	0.0	399.1
.35	111.8	0.0	105.6	100.4	0.0	100.5	83.1	827.2	492.3	420.2	0.0	535.8	414.5	0.0	412.1
.45	107.8	0.0	108.9	99.9	0.0	99.4	83.1	828.1	491.8	490.0	0.0	469.1	428.2	0.0	441.4
.54	109.9	0.0	110.2	99.6	0.0	99.3	83.2	827.7	491.9	452.5	0.0	447.5	437.9	0.0	446.1
.63	108.1	0.0	112.8	99.5	0.0	99.7	83.3	828.1	492.0	486.8	0.0	409.3	442.5	0.0	437.2
.73	108.8	0.0	115.7	99.9	0.0	100.7	83.4	827.9	491.8	474.6	0.0	373.4	433.6	0.0	413.6
.82	112.0	0.0	118.6	103.1	0.0	101.6	83.4	827.2	490.7	422.2	0.0	343.0	363.7	0.0	393.8
.91	115.0	0.0	116.9	105.3	0.0	100.8	83.5	826.5	489.9	382.6	0.0	360.9	327.7	0.0	412.9
1.01	118.4	0.0	0.0	104.5	0.0	0.0	83.6	825.8	490.2	345.7	0.0	0.0	341.5	0.0	0.0
1.10	121.1	0.0	0.0	106.5	0.0	0.0	83.6	825.2	489.4	321.2	0.0	0.0	312.2	0.0	0.0
1.20	124.3	0.0	0.0	108.1	0.0	0.0	83.7	824.5	488.9	296.1	0.0	0.0	292.2	0.0	0.0
1.29	127.8	0.0	0.0	108.7	0.0	0.0	83.8	823.7	488.6	272.8	0.0	0.0	285.9	0.0	0.0
1.38	121.0	0.0	0.0	110.3	0.0	0.0	83.9	825.2	488.1	323.8	0.0	0.0	269.0	0.0	0.0
1.48	110.6	0.0	0.0	111.8	0.0	0.0	83.9	827.5	487.5	452.1	0.0	0.0	254.9	0.0	0.0
1.57	126.3	0.0	0.0	112.8	0.0	0.0	84.0	824.1	487.2	283.9	0.0	0.0	246.5	0.0	0.0
1.66	121.6	0.0	0.0	113.4	0.0	0.0	84.1	825.1	486.9	320.3	0.0	0.0	241.9	0.0	0.0
1.76	119.7	0.0	0.0	114.6	0.0	0.0	84.1	825.5	486.5	338.2	0.0	0.0	232.7	0.0	0.0
1.85	120.2	0.0	0.0	115.8	0.0	0.0	84.2	825.4	486.1	334.1	0.0	0.0	224.2	0.0	0.0
1.95	120.9	0.0	0.0	116.1	0.0	0.0	84.3	825.2	486.0	328.3	0.0	0.0	222.5	0.0	0.0
2.04	122.6	0.0	0.0	117.0	0.0	0.0	84.4	824.9	485.7	314.1	0.0	0.0	216.6	0.0	0.0
2.13	125.3	0.0	0.0	118.4	0.0	0.0	84.4	824.3	485.1	293.7	0.0	0.0	207.9	0.0	0.0
2.23	128.4	0.0	0.0	120.0	0.0	0.0	84.5	823.6	484.6	273.1	0.0	0.0	198.7	0.0	0.0
2.32	122.3	0.0	0.0	118.8	0.0	0.0	84.6	824.9	485.0	318.3	0.0	0.0	206.3	0.0	0.0
2.41	112.8	0.0	0.0	120.6	0.0	0.0	84.6	827.0	484.4	427.5	0.0	0.0	196.1	0.0	0.0
2.51	120.0	0.0	0.0	121.1	0.0	0.0	84.7	825.4	484.2	340.5	0.0	0.0	193.7	0.0	0.0
2.60	124.4	0.0	0.0	121.7	0.0	0.0	84.8	824.5	484.0	302.9	0.0	0.0	190.8	0.0	0.0
2.70	123.6	0.0	0.0	121.8	0.0	0.0	84.9	824.7	483.9	309.7	0.0	0.0	190.6	0.0	0.0
2.79	125.6	0.0	0.0	122.9	0.0	0.0	84.9	824.2	483.5	294.8	0.0	0.0	185.3	0.0	0.0
2.88	127.1	0.0	0.0	123.8	0.0	0.0	85.0	823.9	483.2	284.7	0.0	0.0	181.2	0.0	0.0
2.98	129.4	0.0	0.0	125.2	0.0	0.0	85.1	823.4	482.7	270.2	0.0	0.0	175.0	0.0	0.0
3.07	132.1	0.0	0.0	125.4	0.0	0.0	85.1	822.8	482.6	254.8	0.0	0.0	174.4	0.0	0.0
3.16	133.5	0.0	0.0	126.5	0.0	0.0	85.2	822.5	482.2	247.7	0.0	0.0	169.9	0.0	0.0
3.26	125.4	0.0	0.0	127.0	0.0	0.0	85.3	824.3	482.1	298.8	0.0	0.0	168.0	0.0	0.0
3.35	124.4	0.0	0.0	128.1	0.0	0.0	85.4	824.5	481.7	307.0	0.0	0.0	163.8	0.0	0.0
3.45	125.5	0.0	0.0	128.4	0.0	0.0	85.4	824.2	481.5	299.0	0.0	0.0	162.9	0.0	0.0
3.54	128.7	0.0	0.0	129.0	0.0	0.0	85.5	823.5	481.3	277.1	0.0	0.0	160.8	0.0	0.0
3.63	127.4	0.0	0.0	130.3	0.0	0.0	85.6	823.8	480.9	286.2	0.0	0.0	156.2	0.0	0.0
3.73	128.6	0.0	0.0	130.5	0.0	0.0	85.6	823.6	480.8	278.6	0.0	0.0	155.8	0.0	0.0
4.01	132.8	0.0	0.0	133.0	0.0	0.0	85.9	822.6	479.9	254.6	0.0	0.0	147.9	0.0	0.0
4.95	133.3	0.0	0.0	135.8	0.0	0.0	86.6	822.5	478.9	255.4	0.0	0.0	141.1	0.0	0.0
5.41	126.7	0.0	0.0	136.0	0.0	0.0	86.9	824.0	478.8	300.4	0.0	0.0	141.5	0.0	0.0
6.35	126.3	0.0	0.0	136.8	0.0	0.0	87.6	824.1	478.5	308.8	0.0	0.0	141.0	0.0	0.0
7.29	126.6	0.0	0.0	136.1	0.0	0.0	88.4	824.0	478.8	311.7	0.0	0.0	145.1	0.0	0.0
8.23	126.8	0.0	0.0	135.0	0.0	0.0	89.1	823.9	479.2	315.6	0.0	0.0	150.8	0.0	0.0
8.58	127.0	136.1	133.3	133.4	127.1	120.8	89.3	823.9	479.3	316.0	254.5	270.7	157.1	183.4	220.1
8.60	128.7	129.7	132.8	134.5	126.9	122.2	89.4	823.3	478.7	302.3	294.8	273.7	153.2	184.2	210.5
8.70	130.4	130.5	140.6	133.4	125.5	122.3	89.4	823.1	479.5	290.1	289.4	232.3	157.5	192.0	210.7
8.79	132.4	130.6	130.2	133.2	127.2	126.2	89.5	822.6	481.1	276.9	289.0	291.9	159.0	184.3	189.3
8.88	128.5	133.2	134.1	131.8	128.9	127.0	89.6	823.6	478.9	305.5	272.6	267.1	163.8	175.8	184.7
8.98	122.4	135.2	137.0	132.5	131.5	126.2	89.6	825.3	480.7	363.7	261.6	251.6	161.9	165.8	189.8
9.07	132.0	134.6	137.3	133.0	134.1	126.1	89.7	822.8	481.1	280.9	264.6	249.6	160.4	156.5	190.8
9.16	125.5	136.8	142.3	131.9	134.0	126.3	89.8	824.2	481.0	333.1	253.1	226.6	164.8	157.0	190.1

9.26	134.6	131.2	142.7	133.2	135.9	124.3	89.9	824.3	480.5	265.9	287.8	225.1	160.0	150.6	201.3
9.35	134.5	127.1	143.0	132.9	130.3	123.2	89.9	824.2	480.3	266.8	320.0	224.1	161.3	171.7	208.3
9.63	134.5	0.0	0.0	133.4	0.0	0.0	90.1	823.3	479.7	267.7	0.0	0.0	160.0	0.0	0.0
12.45	132.5	0.0	0.0	128.7	0.0	0.0	92.3	822.7	481.4	294.1	0.0	0.0	190.1	0.0	0.0
13.85	129.1	0.0	0.0	134.6	0.0	0.0	93.4	823.4	479.3	330.6	0.0	0.0	166.8	0.0	0.0
14.79	129.5	0.0	0.0	134.9	0.0	0.0	94.1	823.4	479.2	333.1	0.0	0.0	168.2	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=290.27 NU(S)A=163.35 NU(AV)A=247.96 ST(AV)A=0.00542 ST(AV)/ST(4S)=1.76 F/F(4S)= 4.82
 (ST/ST(4S))/(F/F(4S))=0.365 (F/F(4S))/(ST/ST(4S))**3.0=0.89 (ST/ST(4S))/(F/F(4S))**(1/3)=1.04
 NU(R)A/NU(4S)=2.06 NU(S)A/NU(4S)=1.16 e+(4R)= 391.25 R(4R)= 5.00 H(4R)=17.02

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 17.77

AVERAGE VALUES WITH SL: H(4R)= 16.22

RUN NUMBER= 54HR10-30/10 E/D=0.047 P/E=10.0 ALPHA=30 HYD DIA= 2.667 IN PR= 71 MDOT=0.0331 LBM/SEC
 RE= 10593. QGE(R)= 261.4 BTU/HR-SQ FT QGE(S)= 98.1 INLET TEMP= 77.1 F TATM= 72.2 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	100.7	0.0	102.6	93.2	0.0	93.0	77.2	255.2	90.9	159.9	0.0	147.9	83.6	0.0
2	0.16	112.3	0.0	113.7	95.7	0.0	97.3	77.3	252.6	90.5	106.3	0.0	102.2	72.5	0.0
3	0.26	110.7	0.0	115.9	94.6	0.0	95.4	77.4	253.0	90.9	111.9	0.0	96.8	77.9	0.0
4	0.35	107.0	0.0	111.2	91.1	0.0	92.5	77.5	253.8	91.1	126.7	0.0	110.9	98.5	0.0
5	0.45	102.8	0.0	111.5	88.6	0.0	91.1	77.6	254.7	91.2	148.8	0.0	110.6	121.7	0.0
6	0.54	104.7	0.0	111.4	87.3	0.0	89.8	77.7	254.3	91.2	138.6	0.0	111.1	139.2	0.0
7	0.63	111.6	0.0	112.5	88.1	0.0	89.7	77.8	252.8	90.9	110.1	0.0	107.2	129.3	0.0
8	0.73	111.9	0.0	113.9	93.5	0.0	94.0	77.9	252.7	90.4	109.4	0.0	103.3	85.3	0.0
9	0.82	112.0	0.0	114.7	94.8	0.0	95.0	78.0	252.7	89.9	109.4	0.0	101.3	78.8	0.0
10	0.91	108.7	0.0	112.0	95.4	0.0	92.1	78.1	253.4	89.7	121.9	0.0	110.0	76.3	0.0
11	1.01	107.6	0.0	0.0	94.4	0.0	0.0	78.2	253.7	90.1	127.0	0.0	0.0	81.8	0.0
12	1.10	119.4	0.0	0.0	95.8	0.0	0.0	78.3	251.1	89.6	89.9	0.0	0.0	75.3	0.0
13	1.20	122.0	0.0	0.0	96.5	0.0	0.0	78.4	250.5	89.3	84.5	0.0	0.0	72.6	0.0
14	1.29	120.6	0.0	0.0	97.2	0.0	0.0	78.5	250.8	89.1	87.6	0.0	0.0	70.1	0.0
15	1.38	115.0	0.0	0.0	98.8	0.0	0.0	78.6	252.0	88.5	101.8	0.0	0.0	64.5	0.0
16	1.48	110.1	0.0	0.0	99.6	0.0	0.0	78.7	253.1	88.2	118.6	0.0	0.0	62.1	0.0
17	1.57	122.3	0.0	0.0	100.2	0.0	0.0	78.8	250.4	88.0	84.7	0.0	0.0	60.5	0.0
18	1.66	123.8	0.0	0.0	101.1	0.0	0.0	78.9	250.1	87.7	81.9	0.0	0.0	58.1	0.0
19	1.76	121.8	0.0	0.0	102.2	0.0	0.0	79.0	250.5	87.3	86.1	0.0	0.0	55.3	0.0
20	1.85	117.0	0.0	0.0	103.6	0.0	0.0	79.1	251.6	86.8	97.6	0.0	0.0	52.1	0.0
21	1.95	113.7	0.0	0.0	103.9	0.0	0.0	79.2	252.3	86.6	107.5	0.0	0.0	51.6	0.0
22	2.04	124.9	0.0	0.0	105.0	0.0	0.0	79.3	249.9	86.3	80.5	0.0	0.0	49.4	0.0
23	2.13	126.4	0.0	0.0	106.1	0.0	0.0	79.4	249.5	85.9	78.0	0.0	0.0	47.3	0.0
24	2.23	124.8	0.0	0.0	107.5	0.0	0.0	79.5	249.9	85.4	81.0	0.0	0.0	44.8	0.0
25	2.32	120.0	0.0	0.0	107.8	0.0	0.0	79.6	250.9	85.2	91.3	0.0	0.0	44.4	0.0
26	2.41	118.3	0.0	0.0	108.5	0.0	0.0	79.7	251.3	85.0	95.7	0.0	0.0	43.4	0.0
27	2.51	125.5	0.0	0.0	109.4	0.0	0.0	79.9	249.7	84.7	80.3	0.0	0.0	42.0	0.0
28	2.60	131.2	0.0	0.0	109.5	0.0	0.0	80.0	248.5	84.6	71.1	0.0	0.0	42.0	0.0
29	2.70	128.0	0.0	0.0	110.9	0.0	0.0	80.1	249.2	84.1	76.2	0.0	0.0	40.0	0.0
30	2.79	123.0	0.0	0.0	111.7	0.0	0.0	80.2	250.3	83.8	85.7	0.0	0.0	39.0	0.0
31	2.88	120.6	0.0	0.0	112.8	0.0	0.0	80.3	250.8	83.4	91.2	0.0	0.0	37.6	0.0
32	2.98	131.4	0.0	0.0	113.0	0.0	0.0	80.4	248.4	83.4	71.4	0.0	0.0	37.5	0.0
33	3.07	133.3	0.0	0.0	114.0	0.0	0.0	80.5	248.0	83.0	68.8	0.0	0.0	36.3	0.0
34	3.16	130.6	0.0	0.0	114.8	0.0	0.0	80.6	248.6	82.7	72.8	0.0	0.0	35.4	0.0
35	3.26	128.6	0.0	0.0	115.2	0.0	0.0	80.7	249.0	82.6	76.1	0.0	0.0	35.0	0.0
36	3.35	120.8	0.0	0.0	115.7	0.0	0.0	80.8	250.8	82.4	91.8	0.0	0.0	34.6	0.0
37	3.45	131.9	0.0	0.0	116.2	0.0	0.0	80.9	248.3	82.2	71.3	0.0	0.0	34.1	0.0
38	3.54	133.5	0.0	0.0	116.9	0.0	0.0	81.0	248.0	82.0	69.1	0.0	0.0	33.4	0.0
39	3.63	133.5	0.0	0.0	117.3	0.0	0.0	81.1	248.0	81.8	69.3	0.0	0.0	33.1	0.0
40	3.73	129.2	0.0	0.0	117.8	0.0	0.0	81.2	248.9	81.6	75.9	0.0	0.0	32.6	0.0
41	4.01	135.9	0.0	0.0	121.0	0.0	0.0	81.5	247.4	80.5	66.6	0.0	0.0	29.8	0.0
42	4.95	138.3	0.0	0.0	122.6	0.0	0.0	82.5	246.9	79.9	64.7	0.0	0.0	29.1	0.0
43	5.41	135.8	0.0	0.0	125.0	0.0	0.0	83.0	247.5	79.1	68.5	0.0	0.0	27.5	0.0
44	6.35	137.4	0.0	0.0	126.7	0.0	0.0	84.1	247.1	78.4	67.5	0.0	0.0	26.8	0.0
45	7.29	137.7	0.0	0.0	128.5	0.0	0.0	85.1	247.0	77.8	68.3	0.0	0.0	26.1	0.0
46	8.23	131.0	0.0	0.0	128.5	0.0	0.0	86.1	248.5	77.8	80.4	0.0	0.0	26.7	0.0
47	8.58	128.2	142.3	133.9	130.2	127.2	129.4	86.5	249.1	77.4	86.7	64.8	76.3	25.7	27.6
48	8.60	135.3	141.7	144.0	130.5	127.5	130.0	86.5	247.4	77.3	73.6	65.1	62.5	25.5	27.4
49	8.70	134.4	140.7	136.4	130.1	127.9	129.2	86.6	247.6	77.5	75.2	66.4	60.1	25.9	27.3
50	8.79	133.2	144.4	143.6	131.6	128.8	129.4	86.7	247.9	77.4	77.4	62.4	63.3	25.0	26.7
51	8.88	130.3	143.6	139.5	130.2	128.3	131.5	86.8	248.7	77.2	83.0	63.6	68.5	25.8	27.0
52	8.98	125.3	140.4	140.1	129.8	128.5	131.0	87.0	249.8	77.3	94.5	67.8	68.2	26.2	27.0
53	9.07	132.0	131.8	145.0	130.4	128.5	130.6	87.1	248.3	77.5	80.1	80.5	62.1	25.9	27.1
54	9.16	133.0	131.0	147.0	130.7	129.0	129.7	87.2	247.6	77.4	78.3	81.9	60.0	25.8	26.8
55	9.26	133.3	142.4	144.5	131.0	131.2	129.3	87.3	247.7	77.4	78.0	65.1	62.7	25.6	25.5
56	9.35	132.2	142.6	145.0	130.5	128.9	131.4	87.4	248.2	77.2	80.2	65.1	62.4	25.9	26.9
57	9.63	135.0	0.0	0.0	130.5	0.0	0.0	87.7	247.6	76.9	75.8	0.0	0.0	26.0	0.0
58	12.45	135.2	0.0	0.0	130.6	0.0	0.0	90.8	247.6	77.0	80.3	0.0	0.0	27.9	0.0
59	13.85	134.8	0.0	0.0	131.8	0.0	0.0	92.3	247.7	76.6	83.8	0.0	0.0	27.9	0.0
60	14.79	135.0	0.0	0.0	132.0	0.0	0.0	93.3	247.6	76.5	85.3	0.0	0.0	28.4	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 78.23 NU(S)A= 30.35 NU(AV)A= 62.27 ST(AV)A= 0.00826 ST(AV)/ST(4S)=1.87 F/F(4S)= 2.91
 (ST/ST(4S))/(F/F(4S))=0.641 (F/F(4S))/(ST/ST(4S))*3.0=0.45 (ST/ST(4S))/(F/F(4S))*(1/3)=1.31
 NU(R)A/NU(4S)=2.35 NU(S)A/NU(4S)=0.91 e+(4R)= 61.01 R(4R)= 5.42 H(4R)= 9.39

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 9.16

AVERAGE VALUES WITH SL: H(4R)= 8.36

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER= 55HR30-30/10 E/D=0.047 P/E=10.0 ALPHA=30 HYD DIA= 2.667 IN PR=.71 MDDT=0.1030 LBM/SEC
32948. GGE(R)= 506.5 BTU/HR-SG FT GGE(S)= 218.9 INLET TEMP= 79.6 F TATM= 72.2 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	98.7	0.0	99.4	99.0	0.0	93.7	79.7	500.6	211.0	385.8	0.0	372.1	159.7	0.0	220.2
0.16	109.0	0.0	102.1	99.3	0.0	93.0	79.7	498.4	210.9	249.9	0.0	326.9	157.8	0.0	232.9
0.26	104.5	0.0	105.0	95.8	0.0	95.0	79.8	499.3	211.1	296.7	0.0	290.8	193.9	0.0	203.9
0.35	104.0	0.0	105.7	94.0	0.0	95.2	79.9	499.5	211.3	303.8	0.0	283.8	219.7	0.0	202.4
0.45	101.3	0.0	108.2	94.3	0.0	97.0	80.0	500.0	211.1	343.7	0.0	259.7	215.9	0.0	181.9
0.54	103.9	0.0	110.1	94.1	0.0	97.4	80.0	499.5	211.1	306.9	0.0	243.6	220.2	0.0	178.6
0.63	112.1	0.0	112.7	94.0	0.0	97.5	80.1	497.7	211.0	228.1	0.0	223.9	222.8	0.0	178.2
0.73	111.7	0.0	114.9	95.2	0.0	96.3	80.2	497.8	210.6	231.6	0.0	210.2	205.6	0.0	191.6
0.82	111.7	0.0	116.7	96.9	0.0	96.8	80.3	497.8	210.0	232.1	0.0	200.3	185.0	0.0	186.1
0.91	108.1	0.0	114.1	98.0	0.0	96.6	80.3	498.6	209.6	263.2	0.0	216.4	173.9	0.0	188.9
1.01	105.6	0.0	0.0	97.3	0.0	0.0	80.4	499.1	209.8	290.4	0.0	0.0	182.1	0.0	0.0
1.10	119.7	0.0	0.0	98.5	0.0	0.0	80.5	496.0	209.4	185.4	0.0	0.0	170.3	0.0	0.0
1.20	121.2	0.0	0.0	99.5	0.0	0.0	80.6	495.7	209.1	178.7	0.0	0.0	161.7	0.0	0.0
1.29	119.5	0.0	0.0	100.5	0.0	0.0	80.6	496.0	208.7	187.0	0.0	0.0	153.9	0.0	0.0
1.38	114.1	0.0	0.0	101.3	0.0	0.0	80.7	497.2	208.4	218.2	0.0	0.0	148.3	0.0	0.0
1.48	107.1	0.0	0.0	102.4	0.0	0.0	80.8	498.8	208.0	277.6	0.0	0.0	141.0	0.0	0.0
1.57	123.0	0.0	0.0	103.1	0.0	0.0	80.9	495.3	207.8	172.1	0.0	0.0	136.8	0.0	0.0
1.66	122.9	0.0	0.0	103.9	0.0	0.0	80.9	495.3	207.5	172.8	0.0	0.0	132.3	0.0	0.0
1.76	119.5	0.0	0.0	105.4	0.0	0.0	81.0	496.0	206.9	188.7	0.0	0.0	124.2	0.0	0.0
1.85	114.0	0.0	0.0	106.4	0.0	0.0	81.1	497.3	206.6	221.2	0.0	0.0	119.5	0.0	0.0
1.95	109.5	0.0	0.0	106.7	0.0	0.0	81.2	498.2	206.5	257.4	0.0	0.0	118.3	0.0	0.0
2.04	125.2	0.0	0.0	107.0	0.0	0.0	81.2	494.8	206.4	164.7	0.0	0.0	117.2	0.0	0.0
2.13	125.5	0.0	0.0	108.3	0.0	0.0	81.3	494.7	205.9	163.9	0.0	0.0	111.6	0.0	0.0
2.23	121.9	0.0	0.0	109.7	0.0	0.0	81.4	495.5	205.4	179.0	0.0	0.0	106.1	0.0	0.0
2.32	116.1	0.0	0.0	110.0	0.0	0.0	81.5	496.8	205.3	209.8	0.0	0.0	105.2	0.0	0.0
2.41	115.1	0.0	0.0	111.0	0.0	0.0	81.5	497.0	204.9	216.6	0.0	0.0	101.7	0.0	0.0
2.51	120.0	0.0	0.0	111.6	0.0	0.0	81.6	495.9	204.7	189.0	0.0	0.0	99.8	0.0	0.0
2.60	130.5	0.0	0.0	112.5	0.0	0.0	81.7	493.6	204.4	147.9	0.0	0.0	97.0	0.0	0.0
2.70	124.3	0.0	0.0	113.4	0.0	0.0	81.8	495.0	204.0	170.2	0.0	0.0	94.3	0.0	0.0
2.79	118.3	0.0	0.0	114.0	0.0	0.0	81.8	496.3	203.8	199.0	0.0	0.0	92.7	0.0	0.0
2.88	115.9	0.0	0.0	115.0	0.0	0.0	81.9	496.8	203.5	213.7	0.0	0.0	89.9	0.0	0.0
2.98	131.6	0.0	0.0	115.9	0.0	0.0	82.0	493.4	203.1	145.4	0.0	0.0	87.6	0.0	0.0
3.07	132.2	0.0	0.0	116.3	0.0	0.0	82.1	493.3	203.0	143.8	0.0	0.0	86.7	0.0	0.0
3.16	126.8	0.0	0.0	117.0	0.0	0.0	82.1	494.4	202.8	161.8	0.0	0.0	85.0	0.0	0.0
3.26	125.1	0.0	0.0	118.2	0.0	0.0	82.2	494.8	202.3	168.6	0.0	0.0	82.2	0.0	0.0
3.35	115.2	0.0	0.0	118.8	0.0	0.0	82.3	497.0	202.1	220.6	0.0	0.0	80.9	0.0	0.0
3.45	131.4	0.0	0.0	119.3	0.0	0.0	82.4	493.4	201.9	147.0	0.0	0.0	79.9	0.0	0.0
3.54	131.9	0.0	0.0	120.3	0.0	0.0	82.4	493.3	201.6	145.7	0.0	0.0	77.8	0.0	0.0
3.63	129.7	0.0	0.0	120.8	0.0	0.0	82.5	493.8	201.4	152.9	0.0	0.0	76.8	0.0	0.0
3.73	124.7	0.0	0.0	121.1	0.0	0.0	82.6	494.9	201.3	171.6	0.0	0.0	76.3	0.0	0.0
4.01	133.7	0.0	0.0	125.0	0.0	0.0	82.8	492.9	199.9	141.4	0.0	0.0	69.2	0.0	0.0
4.95	135.3	0.0	0.0	126.4	0.0	0.0	83.6	492.6	199.4	138.8	0.0	0.0	67.9	0.0	0.0
5.41	131.6	0.0	0.0	127.0	0.0	0.0	83.9	493.4	199.2	150.9	0.0	0.0	67.4	0.0	0.0
6.35	132.8	0.0	0.0	129.0	0.0	0.0	84.7	493.1	198.4	149.2	0.0	0.0	65.2	0.0	0.0
7.29	133.4	0.0	0.0	130.1	0.0	0.0	85.4	493.0	198.0	149.4	0.0	0.0	64.5	0.0	0.0
8.23	130.0	0.0	0.0	130.0	0.0	0.0	86.2	493.7	198.1	163.6	0.0	0.0	63.6	0.0	0.0
8.58	125.4	136.1	129.4	128.8	123.9	122.7	86.5	494.8	198.2	184.5	144.7	167.3	67.9	76.8	79.4
8.60	133.0	138.6	144.4	129.6	124.4	121.6	86.5	493.0	197.9	153.8	137.3	123.5	66.6	75.8	81.8
8.70	130.3	138.5	145.0	129.4	124.8	120.7	86.6	493.7	198.0	163.8	137.9	122.6	67.1	75.1	84.2
8.79	129.7	140.7	140.7	130.3	124.9	123.0	86.6	493.8	198.8	166.4	132.5	132.5	66.1	75.4	79.4
8.88	125.7	138.6	135.7	129.6	124.3	125.3	86.7	494.7	197.3	184.1	138.3	146.5	66.7	76.1	74.2
8.98	119.9	134.9	138.9	129.3	124.2	124.3	86.8	496.1	198.1	217.4	149.6	138.1	67.6	76.8	76.6
9.07	129.0	124.7	143.6	130.1	126.8	122.8	86.9	494.0	198.6	170.0	189.4	126.3	66.7	72.1	80.2
9.16	127.3	123.3	144.8	130.7	127.1	122.3	86.9	493.4	198.4	177.1	196.8	123.7	65.8	71.7	81.4

55	9.26	132.7	140.1	142.1	130.9	131.5	122.5	87.0	493.6	198.4	156.8	134.8	129.9	65.6	64.7	81.1
56	9.35	132.1	138.5	142.5	130.8	126.4	125.6	87.1	494.2	198.4	159.4	139.4	129.3	65.8	73.2	74.7
57	9.63	132.1	0.0	0.0	129.4	0.0	0.0	87.3	493.3	198.3	159.6	0.0	0.0	68.3	0.0	0.0
58	12.45	133.5	0.0	0.0	128.9	0.0	0.0	89.6	493.0	198.5	162.0	0.0	0.0	72.9	0.0	0.0
59	13.85	133.8	0.0	0.0	128.7	0.0	0.0	90.7	492.9	198.5	164.8	0.0	0.0	75.3	0.0	0.0
60	14.79	134.0	0.0	0.0	129.3	0.0	0.0	91.4	492.9	198.3	166.7	0.0	0.0	75.4	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=170.22 NU(S)A= 74.44 NU(AV)A=138.29 ST(AV)A=0.00590 ST(AV)/ST(4S)=1.67 F/F(4S)= 3.44
 (ST/ST(4S))/(F/F(4S))=0.486 (F/F(4S))/(ST/ST(4S))*3.0=0.73 (ST/ST(4S))/(F/F(4S))*((1/3))=1.11
 NU(R)A/NU(4S)=2.07 NU(S)A/NU(4S)=0.90 e+(4R)= 180.56 R(4R)= 5.84 H(4R)=13.81

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 13.42

AVERAGE VALUES WITH SL: H(4R)= 12.11

RUN NUMBER= 56HR60-30/10 E/D=0.047 P/E=10.0 ALPHA=30 HYD DIA= 2.667 IN PR=.71 MDDT=0.2020 LBM/SEC
RE= 64494. GGE(R)= 766.0 BTU/HR-SQ FT GGE(S)= 433.3 INLET TEMP= 81.8 F TATM= 74.5 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.07	98.8	0.0	94.3	102.6	0.0	101.6	81.8	760.6	425.7	656.2	0.0	893.3	299.7	0.0
2	0.16	106.7	0.0	100.0	103.4	0.0	101.3	81.9	758.9	425.5	447.7	0.0	613.5	289.2	0.0
3	0.26	102.6	0.0	103.7	99.4	0.0	99.0	82.0	759.8	425.5	538.6	0.0	511.4	356.9	0.0
4	0.35	103.6	0.0	104.3	97.7	0.0	98.5	82.0	759.6	425.6	515.1	0.0	498.9	397.2	0.0
5	0.45	101.8	0.0	107.3	96.6	0.0	96.8	82.1	760.0	425.3	564.0	0.0	440.9	428.9	0.0
6	0.54	104.7	0.0	109.0	96.4	0.0	96.6	82.2	759.3	425.4	492.6	0.0	413.6	436.9	0.0
7	0.63	112.4	0.0	111.8	96.9	0.0	97.5	82.2	757.6	425.2	367.0	0.0	374.5	423.7	0.0
8	0.73	111.0	0.0	114.6	97.5	0.0	98.5	82.3	757.9	425.0	385.9	0.0	342.9	408.5	0.0
9	0.82	111.3	0.0	117.1	100.4	0.0	99.3	82.4	757.9	423.9	382.7	0.0	318.8	343.4	0.0
10	0.91	108.5	0.0	115.2	101.9	0.0	99.1	82.4	758.5	423.4	425.0	0.0	338.1	317.6	0.0
11	1.01	106.3	0.0	0.0	101.1	0.0	0.0	82.5	759.0	423.7	465.7	0.0	0.0	332.6	0.0
12	1.10	119.8	0.0	0.0	102.7	0.0	0.0	82.6	756.0	423.1	296.5	0.0	0.0	306.8	0.0
13	1.20	119.7	0.0	0.0	103.4	0.0	0.0	82.6	756.0	422.9	297.8	0.0	0.0	297.2	0.0
14	1.29	119.1	0.0	0.0	104.4	0.0	0.0	82.7	756.2	422.5	303.2	0.0	0.0	284.1	0.0
15	1.38	115.0	0.0	0.0	105.7	0.0	0.0	82.7	757.1	422.0	342.8	0.0	0.0	268.5	0.0
16	1.48	106.7	0.0	0.0	107.3	0.0	0.0	82.8	758.9	421.5	463.8	0.0	0.0	251.3	0.0
17	1.57	123.2	0.0	0.0	106.2	0.0	0.0	82.9	755.3	421.9	273.4	0.0	0.0	264.0	0.0
18	1.66	121.6	0.0	0.0	109.4	0.0	0.0	82.9	755.6	420.7	285.3	0.0	0.0	232.1	0.0
19	1.76	118.7	0.0	0.0	110.7	0.0	0.0	83.0	756.3	420.2	309.2	0.0	0.0	221.5	0.0
20	1.85	113.3	0.0	0.0	111.1	0.0	0.0	83.1	757.4	420.1	365.7	0.0	0.0	218.7	0.0
21	1.95	108.0	0.0	0.0	111.8	0.0	0.0	83.1	758.6	419.8	445.2	0.0	0.0	213.7	0.0
22	2.04	124.8	0.0	0.0	112.0	0.0	0.0	83.2	754.9	419.8	264.8	0.0	0.0	212.6	0.0
23	2.13	124.1	0.0	0.0	113.7	0.0	0.0	83.3	755.1	419.2	269.7	0.0	0.0	200.9	0.0
24	2.23	120.6	0.0	0.0	115.3	0.0	0.0	83.3	755.8	418.6	295.8	0.0	0.0	191.0	0.0
25	2.32	114.8	0.0	0.0	114.8	0.0	0.0	83.4	757.1	418.8	351.6	0.0	0.0	194.5	0.0
26	2.41	114.3	0.0	0.0	116.2	0.0	0.0	83.5	757.2	418.3	358.0	0.0	0.0	186.3	0.0
27	2.51	120.0	0.0	0.0	116.9	0.0	0.0	83.5	756.0	418.0	302.2	0.0	0.0	182.6	0.0
28	2.60	129.7	0.0	0.0	117.5	0.0	0.0	83.6	753.8	417.8	238.4	0.0	0.0	179.6	0.0
29	2.70	122.7	0.0	0.0	118.3	0.0	0.0	83.6	755.4	417.5	282.0	0.0	0.0	175.7	0.0
30	2.79	116.5	0.0	0.0	119.3	0.0	0.0	83.7	756.7	417.1	336.5	0.0	0.0	170.9	0.0
31	2.88	114.3	0.0	0.0	120.3	0.0	0.0	83.8	757.2	416.8	361.6	0.0	0.0	166.3	0.0
32	2.98	132.6	0.0	0.0	121.7	0.0	0.0	83.8	753.2	416.3	225.1	0.0	0.0	160.3	0.0
33	3.07	131.2	0.0	0.0	121.9	0.0	0.0	83.9	753.5	416.2	232.2	0.0	0.0	159.6	0.0
34	3.16	124.7	0.0	0.0	123.3	0.0	0.0	84.0	754.9	415.7	270.1	0.0	0.0	154.0	0.0
35	3.26	123.7	0.0	0.0	123.9	0.0	0.0	84.0	755.2	415.5	277.4	0.0	0.0	151.9	0.0
36	3.35	112.9	0.0	0.0	124.8	0.0	0.0	84.1	757.5	415.2	383.2	0.0	0.0	148.6	0.0
37	3.45	132.2	0.0	0.0	125.2	0.0	0.0	84.2	753.3	415.0	228.4	0.0	0.0	147.3	0.0
38	3.54	131.4	0.0	0.0	126.0	0.0	0.0	84.2	753.5	414.7	232.6	0.0	0.0	144.6	0.0
39	3.63	128.2	0.0	0.0	126.8	0.0	0.0	84.3	754.2	414.4	250.2	0.0	0.0	142.0	0.0
40	3.73	122.9	0.0	0.0	126.6	0.0	0.0	84.4	755.3	414.5	285.4	0.0	0.0	142.9	0.0
41	4.01	132.6	0.0	0.0	130.0	0.0	0.0	84.5	753.2	413.3	228.2	0.0	0.0	132.4	0.0
42	4.95	134.4	0.0	0.0	131.1	0.0	0.0	85.2	752.8	412.9	222.5	0.0	0.0	130.8	0.0
43	5.41	131.8	0.0	0.0	132.0	0.0	0.0	85.5	753.4	412.6	236.6	0.0	0.0	129.0	0.0
44	6.35	133.1	0.0	0.0	133.5	0.0	0.0	86.2	753.1	412.0	232.9	0.0	0.0	126.4	0.0
45	7.29	132.8	0.0	0.0	134.7	0.0	0.0	86.8	753.1	411.6	237.5	0.0	0.0	124.6	0.0
46	8.23	128.0	0.0	0.0	134.0	0.0	0.0	87.4	754.2	411.9	269.4	0.0	0.0	128.2	0.0
47	8.58	125.8	133.4	127.7	133.4	128.0	124.5	87.7	754.7	411.6	266.8	239.1	273.2	130.4	147.9
48	8.60	132.8	134.3	142.9	133.4	129.3	123.5	87.7	752.9	411.5	241.8	234.0	197.5	130.4	143.2
49	8.70	130.8	136.8	143.1	132.4	128.7	121.7	87.8	753.5	412.2	253.5	222.5	197.2	133.7	145.8
50	8.79	128.9	138.3	139.9	132.4	128.4	124.3	87.8	753.9	413.7	265.8	216.3	209.6	134.4	147.6
51	8.88	124.6	136.5	134.5	131.0	128.9	126.2	87.9	755.0	411.5	297.8	224.9	234.5	138.2	145.3
52	8.98	120.1	133.1	139.0	132.3	130.0	127.3	87.9	756.4	413.1	340.6	242.5	214.5	134.8	142.2
53	9.07	129.1	122.3	143.3	134.0	132.7	125.4	88.0	754.0	413.0	265.7	318.3	197.4	130.0	133.8
54	9.16	130.6	120.5	143.2	132.9	132.3	125.2	88.1	753.6	412.9	256.6	336.5	197.9	133.3	135.1

55	9.26	139.1	137.8	140.3	134.7	135.6	125.4	88.1	753.9	412.3	214.0	219.7	209.2	128.2	125.7
56	9.35	134.7	135.5	142.0	133.6	130.1	127.6	88.2	754.7	412.4	234.8	230.9	203.0	131.5	142.4
57	9.63	136.1	0.0	0.0	132.7	0.0	0.0	88.4	753.5	412.3	228.5	0.0	0.0	134.7	0.0
58	12.45	132.8	0.0	0.0	130.0	0.0	0.0	90.3	753.1	413.3	255.7	0.0	0.0	150.2	0.0
59	13.85	134.2	0.0	0.0	132.8	0.0	0.0	91.3	752.8	412.3	252.6	0.0	0.0	143.0	0.0
60	14.79	135.0	0.0	0.0	133.1	0.0	0.0	91.9	752.7	412.2	251.4	0.0	0.0	144.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
NU(R)A=270.17 NU(S)A=142.12 NU(AV)A=227.49 ST(AV)A=0.00496 ST(AV)/ST(4S)=1.61 F/F(4S)= 3.76
(ST/ST(4S))/(F/F(4S))=0.428 (F/F(4S))/(ST/ST(4S))*3.0=0.90 (ST/ST(4S))/(F/F(4S))*(1/3)=1.03
NU(R)A/NU(4S)=1.92 NU(S)A/NU(4S)=1.01 e+(4R)= 342.68 R(4R)= 6.11 H(4R)=16.54

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 16.56

AVERAGE VALUES WITH SL: H(4R)= 14.83

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER= 58HR10-30/20 E/D=0.047 P/E=20.0 ALPHA=30 HYD DIA= 2.667 IN PR=.71 MDDT=0.0336 LBM/SEC
10748. GGE(R)= 216.0 BTU/HR-SQ FT GGE(S)= 106.6 INLET TEMP= 78.4 F TATM= 73.2 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
.07	99.8	0.0	99.9	94.3	0.0	95.0	78.5	210.2	99.3	144.9	0.0	144.2	92.2	0.0	88.3
.16	109.8	0.0	109.0	98.9	0.0	99.5	78.6	208.0	98.2	97.9	0.0	100.4	70.9	0.0	68.9
.26	109.8	0.0	111.9	97.6	0.0	97.1	78.6	208.0	98.7	98.1	0.0	91.9	76.5	0.0	78.6
.35	106.5	0.0	107.3	92.4	0.0	94.0	78.7	208.7	99.5	110.5	0.0	107.4	107.1	0.0	95.8
.45	104.5	0.0	107.2	90.2	0.0	92.2	78.8	209.1	99.5	119.7	0.0	108.3	128.7	0.0	109.4
.54	104.0	0.0	107.5	90.2	0.0	92.1	78.9	209.2	99.0	122.6	0.0	107.6	129.2	0.0	110.5
.63	105.1	0.0	108.7	91.4	0.0	91.6	79.0	209.0	98.6	117.7	0.0	103.4	117.0	0.0	115.2
.73	107.5	0.0	110.0	95.2	0.0	96.0	79.1	208.5	98.6	107.8	0.0	99.1	90.0	0.0	85.7
.82	110.2	0.0	111.1	96.8	0.0	97.0	79.2	207.9	98.1	98.5	0.0	95.7	81.8	0.0	80.9
.91	111.0	0.0	109.1	97.7	0.0	93.0	79.3	207.7	97.7	96.2	0.0	102.3	77.9	0.0	104.6
1.01	112.7	0.0	0.0	98.0	0.0	0.0	79.4	207.3	97.6	91.3	0.0	0.0	77.0	0.0	0.0
1.10	117.4	0.0	0.0	99.0	0.0	0.0	79.5	206.3	97.3	79.8	0.0	0.0	73.1	0.0	0.0
1.20	117.6	0.0	0.0	100.0	0.0	0.0	79.6	206.2	96.9	79.6	0.0	0.0	69.6	0.0	0.0
1.29	115.6	0.0	0.0	101.0	0.0	0.0	79.6	206.7	96.6	84.4	0.0	0.0	66.3	0.0	0.0
1.38	114.1	0.0	0.0	102.0	0.0	0.0	79.7	207.0	96.2	88.4	0.0	0.0	63.4	0.0	0.0
1.48	114.7	0.0	0.0	103.0	0.0	0.0	79.8	206.9	95.8	87.0	0.0	0.0	60.7	0.0	0.0
1.57	116.6	0.0	0.0	104.0	0.0	0.0	79.9	206.5	95.5	82.6	0.0	0.0	58.1	0.0	0.0
1.66	118.5	0.0	0.0	105.0	0.0	0.0	80.0	206.0	95.1	78.5	0.0	0.0	55.8	0.0	0.0
1.76	119.5	0.0	0.0	105.0	0.0	0.0	80.1	205.8	95.1	76.6	0.0	0.0	56.0	0.0	0.0
1.85	115.4	0.0	0.0	106.0	0.0	0.0	80.2	206.7	94.8	86.1	0.0	0.0	53.8	0.0	0.0
1.95	112.4	0.0	0.0	107.0	0.0	0.0	80.3	207.4	94.4	94.6	0.0	0.0	51.8	0.0	0.0
2.04	123.3	0.0	0.0	108.0	0.0	0.0	80.4	205.0	94.0	70.0	0.0	0.0	49.9	0.0	0.0
2.13	125.1	0.0	0.0	109.0	0.0	0.0	80.5	204.6	93.7	67.2	0.0	0.0	48.1	0.0	0.0
2.23	124.0	0.0	0.0	110.0	0.0	0.0	80.5	204.8	93.3	69.1	0.0	0.0	46.4	0.0	0.0
2.32	123.1	0.0	0.0	111.0	0.0	0.0	80.6	205.0	93.0	70.7	0.0	0.0	44.9	0.0	0.0
2.41	123.2	0.0	0.0	112.0	0.0	0.0	80.7	205.0	92.6	70.7	0.0	0.0	43.4	0.0	0.0
2.51	123.8	0.0	0.0	112.0	0.0	0.0	80.8	204.9	92.6	69.8	0.0	0.0	43.5	0.0	0.0
2.60	124.6	0.0	0.0	113.0	0.0	0.0	80.9	204.7	92.2	68.6	0.0	0.0	42.1	0.0	0.0
2.70	124.5	0.0	0.0	114.0	0.0	0.0	81.0	204.7	91.9	68.9	0.0	0.0	40.8	0.0	0.0
2.79	120.5	0.0	0.0	114.0	0.0	0.0	81.1	205.6	91.9	76.4	0.0	0.0	40.9	0.0	0.0
2.88	118.5	0.0	0.0	115.0	0.0	0.0	81.2	206.0	91.5	80.8	0.0	0.0	39.6	0.0	0.0
2.98	128.2	0.0	0.0	116.0	0.0	0.0	81.3	203.9	91.2	63.6	0.0	0.0	38.4	0.0	0.0
3.07	130.1	0.0	0.0	116.0	0.0	0.0	81.4	203.5	91.2	61.1	0.0	0.0	38.5	0.0	0.0
3.16	128.1	0.0	0.0	117.0	0.0	0.0	81.4	203.9	90.8	64.0	0.0	0.0	37.4	0.0	0.0
3.26	127.8	0.0	0.0	118.0	0.0	0.0	81.5	204.0	90.4	64.5	0.0	0.0	36.3	0.0	0.0
3.35	127.1	0.0	0.0	118.0	0.0	0.0	81.6	204.2	90.4	65.7	0.0	0.0	36.4	0.0	0.0
3.45	127.1	0.0	0.0	119.0	0.0	0.0	81.7	204.2	90.1	65.8	0.0	0.0	35.3	0.0	0.0
3.54	127.2	0.0	0.0	119.0	0.0	0.0	81.8	204.1	90.1	65.8	0.0	0.0	35.4	0.0	0.0
3.63	128.9	0.0	0.0	120.0	0.0	0.0	81.9	203.8	89.7	63.4	0.0	0.0	34.4	0.0	0.0
3.73	125.8	0.0	0.0	120.0	0.0	0.0	82.0	204.4	89.7	68.2	0.0	0.0	34.5	0.0	0.0
4.01	132.1	0.0	0.0	123.0	0.0	0.0	82.3	203.1	88.6	59.5	0.0	0.0	31.8	0.0	0.0
4.95	135.1	0.0	0.0	124.0	0.0	0.0	83.2	202.4	88.3	56.9	0.0	0.0	31.5	0.0	0.0
5.41	129.9	0.0	0.0	126.0	0.0	0.0	83.6	203.5	87.6	64.1	0.0	0.0	30.1	0.0	0.0
6.35	131.0	0.0	0.0	128.0	0.0	0.0	84.5	203.3	86.8	63.7	0.0	0.0	29.1	0.0	0.0
7.29	130.5	0.0	0.0	129.0	0.0	0.0	85.4	203.4	86.5	65.6	0.0	0.0	28.8	0.0	0.0
8.23	128.0	0.0	0.0	130.0	0.0	0.0	86.3	204.0	86.1	71.0	0.0	0.0	28.6	0.0	0.0
8.58	126.2	136.7	129.5	129.6	125.6	124.6	86.7	204.3	86.5	75.0	59.2	69.2	29.2	32.2	33.1
8.60	132.5	135.0	138.2	128.7	124.7	124.7	86.7	202.8	86.8	64.2	60.9	57.1	30.0	33.1	33.1
8.70	132.1	134.2	140.8	129.8	124.8	124.8	86.8	202.9	86.5	64.9	62.0	54.5	29.1	33.0	33.0
8.79	130.7	134.7	139.5	130.9	124.9	126.9	86.9	203.2	86.5	67.2	61.6	56.0	28.5	33.0	31.3
8.88	129.6	135.5	139.1	129.0	125.0	129.0	87.0	203.6	86.5	69.2	60.8	56.6	29.8	33.0	29.8
8.98	129.3	135.2	138.3	128.0	126.0	130.0	87.0	203.7	86.8	69.9	61.3	57.6	30.7	32.3	29.3
9.07	128.2	128.1	137.2	129.6	126.1	131.1	87.1	203.9	86.7	72.0	72.2	59.0	29.6	32.2	28.6
9.16	128.8	127.5	138.4	130.2	127.2	128.2	87.2	203.3	86.5	70.9	73.2	57.6	29.2	31.3	30.6

9.26	129.8	137.8	138.2	129.3	129.3	128.3	87.3	203.3	86.8	69.3	58.3	57.9	30.0	29.9	30.7
9.35	129.2	137.5	139.6	130.4	127.4	127.4	87.4	203.6	86.1	70.6	58.9	56.5	29.0	31.2	31.2
9.63	132.7	0.0	0.0	129.6	0.0	0.0	87.7	202.9	86.1	65.3	0.0	0.0	29.8	0.0	0.0
12.45	131.3	0.0	0.0	130.0	0.0	0.0	90.4	203.2	86.1	71.6	0.0	0.0	31.3	0.0	0.0
13.85	129.4	0.0	0.0	132.0	0.0	0.0	91.7	203.6	85.4	77.8	0.0	0.0	30.5	0.0	0.0
14.79	129.8	0.0	0.0	132.0	0.0	0.0	92.6	203.6	85.4	78.7	0.0	0.0	31.2	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 67.81 NU(S)A= 33.07 NU(AV)A= 56.23 ST(AV)A=0.00736 ST(AV)/ST(4S)=1.67 F/F(4S)= 2.46
 (ST/ST(4S))/(F/F(4S))=0.677 (F/F(4S))/(ST/ST(4S))*3.0=0.53 (ST/ST(4S))/(F/F(4S))*1(1/3)=1.23
 NU(R)A/NU(4S)=2.02 NU(S)A/NU(4S)=0.98 e+(4R)= 56.17 R(4R)= 6.25 H(4R)= 9.96

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 9.89

AVERAGE VALUES WITH SL: H(4R)= 9.08

RUN NUMBER= 59HR30-30/20 E/D=0.047 P/E=20.0 ALPHA=30 HYD DIA= 2.667 IN PR=.71 MDOT=0.1010 LBM/SEC
 RE= 32220. GGE(R)= 437.2 BTU/HR-SQ FT GGE(S)= 295.3 INLET TEMP= 81.6 F TATM= 75.2 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.07	98.3	0.0	97.6	102.0	0.0	97.8	81.7	432.2	287.4	379.8	0.0	396.5	206.2	0.0	2
2	0.16	108.2	0.0	100.4	104.2	0.0	97.1	81.7	430.0	286.6	237.6	0.0	336.9	186.2	0.0	2
3	0.26	105.4	0.0	103.8	99.9	0.0	99.0	81.8	430.6	287.1	266.9	0.0	286.3	231.6	0.0	2
4	0.35	103.1	0.0	104.0	98.1	0.0	99.0	81.9	431.1	287.3	297.1	0.0	285.0	259.4	0.0	2
5	0.45	102.8	0.0	106.2	98.7	0.0	99.6	82.0	431.2	287.0	302.4	0.0	260.0	250.7	0.0	2
6	0.54	104.2	0.0	108.0	100.2	0.0	102.6	82.0	430.9	286.4	284.1	0.0	242.5	230.6	0.0	21
7	0.63	106.2	0.0	110.2	100.9	0.0	101.9	82.1	430.4	286.0	261.1	0.0	223.9	222.4	0.0	21
8	0.73	109.2	0.0	112.1	99.8	0.0	101.0	82.2	429.8	286.4	232.4	0.0	209.9	237.6	0.0	21
9	0.82	111.6	0.0	113.7	102.4	0.0	103.0	82.3	429.2	285.5	213.7	0.0	199.5	207.1	0.0	20
10	0.91	109.4	0.0	111.5	103.6	0.0	99.0	82.3	429.7	285.1	231.9	0.0	215.2	195.8	0.0	20
11	1.01	114.7	0.0	0.0	104.0	0.0	0.0	82.4	428.6	284.9	193.9	0.0	0.0	192.7	0.0	0
12	1.10	119.9	0.0	0.0	104.0	0.0	0.0	82.5	427.4	284.9	166.8	0.0	0.0	193.4	0.0	0
13	1.20	118.1	0.0	0.0	106.0	0.0	0.0	82.5	427.8	284.2	175.8	0.0	0.0	177.0	0.0	0
14	1.29	115.3	0.0	0.0	107.0	0.0	0.0	82.6	428.4	283.8	191.5	0.0	0.0	170.1	0.0	0
15	1.38	114.3	0.0	0.0	108.0	0.0	0.0	82.7	428.6	283.5	198.1	0.0	0.0	163.6	0.0	0
16	1.48	115.1	0.0	0.0	109.0	0.0	0.0	82.8	428.5	283.1	193.5	0.0	0.0	157.6	0.0	0
17	1.57	117.4	0.0	0.0	110.0	0.0	0.0	82.8	428.0	282.8	180.8	0.0	0.0	152.0	0.0	0
18	1.66	119.6	0.0	0.0	111.0	0.0	0.0	82.9	427.5	282.4	170.1	0.0	0.0	146.8	0.0	0
19	1.76	120.4	0.0	0.0	112.0	0.0	0.0	83.0	427.3	282.0	166.7	0.0	0.0	141.9	0.0	0
20	1.85	114.5	0.0	0.0	113.0	0.0	0.0	83.1	428.6	281.7	199.0	0.0	0.0	137.4	0.0	0
21	1.95	109.8	0.0	0.0	114.0	0.0	0.0	83.1	429.6	281.3	235.2	0.0	0.0	133.0	0.0	0
22	2.04	124.2	0.0	0.0	115.0	0.0	0.0	83.2	426.5	281.0	151.8	0.0	0.0	129.0	0.0	0
23	2.13	124.8	0.0	0.0	116.0	0.0	0.0	83.3	426.3	280.6	149.9	0.0	0.0	125.2	0.0	0
24	2.23	122.7	0.0	0.0	117.0	0.0	0.0	83.4	426.8	280.2	158.3	0.0	0.0	121.6	0.0	0
25	2.32	122.4	0.0	0.0	118.0	0.0	0.0	83.4	426.9	279.9	159.8	0.0	0.0	118.1	0.0	0
26	2.41	122.9	0.0	0.0	118.0	0.0	0.0	83.5	426.7	279.9	158.0	0.0	0.0	118.4	0.0	0
27	2.51	123.0	0.0	0.0	119.0	0.0	0.0	83.6	426.7	279.5	157.9	0.0	0.0	115.1	0.0	0
28	2.60	125.2	0.0	0.0	120.0	0.0	0.0	83.7	426.2	279.2	149.6	0.0	0.0	112.0	0.0	0
29	2.70	125.1	0.0	0.0	121.0	0.0	0.0	83.7	426.3	278.8	150.3	0.0	0.0	109.1	0.0	0
30	2.79	119.1	0.0	0.0	121.0	0.0	0.0	83.8	427.6	278.8	176.6	0.0	0.0	109.3	0.0	0
31	2.88	115.5	0.0	0.0	122.0	0.0	0.0	83.9	428.4	278.4	197.5	0.0	0.0	106.5	0.0	0
32	2.98	129.4	0.0	0.0	123.0	0.0	0.0	84.0	425.3	278.1	136.4	0.0	0.0	103.8	0.0	0
33	3.07	129.5	0.0	0.0	124.0	0.0	0.0	84.0	425.3	277.7	136.3	0.0	0.0	101.3	0.0	0
34	3.16	125.5	0.0	0.0	124.0	0.0	0.0	84.1	426.2	277.7	150.0	0.0	0.0	101.4	0.0	0
35	3.26	125.6	0.0	0.0	125.0	0.0	0.0	84.2	426.2	277.4	149.9	0.0	0.0	99.0	0.0	0
36	3.35	126.0	0.0	0.0	126.0	0.0	0.0	84.3	426.1	277.0	148.7	0.0	0.0	96.7	0.0	0
37	3.45	126.8	0.0	0.0	126.0	0.0	0.0	84.3	425.9	277.0	146.1	0.0	0.0	96.8	0.0	0
38	3.54	127.7	0.0	0.0	127.0	0.0	0.0	84.4	425.7	276.6	143.2	0.0	0.0	94.6	0.0	0
39	3.63	129.6	0.0	0.0	128.0	0.0	0.0	84.5	425.3	276.3	137.3	0.0	0.0	92.4	0.0	0
40	3.73	125.1	0.0	0.0	128.0	0.0	0.0	84.6	426.3	276.3	153.1	0.0	0.0	92.6	0.0	0
41	4.01	129.6	0.0	0.0	130.0	0.0	0.0	84.8	425.3	275.6	138.1	0.0	0.0	88.7	0.0	0
42	4.95	131.8	0.0	0.0	132.0	0.0	0.0	85.5	424.8	274.8	133.4	0.0	0.0	86.0	0.0	0
43	5.41	129.8	0.0	0.0	135.0	0.0	0.0	85.9	425.2	273.8	140.7	0.0	0.0	81.0	0.0	0
44	6.35	130.2	0.0	0.0	137.0	0.0	0.0	86.6	425.1	273.0	141.6	0.0	0.0	78.7	0.0	0
45	7.29	129.5	0.0	0.0	137.0	0.0	0.0	87.4	425.3	273.0	146.4	0.0	0.0	79.8	0.0	0
46	8.23	128.0	0.0	0.0	136.2	0.0	0.0	88.1	425.6	273.3	154.5	0.0	0.0	82.3	0.0	0
47	8.58	127.3	133.9	127.5	135.1	127.1	120.1	88.4	425.8	273.4	158.5	135.5	157.7	84.7	102.2	124.
48	8.60	133.1	132.7	139.6	135.2	125.2	120.8	88.4	424.4	273.4	137.4	138.7	120.0	84.5	107.5	122.
49	8.70	129.3	130.8	138.9	134.3	125.3	122.3	88.5	425.3	273.8	150.8	145.5	122.1	86.4	107.6	117.
50	8.79	126.7	133.0	136.1	135.2	127.3	126.2	88.6	425.9	274.5	161.6	138.7	129.6	85.1	102.7	105.
51	8.88	126.6	133.9	137.0	133.5	128.4	127.4	88.7	425.9	273.4	162.4	136.2	127.4	88.2	99.4	102.
52	8.98	128.8	134.5	137.7	135.5	129.5	127.5	88.7	425.6	273.4	153.6	134.5	125.7	84.5	96.9	102.
53	9.07	127.7	124.6	136.7	136.5	131.6	126.5	88.8	425.7	273.8	158.3	172.0	128.5	82.9	92.5	104.
54	9.16	127.1	123.0	139.0	136.1	132.6	125.6	88.9	424.9	273.9	160.6	180.1	122.6	83.8	90.5	107.
55	9.26	132.5	137.8	140.2	135.7	133.5	123.8	89.0	425.1	274.1	141.0	125.8	119.9	84.7	88.9	113.6
56	9.35	131.7	135.5	141.4	135.7	131.7	122.8	89.0	425.8	274.1	144.4	132.4	117.5	84.8	92.8	117.4
57	9.63	128.7	0.0	0.0	135.0	0.0	0.0	89.3	425.5	273.8	155.8	0.0	0.0	86.5	0.0	0
58	12.45	125.9	0.0	0.0	129.0	0.0	0.0	91.5	426.1	275.9	178.3	0.0	0.0	105.9	0.0	0
59	13.85	131.9	0.0	0.0	135.0	0.0	0.0	92.6	424.8	273.8	155.3	0.0	0.0	92.8	0.0	0
60	14.79	132.0	0.0	0.0	137.0	0.0	0.0	93.4	424.7	273.0	157.7	0.0	0.0	89.8	0.0	0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=151.36 NU(S)A= 91.74 NU(AV)A=131.49 ST(AV)A=0.00574 ST(AV)/ST(4S)=1.62 F/F(4S)= 2.73
 (ST/ST(4S))/(F/F(4S))=0.593 (F/F(4S))/(ST/ST(4S))*3.0=0.64 (ST/ST(4S))/(F/F(4S))*1(1/3)=1.16
 NU(R)A/NU(4S)=1.87 NU(S)A/NU(4S)=1.13 e+(4R)= 155.53 R(4R)= 7.00 H(4R)=12.39

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 12.91

AVERAGE VALUES WITH SL: H(4R)= 11.44

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER= 60HR&0-30/20 E/D=0.047 P/E=20.0 ALPHA=30 HYD DIA= 2.667 IN PR= 71 MDDT=0.1980 LBM/SEC
63091. GGE(R)= 735.7 BTU/HR-SQ FT GGE(S)= 465.7 INLET TEMP= 83.2 F TATM= 76.0 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.07	99.8	0.0	94.7	103.0	0.0	103.9	83.2	730.4	458.5	643.9	0.0	930.6	339.2	0.0	323.8
0.16	110.4	0.0	100.9	106.0	0.0	103.4	83.3	728.1	457.5	392.1	0.0	604.0	294.6	0.0	332.6
0.26	107.9	0.0	104.2	101.8	0.0	101.4	83.4	728.6	457.6	433.4	0.0	510.5	361.7	0.0	369.9
0.35	106.0	0.0	104.8	100.2	0.0	99.5	83.4	729.1	457.7	471.4	0.0	497.9	399.3	0.0	417.0
0.45	105.4	0.0	107.4	97.9	0.0	98.0	83.5	729.2	457.8	485.8	0.0	445.1	463.9	0.0	460.7
0.54	106.6	0.0	108.9	99.4	0.0	99.0	83.6	728.9	457.3	461.6	0.0	419.7	421.3	0.0	432.3
0.63	108.2	0.0	111.4	100.8	0.0	99.0	83.6	728.6	456.8	432.5	0.0	382.6	388.1	0.0	433.6
0.73	110.9	0.0	113.7	99.6	0.0	101.0	83.7	728.0	457.2	390.2	0.0	353.8	419.3	0.0	385.4
0.82	113.0	0.0	115.9	101.6	0.0	102.0	83.8	727.5	456.5	362.8	0.0	330.1	373.2	0.0	365.0
0.91	109.7	0.0	113.9	103.1	0.0	100.0	83.8	728.2	456.0	410.4	0.0	353.0	344.9	0.0	411.1
1.01	115.9	0.0	0.0	104.0	0.0	0.0	83.9	726.9	455.6	331.0	0.0	0.0	330.3	0.0	0.0
1.10	121.6	0.0	0.0	105.0	0.0	0.0	84.0	725.6	455.3	281.0	0.0	0.0	315.4	0.0	0.0
1.20	119.4	0.0	0.0	106.0	0.0	0.0	84.0	726.1	454.9	299.1	0.0	0.0	301.7	0.0	0.0
1.29	117.5	0.0	0.0	107.0	0.0	0.0	84.1	726.5	454.6	316.8	0.0	0.0	289.1	0.0	0.0
1.38	117.3	0.0	0.0	109.0	0.0	0.0	84.2	726.6	453.8	319.4	0.0	0.0	266.1	0.0	0.0
1.48	118.2	0.0	0.0	110.0	0.0	0.0	84.2	726.4	453.5	311.4	0.0	0.0	256.3	0.0	0.0
1.57	120.6	0.0	0.0	111.0	0.0	0.0	84.3	725.9	453.1	291.1	0.0	0.0	247.1	0.0	0.0
1.66	122.7	0.0	0.0	112.0	0.0	0.0	84.4	725.4	452.8	275.5	0.0	0.0	238.5	0.0	0.0
1.76	123.3	0.0	0.0	113.0	0.0	0.0	84.4	725.3	452.4	271.6	0.0	0.0	230.5	0.0	0.0
1.85	115.7	0.0	0.0	114.0	0.0	0.0	84.5	725.9	452.0	339.0	0.0	0.0	223.0	0.0	0.0
1.95	109.2	0.0	0.0	115.0	0.0	0.0	84.5	728.4	451.7	430.1	0.0	0.0	215.9	0.0	0.0
2.04	125.9	0.0	0.0	116.0	0.0	0.0	84.6	724.7	451.3	255.5	0.0	0.0	209.3	0.0	0.0
2.13	125.2	0.0	0.0	117.0	0.0	0.0	84.7	724.8	451.0	260.4	0.0	0.0	203.1	0.0	0.0
2.23	122.7	0.0	0.0	118.0	0.0	0.0	84.7	725.4	450.6	278.1	0.0	0.0	197.2	0.0	0.0
2.32	123.4	0.0	0.0	117.0	0.0	0.0	84.8	725.2	451.0	273.5	0.0	0.0	203.8	0.0	0.0
2.41	124.2	0.0	0.0	119.0	0.0	0.0	84.9	725.1	450.2	268.3	0.0	0.0	192.0	0.0	0.0
2.51	125.0	0.0	0.0	119.0	0.0	0.0	84.9	724.9	450.2	263.2	0.0	0.0	192.3	0.0	0.0
2.60	127.2	0.0	0.0	120.0	0.0	0.0	85.0	724.4	449.9	249.7	0.0	0.0	187.0	0.0	0.0
2.70	126.9	0.0	0.0	121.0	0.0	0.0	85.1	724.5	449.5	251.9	0.0	0.0	182.0	0.0	0.0
2.79	119.6	0.0	0.0	121.0	0.0	0.0	85.1	726.1	449.5	306.4	0.0	0.0	182.3	0.0	0.0
2.88	115.4	0.0	0.0	122.0	0.0	0.0	85.2	727.0	449.2	350.0	0.0	0.0	177.5	0.0	0.0
2.98	132.7	0.0	0.0	123.0	0.0	0.0	85.3	723.2	448.8	221.7	0.0	0.0	172.9	0.0	0.0
3.07	130.8	0.0	0.0	124.0	0.0	0.0	85.3	723.6	448.4	231.4	0.0	0.0	168.6	0.0	0.0
3.16	126.6	0.0	0.0	125.0	0.0	0.0	85.4	724.5	448.1	255.6	0.0	0.0	164.5	0.0	0.0
3.26	126.9	0.0	0.0	125.0	0.0	0.0	85.5	724.5	448.1	254.1	0.0	0.0	164.7	0.0	0.0
3.35	127.9	0.0	0.0	126.0	0.0	0.0	85.5	724.2	447.7	248.4	0.0	0.0	160.8	0.0	0.0
3.45	128.9	0.0	0.0	126.0	0.0	0.0	85.6	724.0	447.7	242.9	0.0	0.0	161.0	0.0	0.0
3.54	130.0	0.0	0.0	127.0	0.0	0.0	85.6	723.8	447.4	237.2	0.0	0.0	157.2	0.0	0.0
3.63	131.7	0.0	0.0	128.0	0.0	0.0	85.7	723.4	447.0	228.6	0.0	0.0	153.6	0.0	0.0
3.73	125.8	0.0	0.0	128.0	0.0	0.0	85.8	724.7	447.0	263.1	0.0	0.0	153.8	0.0	0.0
4.01	131.4	0.0	0.0	131.0	0.0	0.0	86.0	723.5	445.9	231.3	0.0	0.0	143.8	0.0	0.0
4.95	134.7	0.0	0.0	132.0	0.0	0.0	86.6	722.7	445.6	218.1	0.0	0.0	142.5	0.0	0.0
5.41	131.6	0.0	0.0	133.0	0.0	0.0	86.9	723.4	445.2	234.9	0.0	0.0	140.2	0.0	0.0
6.35	130.6	0.0	0.0	135.0	0.0	0.0	87.6	723.7	444.5	243.8	0.0	0.0	135.8	0.0	0.0
7.29	130.4	0.0	0.0	136.0	0.0	0.0	88.2	723.7	444.1	248.4	0.0	0.0	134.6	0.0	0.0
8.23	130.8	0.0	0.0	135.5	0.0	0.0	88.9	723.6	444.3	249.6	0.0	0.0	137.8	0.0	0.0
8.58	131.7	135.1	129.7	133.7	128.2	121.2	89.1	723.4	444.5	245.6	227.4	257.7	144.1	164.4	200.2
8.60	137.3	134.1	142.1	133.3	128.3	122.3	89.1	721.9	444.5	216.6	232.1	197.0	145.4	164.1	193.8
8.70	132.8	130.3	141.9	133.4	127.4	122.4	89.2	723.1	444.8	239.7	254.3	198.3	145.4	168.3	193.6
8.79	129.5	134.0	139.0	133.4	128.5	126.5	89.3	723.8	446.3	259.9	233.8	210.3	146.0	164.5	173.4
1 8.88	129.0	135.1	139.5	133.1	130.6	127.0	89.3	724.1	443.8	263.8	228.6	208.5	146.6	155.4	170.0
2 8.98	131.5	136.0	139.5	134.7	132.7	129.6	89.4	723.9	445.2	248.6	224.4	208.7	142.1	148.7	159.8
3 9.07	128.6	124.6	138.0	136.2	134.7	127.2	89.5	724.1	445.2	267.3	297.7	215.5	137.5	142.1	170.3
4 9.16	131.7	122.8	140.7	134.9	135.8	126.6	89.5	723.4	445.2	247.8	314.1	204.2	141.8	138.9	173.3

55	9.26	140.1	139.3	142.0	136.0	136.8	125.0	89.6	723.6	444.8	206.8	210.2	199.4	138.6	136.0	181.7
56	9.35	134.4	135.4	142.2	135.1	133.1	124.6	89.7	724.7	444.8	233.7	228.8	199.2	141.4	148.0	184.0
57	9.63	135.4	0.0	0.0	134.0	0.0	0.0	89.9	723.6	444.8	229.3	0.0	0.0	145.5	0.0	0.0
58	12.45	129.0	0.0	0.0	129.0	0.0	0.0	91.8	724.0	446.6	280.1	0.0	0.0	172.8	0.0	0.0
59	13.85	132.3	0.0	0.0	135.0	0.0	0.0	92.8	723.3	444.5	262.9	0.0	0.0	151.2	0.0	0.0
60	14.79	132.8	0.0	0.0	136.0	0.0	0.0	93.4	723.2	444.1	263.6	0.0	0.0	149.7	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
NU(R)A=248.14 NU(S)A=153.17 NU(AV)A=216.48 ST(AV)A=0.00483 ST(AV)/ST(4S)=1.56 F/F(4S)= 2.88
(ST/ST(4S))/(F/F(4S))=0.541 (F/F(4S))/(ST/ST(4S))**3.0=0.76 (ST/ST(4S))/(F/F(4S))**(1/3)=1.09
NU(R)A/NU(4S)=1.79 NU(S)A/NU(4S)=1.11 e+(4R)= 289.78 R(4R)= 7.49 H(4R)=14.54

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 15.04

AVERAGE VALUES WITH SL: H(4R)= 13.39

RUN NUMBER= 62HR10-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.667 IN PR=.71 MDOT=0.0334 LBM/SEC
 RE= 10658. GGE(R)= 128.7 BTU/HR-SQ FT GGE(S)= 209.5 INLET TEMP= 80.3 F TATM= 74.2 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.07	98.8	0.0	95.1	106.1	0.0	104.0	80.4	123.3	198.4	98.1	0.0	122.7	113.0	0.0	1
2	0.16	103.1	0.0	100.1	113.2	0.0	111.5	80.5	122.4	196.3	79.2	0.0	91.3	87.9	0.0	1
3	0.26	100.8	0.0	102.1	110.6	0.0	106.6	80.5	122.9	197.3	88.9	0.0	83.5	96.2	0.0	1
4	0.35	98.1	0.0	100.2	106.1	0.0	104.6	80.6	123.5	197.9	103.6	0.0	92.5	113.8	0.0	1
5	0.45	96.8	0.0	101.2	102.0	0.0	101.2	80.7	123.7	198.5	112.8	0.0	88.5	136.6	0.0	1
6	0.54	96.8	0.0	101.7	104.0	0.0	101.6	80.8	123.7	197.3	113.4	0.0	86.8	124.6	0.0	1
7	0.63	97.4	0.0	102.2	107.8	0.0	104.6	80.9	123.6	196.0	109.7	0.0	85.0	106.6	0.0	1
8	0.73	98.6	0.0	102.6	108.3	0.0	108.0	81.0	123.4	197.2	102.6	0.0	83.6	105.7	0.0	1
9	0.82	99.8	0.0	103.0	110.1	0.0	108.0	81.1	123.1	196.6	96.3	0.0	82.2	99.2	0.0	1
10	0.91	101.2	0.0	102.3	107.8	0.0	108.5	81.2	122.8	197.4	89.7	0.0	85.0	108.5	0.0	1
11	1.01	103.0	0.0	0.0	113.0	0.0	0.0	81.3	122.4	195.5	82.4	0.0	0.0	90.2	0.0	1
12	1.10	104.7	0.0	0.0	114.5	0.0	0.0	81.3	122.0	195.0	76.5	0.0	0.0	86.1	0.0	1
13	1.20	106.3	0.0	0.0	112.7	0.0	0.0	81.4	121.7	195.6	71.6	0.0	0.0	91.6	0.0	1
14	1.29	107.3	0.0	0.0	113.1	0.0	0.0	81.5	121.4	195.5	68.9	0.0	0.0	90.6	0.0	1
15	1.38	107.8	0.0	0.0	110.6	0.0	0.0	81.6	121.3	196.4	67.8	0.0	0.0	99.1	0.0	1
16	1.48	108.9	0.0	0.0	115.5	0.0	0.0	81.7	121.1	194.6	65.1	0.0	0.0	84.2	0.0	1
17	1.57	110.0	0.0	0.0	117.2	0.0	0.0	81.8	120.8	194.0	62.6	0.0	0.0	80.1	0.0	1
18	1.66	110.8	0.0	0.0	114.4	0.0	0.0	81.9	120.7	195.0	61.0	0.0	0.0	87.7	0.0	1
19	1.76	111.5	0.0	0.0	115.5	0.0	0.0	82.0	120.5	194.6	59.7	0.0	0.0	84.8	0.0	1
20	1.85	112.7	0.0	0.0	114.4	0.0	0.0	82.1	120.2	195.0	57.4	0.0	0.0	88.1	0.0	1
21	1.95	112.7	0.0	0.0	113.6	0.0	0.0	82.1	120.2	195.3	57.5	0.0	0.0	90.7	0.0	1
22	2.04	113.2	0.0	0.0	115.0	0.0	0.0	82.2	120.1	194.8	56.7	0.0	0.0	86.9	0.0	1
23	2.13	113.8	0.0	0.0	116.6	0.0	0.0	82.3	120.0	194.2	55.7	0.0	0.0	82.8	0.0	1
24	2.23	114.7	0.0	0.0	115.8	0.0	0.0	82.4	119.8	194.5	54.2	0.0	0.0	85.1	0.0	1
25	2.32	115.3	0.0	0.0	115.5	0.0	0.0	82.5	119.7	194.6	53.3	0.0	0.0	86.1	0.0	1
26	2.41	116.2	0.0	0.0	116.0	0.0	0.0	82.6	119.5	194.4	51.9	0.0	0.0	85.0	0.0	1
27	2.51	116.5	0.0	0.0	121.0	0.0	0.0	82.7	119.4	192.6	51.6	0.0	0.0	73.4	0.0	1
28	2.60	117.4	0.0	0.0	119.0	0.0	0.0	82.8	119.2	193.4	50.3	0.0	0.0	77.9	0.0	1
29	2.70	117.9	0.0	0.0	118.0	0.0	0.0	82.9	119.1	193.7	49.6	0.0	0.0	80.5	0.0	1
30	2.79	118.6	0.0	0.0	116.5	0.0	0.0	82.9	119.0	194.3	48.7	0.0	0.0	84.5	0.0	1
31	2.88	119.1	0.0	0.0	117.0	0.0	0.0	83.0	118.8	194.1	48.1	0.0	0.0	83.4	0.0	1
32	2.98	119.5	0.0	0.0	123.0	0.0	0.0	83.1	118.8	191.9	47.6	0.0	0.0	70.2	0.0	1
33	3.07	120.1	0.0	0.0	119.0	0.0	0.0	83.2	118.6	193.4	46.9	0.0	0.0	78.8	0.0	1
34	3.16	120.7	0.0	0.0	118.5	0.0	0.0	83.3	118.5	193.5	46.2	0.0	0.0	80.2	0.0	1
35	3.26	121.2	0.0	0.0	118.0	0.0	0.0	83.4	118.4	193.7	45.7	0.0	0.0	81.6	0.0	1
36	3.35	121.4	0.0	0.0	113.4	0.0	0.0	83.5	118.3	195.4	45.5	0.0	0.0	95.2	0.0	1
37	3.45	121.5	0.0	0.0	123.6	0.0	0.0	83.6	118.3	191.7	45.5	0.0	0.0	69.8	0.0	1
38	3.54	121.3	0.0	0.0	120.0	0.0	0.0	83.6	118.4	193.0	45.8	0.0	0.0	77.4	0.0	1
39	3.63	122.6	0.0	0.0	119.5	0.0	0.0	83.7	118.1	193.2	44.3	0.0	0.0	78.8	0.0	1
40	3.73	122.8	0.0	0.0	118.6	0.0	0.0	83.8	118.0	193.5	44.1	0.0	0.0	81.1	0.0	1
41	4.01	122.7	0.0	0.0	120.0	0.0	0.0	84.1	118.0	193.0	44.6	0.0	0.0	78.3	0.0	1
42	4.95	125.5	0.0	0.0	121.0	0.0	0.0	85.0	117.4	192.6	42.2	0.0	0.0	77.8	0.0	1
43	5.41	126.2	0.0	0.0	122.0	0.0	0.0	85.4	117.3	192.3	41.8	0.0	0.0	76.4	0.0	1
44	6.35	127.1	0.0	0.0	123.0	0.0	0.0	86.3	117.1	191.9	41.7	0.0	0.0	75.9	0.0	1
45	7.29	127.8	0.0	0.0	124.4	0.0	0.0	87.2	116.9	191.4	41.7	0.0	0.0	74.6	0.0	1
46	8.23	127.8	0.0	0.0	124.5	0.0	0.0	88.1	116.9	191.4	42.6	0.0	0.0	76.1	0.0	1
47	8.58	128.0	123.4	120.8	120.1	125.6	127.1	88.4	116.8	193.2	42.7	48.3	52.2	88.2	75.2	72.
48	8.60	128.2	123.6	121.1	128.9	127.7	128.7	88.4	116.7	190.0	42.4	48.0	51.7	68.0	70.0	68.
49	8.70	128.1	123.5	121.4	124.6	124.3	125.0	88.5	116.7	191.6	42.6	48.3	51.3	76.9	77.5	76.
50	8.79	128.2	123.8	121.3	125.9	125.5	125.4	88.6	116.7	191.6	42.6	48.0	51.6	74.3	75.1	75.
51	8.88	128.8	123.9	121.3	125.2	125.2	126.0	88.7	116.8	191.1	42.1	48.0	51.8	75.7	75.7	74.
52	8.98	129.0	123.8	121.4	121.0	123.2	123.8	88.8	116.7	192.6	42.0	48.2	51.8	86.5	81.0	79.
53	9.07	127.3	123.6	121.1	132.0	130.1	131.1	88.9	117.0	189.1	44.0	48.7	52.5	63.4	66.3	64.
54	9.16	127.5	124.1	121.9	128.2	126.7	128.4	89.0	116.5	190.5	43.7	47.9	51.1	70.2	73.0	69.

55	9.26	128.0	123.9	121.6	126.3	128.3	125.8	89.1	116.6	191.2	43.3	48.4	51.8	74.2	70.5	75.2
56	9.35	128.7	123.9	122.8	125.6	125.9	126.6	89.2	116.6	191.1	42.6	48.5	50.1	75.8	75.2	73.8
57	9.63	129.1	0.0	0.0	126.8	0.0	0.0	89.4	116.6	190.4	42.5	0.0	0.0	73.6	0.0	0.0
58	12.45	131.6	0.0	0.0	129.0	0.0	0.0	92.1	116.1	189.8	42.2	0.0	0.0	73.9	0.0	0.0
59	13.85	132.3	0.0	0.0	130.4	0.0	0.0	93.4	115.9	189.3	42.8	0.0	0.0	73.4	0.0	0.0
60	14.79	133.0	0.0	0.0	130.5	0.0	0.0	94.3	115.8	189.2	42.9	0.0	0.0	74.9	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 44.39 NU(S)A= 77.49 NU(AV)A= 55.43 ST(AV)A=0.00731 ST(AV)/ST(4S)=1.65 F/F(4S)= 1.93
 (ST/ST(4S))/(F/F(4S))=0.858 (F/F(4S))/(ST/ST(4S))*3.0=0.43 (ST/ST(4S))/(F/F(4S))*3.0=1.33
 NU(R)A/NU(4S)=1.33 NU(S)A/NU(4S)=2.32 e+(4R)= 48.26 R(4R)= 7.63 H(4R)= 8.35

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 13.83

AVERAGE VALUES WITH SL: H(4R)= 8.49

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER= 63HR30-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.667 IN PR=.71 MDDT=0.1002 LBM/SEC
31924. GGE(R)= 376.3 BTU/HR-SQ FT GGE(S)= 434.8 INLET TEMP= 82.2 F TATM= 74.9 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	106.7	0.0	96.5	110.0	0.0	104.9	82.3	369.3	423.9	220.8	0.0	379.0	223.4	0.0	273.3
16	110.6	0.0	99.3	113.6	0.0	104.1	82.3	368.5	422.6	190.5	0.0	317.4	197.6	0.0	284.0
26	106.3	0.0	102.7	108.9	0.0	106.0	82.4	369.4	423.3	226.0	0.0	266.1	233.4	0.0	262.2
35	104.9	0.0	103.6	107.4	0.0	105.0	82.5	369.7	423.4	241.1	0.0	255.9	248.7	0.0	274.8
45	104.1	0.0	105.8	105.8	0.0	106.6	82.6	369.9	423.8	251.0	0.0	232.6	266.7	0.0	257.4
54	104.4	0.0	107.2	110.7	0.0	109.6	82.7	369.8	422.1	248.4	0.0	220.0	219.9	0.0	228.9
63	105.1	0.0	108.5	110.7	0.0	111.9	82.7	369.7	421.9	241.3	0.0	209.5	220.3	0.0	211.1
73	106.8	0.0	109.1	107.9	0.0	110.0	82.8	369.3	422.9	224.8	0.0	205.1	246.1	0.0	227.1
82	108.4	0.0	109.6	109.6	0.0	110.5	82.9	369.0	422.3	211.1	0.0	201.7	230.8	0.0	223.3
91	110.1	0.0	107.5	108.2	0.0	102.4	83.0	368.6	422.8	198.3	0.0	219.3	244.6	0.0	317.6
01	112.0	0.0	0.0	114.5	0.0	0.0	83.0	368.2	420.6	185.6	0.0	0.0	195.2	0.0	0.0
10	114.0	0.0	0.0	114.3	0.0	0.0	83.1	367.7	420.6	173.8	0.0	0.0	196.9	0.0	0.0
20	116.3	0.0	0.0	112.4	0.0	0.0	83.2	367.2	421.3	161.9	0.0	0.0	210.6	0.0	0.0
29	117.5	0.0	0.0	113.2	0.0	0.0	83.3	367.0	421.0	156.5	0.0	0.0	203.3	0.0	0.0
38	117.7	0.0	0.0	111.5	0.0	0.0	83.4	366.9	421.7	155.9	0.0	0.0	218.6	0.0	0.0
48	119.1	0.0	0.0	117.0	0.0	0.0	83.4	366.6	419.7	150.0	0.0	0.0	182.4	0.0	0.0
57	120.1	0.0	0.0	116.2	0.0	0.0	83.5	366.4	420.0	146.1	0.0	0.0	187.4	0.0	0.0
66	120.9	0.0	0.0	114.6	0.0	0.0	83.6	366.2	420.5	143.2	0.0	0.0	197.8	0.0	0.0
76	121.4	0.0	0.0	115.0	0.0	0.0	83.7	366.1	420.4	141.5	0.0	0.0	195.7	0.0	0.0
85	122.9	0.0	0.0	115.8	0.0	0.0	83.8	365.8	420.1	136.2	0.0	0.0	191.1	0.0	0.0
95	123.0	0.0	0.0	114.7	0.0	0.0	83.8	365.7	420.5	136.1	0.0	0.0	198.6	0.0	0.0
04	123.4	0.0	0.0	116.0	0.0	0.0	83.9	365.7	420.0	135.0	0.0	0.0	190.8	0.0	0.0
13	124.1	0.0	0.0	116.4	0.0	0.0	84.0	365.5	419.9	132.8	0.0	0.0	188.8	0.0	0.0
23	125.2	0.0	0.0	116.3	0.0	0.0	84.1	365.3	419.9	129.4	0.0	0.0	189.9	0.0	0.0
32	125.7	0.0	0.0	115.2	0.0	0.0	84.2	365.2	420.3	128.0	0.0	0.0	197.2	0.0	0.0
41	126.6	0.0	0.0	116.4	0.0	0.0	84.2	365.0	419.9	125.5	0.0	0.0	190.1	0.0	0.0
51	127.0	0.0	0.0	119.4	0.0	0.0	84.3	364.9	418.8	124.5	0.0	0.0	173.8	0.0	0.0
60	128.1	0.0	0.0	119.0	0.0	0.0	84.4	364.6	419.0	121.5	0.0	0.0	176.3	0.0	0.0
70	128.6	0.0	0.0	118.2	0.0	0.0	84.5	364.5	419.2	120.3	0.0	0.0	181.0	0.0	0.0
79	129.3	0.0	0.0	117.7	0.0	0.0	84.5	364.4	419.4	118.5	0.0	0.0	184.2	0.0	0.0
88	129.7	0.0	0.0	118.0	0.0	0.0	84.6	364.3	419.3	117.6	0.0	0.0	182.9	0.0	0.0
98	130.0	0.0	0.0	122.2	0.0	0.0	84.7	364.2	417.8	117.0	0.0	0.0	162.2	0.0	0.0
07	130.9	0.0	0.0	118.4	0.0	0.0	84.8	364.0	419.2	114.9	0.0	0.0	181.5	0.0	0.0
16	131.2	0.0	0.0	119.0	0.0	0.0	84.9	363.9	419.0	114.3	0.0	0.0	178.6	0.0	0.0
26	131.8	0.0	0.0	120.2	0.0	0.0	84.9	363.8	418.5	113.0	0.0	0.0	172.7	0.0	0.0
35	132.1	0.0	0.0	112.9	0.0	0.0	85.0	363.7	421.1	112.4	0.0	0.0	219.7	0.0	0.0
45	131.8	0.0	0.0	123.5	0.0	0.0	85.1	363.8	417.3	113.3	0.0	0.0	158.1	0.0	0.0
54	131.2	0.0	0.0	119.0	0.0	0.0	85.2	363.9	419.0	115.0	0.0	0.0	180.1	0.0	0.0
63	133.3	0.0	0.0	120.0	0.0	0.0	85.3	363.5	418.6	110.0	0.0	0.0	175.2	0.0	0.0
73	133.4	0.0	0.0	119.4	0.0	0.0	85.3	363.5	418.8	109.9	0.0	0.0	178.8	0.0	0.0
82	132.5	0.0	0.0	120.0	0.0	0.0	85.6	363.7	418.6	112.6	0.0	0.0	176.7	0.0	0.0
91	136.1	0.0	0.0	121.0	0.0	0.0	86.4	362.9	418.2	105.9	0.0	0.0	175.3	0.0	0.0
01	137.0	0.0	0.0	121.0	0.0	0.0	86.8	362.7	418.2	104.7	0.0	0.0	177.2	0.0	0.0
10	137.8	0.0	0.0	122.0	0.0	0.0	87.5	362.5	417.9	104.5	0.0	0.0	175.7	0.0	0.0
20	139.4	0.0	0.0	123.0	0.0	0.0	88.3	362.1	417.5	102.6	0.0	0.0	174.3	0.0	0.0
29	139.5	0.0	0.0	123.0	0.0	0.0	89.1	362.1	417.5	103.9	0.0	0.0	178.1	0.0	0.0
38	140.3	135.0	131.2	118.1	127.6	129.3	89.4	362.0	419.0	102.8	114.7	125.1	210.7	158.3	151.6
48	141.2	135.9	132.1	128.2	127.7	126.6	89.4	361.7	415.4	100.9	112.4	122.4	154.6	156.6	161.4
57	141.1	135.5	132.4	123.8	124.3	125.3	89.5	361.8	417.0	101.3	113.6	121.8	175.5	173.0	168.3
66	141.1	136.0	132.3	126.2	126.2	126.2	89.6	361.7	417.2	101.4	112.5	122.3	164.5	164.3	164.5
76	140.9	136.0	132.5	124.1	124.4	124.3	89.7	361.8	416.2	102.0	112.8	122.0	174.5	172.9	173.3
85	141.8	136.5	132.8	121.5	121.6	123.5	89.8	361.7	417.9	100.4	111.7	121.3	189.9	189.6	178.8
95	139.0	135.5	131.4	132.5	130.6	129.5	89.8	362.2	414.6	106.3	114.5	125.8	140.1	146.9	150.7
04	142.1	136.8	133.5	129.6	127.6	127.6	89.9	360.7	415.7	99.8	111.0	119.4	151.0	159.1	159.1

9.26	140.4	136.1	132.9	127.7	130.1	126.8	90.0	362.4	416.4	103.7	113.4	121.9	159.2	149.7	163.4
9.35	140.8	135.3	134.0	127.7	127.7	126.8	90.1	362.8	416.4	103.1	115.7	119.1	159.5	159.5	163.7
9.63	141.2	0.0	0.0	126.0	0.0	0.0	90.3	361.7	416.4	102.6	0.0	0.0	168.3	0.0	0.0
12.45	145.0	0.0	0.0	130.0	0.0	0.0	92.7	360.9	415.0	99.1	0.0	0.0	159.7	0.0	0.0
13.85	146.2	0.0	0.0	128.5	0.0	0.0	93.9	360.6	415.5	98.8	0.0	0.0	172.0	0.0	0.0
14.79	147.0	0.0	0.0	129.0	0.0	0.0	94.6	360.5	415.4	98.6	0.0	0.0	173.1	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=107.96 NU(S)A=173.47 NU(AV)A=129.79 ST(AV)A=0.00572 ST(AV)/ST(4S)=1.61 F/F(4S)= 2.55
 (ST/ST(4S))/(F/F(4S))=0.632 (F/F(4S))/(ST/ST(4S))**3.0=0.61 (ST/ST(4S))/(F/F(4S))**(1/3)=1.18
 NU(R)A/NU(4S)=1.34 NU(S)A/NU(4S)=2.16 e+(4R)= 148.22 R(4R)= 7.38 H(4R)=11.89

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 18.17

AVERAGE VALUES WITH SL: H(4R)= 11.95

RUN NUMBER= 64HR60-90/10 E/D=0.047 P/E=10.0 ALPHA=90 HYD DIA= 2.667 IN PR=.71 MDDT=0.2050 LBM/SEC
 RE= 65436. GGE(R)= 464.1 BTU/HR-SQ FT GGE(S)= 695.5 INLET TEMP= 82.8 F TATM= 75.2 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.07	103.2	0.0	91.2	110.7	0.0	110.6	82.8	458.0	685.3	328.4	0.0	799.8	358.8	0.0	0.0
2	0.16	105.7	0.0	95.3	114.1	0.0	111.3	82.9	457.4	684.1	292.8	0.0	538.3	319.7	0.0	0.0
3	0.26	103.0	0.0	97.9	109.5	0.0	107.6	82.9	458.0	684.4	333.4	0.0	447.1	376.8	0.0	0.0
4	0.35	101.7	0.0	99.5	107.6	0.0	106.5	83.0	458.3	684.5	357.7	0.0	405.4	405.6	0.0	0.0
5	0.45	100.4	0.0	101.5	102.6	0.0	103.0	83.1	458.6	685.6	385.9	0.0	362.9	512.0	0.0	0.0
6	0.54	100.2	0.0	102.1	108.7	0.0	105.5	83.1	458.6	683.4	391.6	0.0	352.4	389.7	0.0	0.0
7	0.63	100.7	0.0	103.4	108.3	0.0	109.0	83.2	458.5	683.6	381.5	0.0	330.6	396.8	0.0	0.0
8	0.73	101.7	0.0	103.9	105.7	0.0	108.8	83.2	458.3	684.5	361.8	0.0	323.3	444.2	0.0	0.0
9	0.82	103.0	0.0	104.5	108.6	0.0	108.9	83.3	458.0	683.5	338.7	0.0	314.7	393.6	0.0	0.0
10	0.91	104.3	0.0	103.9	105.3	0.0	103.9	83.3	457.7	684.6	318.3	0.0	324.5	454.5	0.0	0.0
11	1.01	106.1	0.0	0.0	114.0	0.0	0.0	83.4	457.3	681.5	293.6	0.0	0.0	324.6	0.0	0.0
12	1.10	107.7	0.0	0.0	112.0	0.0	0.0	83.4	457.0	682.2	274.6	0.0	0.0	348.3	0.0	0.0
13	1.20	109.4	0.0	0.0	111.0	0.0	0.0	83.5	456.6	682.6	257.0	0.0	0.0	361.8	0.0	0.0
14	1.29	110.6	0.0	0.0	112.0	0.0	0.0	83.5	456.3	682.2	245.9	0.0	0.0	349.5	0.0	0.0
15	1.38	111.2	0.0	0.0	110.0	0.0	0.0	83.6	456.2	682.9	241.0	0.0	0.0	377.1	0.0	0.0
16	1.48	111.9	0.0	0.0	117.0	0.0	0.0	83.6	456.1	680.4	235.3	0.0	0.0	297.4	0.0	0.0
17	1.57	112.6	0.0	0.0	115.0	0.0	0.0	83.7	455.9	681.1	230.0	0.0	0.0	317.3	0.0	0.0
18	1.66	113.3	0.0	0.0	113.0	0.0	0.0	83.8	455.8	681.9	224.9	0.0	0.0	339.9	0.0	0.0
19	1.74	113.9	0.0	0.0	115.0	0.0	0.0	83.8	455.6	681.1	220.7	0.0	0.0	318.3	0.0	0.0
20	1.85	114.7	0.0	0.0	115.0	0.0	0.0	83.9	455.4	681.1	215.2	0.0	0.0	318.8	0.0	0.0
21	1.95	114.7	0.0	0.0	115.0	0.0	0.0	83.9	455.4	681.1	215.6	0.0	0.0	319.3	0.0	0.0
22	2.04	115.0	0.0	0.0	114.9	0.0	0.0	84.0	455.4	681.2	213.8	0.0	0.0	320.9	0.0	0.0
23	2.13	115.7	0.0	0.0	114.9	0.0	0.0	84.0	455.2	681.2	209.4	0.0	0.0	321.4	0.0	0.0
24	2.23	116.3	0.0	0.0	115.0	0.0	0.0	84.1	455.1	681.1	205.8	0.0	0.0	320.9	0.0	0.0
25	2.32	117.2	0.0	0.0	113.3	0.0	0.0	84.1	454.9	681.8	200.4	0.0	0.0	340.5	0.0	0.0
26	2.41	117.5	0.0	0.0	116.0	0.0	0.0	84.2	454.8	680.8	198.9	0.0	0.0	311.7	0.0	0.0
27	2.51	118.0	0.0	0.0	117.7	0.0	0.0	84.2	454.7	680.2	196.2	0.0	0.0	296.1	0.0	0.0
28	2.60	118.6	0.0	0.0	117.0	0.0	0.0	84.3	454.6	680.4	193.0	0.0	0.0	303.0	0.0	0.0
29	2.70	118.9	0.0	0.0	117.0	0.0	0.0	84.3	454.5	680.4	191.5	0.0	0.0	303.4	0.0	0.0
30	2.79	119.7	0.0	0.0	116.5	0.0	0.0	84.4	454.3	680.6	187.4	0.0	0.0	308.7	0.0	0.0
31	2.88	119.9	0.0	0.0	117.0	0.0	0.0	84.4	454.3	680.4	186.6	0.0	0.0	304.4	0.0	0.0
32	2.98	120.2	0.0	0.0	120.5	0.0	0.0	84.5	454.2	679.2	185.3	0.0	0.0	274.7	0.0	0.0
33	3.07	120.9	0.0	0.0	117.0	0.0	0.0	84.6	454.1	680.4	181.9	0.0	0.0	305.3	0.0	0.0
34	3.16	120.9	0.0	0.0	118.0	0.0	0.0	84.6	454.1	680.1	182.2	0.0	0.0	296.5	0.0	0.0
35	3.26	121.5	0.0	0.0	118.0	0.0	0.0	84.7	454.0	680.1	179.4	0.0	0.0	296.9	0.0	0.0
36	3.35	121.8	0.0	0.0	118.0	0.0	0.0	84.7	453.9	680.1	178.1	0.0	0.0	297.4	0.0	0.0
37	3.45	121.7	0.0	0.0	122.2	0.0	0.0	84.8	453.9	678.6	178.9	0.0	0.0	263.8	0.0	0.0
38	3.54	122.1	0.0	0.0	117.0	0.0	0.0	84.8	453.8	680.4	177.2	0.0	0.0	307.7	0.0	0.0
39	3.63	122.6	0.0	0.0	119.0	0.0	0.0	84.9	453.7	679.7	175.0	0.0	0.0	289.9	0.0	0.0
40	3.73	122.8	0.0	0.0	117.5	0.0	0.0	84.9	453.7	680.2	174.3	0.0	0.0	303.9	0.0	0.0
41	4.01	123.5	0.0	0.0	118.0	0.0	0.0	85.1	453.5	680.1	171.8	0.0	0.0	300.6	0.0	0.0
42	4.95	124.4	0.0	0.0	118.8	0.0	0.0	85.6	453.3	679.8	169.9	0.0	0.0	297.8	0.0	0.0
43	5.41	125.5	0.0	0.0	119.0	0.0	0.0	85.9	453.1	679.7	166.2	0.0	0.0	298.3	0.0	0.0
44	6.35	126.1	0.0	0.0	119.5	0.0	0.0	86.4	452.9	679.5	165.7	0.0	0.0	298.3	0.0	0.0
45	7.29	127.9	0.0	0.0	120.5	0.0	0.0	87.0	452.5	679.2	160.3	0.0	0.0	293.7	0.0	0.0
46	8.23	128.0	0.0	0.0	121.0	0.0	0.0	87.5	452.5	679.0	161.9	0.0	0.0	293.7	0.0	0.0
47	8.58	128.9	125.5	123.0	113.4	128.2	128.2	87.7	452.3	681.3	159.1	173.4	185.7	384.4	243.7	243.7
48	8.60	128.9	125.7	123.7	125.3	126.3	123.3	87.7	452.1	676.8	159.1	168.0	182.0	261.1	254.1	275.1
49	8.70	128.9	125.6	123.8	121.2	121.4	120.4	87.8	452.2	678.7	159.3	173.1	181.8	294.2	292.4	301.1
50	8.79	129.3	126.3	123.6	123.9	123.8	121.5	87.8	452.1	679.2	157.9	170.2	183.0	273.0	273.2	291.1
51	8.88	129.9	125.8	123.9	118.4	121.6	120.2	87.9	452.2	678.4	155.8	172.7	181.8	321.6	291.4	304.1
52	8.98	130.9	126.6	124.3	120.5	121.7	120.9	87.9	452.3	679.8	152.3	169.4	180.1	302.0	291.2	298.1
53	9.07	123.7	125.4	122.9	131.4	130.4	125.8	88.0	453.5	676.5	183.8	175.5	188.1	225.8	231.1	259.1
54	9.16	129.9	126.9	124.4	124.9	127.0	123.8	88.0	452.1	678.3	156.4	168.4	180.0	266.2	252.2	274.1
55	9.26	132.3	125.8	124.4	125.8	131.0	125.6	88.1	453.7	678.0	148.7	174.2	180.9	260.0	229.0	261.1
56	9.35	132.5	125.1	124.4	126.1	126.1	124.6	88.2	453.5	677.5	148.2	177.7	181.1	258.3	258.2	268.1
57	9.63	132.1	0.0	0.0	123.0	0.0	0.0	88.3	452.7	678.3	149.6	0.0	0.0	282.9	0.0	0.0
58	12.45	132.6	0.0	0.0	127.0	0.0	0.0	89.9	451.5	676.8	152.7	0.0	0.0	263.4	0.0	0.0
59	13.85	134.1	0.0	0.0	125.0	0.0	0.0	90.7	451.2	677.5	149.9	0.0	0.0	284.9	0.0	0.0
60	14.79	134.8	0.0	0.0	125.0	0.0	0.0	91.3	451.0	677.5	149.2	0.0	0.0	289.2	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=168.96 NU(S)A=289.35 NU(AV)A=209.09 ST(AV)A=0.00450 ST(AV)/ST(4S)=1.46 F/F(4S)= 3.02
 (ST/ST(4S))/(F/F(4S))=0.484 (F/F(4S))/(ST/ST(4S))*3.0=0.97 (ST/ST(4S))/(F/F(4S))*(1/3)=1.01
 NU(R)A/NU(4S)=1.18 NU(S)A/NU(4S)=2.03 e+(4R)= 307.55 R(4R)= 7.26 H(4R)=16.58

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 24.93

AVERAGE VALUES WITH SL: H(4R)= 16.76

ORIGINAL PAGE IS
OF POOR QUALITY

JMBER= 66HR10-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.667 IN PR= 71 MDOT=0.0329 LBM/SEC
3522. GGE(R)= 151.9 BTU/HR-SQ FT GGE(S)= 235.5 INLET TEMP= 77.5 F TATM= 72.0 F PATM= 14.6 PSIA

/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
07	98.5	0.0	95.6	105.1	0.0	103.0	77.6	146.1	223.9	102.9	0.0	119.4	119.9	0.0	129.9
16	103.0	0.0	103.3	112.1	0.0	109.4	77.7	145.1	221.9	84.4	0.0	83.4	95.1	0.0	103.0
26	100.0	0.0	104.4	109.6	0.0	107.6	77.8	145.8	222.9	96.6	0.0	80.6	103.3	0.0	110.2
35	97.3	0.0	100.1	104.7	0.0	104.6	77.9	146.4	223.6	111.0	0.0	97.0	122.7	0.0	123.2
45	96.1	0.0	99.8	101.7	0.0	103.2	78.0	146.6	223.8	119.2	0.0	99.0	138.7	0.0	130.5
54	96.2	0.0	99.7	102.0	0.0	101.1	78.1	146.6	223.3	119.2	0.0	99.9	137.7	0.0	142.5
63	96.8	0.0	100.5	103.7	0.0	102.7	78.2	146.5	222.7	115.9	0.0	96.7	128.7	0.0	134.0
73	98.3	0.0	101.3	107.8	0.0	107.0	78.3	146.2	222.6	107.5	0.0	93.5	111.0	0.0	114.1
82	99.7	0.0	102.1	111.6	0.0	108.0	78.4	145.9	221.2	100.8	0.0	90.6	98.0	0.0	110.0
91	101.2	0.0	101.0	107.5	0.0	95.0	78.5	145.5	222.7	94.3	0.0	95.2	113.0	0.0	198.7
01	102.9	0.0	0.0	114.0	0.0	0.0	78.6	145.2	220.4	87.9	0.0	0.0	91.6	0.0	0.0
10	104.7	0.0	0.0	116.0	0.0	0.0	78.7	144.8	219.6	81.9	0.0	0.0	86.6	0.0	0.0
20	106.5	0.0	0.0	113.0	0.0	0.0	78.8	144.4	220.7	76.7	0.0	0.0	94.9	0.0	0.0
29	107.7	0.0	0.0	112.0	0.0	0.0	78.9	144.1	221.1	73.6	0.0	0.0	98.2	0.0	0.0
38	108.3	0.0	0.0	113.0	0.0	0.0	79.0	144.0	220.7	72.3	0.0	0.0	95.5	0.0	0.0
48	109.6	0.0	0.0	115.0	0.0	0.0	79.1	143.7	220.0	69.3	0.0	0.0	90.1	0.0	0.0
57	110.6	0.0	0.0	116.0	0.0	0.0	79.2	143.5	219.6	67.2	0.0	0.0	87.8	0.0	0.0
66	111.4	0.0	0.0	118.0	0.0	0.0	79.4	143.3	218.9	65.6	0.0	0.0	83.2	0.0	0.0
76	112.1	0.0	0.0	120.0	0.0	0.0	79.5	143.1	218.2	64.4	0.0	0.0	79.0	0.0	0.0
85	113.5	0.0	0.0	118.0	0.0	0.0	79.6	142.8	218.9	61.8	0.0	0.0	83.6	0.0	0.0
95	113.5	0.0	0.0	115.0	0.0	0.0	79.7	142.8	220.0	62.0	0.0	0.0	91.4	0.0	0.0
04	114.0	0.0	0.0	117.0	0.0	0.0	79.8	142.7	219.3	61.2	0.0	0.0	86.4	0.0	0.0
13	114.8	0.0	0.0	118.0	0.0	0.0	79.9	142.5	218.9	59.9	0.0	0.0	84.2	0.0	0.0
23	115.8	0.0	0.0	116.0	0.0	0.0	80.0	142.3	219.6	58.3	0.0	0.0	89.4	0.0	0.0
32	116.3	0.0	0.0	116.0	0.0	0.0	80.1	142.2	219.6	57.6	0.0	0.0	89.7	0.0	0.0
41	117.3	0.0	0.0	117.0	0.0	0.0	80.2	142.0	219.3	56.1	0.0	0.0	87.3	0.0	0.0
51	118.0	0.0	0.0	118.0	0.0	0.0	80.3	141.8	218.9	55.1	0.0	0.0	85.1	0.0	0.0
60	118.5	0.0	0.0	120.0	0.0	0.0	80.4	141.7	218.2	54.5	0.0	0.0	80.8	0.0	0.0
70	119.1	0.0	0.0	121.0	0.0	0.0	80.5	141.6	217.8	53.8	0.0	0.0	78.8	0.0	0.0
79	119.7	0.0	0.0	120.0	0.0	0.0	80.6	141.5	218.2	53.0	0.0	0.0	81.2	0.0	0.0
88	120.2	0.0	0.0	118.0	0.0	0.0	80.7	141.3	218.9	52.4	0.0	0.0	86.0	0.0	0.0
98	120.7	0.0	0.0	126.0	0.0	0.0	80.8	141.2	216.0	51.9	0.0	0.0	70.0	0.0	0.0
07	121.4	0.0	0.0	120.0	0.0	0.0	80.9	141.1	218.2	51.0	0.0	0.0	81.8	0.0	0.0
16	121.9	0.0	0.0	118.0	0.0	0.0	81.0	141.0	218.9	50.5	0.0	0.0	86.7	0.0	0.0
26	122.4	0.0	0.0	118.0	0.0	0.0	81.1	140.9	218.9	50.0	0.0	0.0	86.9	0.0	0.0
35	122.8	0.0	0.0	119.0	0.0	0.0	81.2	140.8	218.6	49.6	0.0	0.0	84.7	0.0	0.0
45	122.7	0.0	0.0	120.0	0.0	0.0	81.3	140.8	218.2	49.8	0.0	0.0	82.6	0.0	0.0
54	122.2	0.0	0.0	122.0	0.0	0.0	81.4	140.9	217.5	50.6	0.0	0.0	78.5	0.0	0.0
63	124.0	0.0	0.0	124.0	0.0	0.0	81.5	140.5	216.8	48.4	0.0	0.0	74.7	0.0	0.0
73	124.1	0.0	0.0	123.0	0.0	0.0	81.6	140.5	217.1	48.4	0.0	0.0	76.8	0.0	0.0
82	123.9	0.0	0.0	122.0	0.0	0.0	82.0	140.5	217.5	49.0	0.0	0.0	79.4	0.0	0.0
91	123.9	0.0	0.0	123.0	0.0	0.0	83.0	139.8	217.1	46.4	0.0	0.0	79.2	0.0	0.0
01	127.0	0.0	0.0	123.0	0.0	0.0	83.5	139.7	216.8	46.1	0.0	0.0	78.1	0.0	0.0
10	127.7	0.0	0.0	124.0	0.0	0.0	84.6	139.5	216.0	45.9	0.0	0.0	75.9	0.0	0.0
20	128.8	0.0	0.0	126.0	0.0	0.0	85.6	139.2	215.7	45.8	0.0	0.0	75.7	0.0	0.0
29	129.8	0.0	0.0	127.0	0.0	0.0	86.7	139.2	215.7	46.6	0.0	0.0	77.6	0.0	0.0
38	130.0	0.0	0.0	127.0	0.0	0.0	87.1	139.1	217.5	47.0	51.9	57.7	88.7	77.8	74.2
48	130.1	125.9	122.0	122.6	127.6	129.6	87.1	139.0	213.5	46.8	51.9	57.2	66.4	67.9	69.4
57	130.1	125.9	122.3	133.7	132.7	131.7	87.1	138.9	216.0	46.8	51.6	56.5	79.1	81.1	81.2
66	130.2	126.2	122.8	126.8	125.8	125.8	87.2	138.9	216.0	46.8	51.9	56.2	81.4	83.6	83.7
76	130.3	126.1	123.1	125.9	124.9	124.8	87.3	139.0	216.8	46.8	51.9	56.2	81.4	83.6	83.7
85	130.6	126.5	124.0	125.0	124.0	124.9	87.4	139.1	216.4	46.7	51.5	55.1	83.4	85.7	83.5
95	130.8	126.6	124.2	126.0	126.0	126.0	87.5	139.1	216.0	46.5	51.5	54.9	81.3	81.3	81.4
04	123.5	126.1	123.2	127.1	127.1	128.0	87.6	140.6	216.0	56.7	52.9	57.2	79.3	79.3	77.4
13	130.4	126.8	123.7	128.2	128.2	127.1	87.7	138.6	215.7	47.0	51.4	55.8	77.2	77.2	79.2
23	130.4	126.5	122.8	131.3	128.1	130.2	87.8	138.8	214.6	47.2	51.9	57.4	71.5	77.0	73.2
32	130.7	126.2	124.3	129.4	129.4	131.3	87.9	138.9	215.0	47.0	52.5	55.3	75.0	75.1	71.7
41	131.2	0.0	0.0	129.6	0.0	0.0	88.2	138.9	214.6	46.8	0.0	0.0	75.0	0.0	0.0
51	133.9	0.0	0.0	132.0	0.0	0.0	91.4	138.3	213.9	46.8	0.0	0.0	75.8	0.0	0.0
60	134.8	0.0	0.0	132.0	0.0	0.0	92.9	138.1	213.9	47.4	0.0	0.0	78.6	0.0	0.0
70	135.0	0.0	0.0	132.0	0.0	0.0	94.0	138.1	213.9	48.2	0.0	0.0	80.6	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A= 49.06 NU(S)A= 79.60 NU(AV)A= 59.24 ST(AV)A= 0.00791 ST(AV)/ST(4S)= 1.79 F/F(4S)= 1.92
 (ST/ST(4S))/(F/F(4S))= 0.931 (F/F(4S))/(ST/ST(4S))*3.0= 0.34 (ST/ST(4S))/(F/F(4S))*3.0= 1.44
 NU(R)A/NU(4S)= 1.48 NU(S)A/NU(4S)= 2.41 e+(4R)= 47.53 R(4R)= 7.65 H(4R)= 7.31

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 12.04

AVERAGE VALUES WITH SL: H(4R)= 7.50

RUN NUMBER= 67HR30-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.667 IN PR= 71 MDOT=0.1024 LBM/SEC
 RE= 32755. GGE(R)= 316.3 BTU/HR-SQ FT GGE(S)= 445.3 INLET TEMP= 80.0 F TATM= 72.7 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU
1	0.07	101.4	0.0	92.0	108.9	0.0	102.8	80.1	310.0	434.1	213.0	0.0	380.5	220.6	0.0	27
2	0.16	105.1	0.0	94.9	111.8	0.0	103.0	80.1	309.2	433.0	181.5	0.0	306.8	200.4	0.0	27
3	0.24	101.5	0.0	97.5	108.0	0.0	105.0	80.2	309.9	433.4	213.3	0.0	262.6	228.8	0.0	25
4	0.35	100.3	0.0	97.8	106.0	0.0	105.0	80.3	310.2	433.6	227.0	0.0	259.3	247.2	0.0	25
5	0.45	99.4	0.0	99.1	106.2	0.0	106.7	80.3	310.4	433.4	238.7	0.0	242.5	245.7	0.0	24
6	0.54	99.5	0.0	100.3	106.6	0.0	108.7	80.4	310.4	433.3	238.2	0.0	228.7	242.5	0.0	22
7	0.63	100.0	0.0	101.8	106.7	0.0	107.0	80.5	310.3	433.1	232.9	0.0	213.2	242.0	0.0	23
8	0.73	101.3	0.0	102.6	106.4	0.0	105.0	80.5	310.0	433.2	218.9	0.0	206.0	245.5	0.0	25
9	0.82	102.8	0.0	103.5	110.5	0.0	108.0	80.6	309.7	431.7	204.5	0.0	198.3	211.7	0.0	23
10	0.91	104.2	0.0	102.7	106.9	0.0	99.0	80.7	309.4	433.0	192.7	0.0	205.9	242.0	0.0	34
11	1.01	106.1	0.0	0.0	112.0	0.0	0.0	80.8	308.9	431.2	178.6	0.0	0.0	202.2	0.0	0
12	1.10	107.9	0.0	0.0	112.0	0.0	0.0	80.8	308.5	431.2	166.9	0.0	0.0	202.6	0.0	0
13	1.20	109.8	0.0	0.0	110.0	0.0	0.0	80.9	308.1	431.9	156.1	0.0	0.0	217.3	0.0	0
14	1.29	111.0	0.0	0.0	110.0	0.0	0.0	81.0	307.9	431.9	150.1	0.0	0.0	217.8	0.0	0
15	1.38	111.4	0.0	0.0	112.0	0.0	0.0	81.0	307.8	431.2	148.4	0.0	0.0	203.9	0.0	0
16	1.48	112.4	0.0	0.0	114.0	0.0	0.0	81.1	307.5	430.5	143.9	0.0	0.0	191.6	0.0	0
17	1.57	113.3	0.0	0.0	116.0	0.0	0.0	81.2	307.3	429.8	140.1	0.0	0.0	180.7	0.0	0
18	1.66	114.1	0.0	0.0	118.0	0.0	0.0	81.2	307.2	429.0	136.9	0.0	0.0	170.9	0.0	0
19	1.76	114.7	0.0	0.0	120.0	0.0	0.0	81.3	307.0	428.3	134.6	0.0	0.0	162.1	0.0	0
20	1.85	115.9	0.0	0.0	116.0	0.0	0.0	81.4	306.8	429.8	130.1	0.0	0.0	181.7	0.0	0
21	1.95	115.9	0.0	0.0	113.0	0.0	0.0	81.5	306.8	430.8	130.3	0.0	0.0	199.9	0.0	0
22	2.04	116.5	0.0	0.0	114.0	0.0	0.0	81.5	306.6	430.5	128.3	0.0	0.0	193.9	0.0	0
23	2.13	117.2	0.0	0.0	114.0	0.0	0.0	81.6	306.5	430.5	125.9	0.0	0.0	194.3	0.0	0
24	2.23	118.1	0.0	0.0	114.0	0.0	0.0	81.7	306.3	430.5	123.0	0.0	0.0	194.7	0.0	0
25	2.32	118.8	0.0	0.0	114.0	0.0	0.0	81.7	306.1	430.5	120.8	0.0	0.0	195.1	0.0	0
26	2.41	119.5	0.0	0.0	116.0	0.0	0.0	81.8	306.0	429.8	118.7	0.0	0.0	183.8	0.0	0
27	2.51	120.0	0.0	0.0	118.0	0.0	0.0	81.9	305.9	429.0	117.3	0.0	0.0	173.7	0.0	0
28	2.60	120.8	0.0	0.0	119.0	0.0	0.0	81.9	305.7	428.7	115.0	0.0	0.0	169.2	0.0	0
29	2.70	121.2	0.0	0.0	122.0	0.0	0.0	82.0	305.6	427.6	114.0	0.0	0.0	156.3	0.0	0
30	2.79	122.0	0.0	0.0	119.0	0.0	0.0	82.1	305.4	428.7	111.9	0.0	0.0	169.8	0.0	0
31	2.88	122.4	0.0	0.0	115.0	0.0	0.0	82.2	305.3	430.1	110.9	0.0	0.0	191.4	0.0	0
32	2.98	122.7	0.0	0.0	119.0	0.0	0.0	82.2	305.3	428.7	110.2	0.0	0.0	170.4	0.0	0
33	3.07	123.5	0.0	0.0	115.0	0.0	0.0	82.3	305.1	430.1	108.2	0.0	0.0	192.2	0.0	0
34	3.16	123.8	0.0	0.0	116.0	0.0	0.0	82.4	305.0	429.8	107.6	0.0	0.0	186.7	0.0	0
35	3.26	124.4	0.0	0.0	118.0	0.0	0.0	82.4	304.9	429.0	106.2	0.0	0.0	176.2	0.0	0
36	3.35	124.7	0.0	0.0	120.0	0.0	0.0	82.5	304.8	428.3	105.5	0.0	0.0	166.9	0.0	0
37	3.45	124.5	0.0	0.0	121.0	0.0	0.0	82.6	304.9	428.0	106.2	0.0	0.0	162.7	0.0	0
38	3.54	124.3	0.0	0.0	124.0	0.0	0.0	82.6	304.9	426.9	106.9	0.0	0.0	150.8	0.0	0
39	3.63	125.6	0.0	0.0	126.0	0.0	0.0	82.7	304.6	426.2	103.7	0.0	0.0	143.8	0.0	0
40	3.73	125.7	0.0	0.0	122.0	0.0	0.0	82.8	304.6	427.6	103.6	0.0	0.0	159.2	0.0	0
41	4.01	125.1	0.0	0.0	118.0	0.0	0.0	83.0	304.8	429.0	105.7	0.0	0.0	178.9	0.0	0
42	4.95	128.3	0.0	0.0	119.0	0.0	0.0	83.7	304.0	428.7	99.4	0.0	0.0	177.0	0.0	0
43	5.41	129.4	0.0	0.0	123.0	0.0	0.0	84.1	303.8	427.2	97.6	0.0	0.0	159.8	0.0	0
44	6.35	130.1	0.0	0.0	126.0	0.0	0.0	84.8	303.7	426.2	97.5	0.0	0.0	150.4	0.0	0
45	7.29	131.8	0.0	0.0	127.0	0.0	0.0	85.5	303.3	425.8	95.1	0.0	0.0	149.0	0.0	0
46	8.23	132.0	0.0	0.0	125.0	0.0	0.0	86.2	303.2	426.5	96.0	0.0	0.0	159.4	0.0	0
47	8.58	133.0	128.7	125.4	117.1	126.1	127.1	86.4	303.1	429.0	94.5	104.0	112.9	202.9	156.9	153.0
48	8.60	133.7	129.2	126.4	126.2	125.2	122.8	86.4	302.8	425.8	93.0	102.8	110.0	155.4	159.4	169.9
49	8.70	133.6	129.1	126.8	121.3	121.3	120.3	86.5	302.9	427.6	93.3	103.2	109.1	178.3	178.3	183.6
50	8.79	133.7	129.5	126.9	123.3	122.3	121.3	86.6	302.8	428.0	93.2	102.4	109.0	169.3	173.9	179.0
51	8.88	133.7	129.4	128.3	121.4	123.4	121.4	86.6	302.9	426.9	93.4	102.8	105.5	178.0	168.5	178.3
52	8.98	133.7	130.2	128.9	124.5	124.5	123.5	86.7	303.0	426.5	93.6	101.1	104.2	163.7	163.7	168.2
53	9.07	136.5	128.5	125.5	127.6	127.6	126.6	86.8	304.4	426.2	111.2	105.9	114.1	151.6	151.5	155.4
54	9.16	133.8	129.6	126.5	128.7	130.7	127.7	86.9	302.0	425.8	93.4	102.5	110.5	147.7	140.9	151.3

55	9.26	132.2	129.5	126.3	132.8	131.7	131.8	86.9	303.7	424.4	97.4	103.5	111.9	134.2	137.6	137.2
56	9.35	132.6	128.0	126.8	131.8	129.8	127.8	87.0	304.0	424.7	96.6	107.5	110.8	137.5	144.0	151.0
57	9.63	133.0	0.0	0.0	124.0	0.0	0.0	87.2	303.0	426.9	95.9	0.0	0.0	168.2	0.0	0.0
58	12.45	137.2	0.0	0.0	130.0	0.0	0.0	89.3	302.1	424.7	91.1	0.0	0.0	150.8	0.0	0.0
59	13.85	138.3	0.0	0.0	134.0	0.0	0.0	90.4	301.8	423.3	90.8	0.0	0.0	139.9	0.0	0.0
60	14.79	138.3	0.0	0.0	133.0	0.0	0.0	91.1	301.8	423.6	92.1	0.0	0.0	145.5	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
 NU(R)A=101.43 NU(S)A=165.94 NU(AV)A=122.93 ST(AV)A=0.00528 ST(AV)/ST(4S)=1.49 F/F(4S)= 2.29
 (ST/ST(4S))/(F/F(4S))=0.653 (F/F(4S))/(ST/ST(4S))*3.0=0.69 (ST/ST(4S))/(F/F(4S))*(1/3)=1.13
 NU(R)A/NU(4S)=1.24 NU(S)A/NU(4S)=2.02 e+(4R)= 142.44 R(4R)= 8.06 H(4R)=12.40

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 18.63

AVERAGE VALUES WITH SL: H(4R)= 12.76

ORIGINAL PAGE IS
OF POOR QUALITY

MBER= 68HR60-90/20 E/D=0.047 P/E=20.0 ALPHA=90 HYD DIA= 2.667 IN PR= .71 MDDT=0.2032 LBM/SEC
Q38. GGE(R)= 466.8 BTU/HR-SQ FT GGE(S)= 696.5 INLET TEMP= 80.8 F TATM= 73.1 F PATM= 14.6 PSIA

D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
17	101.2	0.0	89.3	109.0	0.0	110.1	80.8	460.6	686.1	331.4	0.0	797.6	357.1	0.0	344.0
6	103.9	0.0	93.2	112.3	0.0	109.6	80.9	460.0	685.0	292.9	0.0	547.6	319.6	0.0	349.8
26	100.8	0.0	95.7	106.4	0.0	107.0	80.9	460.7	685.7	339.9	0.0	457.4	394.0	0.0	384.8
35	99.6	0.0	96.3	104.8	0.0	105.5	81.0	461.0	685.8	363.0	0.0	441.3	421.6	0.0	409.5
45	98.2	0.0	97.3	103.5	0.0	103.0	81.1	461.3	685.5	394.0	0.0	415.9	447.3	0.0	457.5
54	98.1	0.0	98.3	104.7	0.0	103.0	81.1	461.3	685.1	397.6	0.0	393.0	425.2	0.0	458.3
53	98.5	0.0	99.9	105.5	0.0	103.0	81.2	461.2	684.8	389.6	0.0	360.5	412.0	0.0	459.2
73	99.6	0.0	100.9	104.7	0.0	105.0	81.2	461.0	685.1	367.2	0.0	342.9	427.1	0.0	421.7
82	100.9	0.0	101.9	108.7	0.0	107.0	81.3	460.7	683.6	343.6	0.0	327.0	364.9	0.0	389.0
91	102.2	0.0	101.5	105.4	0.0	101.0	81.3	460.4	684.8	322.9	0.0	334.1	416.4	0.0	509.6
01	104.1	0.0	0.0	113.0	0.0	0.0	81.4	460.0	682.1	296.4	0.0	0.0	315.7	0.0	0.0
10	105.8	0.0	0.0	111.0	0.0	0.0	81.4	459.6	682.8	276.1	0.0	0.0	338.0	0.0	0.0
20	107.5	0.0	0.0	110.0	0.0	0.0	81.5	459.3	683.2	258.4	0.0	0.0	350.7	0.0	0.0
29	108.7	0.0	0.0	110.0	0.0	0.0	81.5	459.0	683.2	247.3	0.0	0.0	351.3	0.0	0.0
38	109.2	0.0	0.0	112.0	0.0	0.0	81.6	458.9	682.5	243.2	0.0	0.0	328.4	0.0	0.0
48	109.9	0.0	0.0	114.0	0.0	0.0	81.7	458.7	681.7	237.6	0.0	0.0	308.3	0.0	0.0
57	110.5	0.0	0.0	115.0	0.0	0.0	81.7	458.6	681.4	233.0	0.0	0.0	299.4	0.0	0.0
66	111.3	0.0	0.0	117.0	0.0	0.0	81.8	458.4	680.7	227.0	0.0	0.0	282.5	0.0	0.0
76	111.9	0.0	0.0	120.0	0.0	0.0	81.8	458.3	679.6	222.8	0.0	0.0	260.3	0.0	0.0
85	112.8	0.0	0.0	116.0	0.0	0.0	81.9	458.1	681.0	216.6	0.0	0.0	291.8	0.0	0.0
95	112.9	0.0	0.0	113.0	0.0	0.0	81.9	458.1	682.1	216.2	0.0	0.0	321.0	0.0	0.0
04	113.3	0.0	0.0	113.0	0.0	0.0	82.0	458.0	682.1	213.8	0.0	0.0	321.5	0.0	0.0
13	114.0	0.0	0.0	113.0	0.0	0.0	82.0	457.8	682.1	209.4	0.0	0.0	322.0	0.0	0.0
23	114.6	0.0	0.0	114.0	0.0	0.0	82.1	457.7	681.7	205.8	0.0	0.0	312.3	0.0	0.0
32	115.4	0.0	0.0	112.0	0.0	0.0	82.1	457.5	682.5	201.1	0.0	0.0	334.1	0.0	0.0
41	115.8	0.0	0.0	115.0	0.0	0.0	82.2	457.4	681.4	199.0	0.0	0.0	303.6	0.0	0.0
51	116.0	0.0	0.0	117.0	0.0	0.0	82.3	457.4	680.7	198.1	0.0	0.0	286.3	0.0	0.0
60	116.9	0.0	0.0	118.0	0.0	0.0	82.3	457.2	680.3	193.1	0.0	0.0	278.5	0.0	0.0
70	117.1	0.0	0.0	121.0	0.0	0.0	82.4	457.1	679.2	192.3	0.0	0.0	256.8	0.0	0.0
79	118.0	0.0	0.0	118.0	0.0	0.0	82.4	456.9	680.3	187.6	0.0	0.0	279.3	0.0	0.0
88	118.2	0.0	0.0	114.0	0.0	0.0	82.5	456.9	681.7	186.8	0.0	0.0	315.9	0.0	0.0
98	118.5	0.0	0.0	117.0	0.0	0.0	82.5	456.8	680.7	185.5	0.0	0.0	288.4	0.0	0.0
07	119.2	0.0	0.0	113.0	0.0	0.0	82.6	456.7	682.1	182.1	0.0	0.0	327.5	0.0	0.0
16	119.2	0.0	0.0	115.0	0.0	0.0	82.6	456.7	681.4	182.4	0.0	0.0	307.5	0.0	0.0
26	119.8	0.0	0.0	117.0	0.0	0.0	82.7	456.6	680.7	179.6	0.0	0.0	289.7	0.0	0.0
35	120.1	0.0	0.0	119.0	0.0	0.0	82.7	456.5	679.9	178.4	0.0	0.0	273.8	0.0	0.0
45	120.0	0.0	0.0	121.0	0.0	0.0	82.8	456.5	679.2	179.2	0.0	0.0	259.6	0.0	0.0
54	120.1	0.0	0.0	123.0	0.0	0.0	82.9	456.5	678.5	178.9	0.0	0.0	246.7	0.0	0.0
63	120.8	0.0	0.0	126.0	0.0	0.0	82.9	456.3	677.4	175.8	0.0	0.0	229.5	0.0	0.0
73	121.0	0.0	0.0	121.0	0.0	0.0	83.0	456.3	679.2	175.1	0.0	0.0	260.6	0.0	0.0
01	119.8	0.0	0.0	118.0	0.0	0.0	83.1	456.6	680.3	181.6	0.0	0.0	284.6	0.0	0.0
95	122.7	0.0	0.0	118.0	0.0	0.0	83.7	455.9	680.3	170.3	0.0	0.0	288.9	0.0	0.0
41	124.0	0.0	0.0	122.0	0.0	0.0	83.9	455.6	678.9	165.7	0.0	0.0	259.9	0.0	0.0
35	124.5	0.0	0.0	125.0	0.0	0.0	84.5	455.5	677.8	165.7	0.0	0.0	243.6	0.0	0.0
29	126.4	0.0	0.0	126.0	0.0	0.0	85.0	455.1	677.4	160.0	0.0	0.0	240.5	0.0	0.0
23	127.0	0.0	0.0	127.0	0.0	0.0	85.6	455.0	677.1	159.6	0.0	0.0	237.5	0.0	0.0
58	127.5	124.9	122.3	111.7	126.2	126.2	85.8	454.9	682.1	158.4	168.9	180.9	382.5	245.1	245.2
60	127.6	125.8	123.5	123.3	124.3	119.3	85.8	454.6	677.8	158.0	165.1	175.1	262.6	255.7	293.8
70	127.7	125.2	123.6	119.4	119.4	117.4	85.8	454.7	679.6	157.8	167.8	174.9	294.2	294.2	312.9
79	127.6	125.8	123.3	121.5	120.5	119.5	85.9	454.7	680.3	158.4	165.5	176.6	277.2	285.4	293.8
88	127.5	125.6	124.2	118.0	121.6	120.1	85.9	454.9	678.9	159.0	166.6	172.7	308.1	276.6	288.4
98	127.7	126.4	124.3	124.7	125.7	123.7	86.0	455.2	678.5	158.5	163.7	172.6	254.5	248.1	261.2
07	119.5	124.0	121.0	129.3	129.8	126.3	86.1	456.6	677.4	198.3	174.8	189.8	227.3	224.7	244.2
16	125.7	125.8	122.7	131.9	130.9	127.7	86.1	455.3	676.0	167.0	166.6	180.7	214.3	218.9	235.8
26	129.7	124.3	122.7	133.0	134.1	133.0	86.2	456.5	675.6	152.2	173.8	181.4	209.4	204.6	209.4
35	130.2	123.4	122.9	130.1	129.1	127.6	86.2	456.2	676.3	150.6	178.2	180.6	223.7	228.9	237.2
63	129.7	0.0	0.0	120.0	0.0	0.0	86.4	455.4	679.6	152.8	0.0	0.0	293.4	0.0	0.0
2.45	131.3	0.0	0.0	129.0	0.0	0.0	88.0	454.0	676.3	151.8	0.0	0.0	238.9	0.0	0.0
3.85	132.6	0.0	0.0	133.0	0.0	0.0	88.8	453.7	674.9	149.9	0.0	0.0	220.9	0.0	0.0
4.79	133.0	0.0	0.0	131.0	0.0	0.0	89.4	453.6	675.6	150.2	0.0	0.0	234.4	0.0	0.0

... DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 2.9 TO 3.7 AND FROM X/D= 8.5 TO 9.4) :
(R)A=171.10 NU(S)A=272.65 NU(AV)A=204.95 ST(AV)A=0.00443 ST(AV)/ST(4S)=1.44 F/F(4S)= 2.52
F/ST(4S))/(F/F(4S))=0.572 (F/F(4S))/(ST/ST(4S))*3.0=0.84 (ST/ST(4S))/(F/F(4S))*(1/3)=1.06
(R)A/NU(4S)=1.20 NU(S)A/NU(4S)=1.92 e+(4R)= 275.67 R(4R)= 8.35 H(4R)=15.02

USING ROUGH SIDE RESULTS ONLY : H(RB)= 21.76

AVERAGE VALUES WITH SL: H(4R)= 15.01

RUN NUMBER=143HS10-00/00 b/a=4.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 1.600 IN
 FR= 71 MDDT=0.0321 LBM/SEC RE= 12284. GGE(R)= 183.1 BTU/HR-SQ FT
 GGE(S)= 205.6 INLET TEMP= 81.7 F TATM= 75.4 F PATM= 14.6 PSIA

AVERAG VALUES FROM X/D=14.2 TO X/D=15.6:
 NU(R)= 40.90 NU(S)= 42.98 NU(AV)= 41.31

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.12	92.6	0.0	90.7	93.5	0.0	129.0	81.8	179.3	197.2	145.3	0.0	176.1	147.5	0.0	0.0
2	0.27	93.1	0.0	92.2	95.8	0.0	129.5	81.9	179.2	196.2	139.8	0.0	152.0	123.4	0.0	0.0
3	0.43	92.0	0.0	94.5	95.2	0.0	130.0	81.9	179.5	196.5	156.5	0.0	125.4	130.0	0.0	0.0
4	0.59	93.4	0.0	95.1	96.4	0.0	128.8	82.0	179.1	195.9	138.2	0.0	120.2	119.6	0.0	0.0
5	0.74	94.5	0.0	96.8	98.1	0.0	129.8	82.1	178.9	195.1	126.7	0.0	106.9	107.1	0.0	0.0
6	0.90	96.4	0.0	98.7	99.0	0.0	130.0	82.2	178.5	194.7	110.3	0.0	94.9	101.7	0.0	0.0
7	1.05	98.0	0.0	100.3	100.1	0.0	128.2	82.3	178.1	194.2	99.5	0.0	86.7	95.6	0.0	0.0
8	1.21	99.7	0.0	101.4	100.8	0.0	123.5	82.4	177.8	193.9	90.0	0.0	81.9	92.3	0.0	0.0
9	1.37	101.2	0.0	102.3	101.7	0.0	133.0	82.5	177.4	193.5	83.0	0.0	78.4	88.2	0.0	0.0
10	1.52	102.6	0.0	101.4	103.0	0.0	150.0	82.6	177.1	192.9	77.5	0.0	82.4	82.7	0.0	0.0
11	1.68	104.0	0.0	0.0	102.4	0.0	0.0	82.6	176.8	193.2	72.6	0.0	0.0	85.7	0.0	0.0
12	1.84	105.4	0.0	0.0	103.0	0.0	0.0	82.7	176.5	192.9	68.2	0.0	0.0	83.4	0.0	0.0
13	1.99	106.9	0.0	0.0	104.4	0.0	0.0	82.8	176.2	192.2	64.1	0.0	0.0	78.1	0.0	0.0
14	2.15	107.8	0.0	0.0	105.6	0.0	0.0	82.9	176.0	191.7	61.9	0.0	0.0	74.0	0.0	0.0
15	2.30	108.1	0.0	0.0	106.0	0.0	0.0	83.0	175.9	191.5	61.4	0.0	0.0	72.9	0.0	0.0
16	2.46	109.0	0.0	0.0	107.0	0.0	0.0	83.1	175.7	191.0	59.4	0.0	0.0	70.0	0.0	0.0
17	2.62	109.7	0.0	0.0	107.7	0.0	0.0	83.2	175.6	191.1	58.0	0.0	0.0	68.2	0.0	0.0
18	2.77	110.3	0.0	0.0	108.0	0.0	0.0	83.3	175.4	190.6	56.8	0.0	0.0	67.4	0.0	0.0
19	2.93	110.7	0.0	0.0	109.0	0.0	0.0	83.4	175.3	190.1	56.1	0.0	0.0	64.9	0.0	0.0
20	3.09	111.6	0.0	0.0	110.2	0.0	0.0	83.4	175.1	189.6	54.4	0.0	0.0	62.0	0.0	0.0
21	3.24	111.7	0.0	0.0	110.5	0.0	0.0	83.5	175.1	189.4	54.4	0.0	0.0	61.5	0.0	0.0
22	3.40	112.2	0.0	0.0	110.8	0.0	0.0	83.6	175.0	189.3	53.6	0.0	0.0	60.9	0.0	0.0
23	3.55	112.7	0.0	0.0	111.0	0.0	0.0	83.7	174.9	189.2	52.8	0.0	0.0	60.6	0.0	0.0
24	3.71	113.4	0.0	0.0	112.4	0.0	0.0	83.8	174.7	188.6	51.6	0.0	0.0	57.7	0.0	0.0
25	3.87	113.8	0.0	0.0	112.0	0.0	0.0	83.9	174.7	188.7	51.1	0.0	0.0	58.7	0.0	0.0
26	4.02	114.5	0.0	0.0	112.6	0.0	0.0	84.0	174.5	188.5	50.0	0.0	0.0	57.6	0.0	0.0
27	4.18	115.4	0.0	0.0	113.0	0.0	0.0	84.1	174.3	188.3	48.6	0.0	0.0	56.9	0.0	0.0
28	4.34	115.3	0.0	0.0	114.8	0.0	0.0	84.1	174.3	187.5	48.9	0.0	0.0	53.5	0.0	0.0
29	4.49	115.6	0.0	0.0	115.2	0.0	0.0	84.2	174.3	187.3	48.6	0.0	0.0	52.9	0.0	0.0
30	4.65	116.2	0.0	0.0	115.8	0.0	0.0	84.3	174.1	187.0	47.7	0.0	0.0	51.9	0.0	0.0
31	4.80	116.5	0.0	0.0	116.0	0.0	0.0	84.4	174.1	186.9	47.4	0.0	0.0	51.7	0.0	0.0
32	4.96	116.6	0.0	0.0	116.0	0.0	0.0	84.5	174.0	186.9	47.4	0.0	0.0	51.8	0.0	0.0
33	5.12	117.1	0.0	0.0	116.6	0.0	0.0	84.6	173.9	186.6	46.7	0.0	0.0	50.9	0.0	0.0
34	5.27	117.3	0.0	0.0	117.3	0.0	0.0	84.7	173.9	186.3	46.6	0.0	0.0	49.9	0.0	0.0
35	5.43	117.7	0.0	0.0	117.7	0.0	0.0	84.8	173.8	186.1	46.1	0.0	0.0	49.3	0.0	0.0
36	5.59	117.8	0.0	0.0	117.8	0.0	0.0	84.9	173.8	186.1	46.1	0.0	0.0	49.3	0.0	0.0
37	5.74	117.8	0.0	0.0	117.6	0.0	0.0	84.9	173.8	186.2	46.2	0.0	0.0	49.8	0.0	0.0
38	5.90	117.6	0.0	0.0	118.0	0.0	0.0	85.0	173.8	186.0	46.6	0.0	0.0	49.2	0.0	0.0
39	6.05	118.7	0.0	0.0	118.3	0.0	0.0	85.1	173.6	185.8	45.1	0.0	0.0	48.9	0.0	0.0
40	6.21	118.8	0.0	0.0	118.3	0.0	0.0	85.2	173.6	185.8	45.1	0.0	0.0	49.0	0.0	0.0
41	6.68	117.8	0.0	0.0	118.8	0.0	0.0	85.5	173.8	185.6	46.9	0.0	0.0	48.6	0.0	0.0
42	8.24	120.6	0.0	0.0	120.7	0.0	0.0	86.4	173.2	184.7	44.0	0.0	0.0	46.8	0.0	0.0
43	9.02	121.8	0.0	0.0	121.6	0.0	0.0	86.8	172.9	184.3	43.0	0.0	0.0	46.1	0.0	0.0
44	10.59	123.0	0.0	0.0	122.5	0.0	0.0	87.7	172.6	183.9	42.5	0.0	0.0	45.9	0.0	0.0
45	12.15	124.6	0.0	0.0	124.9	0.0	0.0	88.6	172.3	182.8	41.5	0.0	0.0	43.7	0.0	0.0
46	13.71	125.8	0.0	0.0	126.0	0.0	0.0	89.4	172.0	182.3	41.0	0.0	0.0	43.2	0.0	0.0
47	14.30	126.1	124.5	124.1	125.2	129.0	129.0	89.8	172.0	181.8	41.0	42.9	43.4	44.5	40.2	40.0

48	14.34	126.2	124.6	124.3	126.3	129.5	129.5	89.8	171.8	181.4	40.9	42.7	43.1	43.0	39.6	39.0
49	14.49	126.3	124.6	124.5	126.4	130.0	130.0	89.9	171.8	181.0	40.8	42.8	43.0	42.9	39.1	39.0
50	14.65	126.4	125.0	123.8	126.5	128.8	128.8	90.0	171.7	180.9	40.8	42.4	43.9	42.9	40.3	40.0
51	14.80	126.5	125.2	125.3	126.6	129.8	129.8	90.1	171.7	180.9	40.8	42.3	42.2	42.9	39.4	39.0
52	14.96	126.6	125.4	125.6	126.7	130.0	130.0	90.1	171.8	180.7	40.8	42.2	41.9	42.8	39.2	39.0
53	15.12	126.7	124.0	123.9	126.8	128.2	128.2	90.2	172.6	180.5	41.0	44.3	44.4	42.7	41.1	41.0
54	15.27	126.8	125.0	125.8	126.9	123.5	123.5	90.3	171.0	181.0	40.6	42.7	41.7	42.8	47.2	47.0
55	15.43	126.9	126.0	125.0	127.0	133.0	133.0	90.4	171.6	180.6	40.7	41.7	42.9	42.7	36.7	36.0
56	15.59	126.2	125.2	126.1	127.1	150.0	150.0	90.5	171.8	180.5	41.6	42.8	41.8	42.7	26.2	26.0
57	16.05	127.3	0.0	0.0	127.4	0.0	0.0	90.8	172.0	181.3	40.7	0.0	0.0	42.8	0.0	0.0
58	20.74	130.6	0.0	0.0	131.0	0.0	0.0	93.4	171.0	180.0	39.6	0.0	0.0	41.2	0.0	0.0
59	23.09	132.0	0.0	0.0	133.0	0.0	0.0	94.7	170.7	179.1	39.3	0.0	0.0	40.2	0.0	0.0
60	24.65	133.0	0.0	0.0	134.0	0.0	0.0	95.6	170.4	178.6	39.1	0.0	0.0	39.9	0.0	0.0

AVERAG VALUES FROM X/D=14.2 TO X/D=15.6 AND FROM X/D = 4.8 to 6.2:
 NU(R)= 43.61 NU(S)= 46.48 NU(AV)= 44.18

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER=144HS30-00/00 b/a=4.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 1.600 IN
 '1 MDOT=0.0848 LBM/SEC RE= 32457. GGE(R)= 374.7 BTU/HR-SQ FT
 3)= 370.8 INLET TEMP= 82.0 F TATM= 75.0 F PATM= 14.6 PSIA

AVG VALUES FROM X/D=14.2 TO X/D=15.6:
)= 83.96 NU(S)= 85.73 NU(AV)= 84.31

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GCA(R)	GCA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1.12	92.6	0.0	90.6	91.0	0.0	125.4	82.1	370.9	363.4	308.4	0.0	380.6	356.3	0.0	73.5
1.27	93.6	0.0	91.6	92.0	0.0	126.2	82.1	370.6	362.9	283.2	0.0	343.0	322.3	0.0	72.2
1.43	92.9	0.0	95.1	93.0	0.0	126.8	82.2	370.8	362.5	303.7	0.0	233.8	294.2	0.0	71.3
1.59	94.9	0.0	97.2	94.0	0.0	125.3	82.3	370.3	362.0	257.0	0.0	217.4	270.5	0.0	73.8
1.74	96.2	0.0	99.7	95.0	0.0	126.1	82.3	370.1	361.6	234.0	0.0	186.9	250.3	0.0	72.4
1.90	97.9	0.0	101.8	96.0	0.0	126.4	82.4	369.7	361.1	209.2	0.0	167.1	232.9	0.0	72.0
2.05	99.2	0.0	103.4	97.0	0.0	122.4	82.5	369.4	360.6	193.6	0.0	154.8	217.7	0.0	79.2
2.21	101.1	0.0	104.2	98.0	0.0	121.0	82.6	369.0	360.2	174.3	0.0	149.4	204.3	0.0	82.1
2.37	102.7	0.0	104.7	99.0	0.0	130.0	82.6	368.6	359.7	160.9	0.0	146.3	192.5	0.0	66.5
2.52	104.2	0.0	103.0	100.0	0.0	150.0	82.7	368.3	359.3	150.0	0.0	158.9	181.9	0.0	46.8
2.68	105.7	0.0	0.0	100.8	0.0	0.0	82.8	368.0	358.9	140.6	0.0	0.0	174.3	0.0	0.0
2.84	107.0	0.0	0.0	102.0	0.0	0.0	82.8	367.7	358.3	133.3	0.0	0.0	163.8	0.0	0.0
2.99	108.6	0.0	0.0	102.6	0.0	0.0	82.9	367.3	358.1	125.2	0.0	0.0	159.2	0.0	0.0
3.15	109.6	0.0	0.0	104.2	0.0	0.0	83.0	367.1	357.3	120.8	0.0	0.0	147.5	0.0	0.0
3.30	110.0	0.0	0.0	105.2	0.0	0.0	83.0	367.0	356.9	119.2	0.0	0.0	141.1	0.0	0.0
3.46	110.6	0.0	0.0	105.5	0.0	0.0	83.1	366.9	356.7	116.9	0.0	0.0	139.6	0.0	0.0
3.62	111.1	0.0	0.0	106.1	0.0	0.0	83.2	366.8	357.0	115.1	0.0	0.0	136.4	0.0	0.0
3.77	111.6	0.0	0.0	105.7	0.0	0.0	83.3	366.7	356.6	113.3	0.0	0.0	139.1	0.0	0.0
3.93	111.9	0.0	0.0	105.3	0.0	0.0	83.3	366.6	356.8	112.3	0.0	0.0	142.2	0.0	0.0
4.09	112.7	0.0	0.0	107.7	0.0	0.0	83.4	366.4	356.7	109.5	0.0	0.0	128.5	0.0	0.0
4.24	112.8	0.0	0.0	107.0	0.0	0.0	83.5	366.4	356.0	109.3	0.0	0.0	132.4	0.0	0.0
4.40	113.0	0.0	0.0	108.6	0.0	0.0	83.5	366.4	355.3	108.8	0.0	0.0	124.1	0.0	0.0
4.55	113.6	0.0	0.0	108.9	0.0	0.0	83.6	366.2	355.2	106.9	0.0	0.0	122.9	0.0	0.0
4.71	114.1	0.0	0.0	109.1	0.0	0.0	83.7	366.1	354.4	105.3	0.0	0.0	122.0	0.0	0.0
4.87	114.6	0.0	0.0	109.6	0.0	0.0	83.8	366.0	354.4	103.8	0.0	0.0	120.0	0.0	0.0
5.02	115.0	0.0	0.0	111.2	0.0	0.0	83.8	365.9	354.1	102.7	0.0	0.0	113.1	0.0	0.0
5.18	115.8	0.0	0.0	112.0	0.0	0.0	83.9	365.7	353.7	100.3	0.0	0.0	110.1	0.0	0.0
5.34	115.8	0.0	0.0	112.7	0.0	0.0	84.0	365.7	353.4	100.5	0.0	0.0	107.6	0.0	0.0
5.49	116.1	0.0	0.0	113.5	0.0	0.0	84.0	365.7	353.1	99.7	0.0	0.0	104.8	0.0	0.0
5.65	116.7	0.0	0.0	113.2	0.0	0.0	84.1	365.5	353.2	97.4	0.0	0.0	106.1	0.0	0.0
5.80	117.2	0.0	0.0	114.2	0.0	0.0	84.2	365.4	352.7	96.7	0.0	0.0	102.7	0.0	0.0
5.96	116.9	0.0	0.0	114.0	0.0	0.0	84.3	365.5	352.8	97.9	0.0	0.0	103.7	0.0	0.0
6.12	117.5	0.0	0.0	114.2	0.0	0.0	84.3	365.4	352.7	96.2	0.0	0.0	103.2	0.0	0.0
6.27	117.6	0.0	0.0	114.5	0.0	0.0	84.4	365.4	352.6	96.1	0.0	0.0	102.3	0.0	0.0
6.43	118.1	0.0	0.0	115.2	0.0	0.0	84.5	365.2	352.3	94.9	0.0	0.0	100.1	0.0	0.0
6.59	118.3	0.0	0.0	115.2	0.0	0.0	84.5	365.2	352.3	94.5	0.0	0.0	100.4	0.0	0.0
6.74	118.2	0.0	0.0	115.0	0.0	0.0	84.6	365.2	352.4	95.0	0.0	0.0	101.3	0.0	0.0
6.90	118.2	0.0	0.0	115.3	0.0	0.0	84.7	365.2	352.2	95.2	0.0	0.0	100.5	0.0	0.0
7.05	119.2	0.0	0.0	115.5	0.0	0.0	84.8	365.0	352.1	92.5	0.0	0.0	100.0	0.0	0.0
7.21	119.3	0.0	0.0	115.2	0.0	0.0	84.8	365.0	352.3	92.4	0.0	0.0	101.3	0.0	0.0
7.36	118.0	0.0	0.0	115.8	0.0	0.0	85.0	365.3	352.0	96.7	0.0	0.0	99.9	0.0	0.0
7.52	120.7	0.0	0.0	117.8	0.0	0.0	85.7	364.7	351.1	91.0	0.0	0.0	95.5	0.0	0.0
7.67	122.2	0.0	0.0	118.0	0.0	0.0	86.1	364.3	351.0	87.9	0.0	0.0	95.9	0.0	0.0
7.83	122.6	0.0	0.0	119.5	0.0	0.0	86.8	364.3	350.3	88.6	0.0	0.0	93.3	0.0	0.0
7.99	124.5	0.0	0.0	121.5	0.0	0.0	87.5	363.8	349.4	85.5	0.0	0.0	89.4	0.0	0.0
8.14	125.8	0.0	0.0	122.5	0.0	0.0	88.2	363.5	348.9	84.0	0.0	0.0	88.4	0.0	0.0
8.30	125.9	125.3	125.0	123.5	125.4	125.4	88.5	363.5	348.5	84.4	85.7	86.4	86.4	82.0	82.0

14.34	126.0	125.6	125.9	123.4	126.2	126.2	88.5	363.3	348.0	84.1	85.0	84.3	86.6	80.1	80.1
14.49	126.1	125.5	126.4	123.7	126.8	126.8	88.6	363.3	347.5	84.0	85.4	83.4	85.9	78.9	78.9
14.65	126.2	126.4	124.7	123.8	125.3	125.3	88.7	363.3	347.4	84.0	83.5	87.5	85.8	82.3	82.3
14.80	126.3	126.1	127.5	123.9	126.1	126.1	88.7	363.3	347.6	83.9	84.4	81.3	85.7	80.7	80.7
14.96	126.4	125.9	127.0	124.0	126.4	126.4	88.8	363.7	347.2	83.9	85.0	82.6	85.6	80.1	80.1
15.12	126.5	122.8	124.1	124.1	122.4	122.4	88.9	364.7	346.9	84.0	93.2	89.8	85.4	89.8	89.8
15.27	126.7	123.7	127.2	124.2	121.0	121.0	88.9	363.3	347.6	83.5	90.7	82.4	85.5	94.0	94.0
15.43	126.7	124.4	124.8	124.3	130.0	130.0	89.0	364.9	347.3	83.9	89.4	88.4	85.4	73.5	73.5
15.59	126.8	122.9	125.7	124.5	150.0	150.0	89.1	364.7	347.1	83.8	93.5	86.4	85.0	49.4	49.4
16.05	127.0	0.0	0.0	124.8	0.0	0.0	89.3	364.1	349.0	83.7	0.0	0.0	85.2	0.0	0.0
20.74	129.8	0.0	0.0	128.0	0.0	0.0	91.4	362.7	346.4	81.6	0.0	0.0	81.8	0.0	0.0
23.09	131.5	0.0	0.0	130.0	0.0	0.0	92.5	362.3	345.5	80.1	0.0	0.0	79.4	0.0	0.0
24.65	132.2	0.0	0.0	131.0	0.0	0.0	93.2	362.1	345.0	80.0	0.0	0.0	78.6	0.0	0.0

AVERAG VALUES FROM X/D=14.2 TO X/D=15.6 AND FROM X/D = 4.8 to 6.2:
 NU(R)= 89.55 NU(S)= 93.64 NU(AV)= 90.37

RUN NUMBER=143NG55-00/00 b/a=4.0 E/D=0.000 P/E= 0.0 ALPA= 0 HYD DIA= 1.600 IN
 PR= 71 MDT=0.1555 LBM/SEC RE= 59509. GGE(R)= 604.7 BTU/HR-SQ FT
 GGE(S)= 529.3 INLET TEMP= 82.6 F TATM= 74.5 F PATM= 14.6 PSIA

AVERAG VALUES FROM X/D=14.2 TO X/D=15.6:
 NU(R)= 134.27 NU(S)= 140.88 NU(AV)= 135.60

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.12	93.5	0.0	89.8	92.0	0.0	128.0	82.6	600.6	621.3	485.0	0.0	735.9	582.1	0.0
2	0.27	94.3	0.0	92.3	93.0	0.0	129.0	82.7	600.4	620.8	454.0	0.0	548.7	528.8	0.0
3	0.43	93.4	0.0	97.5	92.0	0.0	130.0	82.8	600.6	621.3	495.3	0.0	357.4	590.2	0.0
4	0.59	95.3	0.0	98.1	93.0	0.0	128.0	82.8	600.2	620.8	422.0	0.0	344.6	535.4	0.0
5	0.74	96.6	0.0	101.0	94.5	0.0	128.0	82.9	599.9	620.1	383.7	0.0	290.4	468.5	0.0
6	0.90	98.4	0.0	103.0	95.5	0.0	129.1	83.0	599.5	619.7	340.3	0.0	262.1	433.2	0.0
7	1.05	99.3	0.0	104.7	97.0	0.0	123.0	83.0	599.3	619.0	322.7	0.0	242.3	388.2	0.0
8	1.21	101.4	0.0	105.6	98.5	0.0	119.6	83.1	598.8	618.3	286.5	0.0	233.1	351.6	0.0
9	1.37	103.1	0.0	106.3	99.5	0.0	132.2	83.2	598.5	617.8	262.8	0.0	226.5	331.2	0.0
10	1.52	104.8	0.0	104.1	101.0	0.0	150.0	83.2	598.1	617.1	242.7	0.0	250.9	304.0	0.0
11	1.68	106.8	0.0	0.0	102.4	0.0	0.0	83.3	597.6	616.5	222.6	0.0	0.0	282.5	0.0
12	1.84	108.1	0.0	0.0	104.0	0.0	0.0	83.4	597.4	615.8	211.3	0.0	0.0	261.1	0.0
13	1.99	109.6	0.0	0.0	104.9	0.0	0.0	83.4	597.0	615.3	199.6	0.0	0.0	250.8	0.0
14	2.15	110.8	0.0	0.0	106.1	0.0	0.0	83.5	596.8	614.8	191.2	0.0	0.0	237.9	0.0
15	2.30	111.3	0.0	0.0	107.4	0.0	0.0	83.6	596.6	614.2	188.2	0.0	0.0	225.4	0.0
16	2.46	111.9	0.0	0.0	107.8	0.0	0.0	83.6	596.5	614.0	184.5	0.0	0.0	222.1	0.0
17	2.62	112.4	0.0	0.0	108.6	0.0	0.0	83.7	596.4	614.6	181.7	0.0	0.0	215.5	0.0
18	2.77	112.8	0.0	0.0	107.6	0.0	0.0	83.7	596.3	614.4	179.5	0.0	0.0	225.7	0.0
19	2.93	113.1	0.0	0.0	108.7	0.0	0.0	83.8	596.3	614.1	178.1	0.0	0.0	215.8	0.0
20	3.09	113.8	0.0	0.0	109.6	0.0	0.0	83.9	596.1	614.0	174.2	0.0	0.0	208.4	0.0
21	3.24	113.8	0.0	0.0	108.0	0.0	0.0	83.9	596.1	613.0	174.6	0.0	0.0	223.1	0.0
22	3.40	113.9	0.0	0.0	110.1	0.0	0.0	84.0	596.1	612.1	174.3	0.0	0.0	205.4	0.0
23	3.55	114.5	0.0	0.0	110.6	0.0	0.0	84.1	595.9	612.1	171.2	0.0	0.0	201.6	0.0
24	3.71	115.0	0.0	0.0	111.2	0.0	0.0	84.1	595.8	611.2	168.8	0.0	0.0	197.3	0.0
25	3.87	115.8	0.0	0.0	111.9	0.0	0.0	84.2	595.7	611.6	164.8	0.0	0.0	193.0	0.0
26	4.02	116.0	0.0	0.0	113.3	0.0	0.0	84.3	595.6	611.5	164.0	0.0	0.0	184.1	0.0
27	4.18	116.6	0.0	0.0	114.0	0.0	0.0	84.3	595.5	611.2	161.3	0.0	0.0	180.0	0.0
28	4.34	116.6	0.0	0.0	115.3	0.0	0.0	84.4	595.5	610.6	161.6	0.0	0.0	172.6	0.0
29	4.49	116.8	0.0	0.0	116.0	0.0	0.0	84.5	595.4	610.2	160.9	0.0	0.0	169.0	0.0
30	4.65	117.8	0.0	0.0	116.0	0.0	0.0	84.5	595.2	610.2	156.3	0.0	0.0	169.4	0.0
31	4.80	117.8	0.0	0.0	117.0	0.0	0.0	84.6	595.2	609.8	156.5	0.0	0.0	164.3	0.0
32	4.96	117.4	0.0	0.0	117.5	0.0	0.0	84.7	595.3	609.5	158.8	0.0	0.0	162.1	0.0
33	5.12	118.3	0.0	0.0	117.6	0.0	0.0	84.7	595.1	609.5	154.8	0.0	0.0	161.9	0.0
34	5.27	118.3	0.0	0.0	117.4	0.0	0.0	84.8	595.1	609.6	155.0	0.0	0.0	163.2	0.0
35	5.43	118.9	0.0	0.0	117.6	0.0	0.0	84.8	595.0	609.5	152.6	0.0	0.0	162.5	0.0
36	5.59	119.4	0.0	0.0	117.8	0.0	0.0	84.9	594.9	609.4	150.6	0.0	0.0	161.8	0.0
37	5.74	119.2	0.0	0.0	117.7	0.0	0.0	85.0	594.9	609.4	151.7	0.0	0.0	162.6	0.0
38	5.90	119.3	0.0	0.0	118.0	0.0	0.0	85.0	594.9	609.3	151.6	0.0	0.0	161.4	0.0
39	6.05	120.1	0.0	0.0	118.3	0.0	0.0	85.1	594.7	609.2	148.3	0.0	0.0	160.2	0.0
40	6.21	120.2	0.0	0.0	118.0	0.0	0.0	85.2	594.7	609.3	148.1	0.0	0.0	162.0	0.0
41	6.68	118.6	0.0	0.0	118.2	0.0	0.0	85.4	595.0	609.2	156.2	0.0	0.0	161.9	0.0
42	8.24	121.4	0.0	0.0	120.4	0.0	0.0	86.0	594.4	608.2	146.4	0.0	0.0	154.1	0.0
43	9.02	123.3	0.0	0.0	120.0	0.0	0.0	86.3	594.0	608.4	140.0	0.0	0.0	157.4	0.0
44	10.59	123.4	0.0	0.0	122.4	0.0	0.0	87.0	594.0	607.3	141.9	0.0	0.0	149.2	0.0
45	12.15	125.5	0.0	0.0	124.0	0.0	0.0	87.6	593.5	606.6	136.2	0.0	0.0	144.9	0.0
46	13.71	126.7	0.0	0.0	125.0	0.0	0.0	88.3	593.3	606.1	134.1	0.0	0.0	143.3	0.0
47	14.30	127.0	126.3	126.1	125.2	128.0	128.0	88.5	593.2	605.2	133.8	136.3	137.0	143.0	133.0
48	14.34	127.2	126.5	126.6	124.7	129.0	129.0	88.5	592.9	605.4	133.1	135.5	135.2	145.1	129.8
49	14.49	127.3	125.1	127.3	125.9	130.0	130.0	88.6	593.0	604.4	133.1	141.0	133.0	140.5	126.7
50	14.65	127.3	126.7	125.2	126.0	128.0	128.0	88.7	593.2	604.4	133.2	135.3	140.9	140.4	133.3
51	14.80	127.3	127.1	128.7	126.1	128.0	128.0	88.7	593.5	604.7	133.6	134.2	128.8	140.5	133.6
52	14.96	127.1	126.6	126.5	126.2	129.1	129.1	88.8	594.1	604.3	134.4	136.3	136.7	140.0	130.0
53	15.12	126.8	122.4	122.9	126.4	123.0	123.0	88.9	595.4	603.8	136.3	154.0	151.7	139.5	153.4
54	15.27	127.1	122.5	127.0	126.3	119.6	119.6	88.9	594.6	604.7	135.0	153.6	135.4	140.2	171.0
55	15.43	127.0	121.7	124.9	126.4	132.2	132.2	89.0	595.2	604.7	135.6	157.8	143.7	140.1	121.4
56	15.59	127.3	122.6	126.0	126.6	150.0	150.0	89.1	594.6	604.2	134.7	153.7	139.5	139.5	86.0
57	16.05	127.9	0.0	0.0	126.4	0.0	0.0	89.2	593.8	607.0	133.2	0.0	0.0	141.6	0.0
58	20.74	130.3	0.0	0.0	129.0	0.0	0.0	91.2	592.5	604.3	130.9	0.0	0.0	138.1	0.0
59	23.09	131.8	0.0	0.0	132.2	0.0	0.0	92.2	592.1	602.8	128.9	0.0	0.0	129.9	0.0
60	24.65	132.4	0.0	0.0	131.0	0.0	0.0	92.8	592.0	603.3	128.9	0.0	0.0	136.1	0.0

AVERAG VALUES FROM X/D=14.2 TO X/D=15.6 AND FROM X/D = 4.8 to 6.2:
 NU(R)= 143.54 NU(S)= 151.53 NU(AV)= 145.14

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER=103HR10-90/10 S/D=0.078 P/E=10.0 ALPHA=90 HYD DIA= 1.600 IN PR= 71 MDDT=0.0286 LBM/SEC
 QGE(R)= 294.1 BTU/HR-SQ FT QGE(S)= 173.5 INLET TEMP= 81.7 F TATM= 74.8 F PATM= 14.6 PSIA

XD	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
12	96.7	0.0	93.7	92.6	0.0	116.6	81.8	289.2	165.3	170.4	0.0	213.4	134.4	0.0	41.7
27	97.2	0.0	96.2	93.5	0.0	116.8	82.0	289.1	164.9	166.4	0.0	178.0	125.3	0.0	41.5
43	97.0	0.0	99.5	93.9	0.0	117.2	82.1	289.2	164.7	170.2	0.0	145.7	122.4	0.0	41.1
59	100.4	0.0	100.3	94.8	0.0	116.2	82.2	288.4	164.3	139.3	0.0	140.0	114.7	0.0	42.4
74	101.1	0.0	100.2	95.9	0.0	117.5	82.4	288.3	163.8	135.0	0.0	141.9	106.2	0.0	40.9
90	101.6	0.0	104.0	96.9	0.0	117.8	82.5	288.1	163.3	131.0	0.0	117.6	99.6	0.0	40.6
105	102.1	0.0	106.3	98.0	0.0	118.2	82.7	288.1	162.8	129.9	0.0	106.8	93.1	0.0	40.2
121	102.7	0.0	106.8	99.2	0.0	119.5	82.8	287.9	162.2	126.9	0.0	105.2	86.8	0.0	38.7
137	104.2	0.0	106.6	100.2	0.0	121.2	83.0	287.6	161.8	118.6	0.0	106.6	82.2	0.0	37.1
152	103.9	0.0	102.5	100.8	0.0	150.0	83.1	287.7	161.5	121.1	0.0	129.9	79.9	0.0	21.1
168	106.6	0.0	0.0	100.3	0.0	0.0	83.3	287.1	161.7	107.6	0.0	0.0	83.1	0.0	0.0
184	106.4	0.0	0.0	101.5	0.0	0.0	83.4	287.1	161.2	109.2	0.0	0.0	77.9	0.0	0.0
199	106.8	0.0	0.0	102.2	0.0	0.0	83.5	287.0	160.9	108.0	0.0	0.0	75.4	0.0	0.0
215	108.5	0.0	0.0	102.2	0.0	0.0	83.7	286.6	160.9	100.6	0.0	0.0	76.0	0.0	0.0
230	106.4	0.0	0.0	101.8	0.0	0.0	83.8	287.1	161.0	111.3	0.0	0.0	78.4	0.0	0.0
246	108.9	0.0	0.0	101.5	0.0	0.0	84.0	286.6	161.2	100.5	0.0	0.0	80.4	0.0	0.0
262	108.4	0.0	0.0	102.6	0.0	0.0	84.1	286.7	161.0	103.2	0.0	0.0	76.2	0.0	0.0
277	107.6	0.0	0.0	102.0	0.0	0.0	84.3	286.8	161.0	107.4	0.0	0.0	79.3	0.0	0.0
293	108.5	0.0	0.0	102.5	0.0	0.0	84.4	286.6	160.7	104.0	0.0	0.0	77.6	0.0	0.0
309	106.6	0.0	0.0	102.8	0.0	0.0	84.6	287.1	160.6	113.7	0.0	0.0	76.9	0.0	0.0
324	110.3	0.0	0.0	102.9	0.0	0.0	84.7	286.3	160.5	97.6	0.0	0.0	77.0	0.0	0.0
340	108.5	0.0	0.0	102.8	0.0	0.0	84.8	286.6	160.6	105.8	0.0	0.0	78.1	0.0	0.0
355	107.8	0.0	0.0	103.4	0.0	0.0	85.0	286.8	160.3	109.7	0.0	0.0	76.0	0.0	0.0
371	109.5	0.0	0.0	103.5	0.0	0.0	85.1	286.4	160.3	102.6	0.0	0.0	76.1	0.0	0.0
387	107.9	0.0	0.0	103.8	0.0	0.0	85.3	286.8	160.1	110.6	0.0	0.0	75.4	0.0	0.0
402	110.0	0.0	0.0	103.6	0.0	0.0	85.4	286.3	160.2	101.6	0.0	0.0	76.9	0.0	0.0
418	109.0	0.0	0.0	104.0	0.0	0.0	85.6	286.5	160.0	106.6	0.0	0.0	75.7	0.0	0.0
434	108.7	0.0	0.0	105.0	0.0	0.0	85.7	286.6	159.6	108.7	0.0	0.0	72.1	0.0	0.0
449	110.3	0.0	0.0	105.0	0.0	0.0	85.9	286.3	159.6	102.1	0.0	0.0	72.6	0.0	0.0
465	108.2	0.0	0.0	104.4	0.0	0.0	86.0	286.7	159.9	112.5	0.0	0.0	75.7	0.0	0.0
480	114.3	0.0	0.0	105.2	0.0	0.0	86.1	285.4	159.5	88.3	0.0	0.0	72.9	0.0	0.0
496	111.1	0.0	0.0	105.5	0.0	0.0	86.3	286.1	159.3	100.4	0.0	0.0	72.2	0.0	0.0
512	110.1	0.0	0.0	106.0	0.0	0.0	86.4	286.3	159.1	105.3	0.0	0.0	70.8	0.0	0.0
527	111.3	0.0	0.0	105.8	0.0	0.0	86.6	286.0	159.2	100.7	0.0	0.0	72.1	0.0	0.0
543	109.9	0.0	0.0	105.8	0.0	0.0	86.7	286.3	159.2	107.5	0.0	0.0	72.6	0.0	0.0
559	114.0	0.0	0.0	105.6	0.0	0.0	86.9	285.4	159.3	91.5	0.0	0.0	74.0	0.0	0.0
574	111.7	0.0	0.0	105.0	0.0	0.0	87.0	285.9	159.1	100.8	0.0	0.0	72.9	0.0	0.0
590	110.7	0.0	0.0	105.5	0.0	0.0	87.2	286.2	159.3	105.7	0.0	0.0	75.5	0.0	0.0
605	112.8	0.0	0.0	106.0	0.0	0.0	87.3	285.7	159.1	97.4	0.0	0.0	74.0	0.0	0.0
621	112.3	0.0	0.0	106.0	0.0	0.0	87.4	285.8	159.1	100.0	0.0	0.0	74.5	0.0	0.0
636	110.2	0.0	0.0	107.1	0.0	0.0	87.9	286.3	158.6	111.4	0.0	0.0	71.7	0.0	0.0
652	112.3	0.0	0.0	109.2	0.0	0.0	89.3	285.8	157.6	107.8	0.0	0.0	68.7	0.0	0.0
668	113.4	0.0	0.0	110.2	0.0	0.0	90.0	285.6	157.2	105.8	0.0	0.0	67.5	0.0	0.0
684	114.5	0.0	0.0	112.3	0.0	0.0	91.5	285.3	156.2	107.1	0.0	0.0	64.8	0.0	0.0
700	117.5	0.0	0.0	113.8	0.0	0.0	92.9	284.7	155.5	99.8	0.0	0.0	64.2	0.0	0.0
716	118.5	0.0	0.0	114.5	0.0	0.0	94.4	284.4	155.2	101.4	0.0	0.0	66.3	0.0	0.0
732	122.1	122.6	120.0	114.2	116.6	116.6	94.9	283.7	154.6	89.7	88.0	97.2	68.9	61.3	61.3
748	119.1	118.9	119.0	114.5	116.8	116.8	95.0	284.2	154.5	101.2	101.9	101.5	67.9	60.7	60.7
764	118.4	116.4	119.1	115.1	117.2	117.2	95.1	284.3	154.0	104.9	114.6	101.7	66.2	59.8	59.8
780	120.4	120.4	120.7	114.8	116.2	116.2	95.2	283.9	154.1	96.9	96.9	95.7	67.7	63.1	63.1
796	120.4	120.6	119.6	114.5	117.5	117.5	95.4	283.9	154.2	97.4	96.6	100.6	69.3	59.9	59.9
812	124.8	124.5	122.4	114.3	117.8	117.8	95.5	283.0	154.1	82.8	83.8	90.4	70.4	59.4	59.4
828	122.1	121.5	121.3	114.4	118.2	118.2	95.7	284.4	154.0	92.4	94.5	95.2	70.6	58.6	58.6
844	117.3	119.5	120.4	114.5	119.5	119.5	95.8	284.0	154.4	113.3	102.9	99.1	70.8	55.9	55.9
860	120.2	120.8	120.8	115.0	121.2	121.2	96.0	283.9	153.8	100.4	98.0	98.0	69.2	52.3	52.3
876	121.1	121.7	120.7	115.2	150.0	150.0	96.1	283.8	153.7	97.2	95.1	98.9	68.9	24.4	24.4
892	121.4	0.0	0.0	116.3	0.0	0.0	96.5	284.1	154.1	97.8	0.0	0.0	66.8	0.0	0.0
908	125.2	0.0	0.0	119.5	0.0	0.0	100.9	283.0	152.9	99.0	0.0	0.0	69.8	0.0	0.0
924	126.5	0.0	0.0	121.2	0.0	0.0	103.0	282.7	152.1	102.2	0.0	0.0	71.0	0.0	0.0
940	128.7	0.0	0.0	123.0	0.0	0.0	104.5	282.2	151.3	98.6	0.0	0.0	69.1	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 U(R)A= 98.69 NU(S)A= 71.07 NU(AVA)= 93.17 ST(AVA)=0.01205 ST(AV)/ST(4S)=2.73 F/F(4S)=12.45
 ST/ST(4S))/(F/F(4S))=0.220 (F/F(4S))/(ST/ST(4S))**3.0=0.61 (ST/ST(4S))/(F/F(4S))**(1/3)=1.18
 U(R)A/NU(4S)=2.91 NU(S)A/NU(4S)=2.10 e+(4R)= 206.68 R(4R)= 3.13 H(4R)=16.54

USING ROUGH SIDE RESULTS ONLY : H(RB)= 18.18

RUN NUMBER=135HR30-90/10 E/D=0.078 P/E=10.0 ALPHA=90 HYD DIA= 1.600 IN PR= 71 MDDT=0.0834 LBM/SEC
 RE= 31720. GGE(R)= 759.1 BTU/HR-SQ FT GGE(S)= 442.3 INLET TEMP= 81.5 F TATM= 74.5 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.12	96.9	0.0	93.2	95.7	0.0	119.6	81.6	754.2	432.6	432.7	0.0	570.8	269.4	0.0
2	0.27	96.1	0.0	93.5	95.3	0.0	120.5	81.7	754.3	432.8	461.0	0.0	562.9	280.1	0.0
3	0.43	96.1	0.0	97.7	95.2	0.0	120.5	81.9	754.3	432.8	465.3	0.0	418.3	285.0	0.0
4	0.59	101.0	0.0	98.4	95.0	0.0	119.2	82.0	753.3	432.9	348.0	0.0	403.2	292.4	0.0
5	0.74	102.0	0.0	100.6	96.5	0.0	119.6	82.2	753.0	432.3	332.7	0.0	358.0	264.2	0.0
6	0.90	103.0	0.0	104.5	98.0	0.0	120.3	82.3	752.8	431.6	318.7	0.0	297.2	240.8	0.0
7	1.05	102.4	0.0	105.8	99.9	0.0	118.8	82.4	753.0	430.7	330.4	0.0	282.4	216.0	0.0
8	1.21	103.0	0.0	108.8	100.6	0.0	122.0	82.6	752.8	430.4	322.8	0.0	251.5	209.1	0.0
9	1.37	104.4	0.0	110.4	101.4	0.0	124.5	82.7	752.5	430.0	303.8	0.0	238.0	201.5	0.0
10	1.52	104.9	0.0	105.8	101.7	0.0	150.0	82.8	752.4	429.9	293.7	0.0	287.0	199.6	0.0
11	1.68	109.5	0.0	0.0	102.4	0.0	0.0	83.0	751.4	429.5	248.1	0.0	0.0	193.6	0.0
12	1.84	107.4	0.0	0.0	103.0	0.0	0.0	83.1	751.9	429.3	271.0	0.0	0.0	189.0	0.0
13	1.99	108.4	0.0	0.0	104.4	0.0	0.0	83.2	751.6	428.6	261.6	0.0	0.0	177.4	0.0
14	2.15	111.2	0.0	0.0	104.6	0.0	0.0	83.4	751.0	428.5	236.3	0.0	0.0	176.8	0.0
15	2.30	109.0	0.0	0.0	104.3	0.0	0.0	83.5	751.5	428.7	258.1	0.0	0.0	180.5	0.0
16	2.46	114.5	0.0	0.0	105.0	0.0	0.0	83.7	750.3	428.3	212.8	0.0	0.0	175.6	0.0
17	2.62	111.3	0.0	0.0	105.1	0.0	0.0	83.8	751.0	428.8	238.9	0.0	0.0	176.2	0.0
18	2.77	110.8	0.0	0.0	105.0	0.0	0.0	83.9	751.1	428.3	244.4	0.0	0.0	177.8	0.0
19	2.93	112.0	0.0	0.0	115.5	0.0	0.0	84.1	750.8	423.5	235.0	0.0	0.0	117.8	0.0
20	3.09	110.0	0.0	0.0	105.6	0.0	0.0	84.2	751.3	429.0	254.6	0.0	0.0	175.6	0.0
21	3.24	116.7	0.0	0.0	105.0	0.0	0.0	84.3	749.8	428.3	202.5	0.0	0.0	181.2	0.0
22	3.40	111.5	0.0	0.0	104.9	0.0	0.0	84.5	751.0	428.4	242.8	0.0	0.0	183.3	0.0
23	3.55	111.0	0.0	0.0	105.5	0.0	0.0	84.6	751.1	428.1	248.6	0.0	0.0	179.1	0.0
24	3.71	113.3	0.0	0.0	104.7	0.0	0.0	84.8	750.6	427.8	229.6	0.0	0.0	187.0	0.0
25	3.87	111.1	0.0	0.0	105.1	0.0	0.0	84.9	751.0	427.9	250.2	0.0	0.0	184.7	0.0
26	4.02	114.8	0.0	0.0	106.3	0.0	0.0	85.0	750.2	427.7	220.0	0.0	0.0	175.5	0.0
27	4.18	113.1	0.0	0.0	107.0	0.0	0.0	85.2	750.6	427.4	234.5	0.0	0.0	170.8	0.0
28	4.34	111.2	0.0	0.0	107.8	0.0	0.0	85.3	751.0	427.1	253.0	0.0	0.0	165.6	0.0
29	4.49	113.8	0.0	0.0	107.4	0.0	0.0	85.4	750.4	427.2	230.8	0.0	0.0	169.7	0.0
30	4.65	110.4	0.0	0.0	107.2	0.0	0.0	85.6	751.2	427.3	263.9	0.0	0.0	172.3	0.0
31	4.80	122.0	0.0	0.0	107.7	0.0	0.0	85.7	748.6	427.1	179.9	0.0	0.0	169.4	0.0
32	4.96	113.9	0.0	0.0	108.0	0.0	0.0	85.9	750.4	427.0	233.2	0.0	0.0	168.0	0.0
33	5.12	112.6	0.0	0.0	108.8	0.0	0.0	86.0	750.7	426.6	245.8	0.0	0.0	163.0	0.0
34	5.27	114.5	0.0	0.0	108.5	0.0	0.0	86.1	750.3	426.7	230.4	0.0	0.0	166.2	0.0
35	5.43	112.4	0.0	0.0	109.0	0.0	0.0	86.3	750.8	426.5	250.2	0.0	0.0	163.4	0.0
36	5.59	121.5	0.0	0.0	108.8	0.0	0.0	86.4	748.8	426.6	185.8	0.0	0.0	165.8	0.0
37	5.74	115.0	0.0	0.0	108.9	0.0	0.0	86.5	750.2	426.5	229.5	0.0	0.0	166.1	0.0
38	5.90	113.7	0.0	0.0	108.6	0.0	0.0	86.7	750.5	426.7	241.7	0.0	0.0	169.4	0.0
39	6.05	116.2	0.0	0.0	108.5	0.0	0.0	86.8	749.9	426.7	222.1	0.0	0.0	171.2	0.0
40	6.21	114.4	0.0	0.0	108.2	0.0	0.0	86.9	750.3	426.9	237.8	0.0	0.0	174.8	0.0
41	6.38	112.5	0.0	0.0	110.7	0.0	0.0	87.4	750.7	425.9	259.6	0.0	0.0	158.6	0.0
42	6.54	114.5	0.0	0.0	112.5	0.0	0.0	88.7	750.3	424.9	252.6	0.0	0.0	155.1	0.0
43	9.02	115.8	0.0	0.0	113.3	0.0	0.0	89.4	750.0	424.5	246.3	0.0	0.0	154.0	0.0
44	10.59	117.7	0.0	0.0	116.0	0.0	0.0	90.8	749.6	423.3	240.8	0.0	0.0	145.1	0.0
45	12.15	120.0	0.0	0.0	117.0	0.0	0.0	92.2	749.1	422.8	232.1	0.0	0.0	146.8	0.0
46	13.71	120.7	0.0	0.0	117.5	0.0	0.0	93.5	748.9	422.6	237.2	0.0	0.0	151.7	0.0
47	14.30	129.1	128.1	124.6	118.0	119.6	119.6	94.0	747.1	422.4	183.3	188.7	210.3	151.7	142.2
48	14.34	121.3	118.1	121.7	117.2	120.5	120.5	94.1	748.6	422.2	236.3	267.9	233.0	156.9	137.4
49	14.49	120.6	112.7	121.9	118.4	120.5	120.5	94.2	748.8	421.3	243.8	348.2	232.5	149.5	137.8
50	14.65	123.7	121.3	123.1	116.8	119.2	119.2	94.3	748.1	422.0	219.0	238.6	223.7	161.3	146.0
51	14.80	123.7	123.0	119.8	117.5	119.6	119.6	94.5	748.2	421.9	220.0	225.5	254.0	157.3	144.4
52	14.96	131.1	133.1	128.4	117.4	120.3	120.3	94.6	747.0	421.6	176.1	166.8	190.0	158.7	141.1
53	15.12	125.9	124.0	124.4	117.9	118.8	118.8	94.8	749.1	421.2	206.8	220.1	217.1	156.7	150.5
54	15.27	122.3	120.1	122.9	118.1	122.0	122.0	94.9	748.6	421.8	234.6	255.1	229.6	156.0	133.7
55	15.43	130.9	124.0	124.0	117.8	124.6	124.6	95.0	748.2	421.6	179.4	221.8	221.8	158.8	122.5
56	15.59	130.8	124.8	124.1	118.4	150.0	150.0	95.2	748.1	421.3	180.4	216.8	222.0	155.4	66.0
57	16.05	125.1	0.0	0.0	119.1	0.0	0.0	95.6	748.7	422.9	217.4	0.0	0.0	153.9	0.0
58	20.74	126.5	0.0	0.0	122.0	0.0	0.0	99.7	747.7	420.5	237.7	0.0	0.0	160.7	0.0
59	23.09	127.7	0.0	0.0	124.6	0.0	0.0	101.7	747.4	419.3	244.6	0.0	0.0	155.9	0.0
60	24.65	130.2	0.0	0.0	126.5	0.0	0.0	103.1	746.8	418.5	233.8	0.0	0.0	151.7	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A=216.80 NU(S)A=161.97 NU(AV)A=205.83 ST(AV)A=0.00912 ST(AV)/ST(4S)=2.56 F/F(4S)=16.34
 (ST/ST(4S))/(F/F(4S))=0.157 (F/F(4S))/(ST/ST(4S))*3.0=0.97 (ST/ST(4S))/(F/F(4S))*((1/3))=1.01
 NU(R)A/NU(4S)=2.71 NU(S)A/NU(4S)=2.03 e+(4R)=604.61 R(4R)=3.12 H(4R)=22.33

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 24.52

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NUMBER=137HR50-90/10 E/D=0.078 F/A=10.0 ALPHA=90 HYD DIA= 1.600 IN PR= .71 MDOT=0.1376 LBM/SEC
30371. QGE(R)=1076.3 BTU/HR-SQ FT QGE(S)= 692.0 INLET TEMP= 82.2 F TATM= 75.0 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
12	96.9	0.0	93.2	95.8	0.0	120.1	82.3	1071.4	682.4	643.0	0.0	861.1	442.9	0.0	158.3
27	96.5	0.0	92.9	95.6	0.0	121.5	82.4	1071.5	682.5	666.8	0.0	875.6	453.7	0.0	153.1
43	95.7	0.0	97.2	95.0	0.0	122.2	82.5	1071.7	682.8	713.4	0.0	640.4	480.0	0.0	150.9
59	100.4	0.0	97.6	96.0	0.0	120.0	82.7	1070.7	682.3	528.7	0.0	627.7	448.0	0.0	160.1
74	101.6	0.0	100.9	97.5	0.0	120.4	82.8	1070.4	681.6	498.2	0.0	517.4	405.6	0.0	158.7
90	103.2	0.0	104.3	99.9	0.0	121.0	82.9	1070.1	680.5	461.6	0.0	437.9	350.6	0.0	156.4
105	101.0	0.0	104.7	101.6	0.0	120.0	83.0	1070.5	679.8	521.4	0.0	432.4	320.4	0.0	161.0
21	101.9	0.0	109.3	101.9	0.0	122.2	83.1	1070.3	679.6	499.5	0.0	372.5	317.2	0.0	152.3
37	103.4	0.0	110.5	103.2	0.0	125.2	83.3	1070.0	679.0	465.1	0.0	343.9	298.1	0.0	141.7
52	104.6	0.0	106.4	103.3	0.0	150.0	83.4	1069.8	679.0	441.3	0.0	406.8	298.4	0.0	89.2
68	110.0	0.0	0.0	102.2	0.0	0.0	83.5	1068.6	679.0	352.9	0.0	0.0	301.7	0.0	0.0
84	107.5	0.0	0.0	105.6	0.0	0.0	83.6	1069.1	677.9	391.8	0.0	0.0	269.9	0.0	0.0
99	106.2	0.0	0.0	106.0	0.0	0.0	83.7	1069.0	677.7	382.4	0.0	0.0	266.4	0.0	0.0
15	110.6	0.0	0.0	106.8	0.0	0.0	83.9	1068.4	677.4	349.5	0.0	0.0	258.3	0.0	0.0
30	109.0	0.0	0.0	106.6	0.0	0.0	84.0	1068.8	677.5	373.6	0.0	0.0	262.0	0.0	0.0
46	114.1	0.0	0.0	107.3	0.0	0.0	84.1	1067.2	677.1	291.6	0.0	0.0	255.3	0.0	0.0
62	111.8	0.0	0.0	107.6	0.0	0.0	84.2	1068.2	677.7	338.6	0.0	0.0	251.5	0.0	0.0
77	111.7	0.0	0.0	105.5	0.0	0.0	84.4	1068.3	678.2	347.7	0.0	0.0	280.4	0.0	0.0
93	112.5	0.0	0.0	105.1	0.0	0.0	84.5	1068.0	678.7	332.9	0.0	0.0	288.1	0.0	0.0
109	111.1	0.0	0.0	105.1	0.0	0.0	84.6	1068.3	678.9	352.1	0.0	0.0	288.9	0.0	0.0
124	119.3	0.0	0.0	106.2	0.0	0.0	84.7	1066.5	675.9	269.3	0.0	0.0	251.2	0.0	0.0
140	112.7	0.0	0.0	107.8	0.0	0.0	84.8	1068.0	676.1	334.7	0.0	0.0	257.2	0.0	0.0
155	111.6	0.0	0.0	108.2	0.0	0.0	85.0	1068.2	676.2	350.0	0.0	0.0	254.2	0.0	0.0
171	112.7	0.0	0.0	107.7	0.0	0.0	85.1	1067.7	675.9	325.6	0.0	0.0	260.5	0.0	0.0
187	112.2	0.0	0.0	109.7	0.0	0.0	85.2	1068.1	676.0	345.2	0.0	0.0	250.8	0.0	0.0
202	117.0	0.0	0.0	106.7	0.0	0.0	85.3	1067.0	676.5	293.9	0.0	0.0	252.5	0.0	0.0
218	113.1	0.0	0.0	109.5	0.0	0.0	85.4	1067.9	676.1	336.8	0.0	0.0	245.2	0.0	0.0
234	111.7	0.0	0.0	110.0	0.0	0.0	85.6	1068.2	675.9	356.5	0.0	0.0	241.2	0.0	0.0
249	114.2	0.0	0.0	109.2	0.0	0.0	85.7	1067.6	676.3	326.5	0.0	0.0	250.8	0.0	0.0
265	111.4	0.0	0.0	109.5	0.0	0.0	85.8	1068.3	676.1	363.9	0.0	0.0	248.8	0.0	0.0
280	125.0	0.0	0.0	110.5	0.0	0.0	85.9	1065.3	675.7	237.6	0.0	0.0	239.7	0.0	0.0
296	114.7	0.0	0.0	111.0	0.0	0.0	86.1	1067.5	675.4	324.7	0.0	0.0	235.9	0.0	0.0
311	113.1	0.0	0.0	111.2	0.0	0.0	86.2	1067.9	675.3	345.5	0.0	0.0	235.1	0.0	0.0
327	114.7	0.0	0.0	111.0	0.0	0.0	86.3	1067.5	675.4	327.3	0.0	0.0	238.1	0.0	0.0
343	113.1	0.0	0.0	111.5	0.0	0.0	86.4	1067.9	675.2	348.5	0.0	0.0	234.4	0.0	0.0
358	124.3	0.0	0.0	111.5	0.0	0.0	86.5	1065.4	675.2	245.6	0.0	0.0	235.5	0.0	0.0
374	115.9	0.0	0.0	111.9	0.0	0.0	86.7	1067.3	675.0	317.7	0.0	0.0	232.8	0.0	0.0
390	114.1	0.0	0.0	111.5	0.0	0.0	86.8	1067.7	675.2	340.1	0.0	0.0	237.7	0.0	0.0
405	116.7	0.0	0.0	111.2	0.0	0.0	86.9	1067.1	675.3	311.6	0.0	0.0	241.8	0.0	0.0
421	115.0	0.0	0.0	110.8	0.0	0.0	87.0	1067.5	675.5	331.9	0.0	0.0	247.2	0.0	0.0
436	112.0	0.0	0.0	113.0	0.0	0.0	87.4	1068.0	674.5	368.3	0.0	0.0	229.0	0.0	0.0
452	114.4	0.0	0.0	114.8	0.0	0.0	88.6	1067.6	673.7	359.1	0.0	0.0	223.1	0.0	0.0
467	115.8	0.0	0.0	115.4	0.0	0.0	89.2	1067.3	673.4	347.9	0.0	0.0	222.9	0.0	0.0
483	118.2	0.0	0.0	118.0	0.0	0.0	90.4	1066.8	672.2	332.2	0.0	0.0	210.9	0.0	0.0
498	120.1	0.0	0.0	119.3	0.0	0.0	91.6	1066.3	671.6	323.4	0.0	0.0	209.6	0.0	0.0
514	120.8	0.0	0.0	119.1	0.0	0.0	92.8	1066.2	671.7	328.7	0.0	0.0	220.5	0.0	0.0
529	130.8	129.2	126.4	118.1	120.1	120.1	93.3	1064.0	671.5	244.4	255.3	276.9	233.6	215.8	215.8
545	121.4	117.5	121.4	118.0	121.5	121.5	93.3	1065.8	671.5	326.7	379.7	327.0	234.0	205.3	205.3
560	120.8	110.6	121.7	119.1	122.2	122.2	93.5	1066.1	670.6	335.2	535.2	324.9	225.4	200.8	200.8
576	124.4	120.6	124.9	118.2	120.0	120.0	93.6	1065.4	671.1	297.7	339.3	292.7	234.3	218.6	218.6
591	124.9	123.1	122.2	118.4	120.4	120.4	93.7	1065.6	671.2	293.9	311.9	321.7	233.9	216.3	216.3
607	133.5	134.9	130.0	119.1	121.0	121.0	93.8	1064.2	670.6	230.5	222.9	253.1	228.5	212.3	212.3
622	128.0	121.1	120.4	119.0	120.0	120.0	93.9	1066.5	670.3	269.6	337.8	346.7	229.8	221.2	221.2
638	127.3	117.1	122.0	118.5	122.2	122.2	94.1	1066.1	671.3	275.6	397.9	328.2	235.9	205.2	205.2

5	15.43	131.4	123.2	124.4	119.0	125.2	125.2	94.2	1065.6	671.1	246.5	315.8	303.2	232.3	186.0	186.0
6	15.59	130.1	124.5	124.5	118.8	150.0	150.0	94.3	1065.4	670.8	255.7	303.3	303.3	235.3	103.6	103.6
7	16.05	124.2	0.0	0.0	120.5	0.0	0.0	94.7	1066.1	672.4	310.5	0.0	0.0	223.6	0.0	0.0
8	20.74	125.4	0.0	0.0	123.5	0.0	0.0	98.3	1065.2	669.7	335.8	0.0	0.0	227.0	0.0	0.0
9	23.09	126.2	0.0	0.0	125.2	0.0	0.0	100.1	1065.0	668.9	347.9	0.0	0.0	227.2	0.0	0.0
10	24.65	128.1	0.0	0.0	127.0	0.0	0.0	101.3	1064.6	668.1	338.2	0.0	0.0	221.3	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A=295.32 NU(S)A=235.06 NU(AV)A=283.27 ST(AV)A=0.00760 ST(AV)/ST(4S)=2.36 F/F(4S)=18.42
 (ST/ST(4S))/(F/F(4S))=0.128 (F/F(4S))/(ST/ST(4S))**3.0=1.40 (ST/ST(4S))/(F/F(4S))**(1/3)=0.89
 NU(R)A/NU(4S)=2.48 NU(S)A/NU(4S)=1.97 e+(4R)= 999.28 R(4R)= 3.12 H(4R)=27.19

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 29.94

RUN NUMBER=167HR10-90/20 E/D=0.078 F/E=20.0 ALPHA=90 HYD DIA= 1.600 IN PR=0.71 MDOF=0.0293 LBM/SEC
 RE= 11224. GGE(R)= 341.5 BTU/HR-SS FT GGE(S)= 202.4 INLET TEMP= 74.2 F TATM= 69.7 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	
1	0.12	93.4	0.0	87.4	85.9	0.0	150.0	74.3	336.3	195.9	156.6	0.0	228.5	150.4	0.0	
2	0.27	93.2	0.0	88.8	87.2	0.0	117.8	74.5	336.3	195.3	159.6	0.0	208.7	136.5	0.0	
3	0.43	91.9	0.0	92.9	88.5	0.0	118.0	74.7	336.6	194.7	173.3	0.0	163.8	124.9	0.0	
4	0.59	95.1	0.0	94.4	90.3	0.0	115.8	74.8	335.9	193.9	147.0	0.0	152.3	111.2	0.0	
5	0.74	98.0	0.0	97.7	91.9	0.0	116.8	75.0	335.3	193.2	129.3	0.0	131.0	101.3	0.0	
6	0.90	101.0	0.0	101.3	93.2	0.0	115.5	75.1	334.6	192.6	114.8	0.0	113.5	94.6	0.0	
7	1.05	103.1	0.0	104.5	93.8	0.0	116.9	75.3	334.2	192.3	106.7	0.0	101.5	92.2	0.0	
8	1.21	106.9	0.0	110.8	94.2	0.0	109.1	75.5	333.3	192.1	94.1	0.0	83.7	90.5	0.0	
9	1.37	111.4	0.0	116.1	94.9	0.0	123.0	75.6	333.3	191.8	82.4	0.0	72.8	88.3	0.0	
10	1.52	108.3	0.0	107.0	95.6	0.0	150.0	75.8	332.0	191.5	90.8	0.0	94.6	85.7	0.0	
11	1.68	108.6	0.0	0.0	95.5	0.0	0.0	76.0	332.9	191.5	90.4	0.0	0.0	86.9	0.0	
12	1.84	110.6	0.0	0.0	97.0	0.0	0.0	76.1	332.5	190.8	85.4	0.0	0.0	81.0	0.0	
13	1.99	108.0	0.0	0.0	98.2	0.0	0.0	76.3	333.1	190.3	93.0	0.0	0.0	76.9	0.0	
14	2.15	107.5	0.0	0.0	99.8	0.0	0.0	76.5	333.2	189.5	95.0	0.0	0.0	71.9	0.0	
15	2.30	107.7	0.0	0.0	100.5	0.0	0.0	76.6	333.1	189.2	94.9	0.0	0.0	70.1	0.0	
16	2.46	106.7	0.0	0.0	100.8	0.0	0.0	76.8	332.9	189.1	92.3	0.0	0.0	69.7	0.0	
17	2.62	110.3	0.0	0.0	101.2	0.0	0.0	77.0	332.6	189.3	88.2	0.0	0.0	69.0	0.0	
18	2.77	111.9	0.0	0.0	101.5	0.0	0.0	77.1	332.2	188.8	84.5	0.0	0.0	68.5	0.0	
19	2.93	113.6	0.0	0.0	101.8	0.0	0.0	77.3	331.8	188.6	80.8	0.0	0.0	68.0	0.0	
20	3.09	107.9	0.0	0.0	102.0	0.0	0.0	77.5	333.1	188.5	96.7	0.0	0.0	67.9	0.0	
21	3.24	109.1	0.0	0.0	103.0	0.0	0.0	77.6	332.8	188.1	93.4	0.0	0.0	65.5	0.0	
22	3.40	106.7	0.0	0.0	103.4	0.0	0.0	77.8	333.4	187.9	101.8	0.0	0.0	64.8	0.0	
23	3.55	105.2	0.0	0.0	104.2	0.0	0.0	77.9	333.7	187.5	108.1	0.0	0.0	63.1	0.0	
24	3.71	106.1	0.0	0.0	104.5	0.0	0.0	78.1	333.5	187.4	105.2	0.0	0.0	62.7	0.0	
25	3.87	108.3	0.0	0.0	104.0	0.0	0.0	78.3	333.0	187.6	97.9	0.0	0.0	64.4	0.0	
26	4.02	110.5	0.0	0.0	103.3	0.0	0.0	78.4	332.5	187.9	91.5	0.0	0.0	66.7	0.0	
27	4.18	112.6	0.0	0.0	103.7	0.0	0.0	78.6	332.1	187.7	86.2	0.0	0.0	66.0	0.0	
28	4.34	114.8	0.0	0.0	104.1	0.0	0.0	78.8	331.6	187.6	81.2	0.0	0.0	65.3	0.0	
29	4.49	117.3	0.0	0.0	103.5	0.0	0.0	78.9	331.0	187.8	76.1	0.0	0.0	67.4	0.0	
30	4.65	111.0	0.0	0.0	99.7	0.0	0.0	79.1	332.4	189.6	91.8	0.0	0.0	81.1	0.0	
31	4.80	114.6	0.0	0.0	103.6	0.0	0.0	79.3	331.6	187.8	82.7	0.0	0.0	68.0	0.0	
32	4.96	109.1	0.0	0.0	105.0	0.0	0.0	79.4	332.8	187.1	98.8	0.0	0.0	64.5	0.0	
33	5.12	107.5	0.0	0.0	105.3	0.0	0.0	79.6	333.2	187.0	105.1	0.0	0.0	64.1	0.0	
34	5.27	109.1	0.0	0.0	106.1	0.0	0.0	79.8	333.1	186.6	103.4	0.0	0.0	62.4	0.0	
35	5.43	110.3	0.0	0.0	105.2	0.0	0.0	79.9	332.6	187.1	96.4	0.0	0.0	65.1	0.0	
36	5.59	112.4	0.0	0.0	104.6	0.0	0.0	80.1	332.1	187.3	90.4	0.0	0.0	67.2	0.0	
37	5.74	112.8	0.0	0.0	104.6	0.0	0.0	80.2	331.8	187.3	87.0	0.0	0.0	67.7	0.0	
38	5.90	115.3	0.0	0.0	104.5	0.0	0.0	80.4	331.5	187.4	83.6	0.0	0.0	68.4	0.0	
39	6.05	119.0	0.0	0.0	104.5	0.0	0.0	80.6	330.7	187.4	75.7	0.0	0.0	68.9	0.0	
40	6.21	113.3	0.0	0.0	104.6	0.0	0.0	80.7	331.9	187.3	89.6	0.0	0.0	69.0	0.0	
41	6.38	108.3	0.0	0.0	106.2	0.0	0.0	81.2	333.0	186.6	108.1	0.0	0.0	65.6	0.0	
42	6.54	109.9	0.0	0.0	108.6	0.0	0.0	82.9	332.7	185.5	107.8	0.0	0.0	63.2	0.0	
43	9.02	119.6	0.0	0.0	110.3	0.0	0.0	83.7	330.5	184.7	80.5	0.0	0.0	60.7	0.0	
44	10.59	120.2	0.0	0.0	111.1	0.0	0.0	85.3	330.4	184.3	82.7	0.0	0.0	62.5	0.0	
45	12.15	122.5	0.0	0.0	112.5	0.0	0.0	87.0	329.9	183.7	80.8	0.0	0.0	62.7	0.0	
46	13.71	120.5	0.0	0.0	114.0	0.0	0.0	88.6	330.3	183.0	90.0	0.0	0.0	62.6	0.0	
47	14.30	123.8	127.5	124.3	113.4	150.0	150.0	89.3	329.6	182.5	82.7	74.7	81.6	65.7	26.1	26.6
48	14.34	119.0	119.4	120.4	114.5	117.6	117.6	89.3	330.5	182.0	96.6	95.2	92.1	62.5	55.8	55.8
49	14.49	117.8	116.8	118.8	115.7	118.0	118.0	89.5	330.8	181.2	101.3	104.9	97.7	59.8	55.0	55.0
50	14.65	119.7	119.3	118.9	115.0	115.8	115.8	89.6	330.3	181.0	95.3	96.4	97.8	59.4	59.9	59.9
51	14.80	121.5	120.7	121.3	115.8	116.6	116.6	89.8	330.0	181.2	90.2	92.5	90.7	60.3	58.1	58.1
52	14.96	124.0	122.0	122.4	115.0	115.5	115.5	90.0	329.5	181.4	83.7	89.0	87.9	62.6	61.5	61.5
53	15.12	126.4	122.5	123.1	115.1	116.9	116.9	90.1	329.8	181.2	78.7	88.2	86.6	62.8	58.6	58.6
54	15.27	127.7	126.6	126.7	114.1	109.1	109.1	90.3	328.0	182.2	75.8	78.2	78.0	66.3	83.8	83.8
55	15.43	128.9	127.4	126.8	114.2	123.0	123.0	90.5	328.3	181.7	73.9	76.9	78.1	66.1	48.3	48.3
56	15.59	124.7	123.9	126.9	112.9	150.0	150.0	90.6	329.3	182.3	83.5	85.6	78.5	70.9	26.6	26.6
57	16.05	119.7	0.0	0.0	116.2	0.0	0.0	91.1	330.8	181.7	100.1	0.0	0.0	62.6	0.0	0.0
58	20.74	124.6	0.0	0.0	120.0	0.0	0.0	96.0	329.4	180.2	98.9	0.0	0.0	64.5	0.0	0.0
59	23.09	134.4	0.0	0.0	123.0	0.0	0.0	98.5	327.3	178.9	77.9	0.0	0.0	62.4	0.0	0.0
60	24.65	137.1	0.0	0.0	125.0	0.0	0.0	100.2	326.7	177.9	75.3	0.0	0.0	61.0	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A= 88.72 NU(S)A= 65.08 NU(AV)A= 83.99 ST(AV)A=0.01051 ST(AV)/ST(4S)=2.40 F/F(4S)= 8.93
 (ST/ST(4S))/(F/F(4S))=0.269 (F/F(4S))/(ST/ST(4S))*3.0=0.65 (ST/ST(4S))/(F/F(4S))*(1/3)=1.16
 NU(R)A/NU(4S)=2.55 NU(S)A/NU(4S)=1.87 e+(4R)= 179.38 R(4R)= 3.90 H(4R)=16.09

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 17.53

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OF POOR QUALITY**

NUMBER=18BHR30-90/20 E/D=0.078 P/E=20.0 ALPHA=90 HYD DIA= 1.600 IN PR= 71 MDDT=0.0848 LBM/SEC
32515. QGE(R)= 754.8 BTU/HR-SQ FT QGE(S)= 470.2 INLET TEMP= 75.8 F TATM= 70.0 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	(BULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.12	93.9	0.0	86.1	86.7	0.0	150.0	75.9	749.5	462.6	369.0	0.0	651.2	379.5	0.0	55.3
0.27	92.5	0.0	87.2	88.5	0.0	118.9	76.0	749.8	461.7	403.5	0.0	595.0	328.2	0.0	95.4
0.43	91.8	0.0	91.3	90.3	0.0	119.8	76.2	750.0	460.9	425.0	0.0	439.1	288.9	0.0	93.6
0.59	95.9	0.0	93.2	92.2	0.0	117.4	75.3	749.1	460.0	338.5	0.0	392.6	256.3	0.0	99.1
0.74	98.8	0.0	97.5	94.3	0.0	118.2	76.4	748.5	459.1	296.3	0.0	314.6	227.6	0.0	97.3
0.90	101.0	0.0	100.6	95.9	0.0	117.1	76.6	748.0	458.3	271.1	0.0	275.6	209.9	0.0	100.1
1.05	101.5	0.0	101.8	95.2	0.0	115.3	75.7	747.9	458.6	267.0	0.0	263.8	219.5	0.0	104.6
1.21	105.1	0.0	108.9	94.9	0.0	105.5	75.8	747.1	458.8	233.9	0.0	206.2	224.8	0.0	141.6
1.37	108.6	0.0	114.4	96.2	0.0	123.5	77.0	746.3	458.2	208.8	0.0	176.4	210.9	0.0	87.1
1.52	106.1	0.0	107.6	96.7	0.0	150.0	77.1	746.9	458.0	227.9	0.0	216.6	206.8	0.0	55.6
1.68	108.7	0.0	0.0	96.8	0.0	0.0	77.3	746.3	457.9	209.8	0.0	0.0	207.1	0.0	0.0
1.84	108.7	0.0	0.0	99.6	0.0	0.0	77.4	746.3	456.6	210.6	0.0	0.0	181.7	0.0	0.0
1.99	107.0	0.0	0.0	101.0	0.0	0.0	77.5	746.7	456.0	223.8	0.0	0.0	171.6	0.0	0.0
2.15	107.3	0.0	0.0	101.5	0.0	0.0	77.7	746.6	455.8	222.5	0.0	0.0	168.9	0.0	0.0
2.30	108.3	0.0	0.0	102.5	0.0	0.0	77.8	746.4	455.3	216.1	0.0	0.0	162.8	0.0	0.0
2.46	109.7	0.0	0.0	102.7	0.0	0.0	77.9	746.1	455.2	207.3	0.0	0.0	162.3	0.0	0.0
2.62	111.7	0.0	0.0	103.1	0.0	0.0	78.1	745.6	455.5	195.7	0.0	0.0	160.6	0.0	0.0
2.77	114.0	0.0	0.0	102.7	0.0	0.0	78.2	745.1	455.2	183.7	0.0	0.0	164.0	0.0	0.0
2.93	115.7	0.0	0.0	102.8	0.0	0.0	78.3	744.7	455.2	175.9	0.0	0.0	164.1	0.0	0.0
3.09	109.9	0.0	0.0	103.1	0.0	0.0	78.5	746.0	456.0	209.4	0.0	0.0	163.3	0.0	0.0
3.24	112.6	0.0	0.0	104.0	0.0	0.0	78.6	745.4	454.6	193.4	0.0	0.0	157.9	0.0	0.0
3.40	107.0	0.0	0.0	103.9	0.0	0.0	78.7	746.7	454.6	233.0	0.0	0.0	159.3	0.0	0.0
3.55	105.8	0.0	0.0	106.0	0.0	0.0	78.9	746.9	453.7	244.5	0.0	0.0	147.4	0.0	0.0
3.71	107.1	0.0	0.0	104.5	0.0	0.0	79.0	746.6	453.7	234.3	0.0	0.0	156.9	0.0	0.0
3.87	110.2	0.0	0.0	105.0	0.0	0.0	79.1	746.0	453.7	211.7	0.0	0.0	154.6	0.0	0.0
4.02	112.4	0.0	0.0	104.5	0.0	0.0	79.3	745.5	454.4	198.3	0.0	0.0	158.7	0.0	0.0
4.18	115.0	0.0	0.0	105.2	0.0	0.0	79.4	744.9	454.0	184.4	0.0	0.0	155.1	0.0	0.0
4.34	117.6	0.0	0.0	105.9	0.0	0.0	79.5	744.3	453.7	172.3	0.0	0.0	151.6	0.0	0.0
4.49	121.0	0.0	0.0	105.3	0.0	0.0	79.7	743.6	454.0	158.5	0.0	0.0	156.0	0.0	0.0
4.65	112.4	0.0	0.0	105.0	0.0	0.0	79.8	745.5	453.7	201.4	0.0	0.0	152.5	0.0	0.0
4.80	119.3	0.0	0.0	105.5	0.0	0.0	79.9	743.9	453.5	166.4	0.0	0.0	150.3	0.0	0.0
4.96	109.2	0.0	0.0	101.2	0.0	0.0	80.1	746.2	455.9	225.5	0.0	0.0	190.0	0.0	0.0
5.12	108.0	0.0	0.0	108.0	0.0	0.0	80.2	746.4	452.8	236.4	0.0	0.0	143.4	0.0	0.0
5.27	108.5	0.0	0.0	107.5	0.0	0.0	80.4	746.3	453.0	230.7	0.0	0.0	146.8	0.0	0.0
5.43	111.9	0.0	0.0	107.2	0.0	0.0	80.5	745.6	453.1	208.7	0.0	0.0	149.2	0.0	0.0
5.59	114.4	0.0	0.0	106.8	0.0	0.0	80.6	745.0	453.3	193.9	0.0	0.0	152.2	0.0	0.0
5.74	116.0	0.0	0.0	107.2	0.0	0.0	80.8	744.7	453.1	185.7	0.0	0.0	150.6	0.0	0.0
5.90	117.9	0.0	0.0	107.3	0.0	0.0	80.9	744.3	453.1	176.7	0.0	0.0	150.8	0.0	0.0
6.05	122.4	0.0	0.0	107.5	0.0	0.0	81.0	743.3	453.0	157.8	0.0	0.0	150.3	0.0	0.0
6.21	114.0	0.0	0.0	107.5	0.0	0.0	81.2	745.1	453.0	199.3	0.0	0.0	151.1	0.0	0.0
6.38	107.5	0.0	0.0	109.4	0.0	0.0	81.6	746.5	452.1	252.7	0.0	0.0	142.6	0.0	0.0
6.54	108.7	0.0	0.0	111.3	0.0	0.0	82.9	746.3	451.2	253.5	0.0	0.0	139.2	0.0	0.0
6.70	121.7	0.0	0.0	111.1	0.0	0.0	83.6	743.4	451.3	170.7	0.0	0.0	143.5	0.0	0.0
6.86	121.1	0.0	0.0	112.8	0.0	0.0	84.9	743.6	450.6	179.5	0.0	0.0	141.2	0.0	0.0
7.02	123.8	0.0	0.0	113.4	0.0	0.0	86.3	743.0	450.3	172.5	0.0	0.0	144.7	0.0	0.0
7.18	118.6	0.0	0.0	115.0	0.0	0.0	87.6	744.1	449.5	208.9	0.0	0.0	142.8	0.0	0.0
7.34	122.5	125.6	124.3	116.8	150.0	150.0	88.1	743.2	448.7	187.9	172.3	178.5	136.0	63.0	63.0
7.50	114.6	114.9	117.8	116.9	118.9	118.9	88.2	744.7	448.2	244.8	242.0	218.3	135.5	126.7	126.7
7.66	113.2	110.2	116.8	118.4	119.8	119.8	88.3	745.1	447.1	259.9	295.5	227.1	129.0	123.3	123.3
7.82	113.6	116.8	117.3	117.6	117.4	117.4	88.4	745.0	447.4	257.1	228.1	224.1	133.2	134.1	134.1
7.98	114.5	120.6	120.0	117.5	118.2	118.2	88.6	744.9	447.7	249.4	201.9	205.7	134.4	131.2	131.2
8.14	117.2	121.9	121.6	116.7	117.1	117.1	88.7	744.7	447.7	226.8	194.7	196.5	138.9	136.9	136.9
8.30	118.0	121.6	122.8	117.1	115.5	115.5	88.9	745.6	447.3	221.7	197.5	190.5	137.4	145.6	145.6
8.46	122.0	125.2	126.6	116.3	105.5	105.5	89.0	743.4	448.4	195.3	178.0	171.4	142.4	235.5	235.5
8.62	125.9	127.1	127.8	116.4	123.5	123.5	89.1	744.0	448.1	175.3	169.8	166.8	142.4	113.0	113.0
8.78	126.8	123.1	123.4	115.2	150.0	150.0	89.3	743.7	448.6	171.6	190.5	188.8	149.9	64.0	64.0
8.94	118.6	0.0	0.0	117.9	0.0	0.0	89.7	744.9	449.3	222.9	0.0	0.0	137.8	0.0	0.0
9.10	120.8	0.0	0.0	121.0	0.0	0.0	93.7	743.6	446.8	236.2	0.0	0.0	140.9	0.0	0.0
9.26	133.5	0.0	0.0	123.5	0.0	0.0	95.7	740.8	445.6	168.3	0.0	0.0	137.7	0.0	0.0
9.42	134.9	0.0	0.0	125.0	0.0	0.0	97.1	740.5	444.9	167.6	0.0	0.0	136.4	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4. 8 TO 6. 2 AND FROM X/D=14. 2 TO15. 6) :
 NU(R)A=208. 55 NU(S)A=145. 69 NU(AV)A=195. 98 ST(AV)A=0. 00847 ST(AV)/ST(4S)=2. 39 F/F(4S)=11. 69
 (ST/ST(4S))/(F/F(4S))=0. 205 (F/F(4S))/(ST/ST(4S))**3. 0=0. 85 (ST/ST(4S))/(F/F(4S))**(1/3)=1. 05
 NU(R)A/NU(4S)=2. 56 NU(S)A/NU(4S)=1. 79 e+(4R)= 521. 42 R(4R)= 3. 89 H(4R)=20. 25

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 21. 87

RUN NUMBER=139HR50-90/20 E/D=0.078 P/E=20.0 ALPHA=90 HYD DIA= 1.600 IN PR=71 MDOT=0.1580 LBM/SEC
 RE= 60655 GGE(R)=1137.4 BTU/HR-SQ FT GGE(S)= 822.3 INLET TEMP= 76.6 F TATM= 70.0 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.12	92.9	0.0	85.2	89.0	0.0	150.0	76.6	1132.4	813.6	616.2	0.0	1170.1	582.3	0.0	0.0
2	0.27	92.0	0.0	86.7	91.1	0.0	119.6	76.7	1132.6	812.6	657.1	0.0	1007.1	501.0	0.0	0.0
3	0.43	90.9	0.0	90.0	93.2	0.0	121.3	76.9	1132.8	811.6	713.9	0.0	762.8	439.5	0.0	0.0
4	0.59	94.3	0.0	91.7	95.7	0.0	118.0	77.0	1132.1	810.5	578.0	0.0	680.1	382.9	0.0	0.0
5	0.74	97.3	0.0	96.1	97.4	0.0	117.9	77.1	1131.4	809.7	495.1	0.0	526.3	352.6	0.0	0.0
6	0.90	99.3	0.0	99.0	98.5	0.0	116.6	77.2	1131.0	809.2	452.6	0.0	458.8	336.0	0.0	0.0
7	1.05	99.3	0.0	99.6	95.2	0.0	114.5	77.3	1131.0	810.7	454.8	0.0	448.7	400.8	0.0	0.0
8	1.21	102.6	0.0	106.7	95.4	0.0	104.6	77.4	1130.2	810.6	396.9	0.0	341.3	398.7	0.0	0.0
9	1.37	105.6	0.0	112.0	97.8	0.0	124.0	77.5	1129.6	809.5	355.8	0.0	289.7	353.2	0.0	0.0
10	1.52	104.4	0.0	106.7	98.1	0.0	150.0	77.7	1129.8	809.4	373.3	0.0	343.7	349.8	0.0	0.0
11	1.68	107.3	0.0	0.0	98.0	0.0	0.0	77.8	1129.2	809.4	337.8	0.0	0.0	353.5	0.0	0.0
12	1.84	107.4	0.0	0.0	101.4	0.0	0.0	77.9	1129.2	807.9	337.9	0.0	0.0	303.4	0.0	0.0
13	1.99	105.5	0.0	0.0	102.2	0.0	0.0	78.0	1129.6	807.5	362.7	0.0	0.0	294.6	0.0	0.0
14	2.15	105.6	0.0	0.0	103.0	0.0	0.0	78.1	1129.6	807.1	362.8	0.0	0.0	286.3	0.0	0.0
15	2.30	106.5	0.0	0.0	104.0	0.0	0.0	78.2	1129.4	806.7	352.6	0.0	0.0	276.3	0.0	0.0
16	2.46	107.9	0.0	0.0	105.2	0.0	0.0	78.3	1129.1	806.1	337.1	0.0	0.0	264.9	0.0	0.0
17	2.62	110.1	0.0	0.0	107.0	0.0	0.0	78.5	1128.6	806.2	314.7	0.0	0.0	249.5	0.0	0.0
18	2.77	112.6	0.0	0.0	106.6	0.0	0.0	78.6	1128.0	805.7	292.4	0.0	0.0	253.9	0.0	0.0
19	2.93	114.4	0.0	0.0	107.2	0.0	0.0	78.7	1127.6	805.7	278.5	0.0	0.0	249.0	0.0	0.0
20	3.09	109.8	0.0	0.0	105.4	0.0	0.0	78.8	1128.7	806.9	321.0	0.0	0.0	267.7	0.0	0.0
21	3.24	113.1	0.0	0.0	103.9	0.0	0.0	78.9	1127.9	805.7	290.9	0.0	0.0	283.9	0.0	0.0
22	3.40	106.1	0.0	0.0	104.0	0.0	0.0	79.0	1129.5	805.7	367.7	0.0	0.0	284.1	0.0	0.0
23	3.55	105.0	0.0	0.0	104.9	0.0	0.0	79.1	1129.7	805.6	385.0	0.0	0.0	275.7	0.0	0.0
24	3.71	106.2	0.0	0.0	104.5	0.0	0.0	79.2	1129.4	805.2	369.3	0.0	0.0	281.4	0.0	0.0
25	3.87	109.3	0.0	0.0	105.4	0.0	0.0	79.4	1128.8	805.5	332.2	0.0	0.0	272.9	0.0	0.0
26	4.02	111.5	0.0	0.0	106.5	0.0	0.0	79.5	1128.3	805.5	310.4	0.0	0.0	262.6	0.0	0.0
27	4.18	114.0	0.0	0.0	107.5	0.0	0.0	79.6	1127.7	805.1	288.7	0.0	0.0	254.1	0.0	0.0
28	4.34	116.5	0.0	0.0	108.6	0.0	0.0	79.7	1127.2	804.5	269.8	0.0	0.0	245.2	0.0	0.0
29	4.49	120.1	0.0	0.0	107.4	0.0	0.0	79.8	1126.4	805.1	246.2	0.0	0.0	257.0	0.0	0.0
30	4.65	112.2	0.0	0.0	109.0	0.0	0.0	79.9	1128.1	804.8	307.8	0.0	0.0	252.4	0.0	0.0
31	4.80	121.1	0.0	0.0	109.2	0.0	0.0	80.0	1126.2	804.3	241.4	0.0	0.0	242.8	0.0	0.0
32	4.96	108.0	0.0	0.0	99.4	0.0	0.0	80.2	1129.0	808.8	356.9	0.0	0.0	369.9	0.0	0.0
33	5.12	106.8	0.0	0.0	109.5	0.0	0.0	80.3	1129.3	804.1	374.6	0.0	0.0	242.1	0.0	0.0
34	5.27	107.2	0.0	0.0	108.7	0.0	0.0	80.4	1129.2	804.5	370.5	0.0	0.0	249.9	0.0	0.0
35	5.43	110.6	0.0	0.0	108.5	0.0	0.0	80.5	1128.5	804.6	329.7	0.0	0.0	252.7	0.0	0.0
36	5.59	113.2	0.0	0.0	109.2	0.0	0.0	80.6	1127.9	804.3	304.4	0.0	0.0	247.4	0.0	0.0
37	5.74	115.0	0.0	0.0	109.4	0.0	0.0	80.7	1127.5	804.2	289.2	0.0	0.0	246.6	0.0	0.0
38	5.90	117.1	0.0	0.0	109.7	0.0	0.0	80.8	1127.0	804.0	273.2	0.0	0.0	244.9	0.0	0.0
39	6.05	121.2	0.0	0.0	110.1	0.0	0.0	81.0	1126.1	803.9	245.9	0.0	0.0	242.4	0.0	0.0
40	6.21	113.4	0.0	0.0	110.8	0.0	0.0	81.1	1127.9	803.5	306.5	0.0	0.0	237.5	0.0	0.0
41	6.38	109.7	0.0	0.0	111.2	0.0	0.0	81.4	1129.6	803.4	408.4	0.0	0.0	236.8	0.0	0.0
42	6.54	106.7	0.0	0.0	112.8	0.0	0.0	82.6	1129.3	802.6	409.9	0.0	0.0	232.6	0.0	0.0
43	6.70	119.9	0.0	0.0	110.8	0.0	0.0	83.1	1126.4	803.5	268.2	0.0	0.0	254.2	0.0	0.0
44	10.59	119.4	0.0	0.0	114.8	0.0	0.0	84.3	1126.5	801.7	280.2	0.0	0.0	229.4	0.0	0.0
45	12.15	122.1	0.0	0.0	115.4	0.0	0.0	85.4	1125.9	801.4	267.6	0.0	0.0	233.0	0.0	0.0
46	13.71	115.6	0.0	0.0	116.4	0.0	0.0	86.5	1127.4	801.0	337.7	0.0	0.0	233.5	0.0	0.0
47	14.30	118.2	122.9	121.8	115.5	150.0	150.0	87.0	1126.8	800.5	313.9	273.6	281.5	244.0	110.5	110.5
48	14.34	110.2	112.7	113.3	116.5	119.6	119.6	87.0	1128.3	800.1	423.5	381.8	346.8	235.8	213.5	213.5
49	14.49	108.9	107.3	114.0	117.8	121.3	121.3	87.1	1128.7	799.0	449.6	486.2	365.0	226.6	203.3	203.3
50	14.65	109.0	113.9	113.3	116.7	118.0	118.0	87.2	1128.8	799.6	450.9	368.0	376.4	236.2	225.9	225.9
51	14.80	111.5	117.5	114.9	117.4	117.9	117.9	87.3	1128.6	799.6	406.0	325.3	356.0	231.0	227.5	227.5
52	14.96	113.6	118.3	118.7	116.8	116.6	116.6	87.4	1128.8	799.5	374.8	318.1	314.0	237.0	238.4	238.4
53	15.12	116.7	112.1	120.6	117.6	114.5	114.5	87.6	1129.4	798.7	337.4	400.0	297.1	230.9	257.7	257.7
54	15.27	118.9	108.4	123.5	116.3	104.6	104.6	87.7	1128.2	800.2	314.3	473.0	273.7	242.9	410.9	410.9

55	15.43	122.9	117.6	126.2	116.3	124.0	124.0	87.8	1127.8	800.3	279.0	328.7	255.1	243.9	192.0	192.0
56	15.59	122.2	120.7	121.7	114.1	150.0	150.0	87.9	1127.4	800.9	285.9	298.6	289.8	266.0	112.0	112.0
57	16.05	115.7	0.0	0.0	118.0	0.0	0.0	88.2	1128.2	801.8	357.2	0.0	0.0	234.1	0.0	0.0
58	20.74	117.1	0.0	0.0	122.5	0.0	0.0	91.7	1127.0	798.2	382.5	0.0	0.0	223.4	0.0	0.0
59	23.09	130.0	0.0	0.0	124.0	0.0	0.0	93.4	1124.2	797.5	264.2	0.0	0.0	224.1	0.0	0.0
60	24.65	130.7	0.0	0.0	126.0	0.0	0.0	94.5	1124.1	796.5	266.9	0.0	0.0	217.3	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A=336.37 NU(S)A=248.52 NU(AV)A=318.80 ST(AV)A=0.00739 ST(AV)/ST(4S)=2.37 F/F(4S)=13.56
 (ST/ST(4S))/(F/F(4S))=0.174 (F/F(4S))/(ST/ST(4S))*3.0=1.02 (ST/ST(4S))/(F/F(4S))*(1/3)=0.99
 NU(R)A/NU(4S)=2.51 NU(S)A/NU(4S)=1.85 e+(4R)= 974.34 R(4R)= 3.89 H(4R)=23.41

BY USING ROUGHSIDE RESULTS ONLY : H(RB)= 25.47

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER=146HR10-60/10 E/D=0.078 P/E=10.0 ALPHA=60 HYD DIA= 1.600 IN PR= 71 MDOT=0.0273 LBM/SEC
10425. GGE(R)= 417.8 BTU/HR-SQ FT GGE(S)= 80.6 INLET TEMP= 77.3 F TATM= 72.0 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.12	94.9	0.0	93.3	85.2	0.0	125.9	77.4	412.8	74.5	208.7	0.0	229.7	84.6	0.0	13.6
0.27	101.2	0.0	98.3	85.8	0.0	126.2	77.6	411.4	74.2	153.8	0.0	175.3	79.7	0.0	13.5
0.43	99.0	0.0	101.1	86.3	0.0	126.3	77.7	411.9	74.0	171.0	0.0	155.6	76.2	0.0	13.5
0.59	103.2	0.0	97.8	87.3	0.0	125.1	77.9	410.9	73.5	143.3	0.0	182.2	68.9	0.0	13.8
0.74	101.5	0.0	105.3	88.4	0.0	126.0	78.0	411.3	73.0	154.7	0.0	128.5	62.2	0.0	13.4
0.90	106.6	0.0	111.5	89.5	0.0	126.0	78.2	410.2	72.5	127.4	0.0	108.7	56.6	0.0	13.4
1.05	107.4	0.0	112.4	90.9	0.0	126.9	78.3	410.0	71.9	124.5	0.0	106.2	50.5	0.0	13.1
1.21	107.9	0.0	117.5	91.9	0.0	125.2	78.5	409.9	71.4	123.0	0.0	92.7	47.0	0.0	13.5
1.37	110.3	0.0	106.5	92.8	0.0	134.5	78.6	409.4	71.0	114.1	0.0	129.6	44.2	0.0	11.2
1.52	109.7	0.0	118.4	94.1	0.0	150.0	78.8	409.5	70.4	116.9	0.0	91.2	40.6	0.0	8.7
1.68	109.9	0.0	0.0	94.5	0.0	0.0	79.0	409.5	70.2	116.6	0.0	0.0	39.8	0.0	0.0
1.84	115.0	0.0	0.0	96.1	0.0	0.0	79.1	408.4	69.5	100.3	0.0	0.0	36.0	0.0	0.0
1.99	114.5	0.0	0.0	96.9	0.0	0.0	79.3	408.5	69.1	102.1	0.0	0.0	34.5	0.0	0.0
2.15	116.5	0.0	0.0	97.8	0.0	0.0	79.4	408.0	68.7	96.9	0.0	0.0	32.9	0.0	0.0
2.30	112.4	0.0	0.0	98.6	0.0	0.0	79.6	408.9	68.3	109.7	0.0	0.0	31.6	0.0	0.0
2.46	114.6	0.0	0.0	99.8	0.0	0.0	79.7	408.4	67.8	103.1	0.0	0.0	29.7	0.0	0.0
2.62	120.4	0.0	0.0	101.3	0.0	0.0	79.9	407.2	67.5	88.4	0.0	0.0	27.8	0.0	0.0
2.77	116.9	0.0	0.0	101.0	0.0	0.0	80.0	407.9	67.2	97.4	0.0	0.0	28.2	0.0	0.0
2.93	117.3	0.0	0.0	102.0	0.0	0.0	80.2	407.8	66.8	96.7	0.0	0.0	26.9	0.0	0.0
3.09	113.3	0.0	0.0	103.6	0.0	0.0	80.3	408.7	66.0	109.1	0.0	0.0	25.0	0.0	0.0
3.24	116.8	0.0	0.0	104.0	0.0	0.0	80.5	408.0	65.9	98.8	0.0	0.0	24.6	0.0	0.0
3.40	119.6	0.0	0.0	104.7	0.0	0.0	80.6	407.3	65.5	91.9	0.0	0.0	23.9	0.0	0.0
3.55	117.0	0.0	0.0	105.6	0.0	0.0	80.8	407.9	65.1	99.0	0.0	0.0	23.1	0.0	0.0
3.71	119.2	0.0	0.0	106.2	0.0	0.0	80.9	407.6	64.8	96.2	0.0	0.0	22.6	0.0	0.0
3.87	115.8	0.0	0.0	106.6	0.0	0.0	81.1	408.2	64.7	103.3	0.0	0.0	22.3	0.0	0.0
4.02	116.3	0.0	0.0	106.9	0.0	0.0	81.3	408.1	64.5	102.3	0.0	0.0	22.1	0.0	0.0
4.18	116.9	0.0	0.0	107.2	0.0	0.0	81.4	407.9	64.4	100.9	0.0	0.0	21.9	0.0	0.0
4.34	117.6	0.0	0.0	108.5	0.0	0.0	81.6	407.8	63.8	99.3	0.0	0.0	20.8	0.0	0.0
4.49	118.6	0.0	0.0	108.9	0.0	0.0	81.7	407.6	63.6	97.0	0.0	0.0	20.5	0.0	0.0
4.65	114.5	0.0	0.0	109.3	0.0	0.0	81.9	408.5	63.4	109.8	0.0	0.0	20.3	0.0	0.0
4.80	116.5	0.0	0.0	109.9	0.0	0.0	82.0	408.0	63.1	103.8	0.0	0.0	19.9	0.0	0.0
4.96	121.2	0.0	0.0	110.0	0.0	0.0	82.2	407.0	63.1	91.5	0.0	0.0	19.9	0.0	0.0
5.12	118.5	0.0	0.0	110.6	0.0	0.0	82.3	407.6	62.8	98.8	0.0	0.0	19.5	0.0	0.0
5.27	119.6	0.0	0.0	111.0	0.0	0.0	82.5	407.3	62.6	96.2	0.0	0.0	19.3	0.0	0.0
5.43	116.5	0.0	0.0	111.1	0.0	0.0	82.6	408.0	62.6	105.6	0.0	0.0	19.3	0.0	0.0
5.59	119.4	0.0	0.0	111.5	0.0	0.0	82.8	407.4	62.4	97.5	0.0	0.0	19.0	0.0	0.0
5.74	122.2	0.0	0.0	111.7	0.0	0.0	82.9	406.8	62.3	90.7	0.0	0.0	19.0	0.0	0.0
5.90	118.9	0.0	0.0	112.0	0.0	0.0	83.1	407.5	62.2	99.7	0.0	0.0	18.8	0.0	0.0
6.05	121.0	0.0	0.0	112.3	0.0	0.0	83.2	407.0	62.0	94.4	0.0	0.0	18.7	0.0	0.0
6.21	119.0	0.0	0.0	112.8	0.0	0.0	83.4	407.5	61.8	100.2	0.0	0.0	18.4	0.0	0.0
6.38	118.5	0.0	0.0	113.5	0.0	0.0	83.9	407.6	61.5	102.9	0.0	0.0	18.1	0.0	0.0
6.54	120.3	0.0	0.0	116.9	0.0	0.0	85.4	407.2	59.9	101.8	0.0	0.0	16.6	0.0	0.0
6.70	121.2	0.0	0.0	117.4	0.0	0.0	86.2	407.0	59.7	101.2	0.0	0.0	16.6	0.0	0.0
6.86	123.2	0.0	0.0	119.8	0.0	0.0	87.7	406.5	58.6	99.5	0.0	0.0	15.9	0.0	0.0
7.02	125.6	0.0	0.0	122.5	0.0	0.0	89.2	406.0	57.3	96.8	0.0	0.0	14.9	0.0	0.0
7.18	126.8	0.0	0.0	123.0	0.0	0.0	90.8	405.8	57.1	97.4	0.0	0.0	15.3	0.0	0.0
7.34	137.1	138.6	146.9	123.5	125.9	125.9	91.4	403.5	56.2	76.2	73.8	62.8	15.1	14.1	14.1
7.50	132.0	137.4	144.6	124.1	126.2	126.2	91.4	404.5	56.0	86.0	75.9	65.7	14.8	13.9	13.9
7.66	127.4	127.6	145.5	124.1	126.3	126.3	91.5	405.5	55.7	97.6	97.1	64.9	14.8	13.8	13.8
7.82	129.2	145.5	140.7	124.0	125.1	125.1	91.7	405.1	55.7	93.2	65.0	71.4	14.9	14.4	14.4
7.98	130.0	139.5	153.0	123.9	126.0	126.0	91.8	404.9	55.8	91.6	73.3	57.2	15.0	14.1	14.1
8.14	134.4	138.4	147.7	123.8	126.0	126.0	92.0	404.0	55.6	82.3	75.1	62.6	15.1	14.1	14.1
8.30	132.6	138.2	144.9	123.6	126.9	126.9	92.2	405.2	55.6	86.4	75.9	66.3	15.3	13.8	13.8
8.46	126.4	127.7	145.8	123.5	125.2	125.2	92.3	405.2	56.1	102.4	98.7	65.3	15.5	14.7	14.7
8.62	128.8	143.6	139.9	123.6	134.5	134.5	92.5	405.1	55.7	96.0	68.3	73.6	15.4	11.4	11.4
8.78	129.4	138.5	153.9	123.5	150.0	150.0	92.6	405.1	55.7	95.1	76.1	57.0	15.5	8.4	8.4
8.94	130.6	0.0	0.0	126.2	0.0	0.0	93.1	405.2	55.3	93.1	0.0	0.0	14.4	0.0	0.0
9.10	138.0	0.0	0.0	132.5	0.0	0.0	97.7	403.3	52.7	85.5	0.0	0.0	13.0	0.0	0.0
9.26	141.6	0.0	0.0	134.5	0.0	0.0	100.0	402.5	51.8	82.4	0.0	0.0	12.8	0.0	0.0
9.42	143.0	0.0	0.0	137.0	0.0	0.0	101.5	402.2	50.7	82.4	0.0	0.0	12.1	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A= 94.25 NU(S)A= 17.16 NU(AV)A= 78.83 ST(AV)A=0.01062 ST(AV)/ST(4S)=2.39 F/F(4S)=11.29
 (ST/ST(4S))/(F/F(4S))=0.212 (F/F(4S))/(ST/ST(4S))*3.0=0.83 (ST/ST(4S))/(F/F(4S))*1/3=1.07
 NU(R)A/NU(4S)=2.88 NU(S)A/NU(4S)=0.52 e+(4R)= 189.74 R(4R)= 3.31 H(4R)=18.25

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 17.44

RUN NUMBER=147H530-60/10 E/D=0.078 F/E=10.0 ALPHA=60 HYD DIA= 1.600 IN PR= .71 MDDT=0.0837 LBM/SEC
 RE= 31921. GGE(R)= 928.7 BTU/HR-SQ FT GGE(S)= 285.1 INLET TEMP= 78.5 F TATM= 72.2 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.12	92.2	0.0	92.4	88.0	0.0	126.9	78.6	924.3	278.9	600.1	0.0	591.4	262.0	0.0	0.0
2	0.27	96.2	0.0	93.0	88.1	0.0	126.5	78.8	923.4	278.8	467.0	0.0	572.0	263.4	0.0	0.0
3	0.43	95.6	0.0	96.9	88.2	0.0	126.4	78.9	923.6	278.8	488.0	0.0	463.0	264.7	0.0	0.0
4	0.59	100.4	0.0	94.8	89.7	0.0	124.6	79.1	922.5	278.1	381.1	0.0	516.8	230.5	0.0	0.0
5	0.74	100.6	0.0	104.6	92.2	0.0	125.4	79.2	922.5	278.9	380.1	0.0	320.2	187.9	0.0	0.0
6	0.90	104.3	0.0	106.9	93.7	0.0	125.8	79.4	921.7	278.2	325.7	0.0	294.9	169.8	0.0	0.0
7	1.05	102.8	0.0	107.4	94.3	0.0	124.8	79.5	922.0	278.0	348.8	0.0	291.2	164.4	0.0	0.0
8	1.21	104.1	0.0	115.2	94.6	0.0	125.2	79.7	921.7	275.8	332.2	0.0	288.4	162.6	0.0	0.0
9	1.37	106.4	0.0	105.2	95.9	0.0	133.5	79.8	921.2	275.2	305.1	0.0	319.5	150.7	0.0	0.0
10	1.52	106.9	0.0	120.1	97.1	0.0	150.0	80.0	921.1	274.7	301.0	0.0	202.0	141.1	0.0	0.0
11	1.68	108.9	0.0	0.0	96.9	0.0	0.0	80.1	920.6	274.8	281.5	0.0	0.0	144.1	0.0	0.0
12	1.84	112.0	0.0	0.0	98.7	0.0	0.0	80.3	920.0	273.9	255.1	0.0	0.0	130.8	0.0	0.0
13	1.99	112.3	0.0	0.0	99.6	0.0	0.0	80.4	919.9	273.5	253.8	0.0	0.0	125.4	0.0	0.0
14	2.15	115.3	0.0	0.0	100.5	0.0	0.0	80.6	919.2	273.1	232.7	0.0	0.0	119.9	0.0	0.0
15	2.30	111.5	0.0	0.0	101.3	0.0	0.0	80.7	920.1	272.7	262.8	0.0	0.0	116.5	0.0	0.0
16	2.46	116.5	0.0	0.0	102.3	0.0	0.0	80.9	919.0	272.3	226.7	0.0	0.0	111.7	0.0	0.0
17	2.62	119.2	0.0	0.0	103.5	0.0	0.0	81.0	918.4	272.2	211.4	0.0	0.0	106.5	0.0	0.0
18	2.77	115.6	0.0	0.0	103.0	0.0	0.0	81.2	918.9	272.0	227.8	0.0	0.0	109.4	0.0	0.0
19	2.93	117.5	0.0	0.0	104.0	0.0	0.0	81.3	918.7	271.5	223.0	0.0	0.0	105.1	0.0	0.0
20	3.09	113.1	0.0	0.0	107.7	0.0	0.0	81.5	919.7	270.8	255.3	0.0	0.0	90.7	0.0	0.0
21	3.24	118.7	0.0	0.0	107.0	0.0	0.0	81.6	918.5	270.1	217.4	0.0	0.0	93.4	0.0	0.0
22	3.40	118.2	0.0	0.0	108.2	0.0	0.0	81.8	918.6	269.6	221.3	0.0	0.0	89.5	0.0	0.0
23	3.55	116.3	0.0	0.0	109.5	0.0	0.0	81.9	919.0	269.0	234.6	0.0	0.0	85.6	0.0	0.0
24	3.71	118.1	0.0	0.0	109.3	0.0	0.0	82.1	918.6	268.4	223.7	0.0	0.0	86.4	0.0	0.0
25	3.87	115.9	0.0	0.0	109.6	0.0	0.0	82.2	917.1	268.5	239.3	0.0	0.0	86.0	0.0	0.0
26	4.02	116.8	0.0	0.0	110.8	0.0	0.0	82.4	918.9	268.4	234.0	0.0	0.0	82.8	0.0	0.0
27	4.18	116.7	0.0	0.0	111.5	0.0	0.0	82.5	918.9	268.0	235.7	0.0	0.0	81.1	0.0	0.0
28	4.34	116.9	0.0	0.0	112.5	0.0	0.0	82.7	918.9	267.6	235.3	0.0	0.0	78.6	0.0	0.0
29	4.49	113.4	0.0	0.0	113.2	0.0	0.0	82.8	918.6	267.3	226.2	0.0	0.0	77.1	0.0	0.0
30	4.65	113.0	0.0	0.0	113.2	0.0	0.0	83.0	919.7	267.3	268.3	0.0	0.0	77.5	0.0	0.0
31	4.80	118.4	0.0	0.0	114.2	0.0	0.0	83.1	919.0	266.8	241.9	0.0	0.0	75.2	0.0	0.0
32	4.96	119.6	0.0	0.0	115.0	0.0	0.0	83.3	918.3	266.4	221.3	0.0	0.0	73.5	0.0	0.0
33	5.12	116.7	0.0	0.0	115.2	0.0	0.0	83.4	918.9	266.3	241.7	0.0	0.0	73.4	0.0	0.0
34	5.27	118.1	0.0	0.0	115.5	0.0	0.0	83.6	918.6	266.2	232.8	0.0	0.0	73.0	0.0	0.0
35	5.43	113.9	0.0	0.0	115.6	0.0	0.0	83.7	919.5	266.2	266.6	0.0	0.0	73.1	0.0	0.0
36	5.59	119.6	0.0	0.0	115.1	0.0	0.0	83.9	918.3	266.4	224.8	0.0	0.0	74.6	0.0	0.0
37	5.74	119.6	0.0	0.0	114.6	0.0	0.0	84.0	918.3	266.6	225.7	0.0	0.0	76.3	0.0	0.0
38	5.90	116.9	0.0	0.0	115.0	0.0	0.0	84.2	918.9	266.4	246.3	0.0	0.0	75.6	0.0	0.0
39	6.05	119.1	0.0	0.0	115.8	0.0	0.0	84.3	918.4	266.1	230.9	0.0	0.0	73.9	0.0	0.0
40	6.21	116.3	0.0	0.0	116.0	0.0	0.0	84.5	919.0	266.0	252.4	0.0	0.0	73.7	0.0	0.0
41	6.38	115.1	0.0	0.0	117.8	0.0	0.0	84.9	919.3	265.1	266.1	0.0	0.0	70.4	0.0	0.0
42	6.54	117.5	0.0	0.0	118.8	0.0	0.0	85.4	918.7	264.7	257.6	0.0	0.0	71.2	0.0	0.0
43	6.70	121.5	0.0	0.0	118.9	0.0	0.0	87.2	917.9	264.6	232.7	0.0	0.0	72.6	0.0	0.0
44	10.59	123.3	0.0	0.0	119.5	0.0	0.0	88.7	917.5	264.4	230.1	0.0	0.0	74.5	0.0	0.0
45	12.15	125.9	0.0	0.0	121.0	0.0	0.0	90.2	916.9	263.7	222.4	0.0	0.0	74.1	0.0	0.0
46	13.71	128.0	0.0	0.0	123.0	0.0	0.0	91.7	916.4	262.8	218.1	0.0	0.0	72.5	0.0	0.0
47	14.30	138.7	134.6	143.5	124.0	126.9	126.9	92.3	914.1	262.3	169.9	186.4	154.0	71.3	65.4	65.4
48	14.34	132.1	131.6	141.4	124.6	126.5	126.5	92.3	915.3	261.5	198.4	201.0	160.9	69.8	66.0	66.0
49	14.49	129.2	120.1	132.8	125.6	126.4	126.4	92.5	916.0	260.7	215.0	285.9	156.9	67.8	66.3	66.3
50	14.65	131.5	138.9	137.2	125.4	124.6	124.6	92.6	915.5	260.7	202.9	170.5	177.0	68.5	70.3	70.3
51	14.80	131.9	132.8	132.3	125.4	125.4	125.4	92.8	915.5	261.0	201.6	197.1	132.6	68.9	68.9	68.9
52	14.96	132.3	133.9	145.7	124.3	125.8	125.8	92.9	914.7	261.1	177.7	192.3	149.3	71.6	68.4	68.4
53	15.12	131.6	135.0	142.4	123.7	124.8	124.8	93.1	916.9	261.2	205.0	188.4	160.1	73.4	70.9	70.9
54	15.27	127.9	121.4	142.4	123.5	125.2	125.2	93.2	916.5	262.0	227.6	280.1	160.5	74.5	70.6	70.6
55	15.43	137.5	142.5	139.1	123.6	133.5	133.5	93.4	915.8	261.6	178.7	160.5	172.5	74.5	56.1	56.1
56	15.59	136.7	133.3	154.2	123.9	150.0	150.0	93.5	915.9	261.5	182.6	198.2	129.9	74.0	39.9	39.9
57	16.05	131.3	0.0	0.0	127.2	0.0	0.0	94.0	916.5	261.9	211.0	0.0	0.0	67.9	0.0	0.0
58	20.74	134.3	0.0	0.0	131.0	0.0	0.0	98.5	915.1	259.1	218.3	0.0	0.0	68.1	0.0	0.0
59	23.09	137.6	0.0	0.0	133.5	0.0	0.0	100.8	914.3	257.9	211.2	0.0	0.0	67.0	0.0	0.0
60	24.65	137.5	0.0	0.0	135.0	0.0	0.0	102.3	914.3	257.2	220.3	0.0	0.0	66.7	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A=217.19 NU(S)A= 72.83 NU(AV)A=188.32 ST(AV)A=0.00828 ST(AV)/ST(4S)=2.33 F/F(4S)=15.01
 (ST/ST(4S))/(F/F(4S))=0.155 (F/F(4S))/(ST/ST(4S))*3.0=1.18 (ST/ST(4S))/(F/F(4S))*(1/3)=0.95
 NU(R)A/NU(4S)=2.71 NU(S)A/NU(4S)=0.91 e+(4R)= 582.28 R(4R)= 3.30 H(4R)=23.78

BY USING ROUGHNESS RESULTS ONLY : H(RB)= 23.56

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER=146HR55-60/10 E/D=0.078 P/E=10.0 ALPHA=50 HYD DIA= 1.600 IN PR=71 MDO=0.1434 LBM/SEC
4755 GOR(R)=1310.2 BTU/HR-SS FT GOR(S)= 490.2 INLET TEMP= 79.1 F TATM= 72.0 F PATM= 14.6 PSIA

ZD	TW(P1)	TW(P2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
12	92.7	0.0	92.0	90.2	0.0	125.5	79.2	1305.7	481.9	852.2	0.0	898.8	386.0	0.0	91.7
27	95.9	0.0	91.5	90.1	0.0	125.6	79.3	1304.9	481.9	693.9	0.0	944.7	394.2	0.0	91.8
43	94.6	0.0	93.3	90.3	0.0	125.5	79.5	1305.2	481.8	759.4	0.0	725.9	391.6	0.0	92.2
59	98.9	0.0	92.9	92.9	0.0	123.9	79.6	1304.3	480.6	594.9	0.0	863.1	318.1	0.0	95.5
74	100.0	0.0	103.4	94.8	0.0	124.0	79.7	1304.0	479.7	566.3	0.0	484.9	280.2	0.0	95.4
90	103.6	0.0	104.0	93.5	0.0	124.7	79.9	1303.3	479.4	483.1	0.0	475.1	269.7	0.0	94.1
105	100.4	0.0	104.2	95.2	0.0	121.7	80.0	1304.0	479.1	562.2	0.0	473.9	260.1	0.0	100.6
121	102.0	0.0	111.7	96.0	0.0	122.8	80.1	1303.6	479.2	524.2	0.0	363.2	265.5	0.0	98.8
137	104.3	0.0	104.1	97.0	0.0	130.7	80.2	1303.1	478.7	476.6	0.0	480.6	251.4	0.0	83.1
152	105.5	0.0	118.0	97.3	0.0	150.0	80.4	1302.8	478.6	456.2	0.0	304.6	248.8	0.0	60.5
168	107.8	0.0	0.0	97.5	0.0	0.0	80.5	1302.3	478.5	419.6	0.0	0.0	247.7	0.0	0.0
184	110.1	0.0	0.0	99.0	0.0	0.0	80.6	1301.8	477.8	388.5	0.0	0.0	228.8	0.0	0.0
199	110.1	0.0	0.0	100.6	0.0	0.0	80.8	1301.8	477.1	390.2	0.0	0.0	211.5	0.0	0.0
215	112.7	0.0	0.0	102.2	0.0	0.0	80.9	1301.3	476.3	359.6	0.0	0.0	196.6	0.0	0.0
230	109.7	0.0	0.0	102.4	0.0	0.0	81.0	1301.9	476.2	399.0	0.0	0.0	195.8	0.0	0.0
246	116.2	0.0	0.0	103.3	0.0	0.0	81.2	1300.5	475.8	326.1	0.0	0.0	188.8	0.0	0.0
262	117.6	0.0	0.0	105.0	0.0	0.0	81.3	1300.2	475.9	314.5	0.0	0.0	176.6	0.0	0.0
277	114.8	0.0	0.0	104.5	0.0	0.0	81.4	1300.8	475.5	342.2	0.0	0.0	180.9	0.0	0.0
293	116.1	0.0	0.0	106.1	0.0	0.0	81.6	1300.5	475.1	330.5	0.0	0.0	169.9	0.0	0.0
309	111.9	0.0	0.0	107.1	0.0	0.0	81.7	1301.4	474.9	378.1	0.0	0.0	164.0	0.0	0.0
324	119.0	0.0	0.0	106.6	0.0	0.0	81.8	1299.9	473.4	306.8	0.0	0.0	167.4	0.0	0.0
340	117.0	0.0	0.0	107.2	0.0	0.0	82.0	1300.3	473.2	325.5	0.0	0.0	164.3	0.0	0.0
355	114.8	0.0	0.0	107.8	0.0	0.0	82.1	1300.8	473.2	347.7	0.0	0.0	161.2	0.0	0.0
371	116.6	0.0	0.0	109.1	0.0	0.0	82.2	1300.4	472.1	331.6	0.0	0.0	153.8	0.0	0.0
387	115.0	0.0	0.0	109.5	0.0	0.0	82.3	1300.7	472.5	349.2	0.0	0.0	152.7	0.0	0.0
402	116.9	0.0	0.0	111.3	0.0	0.0	82.5	1300.3	472.2	331.1	0.0	0.0	143.6	0.0	0.0
418	115.5	0.0	0.0	112.0	0.0	0.0	82.6	1300.6	471.8	346.5	0.0	0.0	140.7	0.0	0.0
434	114.8	0.0	0.0	113.3	0.0	0.0	82.7	1300.8	471.2	355.5	0.0	0.0	135.1	0.0	0.0
449	116.5	0.0	0.0	113.8	0.0	0.0	82.9	1300.4	471.0	338.7	0.0	0.0	133.4	0.0	0.0
465	111.8	0.0	0.0	113.9	0.0	0.0	83.0	1301.4	471.0	395.8	0.0	0.0	133.5	0.0	0.0
480	116.4	0.0	0.0	114.8	0.0	0.0	83.1	1300.4	470.5	342.3	0.0	0.0	130.1	0.0	0.0
496	117.6	0.0	0.0	115.0	0.0	0.0	83.3	1300.2	470.5	331.5	0.0	0.0	129.8	0.0	0.0
512	114.6	0.0	0.0	115.3	0.0	0.0	83.4	1300.8	470.3	364.9	0.0	0.0	129.0	0.0	0.0
527	115.8	0.0	0.0	115.9	0.0	0.0	83.5	1300.6	470.0	352.6	0.0	0.0	127.0	0.0	0.0
543	112.4	0.0	0.0	116.5	0.0	0.0	83.7	1301.3	469.8	396.1	0.0	0.0	125.1	0.0	0.0
559	119.3	0.0	0.0	115.8	0.0	0.0	83.8	1299.8	470.1	320.1	0.0	0.0	128.4	0.0	0.0
574	117.7	0.0	0.0	115.0	0.0	0.0	83.9	1300.2	470.5	336.6	0.0	0.0	132.4	0.0	0.0
590	114.8	0.0	0.0	115.7	0.0	0.0	84.1	1300.8	470.1	369.9	0.0	0.0	129.9	0.0	0.0
605	117.1	0.0	0.0	116.2	0.0	0.0	84.2	1300.3	469.9	345.3	0.0	0.0	128.3	0.0	0.0
621	114.5	0.0	0.0	116.2	0.0	0.0	84.3	1300.9	469.9	376.6	0.0	0.0	128.8	0.0	0.0
636	112.3	0.0	0.0	118.3	0.0	0.0	84.7	1301.3	468.9	411.9	0.0	0.0	121.9	0.0	0.0
652	115.5	0.0	0.0	118.6	0.0	0.0	86.0	1300.6	468.8	384.5	0.0	0.0	125.4	0.0	0.0
668	119.3	0.0	0.0	118.6	0.0	0.0	86.7	1299.8	468.8	346.8	0.0	0.0	127.8	0.0	0.0
684	120.5	0.0	0.0	118.6	0.0	0.0	88.0	1299.5	468.8	347.2	0.0	0.0	133.0	0.0	0.0
700	122.6	0.0	0.0	121.3	0.0	0.0	89.3	1299.1	467.6	338.1	0.0	0.0	126.6	0.0	0.0
716	124.8	0.0	0.0	122.0	0.0	0.0	90.6	1298.6	467.2	328.5	0.0	0.0	128.8	0.0	0.0
732	134.7	131.0	143.0	121.4	125.5	125.5	91.1	1296.4	466.8	257.0	280.9	215.9	133.2	117.3	117.3
748	129.4	128.7	137.6	122.3	125.6	125.6	91.1	1297.4	466.4	293.2	298.5	241.3	129.5	117.0	117.0
764	126.3	117.5	138.7	122.8	125.5	125.5	91.3	1298.1	465.7	320.1	427.6	236.5	127.8	117.5	117.5
780	129.4	136.2	134.7	123.3	123.9	123.9	91.4	1297.6	465.5	295.1	250.2	258.9	126.0	123.7	123.7
796	129.9	129.5	151.4	123.7	124.0	124.0	91.5	1297.8	465.6	292.4	295.2	187.2	124.9	123.8	123.8
812	140.2	130.8	140.5	123.1	124.7	124.7	91.7	1296.1	465.6	230.5	285.9	229.1	128.1	121.7	121.7
828	133.4	132.4	137.3	122.2	121.9	121.9	91.8	1298.7	465.6	269.7	276.1	246.4	132.2	133.5	133.5
844	131.1	117.3	137.9	122.4	122.8	122.8	91.9	1298.6	466.4	286.1	441.7	243.8	132.2	130.4	130.4
860	136.0	140.7	134.5	122.6	130.9	130.9	92.1	1298.0	466.3	254.8	230.2	263.9	131.9	103.6	103.6
876	133.9	130.1	152.9	122.4	150.0	150.0	92.2	1298.0	466.0	268.5	295.4	184.4	133.0	69.5	69.5
892	127.7	0.0	0.0	125.0	0.0	0.0	92.6	1298.7	467.3	318.7	0.0	0.0	124.1	0.0	0.0
908	130.9	0.0	0.0	127.5	0.0	0.0	96.5	1297.2	464.7	323.2	0.0	0.0	128.5	0.0	0.0
924	133.4	0.0	0.0	130.9	0.0	0.0	98.5	1296.7	463.1	317.2	0.0	0.0	122.0	0.0	0.0
940	132.9	0.0	0.0	131.0	0.0	0.0	99.8	1296.8	463.1	333.9	0.0	0.0	126.5	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A=315.16 NU(S)A=129.38 NU(AV)A=278.00 ST(AV)A=0.00713 ST(AV)/ST(4S)=2.24 F/F(4S)=17.08
 ST/ST(4S))/(F/F(4S))=0.131 (F/F(4S))/(ST/ST(4S))*3.0=1.53 (ST/ST(4S))/(F/F(4S))*(1/3)=0.87
 U(R)A/NU(4S)=2.55 NU(S)A/NU(4S)=1.05 e+(4R)=1000.08 R(4R)= 3.30 H(4R)=27.92

Y USING ROUGHSIDE RESULTS ONLY : H(RB)= 28.04

RUN NUMBER=150HR10-60/20 ETD=0.078 P/E=20.0 ALPHA=50 HYD DIA= 1.500 IN PR= .71 MDDT=0.0292 LBM/SEC
 RE= 11128 QGE(R)= 356.0 BTU/HR-SQ FT QGE(S)= 137.0 INLET TEMP= 78.5 F TATM= 75.2 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.12	97.4	0.0	91.2	89.7	0.0	129.0	78.6	351.1	150.8	164.9	0.0	246.2	131.9	0.0
2	0.27	97.2	0.0	94.2	89.8	0.0	129.7	78.8	351.2	150.3	168.1	0.0	200.8	120.2	0.0
3	0.43	96.5	0.0	101.0	90.9	0.0	129.8	78.9	351.3	149.8	176.3	0.0	140.4	110.3	0.0
4	0.59	99.9	0.0	101.1	92.2	0.0	126.8	78.1	350.6	149.2	148.5	0.0	140.4	100.3	0.0
5	0.74	102.7	0.0	104.8	93.5	0.0	128.1	79.2	350.0	148.6	131.5	0.0	120.7	91.9	0.0
6	0.90	105.6	0.0	107.7	94.3	0.0	128.0	79.4	349.3	148.2	117.5	0.0	108.8	87.7	0.0
7	1.05	107.5	0.0	110.8	95.1	0.0	130.2	79.6	348.9	147.8	110.0	0.0	98.4	83.8	0.0
8	1.21	111.3	0.0	116.1	95.8	0.0	124.9	79.7	348.1	147.5	97.1	0.0	84.2	80.8	0.0
9	1.37	115.7	0.0	119.5	96.7	0.0	134.5	79.9	347.1	147.1	85.3	0.0	77.1	77.0	0.0
10	1.52	113.1	0.0	115.9	97.6	0.0	150.0	80.0	347.7	146.7	92.5	0.0	85.3	73.5	0.0
11	1.68	110.3	0.0	0.0	97.4	0.0	0.0	80.2	348.3	146.8	101.8	0.0	0.0	75.0	0.0
12	1.84	116.3	0.0	0.0	98.0	0.0	0.0	80.4	347.0	146.5	84.9	0.0	0.0	73.0	0.0
13	1.99	113.4	0.0	0.0	98.5	0.0	0.0	80.5	347.6	146.3	92.9	0.0	0.0	71.5	0.0
14	2.15	112.5	0.0	0.0	99.3	0.0	0.0	80.7	347.8	145.9	96.1	0.0	0.0	68.8	0.0
15	2.30	112.3	0.0	0.0	100.0	0.0	0.0	80.8	347.9	145.6	97.1	0.0	0.0	66.7	0.0
16	2.46	113.1	0.0	0.0	101.5	0.0	0.0	81.0	347.7	144.9	95.1	0.0	0.0	62.0	0.0
17	2.62	114.6	0.0	0.0	102.3	0.0	0.0	81.1	347.4	144.9	91.2	0.0	0.0	60.1	0.0
18	2.77	116.1	0.0	0.0	102.0	0.0	0.0	81.3	347.0	144.7	87.6	0.0	0.0	61.4	0.0
19	2.93	117.5	0.0	0.0	102.5	0.0	0.0	81.5	346.7	144.4	84.4	0.0	0.0	60.3	0.0
20	3.09	112.0	0.0	0.0	102.8	0.0	0.0	81.6	347.9	144.3	100.5	0.0	0.0	59.8	0.0
21	3.24	112.7	0.0	0.0	103.0	0.0	0.0	81.8	347.8	144.2	98.7	0.0	0.0	59.6	0.0
22	3.40	113.5	0.0	0.0	103.5	0.0	0.0	81.9	347.6	144.0	96.6	0.0	0.0	58.5	0.0
23	3.55	110.7	0.0	0.0	105.0	0.0	0.0	82.1	348.2	143.3	106.7	0.0	0.0	54.8	0.0
24	3.71	111.2	0.0	0.0	105.4	0.0	0.0	82.2	348.1	143.1	105.4	0.0	0.0	54.2	0.0
25	3.87	113.0	0.0	0.0	105.0	0.0	0.0	82.4	347.7	143.3	99.6	0.0	0.0	55.6	0.0
26	4.02	114.9	0.0	0.0	106.8	0.0	0.0	82.6	347.3	142.5	94.1	0.0	0.0	51.5	0.0
27	4.18	117.1	0.0	0.0	107.5	0.0	0.0	82.7	346.8	142.1	88.4	0.0	0.0	50.2	0.0
28	4.34	119.1	0.0	0.0	108.5	0.0	0.0	82.9	346.4	141.7	83.7	0.0	0.0	48.4	0.0
29	4.49	121.1	0.0	0.0	108.2	0.0	0.0	83.0	345.9	141.8	79.6	0.0	0.0	49.3	0.0
30	4.65	113.7	0.0	0.0	108.5	0.0	0.0	83.2	347.6	141.7	99.7	0.0	0.0	49.0	0.0
31	4.80	113.0	0.0	0.0	109.0	0.0	0.0	83.3	347.7	141.4	102.6	0.0	0.0	48.3	0.0
32	4.96	116.0	0.0	0.0	110.0	0.0	0.0	83.5	347.1	141.0	93.4	0.0	0.0	46.6	0.0
33	5.12	113.3	0.0	0.0	110.4	0.0	0.0	83.7	347.6	140.8	102.6	0.0	0.0	46.1	0.0
34	5.27	113.3	0.0	0.0	111.0	0.0	0.0	83.8	347.6	140.5	103.1	0.0	0.0	45.2	0.0
35	5.43	115.1	0.0	0.0	111.6	0.0	0.0	84.0	347.2	140.2	97.5	0.0	0.0	44.4	0.0
36	5.59	116.7	0.0	0.0	112.4	0.0	0.0	84.1	346.9	139.9	93.1	0.0	0.0	43.3	0.0
37	5.74	117.9	0.0	0.0	113.0	0.0	0.0	84.3	346.6	139.6	90.1	0.0	0.0	42.5	0.0
38	5.90	118.9	0.0	0.0	112.8	0.0	0.0	84.4	346.4	139.7	87.8	0.0	0.0	43.0	0.0
39	6.05	122.8	0.0	0.0	112.6	0.0	0.0	84.6	345.6	139.8	79.0	0.0	0.0	43.6	0.0
40	6.21	117.7	0.0	0.0	113.0	0.0	0.0	84.8	346.7	139.6	91.9	0.0	0.0	43.2	0.0
41	6.68	112.8	0.0	0.0	113.8	0.0	0.0	85.2	347.8	139.2	110.1	0.0	0.0	42.5	0.0
42	6.24	116.6	0.0	0.0	116.6	0.0	0.0	86.8	346.9	137.9	101.3	0.0	0.0	40.3	0.0
43	9.02	121.9	0.0	0.0	118.5	0.0	0.0	87.6	345.8	137.1	87.6	0.0	0.0	38.6	0.0
44	10.59	123.7	0.0	0.0	122.8	0.0	0.0	89.2	345.4	135.1	86.7	0.0	0.0	34.8	0.0
45	12.15	124.7	0.0	0.0	124.8	0.0	0.0	90.7	345.1	134.2	87.9	0.0	0.0	34.1	0.0
46	13.71	123.3	0.0	0.0	126.0	0.0	0.0	92.3	345.4	133.6	96.2	0.0	0.0	34.2	0.0
47	14.30	130.7	137.1	140.1	125.4	129.0	129.0	92.9	343.8	133.2	78.4	67.1	62.8	35.4	31.8
48	14.34	124.9	134.8	142.3	126.5	129.9	129.9	93.0	345.0	132.7	93.1	71.0	60.2	34.1	30.9
49	14.49	121.3	123.6	143.7	126.8	129.8	129.8	93.1	345.8	132.2	105.8	97.7	58.9	33.8	31.0
50	14.65	122.0	126.5	135.2	127.0	126.8	126.8	93.3	345.6	132.1	103.7	68.7	71.0	33.7	33.9
51	14.80	123.4	130.3	141.3	126.8	128.1	128.1	93.4	345.3	132.2	99.2	80.6	62.1	34.1	32.8
52	14.96	125.0	129.0	135.3	127.4	128.0	128.0	93.6	345.0	131.8	94.4	83.8	71.2	33.6	33.0
53	15.12	124.9	128.8	133.9	126.9	130.2	130.2	93.7	345.8	131.9	95.4	84.9	74.1	34.2	31.1
54	15.27	127.6	131.7	137.4	125.1	124.9	124.9	93.9	343.8	133.3	87.6	78.2	68.0	36.8	37.0
55	15.43	129.4	133.2	136.9	125.6	134.5	134.5	94.1	343.9	132.7	83.7	75.6	69.0	36.2	28.2
56	15.59	127.9	134.4	141.0	125.4	150.0	150.0	94.2	344.3	132.7	87.8	73.7	63.3	36.6	20.5
57	16.05	123.9	0.0	0.0	129.5	0.0	0.0	94.7	345.6	131.7	101.8	0.0	0.0	32.5	0.0
58	20.74	127.2	0.0	0.0	133.0	0.0	0.0	99.4	344.6	130.4	105.7	0.0	0.0	33.1	0.0
59	23.09	136.3	0.0	0.0	134.5	0.0	0.0	101.8	342.6	129.7	84.3	0.0	0.0	33.7	0.0
60	24.65	137.3	0.0	0.0	135.0	0.0	0.0	103.3	342.4	129.5	85.4	0.0	0.0	34.7	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A= 93.52 NU(S)A= 39.72 NU(AV)A= 82.76 ST(AV)A=0.01045 ST(AV)/ST(4S)=2.38 F/F(4S)= 7.23
 (ST/ST(4S))/(F/F(4S))=0.330 (F/F(4S))/(ST/ST(4S))*3.0=0.53 (ST/ST(4S))/(F/F(4S))*(1/3)=1.23
 NU(R)A/NU(4S)=2.71 NU(S)A/NU(4S)=1.15 e+(4R)= 157.82 R(4R)= 4.45 H(4R)=14.46

BY USING ROUGHSDIE RESULTS ONLY : H(RB)= 14.66

**ORIGINAL PAGE IS
OF POOR QUALITY**

NUMBER=151HR30-60/20 E/D=0.078 P/E=20.0 ALPHA=60 HYD DIA= 1.600 IN PR=.71 MDOT=0.0843 LBM/SEC
 12126. GGE(R)= 683.5 BTU/HR-SQ FT GGE(S)= 343.5 INLET TEMP= 81.6 F TATM= 75.8 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
12	95.5	0.0	90.6	91.3	0.0	129.5	81.7	679.0	336.3	402.3	0.0	668.6	307.1	0.0	61.7
27	95.7	0.0	92.6	92.2	0.0	130.4	81.8	679.1	335.9	428.9	0.0	552.0	283.6	0.0	60.7
43	95.4	0.0	97.1	93.1	0.0	129.9	81.9	679.2	335.5	442.1	0.0	392.6	263.3	0.0	61.4
59	99.2	0.0	97.7	93.0	0.0	126.5	82.0	678.4	334.6	346.7	0.0	379.9	226.5	0.0	66.0
74	101.8	0.0	102.3	97.0	0.0	126.9	82.2	677.8	333.7	302.6	0.0	295.1	197.1	0.0	65.4
90	103.9	0.0	104.6	97.3	0.0	125.9	82.3	677.3	333.6	274.6	0.0	266.0	194.6	0.0	67.0
105	104.5	0.0	106.3	97.3	0.0	129.6	82.4	677.2	333.6	268.5	0.0	248.3	196.1	0.0	61.9
21	107.8	0.0	112.7	97.3	0.0	127.2	82.5	676.5	333.6	234.4	0.0	196.4	197.6	0.0	65.4
37	110.9	0.0	116.4	97.9	0.0	132.5	82.6	675.8	333.3	209.4	0.0	175.3	191.2	0.0	58.6
52	109.4	0.0	114.6	98.5	0.0	150.0	82.7	676.1	333.0	222.2	0.0	185.9	185.1	0.0	43.4
68	109.0	0.0	0.0	98.2	0.0	0.0	82.9	676.2	333.2	226.6	0.0	0.0	190.2	0.0	0.0
1.84	114.1	0.0	0.0	99.4	0.0	0.0	83.0	675.1	332.6	189.9	0.0	0.0	177.3	0.0	0.0
1.99	111.7	0.0	0.0	100.4	0.0	0.0	83.1	675.6	332.2	206.8	0.0	0.0	168.0	0.0	0.0
2.15	111.5	0.0	0.0	101.1	0.0	0.0	83.2	675.7	331.8	209.1	0.0	0.0	162.4	0.0	0.0
2.30	111.8	0.0	0.0	101.1	0.0	0.0	83.3	675.6	331.8	207.7	0.0	0.0	163.4	0.0	0.0
2.46	112.7	0.0	0.0	102.5	0.0	0.0	83.4	675.4	331.2	202.0	0.0	0.0	152.1	0.0	0.0
2.62	114.2	0.0	0.0	102.6	0.0	0.0	83.6	675.1	331.7	192.8	0.0	0.0	152.5	0.0	0.0
2.77	116.0	0.0	0.0	103.0	0.0	0.0	83.7	674.7	331.0	182.6	0.0	0.0	149.8	0.0	0.0
2.93	117.5	0.0	0.0	103.0	0.0	0.0	83.8	674.4	331.0	175.0	0.0	0.0	150.7	0.0	0.0
3.09	112.2	0.0	0.0	103.2	0.0	0.0	83.9	675.5	331.8	208.8	0.0	0.0	150.5	0.0	0.0
3.24	112.4	0.0	0.0	103.8	0.0	0.0	84.0	675.5	330.6	208.1	0.0	0.0	146.2	0.0	0.0
3.40	110.2	0.0	0.0	104.0	0.0	0.0	84.1	676.0	330.5	226.7	0.0	0.0	145.5	0.0	0.0
3.55	109.2	0.0	0.0	105.5	0.0	0.0	84.3	676.2	329.8	236.9	0.0	0.0	135.7	0.0	0.0
3.71	110.6	0.0	0.0	105.9	0.0	0.0	84.4	675.9	328.9	225.2	0.0	0.0	133.4	0.0	0.0
3.87	113.3	0.0	0.0	105.7	0.0	0.0	84.5	675.3	329.3	204.8	0.0	0.0	135.6	0.0	0.0
4.02	115.4	0.0	0.0	108.8	0.0	0.0	84.6	674.8	328.3	191.4	0.0	0.0	118.5	0.0	0.0
4.18	117.7	0.0	0.0	109.2	0.0	0.0	84.7	674.3	328.1	178.6	0.0	0.0	117.1	0.0	0.0
4.34	120.0	0.0	0.0	109.7	0.0	0.0	84.8	673.8	327.9	167.3	0.0	0.0	115.2	0.0	0.0
4.49	122.5	0.0	0.0	109.7	0.0	0.0	85.0	673.3	327.9	156.5	0.0	0.0	115.7	0.0	0.0
4.65	113.1	0.0	0.0	109.9	0.0	0.0	85.1	675.3	327.8	210.3	0.0	0.0	115.2	0.0	0.0
4.80	112.0	0.0	0.0	111.4	0.0	0.0	85.2	675.6	327.1	219.9	0.0	0.0	108.9	0.0	0.0
4.96	113.8	0.0	0.0	112.0	0.0	0.0	85.3	675.2	326.8	206.7	0.0	0.0	106.8	0.0	0.0
5.12	111.8	0.0	0.0	112.2	0.0	0.0	85.4	675.6	326.7	223.4	0.0	0.0	106.4	0.0	0.0
5.27	111.8	0.0	0.0	113.2	0.0	0.0	85.5	675.6	326.3	224.4	0.0	0.0	102.9	0.0	0.0
5.43	114.1	0.0	0.0	114.0	0.0	0.0	85.7	675.1	325.9	207.0	0.0	0.0	100.3	0.0	0.0
5.59	115.9	0.0	0.0	114.5	0.0	0.0	85.8	674.7	325.7	195.3	0.0	0.0	98.8	0.0	0.0
5.74	117.3	0.0	0.0	114.6	0.0	0.0	85.9	674.4	325.6	187.2	0.0	0.0	98.9	0.0	0.0
5.90	119.0	0.0	0.0	114.0	0.0	0.0	86.0	674.0	325.9	178.0	0.0	0.0	101.5	0.0	0.0
6.05	122.6	0.0	0.0	113.8	0.0	0.0	86.1	673.2	326.0	160.8	0.0	0.0	102.6	0.0	0.0
6.21	116.3	0.0	0.0	113.9	0.0	0.0	86.2	674.6	326.0	195.5	0.0	0.0	102.7	0.0	0.0
6.38	110.2	0.0	0.0	116.3	0.0	0.0	86.6	676.0	324.8	249.3	0.0	0.0	95.2	0.0	0.0
6.54	112.7	0.0	0.0	117.8	0.0	0.0	87.8	675.4	324.2	235.3	0.0	0.0	93.8	0.0	0.0
7.02	120.5	0.0	0.0	118.1	0.0	0.0	88.3	673.7	324.0	181.9	0.0	0.0	94.5	0.0	0.0
10.59	122.3	0.0	0.0	123.2	0.0	0.0	89.5	673.3	321.7	177.9	0.0	0.0	82.7	0.0	0.0
12.15	123.8	0.0	0.0	125.0	0.0	0.0	90.7	673.0	320.8	175.7	0.0	0.0	80.9	0.0	0.0
13.71	121.2	0.0	0.0	126.0	0.0	0.0	91.9	673.5	320.4	198.1	0.0	0.0	81.0	0.0	0.0
14.30	129.3	134.7	139.3	127.0	129.5	129.5	92.3	671.8	319.9	156.6	136.6	123.3	79.5	74.2	74.2
14.34	120.6	129.6	142.1	127.4	130.4	130.4	92.3	673.4	319.2	205.3	155.8	116.7	78.5	72.3	72.3
14.49	118.4	116.9	143.2	128.4	129.9	129.9	92.4	674.0	318.5	223.8	237.6	114.5	76.3	73.3	73.3
14.65	119.7	131.1	130.9	128.0	126.5	126.5	92.6	673.7	318.5	213.9	150.7	151.5	77.4	80.9	80.9
14.80	121.0	125.1	138.0	128.0	126.9	126.9	92.7	673.5	318.8	204.9	179.0	128.1	77.8	80.3	80.3
14.96	122.9	124.6	129.7	128.2	125.9	125.9	92.8	673.5	318.4	192.8	182.5	157.2	77.4	82.9	82.9
15.12	123.9	123.8	126.2	127.2	129.6	129.6	92.9	674.2	318.6	187.1	188.0	174.5	80.0	74.8	74.8
15.27	125.9	126.4	131.6	126.9	127.2	127.2	93.0	672.5	319.5	176.2	173.6	150.2	81.2	80.5	80.5

5 15.43	134.7	128.4	133.9	127.1	132.5	132.5	93.1	672.1	319.1	139.1	164.2	142.0	80.9	69.8	69.8
6 15.59	133.6	131.0	137.9	126.0	150.0	150.0	93.3	672.2	319.5	143.3	153.4	129.7	84.0	48.5	48.5
7 16.05	121.7	0.0	0.0	129.6	0.0	0.0	93.6	674.2	319.8	206.8	0.0	0.0	76.5	0.0	0.0
8 20.74	121.1	0.0	0.0	131.5	0.0	0.0	97.1	673.6	317.9	240.3	0.0	0.0	79.1	0.0	0.0
9 23.09	132.6	0.0	0.0	132.5	0.0	0.0	98.9	671.0	317.4	169.7	0.0	0.0	80.5	0.0	0.0
0 24.65	132.9	0.0	0.0	134.5	0.0	0.0	100.0	671.0	316.5	173.9	0.0	0.0	78.2	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A=192.07 NU(S)A= 91.14 NU(AV)=171.88 ST(AV)A=0.00752 ST(AV)/ST(4S)=2.12 F/F(4S)= 9.46
 (ST/ST(4S))/(F/F(4S))=0.224 (F/F(4S))/(ST/ST(4S))*3.0=0.99 (ST/ST(4S))/(F/F(4S))*3.0=1.00
 NU(R)A/NU(4S)=2.38 NU(S)A/NU(4S)=1.13 e+(4R)= 463.39 R(4R)= 4.44 H(4R)=20.78

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 21.07

RUN NUMBER=152HR60-60/20 E/D=0.078 P/E=30.0 ALPHA=60 HYD DIA= 1.600 IN PR= 71 MDOT=0.1720 LBM/SEC
 RE= 65680. QGE(R)= 881.0 BTU/HR-50 FT QGE(S)= 744.4 INLET TEMP= 82.8 F TATM= 76.0 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TGULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU
1	0.12	92.9	0.0	89.4	92.8	0.0	132.5	82.9	877.3	736.7	765.5	0.0	1387.5	649.3	0.0	13
2	0.27	92.5	0.0	90.0	92.0	0.0	133.3	82.9	877.4	737.0	804.1	0.0	1044.6	712.8	0.0	12
3	0.43	92.0	0.0	92.9	91.0	0.0	133.0	83.0	877.5	737.5	856.3	0.0	778.3	810.0	0.0	12
4	0.59	94.4	0.0	93.3	93.0	0.0	139.2	83.1	876.9	736.6	680.0	0.0	753.4	652.0	0.0	13
5	0.74	95.9	0.0	97.1	94.0	0.0	127.7	83.2	876.6	736.1	603.9	0.0	551.8	596.2	0.0	14
6	0.90	97.6	0.0	98.3	95.0	0.0	125.3	83.3	876.2	735.7	535.4	0.0	510.4	549.2	0.0	15
7	1.05	97.5	0.0	99.1	96.0	0.0	122.0	83.4	876.3	735.2	542.2	0.0	497.1	508.9	0.0	13
8	1.21	99.8	0.0	103.8	98.0	0.0	124.4	83.4	875.7	734.3	468.4	0.0	376.4	441.3	0.0	15
9	1.37	101.7	0.0	106.5	100.8	0.0	130.2	83.5	875.3	733.0	421.3	0.0	333.3	371.2	0.0	13
10	1.52	101.8	0.0	106.0	100.8	0.0	150.0	83.6	875.3	733.0	420.8	0.0	341.9	372.9	0.0	9
11	1.68	102.3	0.0	0.0	101.8	0.0	0.0	83.7	875.2	732.5	411.3	0.0	0.0	353.7	0.0	0
12	1.84	105.2	0.0	0.0	104.7	0.0	0.0	83.8	874.6	731.2	356.9	0.0	0.0	305.5	0.0	0
13	1.99	103.5	0.0	0.0	104.9	0.0	0.0	83.9	874.9	731.1	389.4	0.0	0.0	303.7	0.0	0
14	2.15	103.2	0.0	0.0	106.3	0.0	0.0	83.9	875.0	730.5	397.1	0.0	0.0	285.6	0.0	0
15	2.30	103.7	0.0	0.0	106.5	0.0	0.0	84.0	874.9	730.4	388.6	0.0	0.0	284.0	0.0	0
16	2.46	104.4	0.0	0.0	107.7	0.0	0.0	84.1	874.7	729.8	376.6	0.0	0.0	270.3	0.0	0
17	2.62	105.8	0.0	0.0	107.4	0.0	0.0	84.2	874.4	731.0	353.5	0.0	0.0	274.7	0.0	0
18	2.77	107.3	0.0	0.0	105.6	0.0	0.0	84.3	874.1	730.6	331.6	0.0	0.0	285.7	0.0	0
19	2.93	108.8	0.0	0.0	108.3	0.0	0.0	84.3	873.8	730.1	312.2	0.0	0.0	266.1	0.0	0
20	2.07	105.5	0.0	0.0	106.5	0.0	0.0	84.4	874.5	731.3	362.6	0.0	0.0	289.0	0.0	0
21	3.24	106.8	0.0	0.0	107.8	0.0	0.0	84.5	874.2	728.3	342.6	0.0	0.0	273.8	0.0	0
22	3.40	108.9	0.0	0.0	107.9	0.0	0.0	84.6	874.8	728.8	395.8	0.0	0.0	273.6	0.0	0
23	3.55	103.1	0.0	0.0	108.1	0.0	0.0	84.7	875.0	728.9	414.7	0.0	0.0	272.1	0.0	0
24	3.71	103.8	0.0	0.0	109.1	0.0	0.0	84.8	874.9	727.8	401.2	0.0	0.0	260.6	0.0	0
25	3.87	106.0	0.0	0.0	110.1	0.0	0.0	84.8	874.4	728.2	360.8	0.0	0.0	251.9	0.0	0
26	4.02	107.3	0.0	0.0	112.9	0.0	0.0	84.9	874.1	727.4	341.0	0.0	0.0	227.0	0.0	0
27	4.18	108.5	0.0	0.0	113.5	0.0	0.0	85.0	873.8	727.1	320.5	0.0	0.0	222.7	0.0	0
28	4.34	110.3	0.0	0.0	114.2	0.0	0.0	85.1	873.4	726.8	302.3	0.0	0.0	217.9	0.0	0
29	4.49	112.2	0.0	0.0	114.0	0.0	0.0	85.2	873.0	726.9	281.8	0.0	0.0	220.0	0.0	0
30	4.65	106.4	0.0	0.0	114.0	0.0	0.0	85.3	874.3	726.9	360.7	0.0	0.0	220.6	0.0	0
31	4.80	106.5	0.0	0.0	116.0	0.0	0.0	85.3	874.3	726.0	360.3	0.0	0.0	206.5	0.0	0
32	4.96	106.6	0.0	0.0	117.0	0.0	0.0	85.4	874.3	725.5	360.0	0.0	0.0	200.4	0.0	0
33	5.12	104.6	0.0	0.0	117.5	0.0	0.0	85.5	874.7	725.3	399.4	0.0	0.0	197.7	0.0	0
34	5.27	104.2	0.0	0.0	117.8	0.0	0.0	85.6	874.8	725.2	409.7	0.0	0.0	196.3	0.0	0
35	5.43	106.2	0.0	0.0	120.0	0.0	0.0	85.7	874.3	724.2	371.2	0.0	0.0	183.9	0.0	0
36	5.59	107.4	0.0	0.0	120.1	0.0	0.0	85.7	874.1	724.1	351.9	0.0	0.0	183.8	0.0	0
37	5.74	108.7	0.0	0.0	119.5	0.0	0.0	85.8	873.8	724.4	333.0	0.0	0.0	187.5	0.0	0
38	5.90	110.5	0.0	0.0	119.0	0.0	0.0	85.9	873.4	724.6	309.6	0.0	0.0	190.9	0.0	0
39	6.05	112.6	0.0	0.0	118.4	0.0	0.0	86.0	872.9	724.9	285.9	0.0	0.0	194.9	0.0	0
40	6.21	103.3	0.0	0.0	118.5	0.0	0.0	86.1	873.9	724.8	342.6	0.0	0.0	194.8	0.0	0
41	6.38	103.1	0.0	0.0	122.6	0.0	0.0	86.3	875.0	723.0	454.2	0.0	0.0	173.6	0.0	0
42	6.54	104.6	0.0	0.0	122.6	0.0	0.0	87.1	874.7	723.0	435.9	0.0	0.0	177.4	0.0	0
43	6.62	110.3	0.0	0.0	120.9	0.0	0.0	87.6	873.3	723.7	325.2	0.0	0.0	188.7	0.0	0
44	6.89	112.4	0.0	0.0	125.0	0.0	0.0	88.4	873.0	721.9	315.5	0.0	0.0	171.1	0.0	0
45	7.15	114.0	0.0	0.0	128.2	0.0	0.0	89.2	872.6	720.4	305.1	0.0	0.0	160.2	0.0	0
46	7.31	112.0	0.0	0.0	129.0	0.0	0.0	90.0	873.1	720.0	344.0	0.0	0.0	160.0	0.0	0
47	7.46	115.9	121.3	124.8	128.1	132.5	132.5	90.3	872.2	719.6	295.3	243.8	219.0	165.1	147.7	147.7
48	7.62	117.0	117.5	126.9	128.7	133.3	133.3	90.4	872.8	719.3	349.3	278.3	206.7	162.5	144.9	144.9
49	7.77	109.7	108.3	127.8	125.9	133.0	133.0	90.4	873.4	718.2	392.6	423.1	202.3	157.3	146.0	146.0
50	7.93	111.8	118.2	118.1	130.5	129.2	129.2	90.5	873.1	718.0	355.0	272.9	273.9	155.2	160.6	160.6
51	8.08	114.6	114.0	124.2	130.4	127.7	127.7	90.6	872.8	718.4	314.3	322.7	224.7	156.3	167.5	167.5
52	8.24	118.5	113.8	118.2	130.2	125.3	125.3	90.7	872.7	718.0	271.5	326.5	274.3	157.0	179.4	179.4
53	8.40	124.7	115.0	118.2	129.0	132.0	132.0	90.8	872.7	718.2	222.4	311.4	275.1	162.3	150.6	150.6
54	8.56	123.9	116.8	119.7	130.2	124.4	124.4	90.9	872.1	718.6	227.9	290.6	261.4	158.0	185.2	185.2
55	8.72	128.3	118.4	121.5	129.2	130.2	130.2	90.9	871.7	719.6	201.8	274.4	246.5	167.1	158.4	158.4
56	8.88	124.9	120.0	123.6	128.3	150.0	150.0	91.0	871.9	719.1	222.2	260.0	231.3	166.9	105.4	105.4
57	9.04	113.9	0.0	0.0	129.8	0.0	0.0	91.3	873.5	721.4	333.9	0.0	0.0	161.9	0.0	0.0
58	9.20	112.6	0.0	0.0	130.0	0.0	0.0	93.7	872.9	719.6	398.2	0.0	0.0	170.8	0.0	0.0
59	9.36	121.3	0.0	0.0	130.2	0.0	0.0	95.0	871.0	719.5	284.1	0.0	0.0	175.4	0.0	0.0
60	9.52	121.3	0.0	0.0	130.5	0.0	0.0	95.8	871.0	719.3	292.9	0.0	0.0	177.8	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A=318.80 NU(S)A=177.21 NU(AV)A=290.48 ST(AV)A=0.00622 ST(AV)/ST(4S)=2.02 F/F(4S)=11.21
 (ST/ST(4S))/(F/F(4S))=0.180 (F/F(4S))/(ST/ST(4S))*3.0=1.35 (ST/ST(4S))/(F/F(4S))*(1/3)=0.90
 NU(R)A/NU(4S)=2.23 NU(S)A/NU(4S)=1.24 e+(4R)= 949.70 R(4R)= 4.43 H(4R)=25.51

BY USING ROUGHNESS RESULTS ONLY : H(RB)= 26.21

**ORIGINAL PAGE IS
OF POOR QUALITY**

INSTR=154R-1D-4C/2C R/D=0.016 P/2=0.0 ALPH=1.35 HYD DIA= 1.600 IN PR= 71 MDOT=0.0275 LBM/SEC
 413 100R1= 325.6 BTU/HR=59 FT 1/30(S)= 113.0 INLET TEMP= 77.3 F TATM= 72.6 F PATM= 14.6 PSIA

NO	TW(S1)	TW(S2)	TW(S3)	TW(S1)	TW(S2)	TW(S3)	TBLK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
11	95.0	0.0	90.0	96.0	0.0	122.4	77.4	320.6	112.2	150.0	0.0	221.5	115.4	0.0	22.0
17	95.9	0.0	92.5	96.6	0.0	122.6	77.6	320.6	111.9	154.4	0.0	189.5	109.3	0.0	21.9
18	95.1	0.0	98.2	97.2	0.0	122.5	77.7	320.8	111.6	162.8	0.0	138.2	103.7	0.0	22.0
29	99.0	0.0	98.8	98.6	0.0	120.5	77.8	320.2	111.0	140.3	0.0	134.9	91.1	0.0	23.0
34	100.5	0.0	102.1	99.7	0.0	121.6	78.0	319.6	110.5	125.3	0.0	117.0	83.2	0.0	22.4
36	100.4	0.0	105.1	99.4	0.0	122.3	78.1	319.0	110.1	111.4	0.0	104.4	79.2	0.0	22.0
39	100.2	0.0	108.1	91.1	0.0	124.9	78.3	318.5	109.8	102.5	0.0	94.2	75.5	0.0	20.8
31	105.4	0.0	112.5	91.7	0.0	118.7	78.4	317.7	109.5	90.5	0.0	82.2	72.7	0.0	24.0
37	113.5	0.0	115.2	92.7	0.0	128.2	78.6	316.8	109.1	80.0	0.0	76.3	68.0	0.0	19.4
38	112.5	0.0	112.5	94.0	0.0	150.0	78.7	317.0	108.5	82.7	0.0	82.5	62.5	0.0	13.4
45	105.9	0.0	0.0	93.5	0.0	0.0	78.8	318.4	108.7	103.8	0.0	0.0	65.4	0.0	0.0
38	115.4	0.0	0.0	94.4	0.0	0.0	79.0	316.4	108.3	76.6	0.0	0.0	61.9	0.0	0.0
39	114.1	0.0	0.0	95.3	0.0	0.0	79.1	316.6	107.9	79.8	0.0	0.0	58.8	0.0	0.0
41	112.5	0.0	0.0	95.5	0.0	0.0	79.3	317.0	107.3	84.1	0.0	0.0	54.9	0.0	0.0
42	111.4	0.0	0.0	95.7	0.0	0.0	79.4	317.2	107.2	87.4	0.0	0.0	54.7	0.0	0.0
46	111.5	0.0	0.0	97.3	0.0	0.0	79.6	317.2	107.0	87.5	0.0	0.0	53.1	0.0	0.0
40	112.3	0.0	0.0	99.0	0.0	0.0	79.7	317.0	106.6	85.6	0.0	0.0	48.7	0.0	0.0
47	111.4	0.0	0.0	100.0	0.0	0.0	79.8	316.8	105.7	83.1	0.0	0.0	46.2	0.0	0.0
39	114.0	0.0	0.0	101.0	0.0	0.0	80.0	316.7	105.3	81.9	0.0	0.0	44.1	0.0	0.0
32	108.7	0.0	0.0	102.4	0.0	0.0	80.1	317.8	104.6	97.9	0.0	0.0	41.3	0.0	0.0
28	107.2	0.0	0.0	102.8	0.0	0.0	80.3	318.1	104.4	102.0	0.0	0.0	40.8	0.0	0.0
30	114.3	0.0	0.0	103.0	0.0	0.0	80.4	316.6	104.4	82.2	0.0	0.0	40.6	0.0	0.0
105	110.6	0.0	0.0	103.5	0.0	0.0	80.6	317.4	104.1	92.9	0.0	0.0	39.9	0.0	0.0
71	110.4	0.0	0.0	103.7	0.0	0.0	80.7	317.5	104.0	94.0	0.0	0.0	39.8	0.0	0.0
37	112.0	0.0	0.0	103.0	0.0	0.0	80.8	317.1	104.4	89.5	0.0	0.0	41.4	0.0	0.0
100	113.9	0.0	0.0	104.7	0.0	0.0	81.0	316.7	103.6	84.6	0.0	0.0	38.4	0.0	0.0
130	115.7	0.0	0.0	105.5	0.0	0.0	81.1	316.3	103.2	80.4	0.0	0.0	37.2	0.0	0.0
34	117.6	0.0	0.0	106.6	0.0	0.0	81.3	315.9	102.7	76.4	0.0	0.0	35.6	0.0	0.0
32	118.9	0.0	0.0	107.5	0.0	0.0	81.4	315.6	102.3	73.9	0.0	0.0	34.4	0.0	0.0
33	113.3	0.0	0.0	108.0	0.0	0.0	81.6	316.8	102.1	87.6	0.0	0.0	33.9	0.0	0.0
100	111.5	0.0	0.0	109.1	0.0	0.0	81.7	317.2	101.5	93.5	0.0	0.0	32.5	0.0	0.0
105	119.6	0.0	0.0	109.5	0.0	0.0	81.9	315.4	101.4	73.3	0.0	0.0	32.2	0.0	0.0
33	115.6	0.0	0.0	110.1	0.0	0.0	82.0	316.3	101.1	82.6	0.0	0.0	31.6	0.0	0.0
37	115.1	0.0	0.0	110.4	0.0	0.0	82.1	316.9	100.9	89.8	0.0	0.0	31.3	0.0	0.0
34	113.9	0.0	0.0	110.5	0.0	0.0	82.3	316.7	100.9	87.8	0.0	0.0	31.4	0.0	0.0
38	114.7	0.0	0.0	110.5	0.0	0.0	82.4	316.5	100.9	86.0	0.0	0.0	31.5	0.0	0.0
37	115.6	0.0	0.0	110.4	0.0	0.0	82.6	316.3	100.9	83.9	0.0	0.0	31.5	0.0	0.0
30	116.5	0.0	0.0	111.0	0.0	0.0	82.7	316.1	100.7	82.0	0.0	0.0	31.2	0.0	0.0
30	119.1	0.0	0.0	111.8	0.0	0.0	82.9	315.5	100.3	76.3	0.0	0.0	30.4	0.0	0.0
31	115.1	0.0	0.0	112.1	0.0	0.0	83.0	316.2	100.2	83.7	0.0	0.0	30.1	0.0	0.0
33	115.2	0.0	0.0	113.1	0.0	0.0	83.4	316.8	99.7	92.8	0.0	0.0	29.4	0.0	0.0
34	115.0	0.0	0.0	115.3	0.0	0.0	84.9	316.2	98.7	88.7	0.0	0.0	28.3	0.0	0.0
9 02	119.1	0.0	0.0	115.7	0.0	0.0	85.6	315.5	98.5	82.1	0.0	0.0	28.5	0.0	0.0
0 09	130.3	0.0	0.0	118.1	0.0	0.0	87.0	315.3	97.4	82.4	0.0	0.0	27.3	0.0	0.0
2 15	122.0	0.0	0.0	120.0	0.0	0.0	88.5	314.9	96.5	81.5	0.0	0.0	26.6	0.0	0.0
3 71	121.5	0.0	0.0	121.0	0.0	0.0	89.9	315.0	96.1	86.3	0.0	0.0	26.7	0.0	0.0
4 30	125.9	131.3	133.1	120.5	122.4	122.4	90.4	313.8	95.6	74.5	66.4	63.6	27.5	25.9	25.9
4 34	124.1	132.2	134.6	121.1	122.6	122.6	90.5	314.3	95.3	80.8	65.1	61.6	26.9	25.7	25.7
4 49	120.4	131.5	137.1	121.2	122.5	122.5	90.6	315.1	95.0	91.5	66.6	58.6	26.8	25.8	25.8
4 55	120.3	128.4	136.5	121.0	120.5	120.5	90.7	315.1	95.1	92.2	72.4	59.6	27.2	27.6	27.6
4 80	121.5	131.9	139.1	120.3	121.6	121.6	90.9	314.9	95.4	88.9	66.4	56.5	28.0	26.9	26.9
4 96	123.0	133.9	130.5	120.2	122.3	122.3	91.0	314.6	95.3	85.2	63.4	68.9	28.2	26.4	26.4
15 12	124.4	128.5	138.3	119.8	124.9	124.9	91.2	315.1	95.4	82.0	73.0	73.3	28.8	24.4	24.4
15 37	125.6	127.7	133.4	119.9	118.7	118.7	91.3	313.4	95.8	78.9	74.4	57.5	29.0	30.2	30.2

15.43	126.8	128.5	124.3	119.6	128.2	128.2	91.5	313.7	95.6	76.6	73.2	63.2	29.3	22.5	22.5
15.39	124.4	129.3	135.4	120.0	150.0	150.0	91.6	314.3	95.4	82.9	72.0	62.0	29.0	14.1	14.1
15.05	121.2	0.0	0.0	121.3	0.0	0.0	92.0	315.3	95.6	93.3	0.0	0.0	28.2	0.0	0.0
20.74	126.1	0.0	0.0	127.0	0.0	0.0	96.3	314.0	93.3	90.4	0.0	0.0	26.1	0.0	0.0
23.07	133.1	0.0	0.0	128.2	0.0	0.0	98.5	312.5	92.8	77.1	0.0	0.0	26.7	0.0	0.0
24.65	134.8	0.0	0.0	129.0	0.0	0.0	99.9	312.1	92.4	76.3	0.0	0.0	27.1	0.0	0.0

ONLY DEVELOPED REGION-BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 (R/A)= 63.61 NU(S)A= 29.73 NU(AV)A= 72.83 ST(AV)A=0.00973 ST(AV)/ST(4S)=2.19 F/F(4S)= 6.40
 ST/ST(4S)/(F/F(4S))=0.343 (F/F(4S))/(ST/ST(4S))**3 C=0.61 (ST/ST(4S))/(F/F(4S))**(1/3)=1.18
 U(R)A/NU(4S)=2.53 NU(S)A/NU(4S)=0.90 g+(4R)= 132.59 R(4R)= 4.76 H(4R)=14.82

ONLY USING BOLD-FACE RESULTS ONLY H(RR)= 14.55

RUN NUMBER=1507R00-45/20 S/D=0.075 P/E=0.0 ALPHA=15 HYD DIA= 1.500 IN PR= 71 MDOT=0.0844 LBM/SEC
 RE= 32266 QSR(R)= 677.0 BTU/HR-50 FT GGR(S)= 294.6 INLET TEMP= 79.6 F TATM= 73.0 F PATM= 14.6 PSIA

NU	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TEBLK	QQA(R)	QQA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.12	95.9	0.0	89.7	88.9	0.0	123.3	77.7	672.0	267.3	364.9	0.0	590.8	274.5	0.0	0.0
2	0.27	94.6	0.0	91.0	89.5	0.0	123.3	77.8	672.3	267.0	399.8	0.0	528.3	260.4	0.0	0.0
3	0.43	94.3	0.0	96.0	90.1	0.0	123.3	79.9	672.3	266.7	411.3	0.0	367.8	247.7	0.0	0.0
4	0.59	97.8	0.0	96.6	91.6	0.0	121.0	80.0	671.6	266.0	332.5	0.0	356.5	217.5	0.0	0.0
5	0.74	100.6	0.0	101.2	93.3	0.0	120.9	80.1	671.0	265.3	288.5	0.0	280.3	190.7	0.0	0.0
6	0.90	102.8	0.0	103.7	93.9	0.0	120.0	80.2	670.5	265.0	261.6	0.0	251.5	183.7	0.0	0.0
7	1.05	103.6	0.0	105.1	94.4	0.0	123.0	80.4	670.3	264.8	253.7	0.0	238.3	178.4	0.0	0.0
8	1.21	107.1	0.0	110.8	94.9	0.0	118.6	80.5	669.5	264.5	221.1	0.0	194.2	173.5	0.0	0.0
9	1.37	110.2	0.0	113.9	95.3	0.0	127.3	80.6	668.8	264.3	198.6	0.0	176.5	169.9	0.0	0.0
10	1.52	109.6	0.0	112.5	96.1	0.0	150.0	80.7	669.0	264.0	203.5	0.0	184.9	162.1	0.0	0.0
11	1.68	104.3	0.0	0.0	95.4	0.0	0.0	80.8	670.1	264.3	250.8	0.0	0.0	171.3	0.0	0.0
12	1.84	112.9	0.0	0.0	96.8	0.0	0.0	80.9	668.2	263.7	183.7	0.0	0.0	157.0	0.0	0.0
13	1.99	110.8	0.0	0.0	97.8	0.0	0.0	81.0	668.7	263.2	197.4	0.0	0.0	148.5	0.0	0.0
14	2.15	110.3	0.0	0.0	98.4	0.0	0.0	81.2	668.8	262.9	201.6	0.0	0.0	144.1	0.0	0.0
15	2.30	110.4	0.0	0.0	98.8	0.0	0.0	81.3	668.8	262.7	201.6	0.0	0.0	141.6	0.0	0.0
16	2.46	110.9	0.0	0.0	99.0	0.0	0.0	81.4	668.7	262.6	198.9	0.0	0.0	140.9	0.0	0.0
17	2.62	112.3	0.0	0.0	101.1	0.0	0.0	81.5	668.4	262.2	190.5	0.0	0.0	126.4	0.0	0.0
18	2.77	114.2	0.0	0.0	100.9	0.0	0.0	81.6	668.0	262.0	179.9	0.0	0.0	131.0	0.0	0.0
19	2.93	115.6	0.0	0.0	101.0	0.0	0.0	81.7	667.7	261.7	172.9	0.0	0.0	128.2	0.0	0.0
20	3.09	108.7	0.0	0.0	103.6	0.0	0.0	81.8	669.2	261.5	218.5	0.0	0.0	113.5	0.0	0.0
21	3.24	107.2	0.0	0.0	103.0	0.0	0.0	81.9	669.5	260.8	232.6	0.0	0.0	117.0	0.0	0.0
22	3.40	113.1	0.0	0.0	104.0	0.0	0.0	82.0	668.2	260.3	188.8	0.0	0.0	112.1	0.0	0.0
23	3.55	110.2	0.0	0.0	105.2	0.0	0.0	82.2	668.8	259.8	209.3	0.0	0.0	106.5	0.0	0.0
24	3.71	110.4	0.0	0.0	103.9	0.0	0.0	82.3	668.8	259.7	208.6	0.0	0.0	113.4	0.0	0.0
25	3.87	112.5	0.0	0.0	104.0	0.0	0.0	82.4	668.3	259.9	194.6	0.0	0.0	113.6	0.0	0.0
26	4.02	114.2	0.0	0.0	107.2	0.0	0.0	82.5	668.0	259.9	184.7	0.0	0.0	99.0	0.0	0.0
27	4.18	116.3	0.0	0.0	108.0	0.0	0.0	82.6	667.5	258.5	173.7	0.0	0.0	96.2	0.0	0.0
28	4.34	118.4	0.0	0.0	109.3	0.0	0.0	82.7	667.0	257.9	163.9	0.0	0.0	91.7	0.0	0.0
29	4.49	120.2	0.0	0.0	109.6	0.0	0.0	82.8	666.6	257.8	156.3	0.0	0.0	91.0	0.0	0.0
30	4.65	112.9	0.0	0.0	109.6	0.0	0.0	83.0	668.2	257.8	195.5	0.0	0.0	91.3	0.0	0.0
31	4.80	111.5	0.0	0.0	111.3	0.0	0.0	83.1	668.5	257.0	203.1	0.0	0.0	85.9	0.0	0.0
32	4.96	119.8	0.0	0.0	102.0	0.0	0.0	83.2	666.7	261.3	159.4	0.0	0.0	130.9	0.0	0.0
33	5.12	114.8	0.0	0.0	113.2	0.0	0.0	83.3	667.8	256.1	185.6	0.0	0.0	80.8	0.0	0.0
34	5.27	113.6	0.0	0.0	113.6	0.0	0.0	83.4	668.1	255.9	193.7	0.0	0.0	80.0	0.0	0.0
35	5.43	115.1	0.0	0.0	115.0	0.0	0.0	83.5	667.8	255.3	185.1	0.0	0.0	76.5	0.0	0.0
36	5.59	118.5	0.0	0.0	115.0	0.0	0.0	83.6	667.5	255.3	177.7	0.0	0.0	76.8	0.0	0.0
37	5.74	117.6	0.0	0.0	115.0	0.0	0.0	83.8	667.2	255.3	172.4	0.0	0.0	77.1	0.0	0.0
38	5.90	119.1	0.0	0.0	114.0	0.0	0.0	83.9	666.9	255.7	165.5	0.0	0.0	80.0	0.0	0.0
39	6.05	122.4	0.0	0.0	113.6	0.0	0.0	84.0	666.2	255.9	151.6	0.0	0.0	81.5	0.0	0.0
40	6.21	118.5	0.0	0.0	113.3	0.0	0.0	84.1	667.0	256.1	169.5	0.0	0.0	82.6	0.0	0.0
41	6.38	113.1	0.0	0.0	116.0	0.0	0.0	84.4	668.2	254.8	203.6	0.0	0.0	76.1	0.0	0.0
42	6.54	115.7	0.0	0.0	117.2	0.0	0.0	85.6	667.6	254.3	193.2	0.0	0.0	75.6	0.0	0.0
43	6.70	121.4	0.0	0.0	116.0	0.0	0.0	86.1	666.4	254.8	164.6	0.0	0.0	80.2	0.0	0.0
44	6.87	122.4	0.0	0.0	119.2	0.0	0.0	87.3	666.2	253.1	164.9	0.0	0.0	73.0	0.0	0.0
45	7.03	122.4	0.0	0.0	120.9	0.0	0.0	88.4	666.2	252.6	170.0	0.0	0.0	72.8	0.0	0.0
46	7.19	121.6	0.0	0.0	122.0	0.0	0.0	89.5	666.3	252.1	180.0	0.0	0.0	72.6	0.0	0.0
47	7.35	127.1	130.3	131.8	122.7	123.5	123.5	89.9	665.1	251.7	155.0	142.7	137.6	71.8	70.1	70.0
48	7.51	123.8	129.1	134.3	122.2	123.5	123.5	90.0	665.6	251.5	170.3	147.3	130.0	72.9	70.1	70.0
49	7.67	120.0	123.9	136.3	122.4	123.3	123.3	90.1	666.5	251.1	192.8	170.6	124.8	72.6	70.6	70.0
50	7.83	119.5	123.8	131.2	121.8	121.0	121.0	90.2	666.6	251.2	196.9	171.7	140.7	74.3	76.2	76.0
51	8.00	120.2	130.9	132.9	121.7	120.9	120.9	90.3	666.5	251.5	193.0	142.1	135.4	74.8	76.8	76.0
52	8.16	121.7	128.5	126.7	121.3	120.0	120.0	90.4	666.6	251.4	184.4	151.5	159.0	76.0	79.4	79.0
53	8.32	122.9	123.5	125.1	121.3	123.0	123.0	90.5	667.4	251.1	178.5	175.1	167.0	76.2	72.3	72.0
54	8.48	123.7	123.9	134.3	120.9	118.6	118.6	90.6	665.9	252.1	174.3	173.2	131.9	77.8	84.2	84.0
55	15.43	130.9	126.6	130.3	121.1	127.8	127.8	90.8	665.8	251.7	143.5	160.7	145.6	77.4	63.4	63.4
56	15.59	129.2	128.6	131.1	120.1	150.0	150.0	90.9	666.0	252.1	150.4	152.6	143.2	80.5	39.8	39.8
57	16.05	121.5	0.0	0.0	123.4	0.0	0.0	91.2	667.1	252.5	190.4	0.0	0.0	73.2	0.0	0.0
58	20.74	123.3	0.0	0.0	126.0	0.0	0.0	94.6	666.0	250.2	199.5	0.0	0.0	74.0	0.0	0.0
59	23.09	131.7	0.0	0.0	127.8	0.0	0.0	96.3	664.1	269.4	160.8	0.0	0.0	73.3	0.0	0.0
60	24.65	133.4	0.0	0.0	128.0	0.0	0.0	97.4	663.7	269.3	157.9	0.0	0.0	75.4	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A=175.14 NU(S)A= 80.33 NU(AV)A=156.17 ST(AV)A=0.00680 ST(AV)/ST(4S)=1.92 F/F(4S)= 8.08
 (ST/ST(4S))/(F/F(4S))=0.238 (F/F(4S))/(ST/ST(4S))*3.0=1.14 (ST/ST(4S))/(F/F(4S))*(1/3)=0.96
 NU(R)A/NU(4S)=2.16 NU(S)A/NU(4S)=0.99 e+(4R)= 429.18 R(4R)= 4.89 H(4R)=21.44

BY USING ROUGHSIDE RESULTS ONLY : H(RB)= 21.41

ORIGINAL PAGE IS OF POOR QUALITY

NUMBER=161HR60-45/20 E/D=0.078 P/E=20.0 ALPHA=45 HYD DIA= 1.600 IN PR=71 MDOT=0.1680 LBM/SEC
1325. GGE(R)=1011.5 BTU/HR-SQ FT GGE(S)= 628.3 INLET TEMP= 80.1 F TATM= 72.6 F PATM= 14.6 PSIA

TD	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
12	94.6	0.0	87.9	90.6	0.0	125.5	80.2	1006.7	620.1	613.8	0.0	1145.7	523.0	0.0	120.4
27	94.0	0.0	90.0	91.3	0.0	126.5	80.3	1006.8	619.7	644.7	0.0	909.5	493.9	0.0	117.9
43	92.9	0.0	93.7	93.1	0.0	126.9	80.4	1007.0	618.9	706.0	0.0	663.7	427.1	0.0	117.0
59	95.9	0.0	94.1	96.0	0.0	123.5	80.4	1006.4	617.6	572.7	0.0	648.2	349.2	0.0	126.1
74	98.1	0.0	99.2	97.2	0.0	122.4	80.5	1005.9	617.0	503.6	0.0	474.0	325.6	0.0	129.6
90	100.1	0.0	101.1	98.7	0.0	119.5	80.6	1005.5	617.3	454.0	0.0	431.8	337.7	0.0	139.6
105	100.2	0.0	101.9	97.0	0.0	124.3	80.7	1005.4	617.1	453.8	0.0	417.3	333.3	0.0	124.5
121	103.2	0.0	107.7	97.7	0.0	117.1	80.8	1004.8	616.8	394.5	0.0	328.5	321.0	0.0	149.4
137	105.8	0.0	111.0	98.3	0.0	129.4	80.9	1004.2	616.5	354.5	0.0	293.2	311.5	0.0	111.7
152	106.6	0.0	109.8	98.9	0.0	150.0	81.0	1004.0	616.2	344.6	0.0	306.3	302.5	0.0	78.5
168	102.3	0.0	0.0	99.2	0.0	0.0	81.1	1005.0	616.1	416.3	0.0	0.0	298.9	0.0	0.0
184	109.1	0.0	0.0	100.6	0.0	0.0	81.2	1003.5	615.5	315.7	0.0	0.0	278.4	0.0	0.0
199	107.4	0.0	0.0	101.2	0.0	0.0	81.3	1003.9	615.2	337.5	0.0	0.0	271.2	0.0	0.0
215	107.1	0.0	0.0	102.2	0.0	0.0	81.4	1003.9	614.7	342.6	0.0	0.0	259.1	0.0	0.0
230	107.5	0.0	0.0	101.1	0.0	0.0	81.5	1003.8	615.2	338.4	0.0	0.0	275.0	0.0	0.0
246	108.4	0.0	0.0	102.5	0.0	0.0	81.6	1003.6	614.6	328.2	0.0	0.0	257.5	0.0	0.0
262	110.3	0.0	0.0	106.2	0.0	0.0	81.6	1003.2	613.9	307.3	0.0	0.0	219.5	0.0	0.0
277	112.3	0.0	0.0	103.6	0.0	0.0	81.7	1002.8	614.4	287.9	0.0	0.0	246.6	0.0	0.0
293	113.9	0.0	0.0	103.3	0.0	0.0	81.8	1002.4	614.8	274.3	0.0	0.0	251.3	0.0	0.0
309	107.6	0.0	0.0	103.0	0.0	0.0	81.9	1003.8	615.3	342.9	0.0	0.0	256.1	0.0	0.0
324	106.2	0.0	0.0	102.8	0.0	0.0	82.0	1004.1	613.4	364.2	0.0	0.0	258.8	0.0	0.0
340	112.0	0.0	0.0	102.5	0.0	0.0	82.1	1002.8	613.6	294.2	0.0	0.0	263.8	0.0	0.0
355	108.6	0.0	0.0	105.2	0.0	0.0	82.2	1003.6	612.7	333.3	0.0	0.0	233.5	0.0	0.0
371	108.5	0.0	0.0	105.0	0.0	0.0	82.3	1003.6	612.2	335.7	0.0	0.0	236.2	0.0	0.0
387	110.6	0.0	0.0	105.5	0.0	0.0	82.4	1003.1	612.7	311.6	0.0	0.0	232.3	0.0	0.0
402	111.9	0.0	0.0	109.4	0.0	0.0	82.5	1002.9	611.4	298.7	0.0	0.0	199.0	0.0	0.0
418	113.5	0.0	0.0	111.0	0.0	0.0	82.6	1002.5	610.7	284.0	0.0	0.0	188.2	0.0	0.0
434	115.5	0.0	0.0	112.3	0.0	0.0	82.7	1002.1	610.1	267.4	0.0	0.0	180.3	0.0	0.0
449	117.5	0.0	0.0	111.4	0.0	0.0	82.8	1001.6	610.5	252.5	0.0	0.0	186.7	0.0	0.0
465	110.8	0.0	0.0	111.4	0.0	0.0	82.8	1003.1	610.5	314.3	0.0	0.0	187.3	0.0	0.0
480	110.4	0.0	0.0	113.5	0.0	0.0	82.9	1003.2	609.5	319.9	0.0	0.0	174.7	0.0	0.0
496	117.2	0.0	0.0	115.0	0.0	0.0	83.0	1001.7	608.8	256.7	0.0	0.0	166.8	0.0	0.0
512	111.7	0.0	0.0	116.6	0.0	0.0	83.1	1002.9	608.1	307.2	0.0	0.0	159.0	0.0	0.0
527	110.3	0.0	0.0	116.3	0.0	0.0	83.2	1003.2	608.2	324.2	0.0	0.0	160.9	0.0	0.0
543	112.2	0.0	0.0	118.3	0.0	0.0	83.3	1002.8	607.3	303.8	0.0	0.0	151.9	0.0	0.0
559	113.7	0.0	0.0	119.0	0.0	0.0	83.4	1002.5	607.0	289.5	0.0	0.0	149.2	0.0	0.0
574	114.9	0.0	0.0	118.8	0.0	0.0	83.5	1002.2	607.1	279.2	0.0	0.0	150.4	0.0	0.0
590	116.5	0.0	0.0	117.0	0.0	0.0	83.6	1001.9	607.9	266.3	0.0	0.0	159.1	0.0	0.0
605	119.6	0.0	0.0	116.9	0.0	0.0	83.7	1001.2	608.0	243.8	0.0	0.0	160.1	0.0	0.0
621	115.5	0.0	0.0	116.6	0.0	0.0	83.8	1002.1	608.1	276.2	0.0	0.0	162.0	0.0	0.0
636	109.4	0.0	0.0	120.1	0.0	0.0	84.0	1003.4	606.5	345.9	0.0	0.0	147.0	0.0	0.0
652	111.4	0.0	0.0	120.5	0.0	0.0	85.0	1003.0	606.3	331.2	0.0	0.0	148.9	0.0	0.0
667	117.7	0.0	0.0	117.7	0.0	0.0	85.4	1001.6	607.6	270.7	0.0	0.0	164.2	0.0	0.0
683	119.2	0.0	0.0	122.2	0.0	0.0	86.3	1001.3	605.5	265.4	0.0	0.0	147.1	0.0	0.0
698	119.1	0.0	0.0	122.9	0.0	0.0	87.3	1001.3	605.2	273.5	0.0	0.0	147.7	0.0	0.0
714	118.4	0.0	0.0	123.3	0.0	0.0	88.2	1001.4	605.0	287.8	0.0	0.0	149.6	0.0	0.0
729	120.8	125.4	127.6	121.7	125.5	125.5	88.5	1000.9	604.9	269.3	235.7	222.4	158.3	142.0	142.0
745	119.4	124.4	128.9	122.2	126.5	126.5	88.6	1000.9	604.7	281.6	242.4	215.3	156.0	138.3	138.3
760	117.0	117.6	130.6	122.9	126.9	126.9	88.6	1001.6	603.8	306.5	300.2	207.2	152.9	137.0	137.0
776	117.4	119.5	126.5	123.2	123.5	123.5	88.7	1001.7	603.8	303.2	282.5	230.2	152.0	150.7	150.7
791	118.9	125.5	128.6	123.4	122.4	122.4	88.8	1001.7	604.0	289.0	237.0	218.5	151.6	156.1	156.1
807	121.7	126.7	122.5	123.5	119.5	119.5	88.9	1001.7	603.6	265.2	230.0	258.8	151.4	171.2	171.2
822	124.8	120.4	123.3	123.0	124.3	124.3	89.0	1002.4	603.4	243.1	277.0	253.6	153.9	148.3	148.3
838	126.3	119.3	129.9	122.7	117.1	117.1	89.1	1001.3	604.5	233.6	287.6	212.8	156.0	187.2	187.2

15.43	131.2	122.1	125.7	122.2	129.4	129.4	89.2	1000.8	604.7	206.7	263.7	237.7	158.9	130.4	130.4
15.59	127.9	124.6	126.0	121.8	150.0	150.0	89.3	1000.9	604.5	224.9	245.7	236.4	161.2	86.3	86.3
16.05	118.6	0.0	0.0	123.7	0.0	0.0	89.6	1002.2	606.5	299.2	0.0	0.0	154.0	0.0	0.0
20.74	119.8	0.0	0.0	127.0	0.0	0.0	92.3	1001.1	603.3	314.4	0.0	0.0	150.1	0.0	0.0
23.09	127.1	0.0	0.0	129.4	0.0	0.0	93.7	999.5	602.2	257.7	0.0	0.0	145.3	0.0	0.0
24.65	128.2	0.0	0.0	131.0	0.0	0.0	94.6	999.3	601.5	255.9	0.0	0.0	142.2	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 S(R)A=274.49 NU(S)A=157.31 NU(AV)A=251.05 ST(AV)A=0.00549 ST(AV)/ST(4S)=1.78 F/F(4S)= 9.23
 ST/ST(4S))/(F/F(4S))=0.193 (F/F(4S))/(ST/ST(4S))*3.0=1.64 (ST/ST(4S))/(F/F(4S))*3.0=0.85
 U(R)A/NU(4S)=1.95 NU(S)A/NU(4S)=1.12 e+(4R)= 843.92 R(4R)= 4.98 H(4R)=26.68

Y USING ROUGH SIDE RESULTS ONLY : H(RB)= 27.08

RUN NUMBER=167HR10-45/10 E/D=0.078 P/E=10.0 ALPHA=45 HYD DIA= 1.600 IN PR= 71 MDDT=0.0272 LBM/SEC
 RE= 11119. GGE(R)= 403.0 BTU/HR-SQ FT GGE(S)= 150.9 INLET TEMP= 77.7 F TATM= 74.0 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBLK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.12	100.1	0.0	93.1	87.1	0.0	125.4	77.8	397.2	144.8	157.6	0.0	229.8	138.0	0.0
2	0.27	100.3	0.0	95.5	88.1	0.0	125.8	78.0	397.2	144.4	157.3	0.0	200.5	126.3	0.0
3	0.43	99.4	0.0	101.5	89.3	0.0	125.9	78.2	397.4	143.8	165.3	0.0	150.4	114.2	0.0
4	0.59	103.1	0.0	101.5	91.0	0.0	123.6	78.4	396.6	143.0	141.5	0.0	151.2	99.9	0.0
5	0.74	102.8	0.0	105.4	92.2	0.0	124.8	78.5	396.6	142.5	144.2	0.0	130.2	92.0	0.0
6	0.90	102.4	0.0	109.7	93.0	0.0	125.3	78.7	396.7	142.1	147.7	0.0	112.9	87.7	0.0
7	1.05	106.5	0.0	112.7	93.9	0.0	126.5	78.9	395.8	141.7	126.4	0.0	103.2	83.2	0.0
8	1.21	105.8	0.0	119.1	94.7	0.0	120.0	79.1	396.0	141.3	130.5	0.0	87.2	79.7	0.0
9	1.37	107.9	0.0	124.1	95.6	0.0	131.3	79.2	395.5	140.9	121.6	0.0	77.7	75.9	0.0
10	1.52	108.3	0.0	119.0	96.6	0.0	150.0	79.4	395.4	140.5	120.6	0.0	88.0	72.0	0.0
11	1.68	105.2	0.0	0.0	95.8	0.0	0.0	79.6	396.1	140.8	136.2	0.0	0.0	76.5	0.0
12	1.84	116.0	0.0	0.0	96.8	0.0	0.0	79.8	393.7	140.4	95.7	0.0	0.0	72.5	0.0
13	1.99	114.9	0.0	0.0	98.5	0.0	0.0	79.9	394.0	139.6	99.2	0.0	0.0	66.2	0.0
14	2.15	115.1	0.0	0.0	100.0	0.0	0.0	80.1	393.9	138.9	99.1	0.0	0.0	61.5	0.0
15	2.30	110.3	0.0	0.0	101.3	0.0	0.0	80.3	395.0	138.3	115.8	0.0	0.0	57.9	0.0
16	2.46	109.1	0.0	0.0	102.8	0.0	0.0	80.5	395.2	137.6	121.4	0.0	0.0	54.2	0.0
17	2.62	121.7	0.0	0.0	104.7	0.0	0.0	80.6	392.5	137.1	84.0	0.0	0.0	50.1	0.0
18	2.77	117.3	0.0	0.0	104.1	0.0	0.0	80.8	393.4	137.0	94.8	0.0	0.0	51.7	0.0
19	2.93	115.3	0.0	0.0	104.3	0.0	0.0	81.0	393.9	136.9	100.9	0.0	0.0	51.6	0.0
20	3.09	109.8	0.0	0.0	104.5	0.0	0.0	81.2	395.1	136.8	121.2	0.0	0.0	51.5	0.0
21	3.24	111.0	0.0	0.0	107.5	0.0	0.0	81.3	394.8	135.4	116.9	0.0	0.0	45.5	0.0
22	3.40	122.1	0.0	0.0	108.5	0.0	0.0	81.5	392.4	135.0	84.9	0.0	0.0	43.9	0.0
23	3.55	118.7	0.0	0.0	109.7	0.0	0.0	81.7	393.1	134.4	93.2	0.0	0.0	42.1	0.0
24	3.71	117.0	0.0	0.0	109.8	0.0	0.0	81.9	393.5	134.4	98.3	0.0	0.0	42.2	0.0
25	3.87	111.6	0.0	0.0	110.5	0.0	0.0	82.1	394.7	134.1	117.2	0.0	0.0	41.3	0.0
26	4.02	110.2	0.0	0.0	111.3	0.0	0.0	82.2	395.0	133.7	123.8	0.0	0.0	40.3	0.0
27	4.18	114.5	0.0	0.0	112.0	0.0	0.0	82.4	394.1	133.4	107.6	0.0	0.0	39.5	0.0
28	4.34	118.5	0.0	0.0	113.1	0.0	0.0	82.6	393.2	132.9	95.9	0.0	0.0	38.1	0.0
29	4.49	117.9	0.0	0.0	113.5	0.0	0.0	82.8	393.3	132.7	98.0	0.0	0.0	37.8	0.0
30	4.65	113.6	0.0	0.0	114.2	0.0	0.0	82.9	394.3	132.4	112.6	0.0	0.0	37.1	0.0
31	4.80	114.0	0.0	0.0	115.4	0.0	0.0	83.1	394.2	131.8	111.7	0.0	0.0	35.7	0.0
32	4.96	124.1	0.0	0.0	115.0	0.0	0.0	83.3	391.9	132.0	84.1	0.0	0.0	36.4	0.0
33	5.12	119.8	0.0	0.0	115.2	0.0	0.0	83.5	392.9	131.9	94.6	0.0	0.0	36.4	0.0
34	5.27	117.8	0.0	0.0	114.8	0.0	0.0	83.6	393.3	132.1	100.7	0.0	0.0	37.1	0.0
35	5.43	113.2	0.0	0.0	115.3	0.0	0.0	83.8	394.3	131.9	117.3	0.0	0.0	36.6	0.0
36	5.59	113.1	0.0	0.0	115.8	0.0	0.0	84.0	394.4	131.6	118.4	0.0	0.0	36.2	0.0
37	5.74	123.8	0.0	0.0	115.9	0.0	0.0	84.2	392.0	131.6	86.4	0.0	0.0	36.2	0.0
38	5.90	119.2	0.0	0.0	116.0	0.0	0.0	84.3	393.0	131.5	98.5	0.0	0.0	36.3	0.0
39	6.05	119.5	0.0	0.0	116.2	0.0	0.0	84.5	393.0	131.4	98.1	0.0	0.0	36.2	0.0
40	6.21	117.7	0.0	0.0	116.3	0.0	0.0	84.7	393.4	131.4	104.1	0.0	0.0	36.3	0.0
41	6.36	118.7	0.0	0.0	117.0	0.0	0.0	85.2	393.1	131.1	102.4	0.0	0.0	36.0	0.0
42	6.52	121.6	0.0	0.0	118.3	0.0	0.0	87.0	392.5	130.5	98.6	0.0	0.0	36.2	0.0
43	6.68	122.7	0.0	0.0	119.1	0.0	0.0	87.9	392.3	130.1	97.8	0.0	0.0	36.2	0.0
44	10.59	124.3	0.0	0.0	121.9	0.0	0.0	89.6	391.9	128.8	97.9	0.0	0.0	34.6	0.0
45	12.15	125.6	0.0	0.0	123.4	0.0	0.0	91.4	391.6	128.1	98.8	0.0	0.0	34.6	0.0
46	13.71	127.6	0.0	0.0	124.0	0.0	0.0	93.1	391.2	127.9	97.7	0.0	0.0	35.7	0.0
47	14.30	130.7	140.5	137.4	122.9	125.4	125.4	93.8	390.5	127.6	91.0	71.9	77.1	37.8	34.7
48	14.34	131.6	133.2	143.5	123.4	125.8	125.8	93.8	390.2	127.4	89.0	85.3	67.6	37.1	34.3
49	14.49	129.0	130.8	149.8	123.4	125.9	125.9	94.0	390.7	127.1	96.1	91.3	61.3	37.2	34.3
50	14.65	129.5	130.9	141.7	123.2	123.6	123.6	94.2	390.6	127.2	95.2	91.5	70.7	37.6	37.2
51	14.80	130.0	137.2	141.4	123.2	124.8	124.8	94.4	390.5	127.2	94.2	78.4	71.4	37.9	35.9
52	14.96	133.0	139.4	132.8	123.3	125.3	125.3	94.5	389.9	127.0	87.0	74.7	87.6	38.0	35.5
53	15.12	130.1	133.4	132.0	123.0	126.5	126.5	94.7	391.4	127.0	94.9	86.9	90.2	38.6	34.3
54	15.27	126.6	134.7	145.2	121.9	120.0	120.0	94.9	390.7	128.0	105.6	84.3	66.7	40.7	43.8

55	15.43	127.1	132.2	141.6	122.3	131.3	131.3	95.1	391.1	127.5	104.9	90.4	72.2	40.2	30.2
56	15.59	126.0	131.1	142.6	122.7	150.0	150.0	95.2	391.4	127.3	109.1	93.7	70.9	39.8	19.9
57	16.05	129.3	0.0	0.0	125.8	0.0	0.0	95.8	391.1	126.7	100.1	0.0	0.0	36.2	0.0
58	20.74	136.6	0.0	0.0	129.0	0.0	0.0	101.0	389.2	125.6	93.1	0.0	0.0	38.2	0.0
59	23.09	137.3	0.0	0.0	131.3	0.0	0.0	103.7	389.0	124.5	98.0	0.0	0.0	38.2	0.0
60	24.65	140.2	0.0	0.0	132.0	0.0	0.0	105.4	388.4	124.2	94.3	0.0	0.0	39.5	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A= 99.05 NU(S)A= 37.42 NU(AV)A= 86.72 ST(AV)A=0.01095 ST(AV)/ST(4S)=2.50 F/F(4S)= 8.69
 (ST/ST(4S))/(F/F(4S))=0.287 (F/F(4S))/(ST/ST(4S))*3.0=0.56 (ST/ST(4S))/(F/F(4S))*(1/3)=1.21
 NU(R)A/NU(4S)=2.87 NU(S)A/NU(4S)=1.08 e+(4R)= 175.43 R(4R)= 3.97 H(4R)=15.13

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 15.24

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER=168HR00-45/10 E/D=0.078 P/F=10.0 ALPHA=45 HYD DIA= 1.600 IN PR=.71 MDOT=0.0844 LBM/SEC
R2168 QGE(R)= 803.6 BTU/HR-SQ FT QGE(S)= 267.5 INLET TEMP= 80.3 F TATM= 73.4 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1.12	99.1	0.0	92.3	88.1	0.0	121.8	80.4	797.9	280.8	376.2	0.0	592.1	322.7	0.0	59.7
1.27	98.4	0.0	92.9	89.3	0.0	122.4	80.6	798.1	280.2	393.8	0.0	569.6	282.6	0.0	58.9
1.43	98.1	0.0	97.5	90.6	0.0	122.9	80.7	798.1	279.6	403.5	0.0	417.9	248.6	0.0	58.3
1.59	102.5	0.0	98.4	92.0	0.0	120.9	80.8	797.2	279.0	323.5	0.0	399.1	219.8	0.0	61.2
1.74	102.2	0.0	104.0	93.6	0.0	120.9	81.0	797.2	278.2	330.1	0.0	304.3	193.7	0.0	61.2
1.90	101.2	0.0	107.5	94.7	0.0	120.6	81.1	797.4	277.7	348.7	0.0	265.5	179.5	0.0	61.8
2.05	104.2	0.0	108.7	95.3	0.0	121.9	81.2	796.8	277.5	304.8	0.0	254.9	173.3	0.0	59.9
2.21	104.2	0.0	116.5	95.3	0.0	119.8	81.4	796.8	277.5	306.5	0.0	199.2	175.0	0.0	63.4
2.37	106.4	0.0	121.4	95.8	0.0	127.9	81.5	796.3	277.2	280.8	0.0	175.2	170.3	0.0	52.5
2.52	107.6	0.0	119.1	96.6	0.0	150.0	81.6	796.0	276.9	269.1	0.0	186.5	162.4	0.0	35.5
2.68	105.2	0.0	0.0	96.2	0.0	0.0	81.8	796.6	277.0	298.3	0.0	0.0	168.5	0.0	0.0
2.84	115.0	0.0	0.0	97.2	0.0	0.0	81.9	794.4	276.6	210.6	0.0	0.0	158.6	0.0	0.0
2.99	113.1	0.0	0.0	98.3	0.0	0.0	82.0	794.8	276.1	224.4	0.0	0.0	148.9	0.0	0.0
3.15	114.6	0.0	0.0	99.7	0.0	0.0	82.2	794.5	275.4	214.8	0.0	0.0	137.8	0.0	0.0
3.30	110.7	0.0	0.0	100.4	0.0	0.0	82.3	795.4	275.1	245.5	0.0	0.0	133.3	0.0	0.0
3.46	110.6	0.0	0.0	101.2	0.0	0.0	82.4	795.4	274.7	247.5	0.0	0.0	128.3	0.0	0.0
3.62	122.1	0.0	0.0	103.4	0.0	0.0	82.6	792.8	274.2	175.7	0.0	0.0	115.4	0.0	0.0
3.77	117.6	0.0	0.0	102.5	0.0	0.0	82.7	793.8	274.2	199.3	0.0	0.0	121.3	0.0	0.0
3.93	116.3	0.0	0.0	103.0	0.0	0.0	82.8	794.1	273.9	207.8	0.0	0.0	119.0	0.0	0.0
4.09	110.1	0.0	0.0	106.1	0.0	0.0	83.0	795.5	273.5	256.7	0.0	0.0	103.6	0.0	0.0
4.24	111.8	0.0	0.0	105.0	0.0	0.0	83.1	795.1	273.0	242.5	0.0	0.0	109.1	0.0	0.0
4.40	123.3	0.0	0.0	106.0	0.0	0.0	83.2	792.6	272.5	173.1	0.0	0.0	104.8	0.0	0.0
4.55	119.4	0.0	0.0	108.7	0.0	0.0	83.4	793.4	271.3	192.7	0.0	0.0	93.7	0.0	0.0
4.71	118.4	0.0	0.0	107.1	0.0	0.0	83.5	793.7	271.3	198.9	0.0	0.0	100.5	0.0	0.0
4.87	112.1	0.0	0.0	108.1	0.0	0.0	83.6	795.0	271.2	244.2	0.0	0.0	96.9	0.0	0.0
5.02	109.9	0.0	0.0	109.8	0.0	0.0	83.8	795.5	270.8	266.1	0.0	0.0	90.9	0.0	0.0
5.18	115.1	0.0	0.0	111.0	0.0	0.0	83.9	794.4	270.2	222.5	0.0	0.0	87.2	0.0	0.0
5.34	120.0	0.0	0.0	112.4	0.0	0.0	84.0	793.3	269.6	192.8	0.0	0.0	83.0	0.0	0.0
5.49	120.0	0.0	0.0	112.8	0.0	0.0	84.1	793.3	269.4	193.4	0.0	0.0	82.2	0.0	0.0
5.65	114.8	0.0	0.0	113.0	0.0	0.0	84.3	794.5	269.3	227.5	0.0	0.0	82.0	0.0	0.0
5.80	115.3	0.0	0.0	114.4	0.0	0.0	84.4	794.3	268.7	224.7	0.0	0.0	78.3	0.0	0.0
5.96	126.6	0.0	0.0	114.5	0.0	0.0	84.5	791.9	268.6	164.5	0.0	0.0	78.3	0.0	0.0
6.12	121.5	0.0	0.0	114.3	0.0	0.0	84.7	793.0	268.7	187.6	0.0	0.0	79.2	0.0	0.0
6.27	119.9	0.0	0.0	113.3	0.0	0.0	84.8	793.3	269.2	197.4	0.0	0.0	82.5	0.0	0.0
6.43	113.6	0.0	0.0	113.9	0.0	0.0	84.9	794.7	268.9	242.1	0.0	0.0	81.1	0.0	0.0
6.59	112.6	0.0	0.0	115.1	0.0	0.0	85.1	794.9	268.4	252.1	0.0	0.0	78.0	0.0	0.0
6.74	126.4	0.0	0.0	113.4	0.0	0.0	85.2	791.9	268.2	167.7	0.0	0.0	77.5	0.0	0.0
6.90	122.0	0.0	0.0	114.6	0.0	0.0	85.3	792.9	268.6	188.7	0.0	0.0	80.1	0.0	0.0
7.05	122.4	0.0	0.0	114.1	0.0	0.0	85.5	792.8	268.8	187.2	0.0	0.0	81.9	0.0	0.0
7.21	119.2	0.0	0.0	114.2	0.0	0.0	85.6	793.5	268.8	206.0	0.0	0.0	82.0	0.0	0.0
7.36	120.1	0.0	0.0	115.9	0.0	0.0	86.0	793.3	268.0	202.7	0.0	0.0	78.1	0.0	0.0
7.52	122.5	0.0	0.0	115.6	0.0	0.0	87.3	792.8	268.1	196.0	0.0	0.0	82.4	0.0	0.0
7.67	124.4	0.0	0.0	116.4	0.0	0.0	88.0	792.3	267.8	189.0	0.0	0.0	81.8	0.0	0.0
7.83	125.7	0.0	0.0	119.2	0.0	0.0	89.3	792.1	266.5	188.6	0.0	0.0	77.3	0.0	0.0
7.98	125.2	0.0	0.0	119.9	0.0	0.0	90.6	792.2	266.1	198.2	0.0	0.0	78.6	0.0	0.0
8.14	128.2	0.0	0.0	120.5	0.0	0.0	91.9	791.5	265.9	188.4	0.0	0.0	80.4	0.0	0.0
8.29	131.3	138.3	133.6	121.0	121.8	121.8	92.4	790.8	265.6	175.5	148.7	165.7	80.2	78.0	78.0
8.45	132.3	128.8	147.3	120.5	122.4	122.4	92.5	790.4	265.4	171.1	187.6	124.3	81.6	76.5	76.5
8.60	130.0	123.3	145.5	120.6	122.9	122.9	92.6	790.9	265.0	182.3	222.2	128.9	81.6	75.4	75.4
8.76	129.0	127.8	132.9	120.1	120.9	120.9	92.7	791.1	265.1	188.0	194.5	169.8	83.5	81.2	81.2
8.91	126.5	138.7	134.9	120.3	120.9	120.9	92.9	791.8	265.3	202.9	148.9	162.3	83.3	81.6	81.6
9.07	132.2	135.8	129.4	120.2	120.6	120.6	93.0	790.9	265.0	173.9	159.2	187.2	83.9	82.7	82.7
9.22	130.5	130.4	130.7	120.2	121.9	121.9	93.1	792.3	264.8	182.9	183.2	181.7	84.2	79.3	79.3
9.38	128.8	133.1	141.6	119.8	119.8	119.8	93.3	791.4	265.7	191.8	171.1	141.0	86.2	86.2	86.2
15.43	134.7	130.9	136.0	119.1	127.9	127.9	93.4	791.6	265.7	165.2	181.8	160.0	89.0	66.3	66.3
15.59	130.6	130.1	138.3	118.7	150.0	150.0	93.5	792.4	265.8	184.2	186.5	152.4	90.9	40.5	40.5
16.05	130.9	0.0	0.0	124.3	0.0	0.0	93.9	791.7	265.2	184.4	0.0	0.0	75.2	0.0	0.0
20.74	135.8	0.0	0.0	126.0	0.0	0.0	97.9	789.8	263.3	178.1	0.0	0.0	80.1	0.0	0.0
23.09	136.4	0.0	0.0	127.9	0.0	0.0	99.9	789.7	262.5	184.2	0.0	0.0	79.8	0.0	0.0
24.65	138.4	0.0	0.0	129.0	0.0	0.0	101.2	789.3	262.0	180.4	0.0	0.0	80.1	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A=191.79 NU(S)A= 82.16 NU(AV)A=169.87 ST(AV)A=0.00742 ST(AV)/ST(4S)=2.09 F/F(4S)=11.10
 ST/ST(4S)/(F/F(4S))=0.188 (F/F(4S))/(ST/ST(4S))**3 0=1.21 (ST/ST(4S))/(F/F(4S))**(1/3)=0.94
 NU(R)A/NU(4S)=2.37 NU(S)A/NU(4S)=1.02 e+(4R)= 503.16 R(4R)= 4.01 H(4R)=22.98

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 23.01

RUN NUMBER=169HR60-45/10 E/D=0.078 P/E=10.0 ALPHA=45 HYD DIA= 1.600 IN PR= 71 MDOF=0.1630 LBM/SEC
 RE= 62164. GGE(R)=1284.3 BTU/HR-SQ FT GGE(S)= 543.6 INLET TEMP= 81.0 F TATM= 73.4 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.12	98.1	0.0	90.7	91.2	0.0	125.0	81.1	1278.9	635.4	660.4	0.0	1168.9	552.1	0.0
2	0.27	97.9	0.0	92.6	93.2	0.0	126.2	81.2	1279.0	634.5	672.9	0.0	985.9	464.7	0.0
3	0.43	96.7	0.0	96.4	95.2	0.0	127.4	81.3	1279.2	633.6	730.6	0.0	745.1	401.0	0.0
4	0.59	100.8	0.0	97.3	98.1	0.0	125.0	81.4	1278.3	632.3	579.8	0.0	707.7	333.2	0.0
5	0.74	101.0	0.0	103.5	98.6	0.0	124.2	81.6	1278.3	632.0	577.2	0.0	511.4	325.6	0.0
6	0.90	100.9	0.0	106.2	97.6	0.0	123.0	81.7	1278.3	632.5	583.6	0.0	457.5	348.6	0.0
7	1.05	101.3	0.0	107.1	98.0	0.0	126.4	81.8	1278.2	632.3	575.0	0.0	443.2	342.4	0.0
8	1.21	102.1	0.0	115.2	98.1	0.0	118.8	81.9	1278.0	632.3	555.4	0.0	336.8	342.7	0.0
9	1.37	104.7	0.0	120.2	99.6	0.0	131.2	82.0	1277.5	631.6	494.3	0.0	293.6	315.3	0.0
10	1.52	106.7	0.0	118.8	99.6	0.0	150.0	82.1	1277.0	631.6	456.1	0.0	305.6	317.4	0.0
11	1.68	105.4	0.0	0.0	99.9	0.0	0.0	82.3	1277.3	631.4	484.1	0.0	0.0	314.0	0.0
12	1.84	114.3	0.0	0.0	102.2	0.0	0.0	82.4	1275.3	630.4	350.3	0.0	0.0	278.9	0.0
13	1.99	112.4	0.0	0.0	103.1	0.0	0.0	82.5	1275.8	630.0	374.0	0.0	0.0	268.0	0.0
14	2.15	113.7	0.0	0.0	104.5	0.0	0.0	82.6	1275.5	629.3	359.6	0.0	0.0	252.0	0.0
15	2.30	110.1	0.0	0.0	104.5	0.0	0.0	82.7	1276.3	629.3	408.6	0.0	0.0	253.3	0.0
16	2.46	111.2	0.0	0.0	105.4	0.0	0.0	82.9	1276.0	628.9	394.3	0.0	0.0	244.3	0.0
17	2.62	120.1	0.0	0.0	108.4	0.0	0.0	83.0	1274.1	628.5	300.5	0.0	0.0	216.3	0.0
18	2.77	116.2	0.0	0.0	105.6	0.0	0.0	83.1	1274.9	629.1	337.2	0.0	0.0	244.9	0.0
19	2.93	115.9	0.0	0.0	105.3	0.0	0.0	83.2	1275.0	629.5	341.4	0.0	0.0	250.0	0.0
20	3.09	109.6	0.0	0.0	105.1	0.0	0.0	83.3	1276.4	629.9	425.2	0.0	0.0	252.9	0.0
21	3.24	112.4	0.0	0.0	100.1	0.0	0.0	83.4	1275.8	630.4	385.5	0.0	0.0	331.6	0.0
22	3.40	123.4	0.0	0.0	100.4	0.0	0.0	83.6	1273.3	630.3	279.6	0.0	0.0	327.9	0.0
23	3.55	118.9	0.0	0.0	110.4	0.0	0.0	83.7	1274.3	626.0	316.5	0.0	0.0	205.3	0.0
24	3.71	118.1	0.0	0.0	109.5	0.0	0.0	83.8	1274.5	625.8	324.9	0.0	0.0	212.9	0.0
25	3.87	112.1	0.0	0.0	107.1	0.0	0.0	83.9	1275.8	627.6	395.8	0.0	0.0	236.2	0.0
26	4.02	109.7	0.0	0.0	112.8	0.0	0.0	84.0	1276.4	625.5	434.7	0.0	0.0	190.1	0.0
27	4.18	114.9	0.0	0.0	114.5	0.0	0.0	84.1	1275.2	624.7	362.5	0.0	0.0	179.9	0.0
28	4.34	119.7	0.0	0.0	116.3	0.0	0.0	84.3	1274.2	623.9	314.3	0.0	0.0	170.2	0.0
29	4.49	119.9	0.0	0.0	116.4	0.0	0.0	84.4	1274.1	623.8	313.5	0.0	0.0	170.3	0.0
30	4.65	114.5	0.0	0.0	116.2	0.0	0.0	84.5	1275.3	623.9	371.4	0.0	0.0	172.0	0.0
31	4.80	116.5	0.0	0.0	118.4	0.0	0.0	84.6	1274.9	622.9	349.3	0.0	0.0	161.1	0.0
32	4.96	127.8	0.0	0.0	110.0	0.0	0.0	84.7	1272.4	626.8	258.0	0.0	0.0	216.7	0.0
33	5.12	121.4	0.0	0.0	118.0	0.0	0.0	84.9	1273.8	623.1	304.3	0.0	0.0	164.1	0.0
34	5.27	118.8	0.0	0.0	116.7	0.0	0.0	85.0	1274.4	623.7	328.9	0.0	0.0	171.6	0.0
35	5.43	112.5	0.0	0.0	117.3	0.0	0.0	85.1	1275.7	623.4	406.2	0.0	0.0	168.9	0.0
36	5.59	112.2	0.0	0.0	118.9	0.0	0.0	85.2	1275.8	622.7	412.4	0.0	0.0	161.3	0.0
37	5.74	127.0	0.0	0.0	120.1	0.0	0.0	85.3	1272.6	622.1	266.4	0.0	0.0	156.1	0.0
38	5.90	121.7	0.0	0.0	119.0	0.0	0.0	85.4	1273.7	622.6	306.4	0.0	0.0	161.8	0.0
39	6.05	121.4	0.0	0.0	118.6	0.0	0.0	85.6	1273.8	622.8	310.0	0.0	0.0	164.4	0.0
40	6.21	118.0	0.0	0.0	118.4	0.0	0.0	85.7	1274.5	622.9	343.8	0.0	0.0	166.0	0.0
41	6.68	118.3	0.0	0.0	121.2	0.0	0.0	86.0	1274.5	621.6	344.2	0.0	0.0	154.0	0.0
42	8.24	120.7	0.0	0.0	120.5	0.0	0.0	87.2	1273.9	622.0	330.8	0.0	0.0	162.5	0.0
43	9.02	123.7	0.0	0.0	120.9	0.0	0.0	87.8	1273.3	621.8	308.2	0.0	0.0	163.2	0.0
44	10.59	125.1	0.0	0.0	124.3	0.0	0.0	89.0	1273.0	620.2	305.6	0.0	0.0	152.3	0.0
45	12.15	124.1	0.0	0.0	124.6	0.0	0.0	90.2	1273.2	620.1	324.6	0.0	0.0	155.8	0.0
46	13.71	127.0	0.0	0.0	124.7	0.0	0.0	91.3	1272.6	620.0	308.2	0.0	0.0	160.5	0.0
47	14.30	132.1	137.8	128.9	124.0	125.0	125.0	91.8	1271.4	619.5	272.2	238.5	295.7	166.1	161.0
48	14.34	131.7	128.1	144.0	123.8	126.2	126.2	91.8	1271.3	619.7	274.7	302.3	210.2	167.3	155.5
49	14.49	129.2	120.0	146.2	124.1	127.4	127.4	91.9	1271.9	619.0	294.3	390.9	202.2	166.0	150.6
50	14.65	128.3	124.8	132.6	123.9	125.0	125.0	92.0	1272.3	619.1	302.8	335.1	270.7	167.7	162.1
51	14.80	125.7	139.7	133.9	124.0	124.2	124.2	92.2	1273.2	619.4	327.0	231.0	263.1	167.9	166.8
52	14.96	133.0	137.1	128.1	123.3	123.0	123.0	92.3	1272.2	619.3	269.2	244.8	306.3	172.1	173.9
53	15.12	132.9	129.3	132.2	124.4	126.4	126.4	92.4	1273.5	618.4	271.1	297.6	275.9	166.4	156.8
54	15.27	134.0	129.3	140.3	125.3	118.8	118.8	92.5	1272.6	619.0	264.2	298.2	229.6	162.9	203.0
55	15.43	136.7	129.3	134.9	125.4	131.2	131.2	92.6	1272.5	619.0	248.6	299.1	259.5	163.0	138.3
56	15.59	130.6	130.9	137.0	124.4	150.0	150.0	92.7	1273.3	619.0	289.6	287.6	248.0	168.5	93.2
57	16.05	129.8	0.0	0.0	125.3	0.0	0.0	93.1	1272.8	620.9	299.1	0.0	0.0	161.3	0.0
58	20.74	134.2	0.0	0.0	129.0	0.0	0.0	96.6	1271.0	618.0	289.7	0.0	0.0	163.5	0.0
59	23.09	133.9	0.0	0.0	131.2	0.0	0.0	98.4	1271.0	617.0	305.8	0.0	0.0	160.6	0.0
60	24.65	135.3	0.0	0.0	132.0	0.0	0.0	99.6	1270.7	616.7	303.2	0.0	0.0	162.1	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A=304.98 NU(S)A=168.00 NU(AV)A=277.58 ST(AV)A=0.00627 ST(AV)/ST(4S)=2.02 F/F(4S)=12.79
 (ST/ST(4S))/(F/F(4S))=0.158 (F/F(4S))/(ST/ST(4S))*3.0=1.55 (ST/ST(4S))/(F/F(4S))*((1/3)=0.86
 NU(R)A/NU(4S)=2.23 NU(S)A/NU(4S)=1.23 e+(4R)= 966.45 R(4R)= 4.05 H(4R)=27.27

BY USING ROUGH SIDE RESULTS ONLY : H(RB) = 27.98

ORIGINAL PAGE IS
OF POOR QUALITY

NUMBER=171HR10-30/10 E/D=0.078 P/E=10.0 ALPHA=30 HYD DIA= 1.600 IN PR= .71 MDOT=0.0314 LBM/SEC
1983. QGE(R)= 413.3 BTU/HR-SQ FT QGE(S)= 138.3 INLET TEMP= 77.0 F TATM= 72.7 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
12	91.7	0.0	94.8	85.7	0.0	122.7	77.1	409.2	132.3	248.2	0.0	204.7	136.4	0.0	25.7
27	92.9	0.0	98.5	86.8	0.0	123.1	77.3	408.9	131.8	231.5	0.0	170.4	122.5	0.0	25.4
43	94.6	0.0	100.8	87.9	0.0	123.3	77.5	408.5	131.3	210.5	0.0	154.6	111.1	0.0	25.3
59	99.7	0.0	100.7	89.5	0.0	121.2	77.6	407.4	130.6	163.0	0.0	155.9	97.1	0.0	26.5
74	99.7	0.0	104.9	90.6	0.0	122.2	77.8	407.4	130.1	164.2	0.0	132.7	89.6	0.0	25.9
90	99.4	0.0	108.7	91.5	0.0	122.3	77.9	407.5	129.7	167.7	0.0	117.0	84.5	0.0	25.8
105	107.7	0.0	112.3	92.5	0.0	124.3	78.1	405.6	129.2	121.0	0.0	104.7	79.3	0.0	24.7
21	110.9	0.0	117.9	93.1	0.0	115.8	78.3	404.9	128.9	109.5	0.0	90.2	76.7	0.0	30.3
37	111.4	0.0	121.1	93.7	0.0	128.2	78.4	404.8	128.7	108.4	0.0	83.7	74.4	0.0	22.8
52	111.1	0.0	114.8	94.6	0.0	150.0	78.6	404.9	128.2	109.9	0.0	98.7	70.7	0.0	15.8
68	104.2	0.0	0.0	94.0	0.0	0.0	78.8	406.4	128.5	140.9	0.0	0.0	74.4	0.0	0.0
84	113.6	0.0	0.0	95.2	0.0	0.0	78.9	404.3	128.0	102.8	0.0	0.0	69.3	0.0	0.0
99	117.3	0.0	0.0	96.6	0.0	0.0	79.1	403.5	127.3	93.1	0.0	0.0	64.1	0.0	0.0
115	114.2	0.0	0.0	98.2	0.0	0.0	79.3	404.2	126.6	101.9	0.0	0.0	58.9	0.0	0.0
130	105.7	0.0	0.0	99.8	0.0	0.0	79.4	406.1	125.8	136.1	0.0	0.0	54.4	0.0	0.0
146	102.9	0.0	0.0	101.2	0.0	0.0	79.6	406.7	125.2	153.6	0.0	0.0	51.0	0.0	0.0
162	119.6	0.0	0.0	103.3	0.0	0.0	79.8	403.0	124.7	89.0	0.0	0.0	46.7	0.0	0.0
177	118.8	0.0	0.0	103.3	0.0	0.0	79.9	403.2	124.2	91.3	0.0	0.0	46.8	0.0	0.0
193	115.3	0.0	0.0	103.5	0.0	0.0	80.1	404.0	124.1	100.9	0.0	0.0	46.6	0.0	0.0
209	110.2	0.0	0.0	103.8	0.0	0.0	80.2	405.1	124.0	119.0	0.0	0.0	46.3	0.0	0.0
224	107.6	0.0	0.0	104.0	0.0	0.0	80.4	405.7	123.9	131.2	0.0	0.0	46.2	0.0	0.0
240	121.8	0.0	0.0	105.0	0.0	0.0	80.6	402.5	123.5	85.8	0.0	0.0	44.4	0.0	0.0
255	123.9	0.0	0.0	106.3	0.0	0.0	80.7	402.1	122.9	81.9	0.0	0.0	42.2	0.0	0.0
271	119.3	0.0	0.0	105.8	0.0	0.0	80.9	403.1	123.1	92.2	0.0	0.0	43.4	0.0	0.0
287	112.5	0.0	0.0	106.0	0.0	0.0	81.1	404.6	123.0	113.1	0.0	0.0	43.3	0.0	0.0
302	110.5	0.0	0.0	106.6	0.0	0.0	81.2	405.0	122.7	121.5	0.0	0.0	42.5	0.0	0.0
318	117.2	0.0	0.0	108.0	0.0	0.0	81.4	403.6	122.1	99.0	0.0	0.0	40.3	0.0	0.0
334	125.8	0.0	0.0	109.2	0.0	0.0	81.6	401.7	121.5	79.7	0.0	0.0	38.6	0.0	0.0
349	120.9	0.0	0.0	110.0	0.0	0.0	81.7	402.7	121.2	90.2	0.0	0.0	37.6	0.0	0.0
365	115.4	0.0	0.0	110.2	0.0	0.0	81.9	403.9	121.1	105.8	0.0	0.0	37.5	0.0	0.0
380	112.9	0.0	0.0	111.4	0.0	0.0	82.1	404.5	120.5	115.0	0.0	0.0	36.0	0.0	0.0
396	124.4	0.0	0.0	112.0	0.0	0.0	82.2	402.0	120.2	83.6	0.0	0.0	35.4	0.0	0.0
412	125.8	0.0	0.0	112.3	0.0	0.0	82.4	401.7	120.1	81.1	0.0	0.0	35.2	0.0	0.0
427	119.9	0.0	0.0	112.4	0.0	0.0	82.5	403.0	120.1	94.5	0.0	0.0	35.2	0.0	0.0
443	115.1	0.0	0.0	112.8	0.0	0.0	82.7	404.0	119.9	109.3	0.0	0.0	34.9	0.0	0.0
459	111.1	0.0	0.0	113.2	0.0	0.0	82.9	404.9	119.7	125.6	0.0	0.0	34.6	0.0	0.0
474	123.5	0.0	0.0	113.5	0.0	0.0	83.0	402.2	119.5	87.0	0.0	0.0	34.4	0.0	0.0
490	122.9	0.0	0.0	113.2	0.0	0.0	83.2	402.3	119.7	88.7	0.0	0.0	34.9	0.0	0.0
505	120.9	0.0	0.0	113.0	0.0	0.0	83.4	402.7	119.8	93.9	0.0	0.0	35.4	0.0	0.0
521	117.1	0.0	0.0	113.3	0.0	0.0	83.5	403.6	119.6	105.2	0.0	0.0	35.2	0.0	0.0
536	123.6	0.0	0.0	114.5	0.0	0.0	84.0	402.1	119.1	88.8	0.0	0.0	34.2	0.0	0.0
552	129.9	0.0	0.0	117.4	0.0	0.0	85.7	400.8	117.8	79.0	0.0	0.0	32.4	0.0	0.0
567	124.4	0.0	0.0	118.0	0.0	0.0	86.5	402.0	117.5	92.3	0.0	0.0	32.5	0.0	0.0
583	126.4	0.0	0.0	119.4	0.0	0.0	88.1	401.5	116.8	91.1	0.0	0.0	32.4	0.0	0.0
598	128.2	0.0	0.0	120.2	0.0	0.0	89.8	401.1	116.5	90.4	0.0	0.0	33.1	0.0	0.0
614	139.5	0.0	0.0	121.0	0.0	0.0	91.4	400.8	116.1	90.9	0.0	0.0	33.9	0.0	0.0
630	122.0	137.8	138.3	119.8	122.7	122.7	92.0	402.5	115.8	115.9	75.9	75.1	35.9	32.6	32.6
645	132.3	135.8	142.7	120.4	123.1	123.1	92.1	400.1	115.6	85.8	78.9	68.2	35.2	32.1	32.1
661	130.1	130.3	145.4	120.7	123.3	123.3	92.2	400.6	115.2	91.2	90.8	65.0	35.0	32.0	32.0
676	128.5	142.2	141.8	120.6	121.2	121.2	92.4	400.9	115.2	95.7	69.4	70.0	35.3	34.5	34.5
692	123.9	140.3	139.7	120.4	122.2	122.2	92.6	401.9	115.3	110.5	72.6	73.5	35.8	33.5	33.5
707	118.7	135.7	134.2	120.4	122.3	122.3	92.7	403.1	115.1	133.7	80.9	83.8	35.9	33.6	33.6
723	128.2	128.3	140.9	121.2	124.3	124.3	92.9	401.9	114.6	98.1	97.8	72.1	34.9	31.4	31.4
738	125.8	127.1	144.6	121.3	115.8	115.8	93.1	400.9	115.1	105.5	101.4	67.0	35.0	43.6	43.6

15.43	125.9	140.1	140.4	121.6	128.2	128.2	93.2	401.4	114.6	105.7	73.8	73.3	34.8	28.2	28.2
15.59	122.8	138.0	141.2	121.5	150.0	150.0	93.4	402.2	114.6	117.7	77.6	72.4	35.1	17.4	17.4
16.05	129.7	0.0	0.0	121.5	0.0	0.0	93.9	401.1	115.5	96.4	0.0	0.0	35.9	0.0	0.0
20.74	137.0	0.0	0.0	126.0	0.0	0.0	98.8	399.2	113.8	89.2	0.0	0.0	35.7	0.0	0.0
23.09	138.4	0.0	0.0	128.2	0.0	0.0	101.3	398.9	112.8	91.3	0.0	0.0	35.6	0.0	0.0
24.65	143.0	0.0	0.0	129.0	0.0	0.0	102.9	397.9	112.4	84.2	0.0	0.0	36.5	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A=102.19 NU(S)A= 35.20 NU(AV)A= 98.79 ST(AV)A=0.01041 ST(AV)/ST(4S)=2.41 F/F(4S)= 5.81
 (ST/ST(4S))/(F/F(4S))=0.415 (F/F(4S))/(ST/ST(4S))*3.0=0.42 (ST/ST(4S))/(F/F(4S))*((1/3))=1.34
 NU(R)A/NU(4S)=2.79 NU(S)A/NU(4S)=0.96 e+(4R)= 152.20 R(4R)= 5.16 H(4R)=12.71

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 12.65

RUN NUMBER=172HR30-30/10 E/D=0.078 P/F=10.0 ALPHA=30 HYD DIA= 1.600 IN PR= 71 MDDT=0.0851 LBM/SEC
 RE= 32488. QGE(R)= 786.5 BTU/HR-SQ FT QGE(S)= 300.5 INLET TEMP= 79.4 F TATM= 73.2 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TGULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.12	91.8	0.0	93.9	89.0	0.0	121.9	79.5	782.4	293.2	560.2	0.0	478.5	271.8	0.0	
2	0.27	92.3	0.0	93.6	89.5	0.0	122.6	79.6	782.3	293.0	543.6	0.0	493.0	261.3	0.0	
3	0.43	94.7	0.0	98.3	90.0	0.0	123.2	79.8	781.8	292.8	460.6	0.0	371.2	251.6	0.0	
4	0.59	100.3	0.0	99.5	91.8	0.0	121.0	79.9	780.6	292.0	336.5	0.0	350.3	215.7	0.0	
5	0.74	100.6	0.0	104.6	93.8	0.0	120.9	80.0	780.5	291.0	333.6	0.0	279.4	185.8	0.0	
6	0.90	106.2	0.0	107.4	94.5	0.0	120.9	80.1	780.6	290.7	342.4	0.0	252.0	178.1	0.0	
7	1.05	107.0	0.0	109.3	94.8	0.0	122.6	80.3	779.1	290.6	256.4	0.0	236.1	175.9	0.0	
8	1.21	108.8	0.0	116.6	94.9	0.0	118.0	80.4	778.7	290.5	241.1	0.0	189.2	176.2	0.0	
9	1.37	108.6	0.0	120.9	95.7	0.0	120.0	80.5	778.7	290.2	243.9	0.0	169.6	168.2	0.0	
10	1.52	108.6	0.0	117.4	96.7	0.0	150.0	80.7	778.7	289.7	245.0	0.0	186.3	158.8	0.0	
11	1.68	103.6	0.0	0.0	96.0	0.0	0.0	80.8	779.8	290.0	300.4	0.0	0.0	167.5	0.0	
12	1.84	114.9	0.0	0.0	97.6	0.0	0.0	80.9	777.3	289.3	201.0	0.0	0.0	152.4	0.0	
13	1.99	116.9	0.0	0.0	98.4	0.0	0.0	81.0	776.9	288.9	190.4	0.0	0.0	146.2	0.0	
14	2.15	114.9	0.0	0.0	100.0	0.0	0.0	81.2	777.3	288.2	202.4	0.0	0.0	134.5	0.0	
15	2.30	106.9	0.0	0.0	100.8	0.0	0.0	81.3	779.1	287.8	267.3	0.0	0.0	129.6	0.0	
16	2.46	102.6	0.0	0.0	102.0	0.0	0.0	81.4	780.0	287.3	323.5	0.0	0.0	122.6	0.0	
17	2.62	121.2	0.0	0.0	104.1	0.0	0.0	81.6	776.0	286.8	171.8	0.0	0.0	111.7	0.0	
18	2.77	119.0	0.0	0.0	103.0	0.0	0.0	81.7	776.4	286.8	182.6	0.0	0.0	118.1	0.0	
19	2.93	116.3	0.0	0.0	104.0	0.0	0.0	81.8	777.0	286.3	197.7	0.0	0.0	113.3	0.0	
20	3.09	110.6	0.0	0.0	104.6	0.0	0.0	81.9	778.3	287.0	238.3	0.0	0.0	111.1	0.0	
21	3.24	107.0	0.0	0.0	108.0	0.0	0.0	82.1	779.1	284.5	274.1	0.0	0.0	96.3	0.0	
22	3.40	124.4	0.0	0.0	108.0	0.0	0.0	82.2	775.3	284.5	161.1	0.0	0.0	96.7	0.0	
23	3.55	125.0	0.0	0.0	108.6	0.0	0.0	82.3	775.1	284.2	159.3	0.0	0.0	94.9	0.0	
24	3.71	119.5	0.0	0.0	106.7	0.0	0.0	82.5	776.3	284.4	183.7	0.0	0.0	102.9	0.0	
25	3.87	112.5	0.0	0.0	107.1	0.0	0.0	82.6	777.9	284.5	227.9	0.0	0.0	101.7	0.0	
26	4.02	110.0	0.0	0.0	108.4	0.0	0.0	82.7	778.4	284.3	250.0	0.0	0.0	97.0	0.0	
27	4.18	118.5	0.0	0.0	109.7	0.0	0.0	82.8	776.5	283.7	190.8	0.0	0.0	92.6	0.0	
28	4.34	127.0	0.0	0.0	111.2	0.0	0.0	83.0	774.7	283.0	154.1	0.0	0.0	87.8	0.0	
29	4.49	121.3	0.0	0.0	111.6	0.0	0.0	83.1	775.9	282.8	177.9	0.0	0.0	86.9	0.0	
30	4.65	115.0	0.0	0.0	110.9	0.0	0.0	83.2	777.3	283.2	214.2	0.0	0.0	89.6	0.0	
31	4.80	113.7	0.0	0.0	112.2	0.0	0.0	83.4	777.6	282.6	224.3	0.0	0.0	85.8	0.0	
32	4.96	128.1	0.0	0.0	112.3	0.0	0.0	83.5	774.4	282.5	151.9	0.0	0.0	85.8	0.0	
33	5.12	127.1	0.0	0.0	112.4	0.0	0.0	83.6	774.7	282.5	155.9	0.0	0.0	85.9	0.0	
34	5.27	120.6	0.0	0.0	112.6	0.0	0.0	83.8	776.1	282.4	184.2	0.0	0.0	85.6	0.0	
35	5.43	114.5	0.0	0.0	113.3	0.0	0.0	83.9	777.4	282.1	222.0	0.0	0.0	83.8	0.0	
36	5.59	109.6	0.0	0.0	114.4	0.0	0.0	84.0	778.5	281.6	266.0	0.0	0.0	81.0	0.0	
37	5.74	126.2	0.0	0.0	114.7	0.0	0.0	84.1	774.9	281.4	161.0	0.0	0.0	80.5	0.0	
38	5.90	124.2	0.0	0.0	114.0	0.0	0.0	84.3	775.3	281.7	169.7	0.0	0.0	82.8	0.0	
39	6.05	122.7	0.0	0.0	113.7	0.0	0.0	84.4	775.6	281.9	176.9	0.0	0.0	84.0	0.0	
40	6.21	117.7	0.0	0.0	113.8	0.0	0.0	84.5	776.7	281.8	204.5	0.0	0.0	84.1	0.0	
41	6.38	124.4	0.0	0.0	116.1	0.0	0.0	84.9	775.3	280.8	171.4	0.0	0.0	78.6	0.0	
42	6.54	129.3	0.0	0.0	118.8	0.0	0.0	86.2	774.2	279.5	156.5	0.0	0.0	74.7	0.0	
43	6.70	125.2	0.0	0.0	118.3	0.0	0.0	86.8	775.1	279.8	175.9	0.0	0.0	77.4	0.0	
44	10.59	126.3	0.0	0.0	120.2	0.0	0.0	88.1	774.8	278.9	176.3	0.0	0.0	75.5	0.0	
45	12.15	129.3	0.0	0.0	121.4	0.0	0.0	89.4	774.2	278.3	168.2	0.0	0.0	75.4	0.0	
46	13.71	130.8	0.0	0.0	122.0	0.0	0.0	90.7	773.8	278.1	166.9	0.0	0.0	76.9	0.0	
47	14.30	120.9	133.5	140.0	122.5	121.9	121.9	91.2	776.0	277.8	225.8	158.5	137.4	76.7	78.2	78.
48	14.34	133.0	128.2	146.3	122.8	122.6	122.6	91.2	773.1	277.2	159.9	180.7	121.3	75.9	76.3	76.
49	14.49	131.5	127.4	147.5	122.9	123.2	123.2	91.4	773.5	276.8	166.5	185.4	119.0	75.8	75.1	75.
50	14.65	130.1	138.4	139.2	123.3	121.0	121.0	91.5	773.8	276.5	173.1	142.5	140.1	75.1	80.9	80.
51	14.80	123.8	137.6	136.9	122.4	120.9	120.9	91.6	775.3	277.2	208.0	145.6	147.8	77.8	81.7	81.
52	14.96	118.7	133.2	134.2	122.4	120.9	120.9	91.7	776.8	276.9	248.8	161.8	158.0	78.0	82.0	82.
53	15.12	133.0	125.8	142.8	123.0	122.6	122.6	91.9	774.7	276.4	162.5	197.1	131.3	76.7	77.6	77.
54	15.27	131.3	123.4	144.5	122.9	118.0	118.0	92.0	773.7	277.1	169.9	212.7	127.2	77.4	92.0	92.

55	15.43	134.7	138.8	138.4	123.1	128.0	128.0	92.1	774.5	276.7	156.9	143.2	144.4	77.1	66.6	66.6
56	15.59	128.1	134.7	135.7	123.0	150.0	150.0	92.3	775.8	276.7	186.6	157.7	154.1	77.7	41.3	41.3
57	16.05	132.9	0.0	0.0	125.0	0.0	0.0	92.6	774.2	277.8	165.8	0.0	0.0	74.0	0.0	0.0
58	20.74	138.1	0.0	0.0	127.0	0.0	0.0	96.5	772.2	275.8	159.1	0.0	0.0	77.5	0.0	0.0
59	23.09	137.7	0.0	0.0	128.0	0.0	0.0	98.4	772.3	275.3	168.0	0.0	0.0	79.6	0.0	0.0
60	24.65	141.4	0.0	0.0	129.0	0.0	0.0	99.7	771.5	274.8	157.8	0.0	0.0	80.0	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A=188.72 NU(S)A= 80.37 NU(AV)A=167.05 ST(AV)A=0.00723 ST(AV)/ST(4S)=2.04 F/F(4S)= 6.18
 (ST/ST(4S))/(F/F(4S))=0.330 (F/F(4S))/(ST/ST(4S))*3.0=0.73 (ST/ST(4S))/(F/F(4S))*((1/3)=1.11
 NU(R)A/NU(4S)=2.32 NU(S)A/NU(4S)=0.99 e+(4R)= 376.00 R(4R)= 5.77 H(4R)=17.27

BY USING ROUGHSIDE RESULTS ONLY : H(RB)= 17.23

ORIGINAL PAGE IS
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NUMBER=173HR&O-30/10 E/D=0.078 P/E=10.0 ALPHA=30 HYD DIA= 1.600 IN PR=.71 MDDT=0.1680 LBM/SEC
54136. GGE(R)=1203.1 BTU/HR-SQ FT GGE(S)= 548.8 INLET TEMP= 81.2 F TATM= 74.5 F PATM= 10.2 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
12	92.1	0.0	93.7	90.5	0.0	122.2	81.3	1199.3	541.4	973.3	0.0	847.9	515.7	0.0	116.2
27	92.5	0.0	93.2	91.4	0.0	123.8	81.4	1199.2	541.0	947.3	0.0	891.2	474.3	0.0	112.0
43	94.5	0.0	97.2	92.3	0.0	124.0	81.5	1198.7	540.6	808.9	0.0	669.9	439.0	0.0	111.6
59	99.8	0.0	97.8	94.8	0.0	121.6	81.6	1197.6	539.4	577.4	0.0	648.7	358.6	0.0	118.4
74	100.6	0.0	103.2	95.8	0.0	120.1	81.7	1197.4	539.0	556.0	0.0	488.8	335.5	0.0	123.2
90	100.6	0.0	105.3	95.8	0.0	120.5	81.8	1197.4	539.0	559.1	0.0	447.2	338.0	0.0	122.2
05	105.2	0.0	106.8	96.4	0.0	122.6	81.9	1196.4	538.7	450.7	0.0	421.7	326.2	0.0	116.2
21	105.9	0.0	114.3	96.4	0.0	116.0	82.0	1196.2	538.7	439.4	0.0	325.0	328.5	0.0	139.0
37	106.1	0.0	118.8	97.2	0.0	127.6	82.1	1196.2	538.3	437.5	0.0	286.0	313.1	0.0	103.8
52	106.9	0.0	116.5	97.7	0.0	150.0	82.2	1196.0	538.1	425.1	0.0	306.0	305.0	0.0	69.6
68	102.7	0.0	0.0	97.8	0.0	0.0	82.3	1196.9	538.0	515.3	0.0	0.0	305.0	0.0	0.0
84	113.8	0.0	0.0	99.7	0.0	0.0	82.4	1194.5	537.2	333.9	0.0	0.0	272.8	0.0	0.0
1.99	116.4	0.0	0.0	100.7	0.0	0.0	82.5	1193.9	536.7	309.1	0.0	0.0	259.1	0.0	0.0
2.15	113.4	0.0	0.0	102.3	0.0	0.0	82.7	1194.6	536.0	340.4	0.0	0.0	239.0	0.0	0.0
2.30	106.3	0.0	0.0	101.9	0.0	0.0	82.8	1196.1	536.2	445.1	0.0	0.0	245.4	0.0	0.0
2.46	101.9	0.0	0.0	103.7	0.0	0.0	82.9	1197.1	535.3	550.8	0.0	0.0	225.0	0.0	0.0
2.62	119.2	0.0	0.0	106.8	0.0	0.0	83.0	1193.3	534.9	288.4	0.0	0.0	196.7	0.0	0.0
2.77	116.1	0.0	0.0	105.6	0.0	0.0	83.1	1194.0	534.7	316.6	0.0	0.0	207.9	0.0	0.0
2.93	115.1	0.0	0.0	105.8	0.0	0.0	83.2	1194.2	535.0	327.5	0.0	0.0	207.1	0.0	0.0
3.09	109.9	0.0	0.0	106.3	0.0	0.0	83.3	1195.3	535.1	393.1	0.0	0.0	203.6	0.0	0.0
3.24	105.6	0.0	0.0	106.0	0.0	0.0	83.4	1196.3	533.3	471.4	0.0	0.0	206.3	0.0	0.0
3.40	124.0	0.0	0.0	106.4	0.0	0.0	83.5	1192.2	533.1	257.6	0.0	0.0	203.6	0.0	0.0
3.55	122.7	0.0	0.0	107.5	0.0	0.0	83.6	1192.5	532.9	266.8	0.0	0.0	195.0	0.0	0.0
3.71	117.8	0.0	0.0	106.8	0.0	0.0	83.7	1193.6	532.6	306.2	0.0	0.0	201.6	0.0	0.0
3.87	111.8	0.0	0.0	108.3	0.0	0.0	83.8	1194.9	532.7	373.4	0.0	0.0	190.2	0.0	0.0
4.02	108.8	0.0	0.0	108.7	0.0	0.0	83.9	1195.6	533.0	420.1	0.0	0.0	188.1	0.0	0.0
4.18	117.1	0.0	0.0	110.0	0.0	0.0	84.0	1193.8	532.4	315.5	0.0	0.0	179.2	0.0	0.0
4.34	125.4	0.0	0.0	112.2	0.0	0.0	84.1	1191.9	531.4	252.4	0.0	0.0	165.5	0.0	0.0
4.49	120.1	0.0	0.0	112.4	0.0	0.0	84.2	1193.1	531.3	290.7	0.0	0.0	164.9	0.0	0.0
4.65	114.0	0.0	0.0	111.9	0.0	0.0	84.3	1194.4	531.6	351.9	0.0	0.0	168.5	0.0	0.0
4.80	113.3	0.0	0.0	113.6	0.0	0.0	84.4	1194.6	530.8	361.7	0.0	0.0	159.1	0.0	0.0
4.96	128.4	0.0	0.0	113.3	0.0	0.0	84.6	1191.3	530.9	237.3	0.0	0.0	161.3	0.0	0.0
5.12	126.3	0.0	0.0	113.0	0.0	0.0	84.7	1191.7	531.1	249.9	0.0	0.0	163.6	0.0	0.0
5.27	119.4	0.0	0.0	112.7	0.0	0.0	84.8	1193.2	531.2	300.8	0.0	0.0	166.0	0.0	0.0
5.43	113.2	0.0	0.0	113.8	0.0	0.0	84.9	1194.6	530.7	368.1	0.0	0.0	160.1	0.0	0.0
5.59	107.5	0.0	0.0	115.0	0.0	0.0	85.0	1195.9	530.1	463.4	0.0	0.0	154.1	0.0	0.0
5.74	126.1	0.0	0.0	115.2	0.0	0.0	85.1	1191.8	530.0	253.6	0.0	0.0	153.6	0.0	0.0
5.90	123.9	0.0	0.0	114.0	0.0	0.0	85.2	1192.3	530.6	268.7	0.0	0.0	160.7	0.0	0.0
6.05	121.9	0.0	0.0	113.0	0.0	0.0	85.3	1192.7	531.1	284.2	0.0	0.0	167.2	0.0	0.0
6.21	116.4	0.0	0.0	114.5	0.0	0.0	85.4	1193.9	530.4	335.9	0.0	0.0	159.0	0.0	0.0
6.68	123.7	0.0	0.0	116.4	0.0	0.0	85.7	1192.3	529.5	273.6	0.0	0.0	150.4	0.0	0.0
8.24	128.0	0.0	0.0	119.0	0.0	0.0	86.8	1191.4	528.3	251.5	0.0	0.0	142.6	0.0	0.0
9.02	124.8	0.0	0.0	118.5	0.0	0.0	87.3	1192.1	528.5	276.4	0.0	0.0	147.3	0.0	0.0
10.59	125.7	0.0	0.0	121.7	0.0	0.0	88.3	1191.9	527.1	277.0	0.0	0.0	137.2	0.0	0.0
12.15	127.8	0.0	0.0	122.0	0.0	0.0	89.4	1191.4	526.9	268.9	0.0	0.0	140.1	0.0	0.0
13.71	129.8	0.0	0.0	122.5	0.0	0.0	90.5	1191.0	526.7	261.9	0.0	0.0	142.2	0.0	0.0
14.30	118.3	130.6	136.0	121.9	122.2	122.2	90.9	1193.5	526.1	376.1	259.7	228.6	146.5	145.1	145.1
14.34	130.2	123.8	143.2	122.4	123.8	123.8	90.9	1190.6	525.9	261.8	312.7	196.7	144.2	138.1	138.1
14.49	131.1	125.2	145.1	122.0	124.0	124.0	91.0	1190.5	525.5	256.5	300.8	190.2	146.4	137.6	137.6
14.65	128.7	134.4	136.2	122.4	121.6	121.6	91.1	1191.2	525.4	273.8	237.7	228.2	145.0	148.9	148.9
14.80	122.9	134.8	132.3	122.6	120.1	120.1	91.2	1192.8	525.7	325.2	236.4	250.8	144.6	157.2	157.2
14.96	120.6	130.1	132.0	122.8	120.5	120.5	91.3	1194.0	525.2	352.4	265.9	253.5	144.0	155.4	155.4
15.12	138.0	123.0	141.3	123.1	122.6	122.6	91.4	1191.5	524.6	220.7	325.8	206.3	142.9	145.3	145.3
15.27	136.9	119.1	141.0	122.8	116.0	116.0	91.5	1191.0	525.7	226.9	372.9	207.9	145.1	185.4	185.4

15.43	135.4	135.2	135.3	122.4	127.6	127.6	91.6	1191.9	525.9	234.8	236.2	235.6	147.5	126.2	126.2
15.59	126.0	131.2	138.1	121.8	150.0	150.0	91.7	1193.4	525.8	301.0	261.0	222.2	150.9	77.9	77.9
16.05	132.4	0.0	0.0	124.3	0.0	0.0	92.0	1191.2	527.6	254.9	0.0	0.0	141.2	0.0	0.0
20.74	135.7	0.0	0.0	126.6	0.0	0.0	95.2	1189.7	524.8	252.2	0.0	0.0	143.5	0.0	0.0
23.09	135.3	0.0	0.0	127.6	0.0	0.0	96.8	1189.7	524.3	264.6	0.0	0.0	145.7	0.0	0.0
24.65	138.6	0.0	0.0	128.0	0.0	0.0	97.8	1189.0	524.2	249.4	0.0	0.0	148.6	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A=297.64 NU(S)A=153.08 NU(AV)A=268.73 ST(AV)A=0.00569 ST(AV)/ST(4S)=1.91 F/F(4S)= 6.38
 (ST/ST(4S))/(F/F(4S))=0.299 (F/F(4S))/(ST/ST(4S))*3.0=0.92 (ST/ST(4S))/(F/F(4S))*3.0=1.03
 NU(R)A/NU(4S)=2.12 NU(S)A/NU(4S)=1.09 e+(4R)= 696.48 R(4R)= 6.21 H(4R)=20.18

BY USING ROUGHSDIE RESULTS ONLY : H(RB)= 20.39

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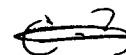
RUN NUMBER=175HR10-30/20 E/D=0.078 P/E=20.0 ALPHA=30 HYD DIA= 1.600 IN PR= 71 MDOT=0.0335 LBM/SEC
RE= 12835. QGE(R)= 385.2 BTU/HR-SQ FT QGE(S)= 170.8 INLET TEMP= 75.2 F TATM= 70.6 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.12	97.0	0.0	90.9	85.0	0.0	126.0	75.3	379.3	164.2	155.1	0.0	215.9	150.3	0.0
2	0.27	95.8	0.0	92.8	86.1	0.0	127.0	75.5	379.6	163.7	165.5	0.0	194.1	136.5	0.0
3	0.43	94.2	0.0	97.6	87.2	0.0	127.6	75.6	380.0	163.2	181.2	0.0	153.2	124.9	0.0
4	0.59	97.3	0.0	98.3	88.8	0.0	129.7	75.8	379.3	162.5	156.1	0.0	149.1	110.4	0.0
5	0.74	100.1	0.0	102.1	90.2	0.0	126.4	75.9	378.7	161.8	138.7	0.0	128.1	100.4	0.0
6	0.90	103.5	0.0	105.9	91.0	0.0	129.9	76.1	377.9	161.5	122.0	0.0	112.2	95.7	0.0
7	1.05	105.9	0.0	109.0	92.0	0.0	126.4	76.2	377.4	161.0	112.6	0.0	101.9	90.3	0.0
8	1.21	109.9	0.0	113.4	92.7	0.0	119.2	76.4	376.5	160.7	99.4	0.0	90.0	87.1	0.0
9	1.37	113.8	0.0	115.9	93.4	0.0	131.2	76.5	375.6	160.3	89.2	0.0	84.4	84.0	0.0
10	1.52	114.6	0.0	112.9	94.5	0.0	150.0	76.7	375.5	159.8	87.6	0.0	91.7	79.3	0.0
11	1.68	104.2	0.0	0.0	94.0	0.0	0.0	76.8	377.8	160.1	122.0	0.0	0.0	82.4	0.0
12	1.84	112.8	0.0	0.0	95.1	0.0	0.0	77.0	375.9	159.6	92.8	0.0	0.0	77.8	0.0
13	1.99	118.3	0.0	0.0	96.0	0.0	0.0	77.1	374.7	159.2	80.4	0.0	0.0	74.5	0.0
14	2.15	116.4	0.0	0.0	97.2	0.0	0.0	77.3	375.1	158.6	84.7	0.0	0.0	70.3	0.0
15	2.30	113.5	0.0	0.0	97.8	0.0	0.0	77.4	375.7	158.3	92.0	0.0	0.0	68.6	0.0
16	2.46	112.5	0.0	0.0	98.4	0.0	0.0	77.6	375.9	158.0	95.1	0.0	0.0	67.0	0.0
17	2.62	113.0	0.0	0.0	100.5	0.0	0.0	77.7	375.8	157.5	94.1	0.0	0.0	60.9	0.0
18	2.77	114.2	0.0	0.0	101.5	0.0	0.0	77.9	375.6	156.6	91.3	0.0	0.0	58.5	0.0
19	2.93	114.7	0.0	0.0	103.0	0.0	0.0	78.0	375.5	155.9	90.4	0.0	0.0	55.1	0.0
20	3.09	109.7	0.0	0.0	103.0	0.0	0.0	78.2	376.6	155.9	105.4	0.0	0.0	55.4	0.0
21	3.24	106.4	0.0	0.0	104.0	0.0	0.0	78.3	377.3	155.5	118.5	0.0	0.0	53.4	0.0
22	3.40	119.6	0.0	0.0	104.0	0.0	0.0	78.5	374.4	155.5	80.3	0.0	0.0	53.7	0.0
23	3.55	119.6	0.0	0.0	104.2	0.0	0.0	78.6	374.4	155.4	80.6	0.0	0.0	53.6	0.0
24	3.71	116.2	0.0	0.0	105.6	0.0	0.0	78.8	375.1	154.7	88.4	0.0	0.0	50.8	0.0
25	3.87	115.8	0.0	0.0	107.0	0.0	0.0	78.9	375.2	154.1	89.7	0.0	0.0	48.4	0.0
26	4.02	116.8	0.0	0.0	107.7	0.0	0.0	79.1	375.0	153.8	87.6	0.0	0.0	47.3	0.0
27	4.18	118.4	0.0	0.0	109.4	0.0	0.0	79.2	374.6	153.0	84.2	0.0	0.0	44.7	0.0
28	4.34	120.2	0.0	0.0	110.5	0.0	0.0	79.4	374.2	152.5	80.7	0.0	0.0	43.1	0.0
29	4.49	120.3	0.0	0.0	111.4	0.0	0.0	79.5	374.1	152.1	79.8	0.0	0.0	42.0	0.0
30	4.65	116.7	0.0	0.0	112.0	0.0	0.0	79.7	375.0	151.8	89.2	0.0	0.0	41.3	0.0
31	4.80	112.5	0.0	0.0	113.9	0.0	0.0	79.8	375.9	150.9	101.2	0.0	0.0	39.0	0.0
32	4.96	124.0	0.0	0.0	104.5	0.0	0.0	80.0	373.4	155.2	74.6	0.0	0.0	55.7	0.0
33	5.12	125.7	0.0	0.0	115.6	0.0	0.0	80.1	373.0	150.1	72.0	0.0	0.0	37.2	0.0
34	5.27	121.7	0.0	0.0	116.4	0.0	0.0	80.3	373.9	149.8	79.4	0.0	0.0	36.5	0.0
35	5.43	120.4	0.0	0.0	117.0	0.0	0.0	80.4	374.2	149.5	82.3	0.0	0.0	35.9	0.0
36	5.59	120.0	0.0	0.0	117.4	0.0	0.0	80.6	374.3	149.3	83.4	0.0	0.0	35.6	0.0
37	5.74	120.1	0.0	0.0	117.0	0.0	0.0	80.7	374.3	149.5	83.5	0.0	0.0	36.2	0.0
38	5.90	120.1	0.0	0.0	116.4	0.0	0.0	80.9	374.3	149.8	83.8	0.0	0.0	37.0	0.0
39	6.05	121.7	0.0	0.0	115.6	0.0	0.0	81.0	373.9	150.1	80.7	0.0	0.0	38.1	0.0
40	6.21	118.1	0.0	0.0	115.0	0.0	0.0	81.2	374.7	150.4	89.1	0.0	0.0	39.0	0.0
41	6.68	122.5	0.0	0.0	114.2	0.0	0.0	81.6	373.7	150.8	80.2	0.0	0.0	40.6	0.0
42	8.24	128.6	0.0	0.0	119.0	0.0	0.0	83.1	372.4	148.6	71.7	0.0	0.0	36.2	0.0
43	9.02	123.0	0.0	0.0	120.3	0.0	0.0	83.9	373.6	148.0	83.5	0.0	0.0	35.5	0.0
44	10.59	123.7	0.0	0.0	122.0	0.0	0.0	85.4	373.5	147.2	85.0	0.0	0.0	35.0	0.0
45	12.15	124.8	0.0	0.0	123.5	0.0	0.0	86.9	373.2	146.5	85.6	0.0	0.0	34.8	0.0
46	13.71	125.9	0.0	0.0	123.8	0.0	0.0	88.3	373.0	146.4	86.2	0.0	0.0	35.8	0.0
47	14.30	119.5	134.5	136.5	123.1	126.0	126.0	88.9	374.4	145.8	106.2	71.2	68.2	37.0	34.1
48	14.34	129.3	132.2	140.7	123.6	127.0	127.0	88.9	372.1	145.6	80.0	74.6	62.4	36.4	33.2
49	14.49	126.2	131.1	142.5	124.0	127.6	127.6	89.1	372.8	145.1	87.2	77.0	60.5	36.1	32.7
50	14.65	123.5	134.8	137.8	124.1	125.7	125.7	89.2	373.3	145.0	94.6	71.0	66.7	36.1	34.5
51	14.80	123.0	135.6	137.1	124.5	126.4	126.4	89.4	373.4	144.9	96.4	70.1	67.8	35.8	33.9
52	14.96	124.6	135.7	137.0	125.1	125.9	125.9	89.5	373.2	144.4	92.3	70.1	68.1	35.2	34.4
53	15.12	126.9	127.0	137.6	125.3	126.4	126.4	89.7	373.6	144.2	87.1	86.8	67.6	35.1	34.0
54	15.27	125.3	125.3	140.7	124.7	119.2	119.2	89.8	372.3	145.0	90.8	90.9	63.4	36.0	42.8

55	15.43	127.2	136.9	139.6	124.5	131.2	131.2	90.0	372.5	144.7	86.8	68.8	65.0	36.3	30.4
56	15.59	123.1	133.6	140.8	123.9	150.0	150.0	90.1	373.5	144.9	98.2	74.4	63.8	37.2	21.0
57	16.05	128.0	0.0	0.0	125.6	0.0	0.0	90.6	372.9	145.2	86.3	0.0	0.0	35.9	0.0
58	20.74	132.6	0.0	0.0	129.5	0.0	0.0	95.1	371.5	143.7	85.1	0.0	0.0	35.9	0.0
59	23.09	134.9	0.0	0.0	131.2	0.0	0.0	97.3	371.0	143.0	84.5	0.0	0.0	36.1	0.0
60	24.65	138.1	0.0	0.0	132.5	0.0	0.0	98.8	370.3	142.4	80.5	0.0	0.0	36.1	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A= 87.49 NU(S)A= 37.58 NU(AV)A= 77.50 ST(AV)A=0.00848 ST(AV)/ST(4S)=1.99 F/F(4S)= 4.48
 (ST/ST(4S))/(F/F(4S))=0.445 (F/F(4S))/(ST/ST(4S))*3.0=0.57 (ST/ST(4S))/(F/F(4S))*(1/3)=1.21
 NU(R)A/NU(4S)=2.26 NU(S)A/NU(4S)=0.97 e+(4R)= 141.15 R(4R)= 6.11 H(4R)=13.84

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 13.78



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NUMBER=176HR30-30/20 E/D=0.078 F/E=20.0 ALPHA=30 HYD DIA= 1.600 IN PR=.71 MDOT=0.0860 LBM/SEC
32942. QGE(R)= 775.2 BTU/HR-SQ FT QGE(S)= 309.0 INLET TEMP= 77.2 F TATM= 71.8 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.12	99.8	0.0	89.6	86.2	0.0	125.4	77.3	769.0	302.4	302.1	0.0	552.5	300.2	0.0	55.6
0.27	96.9	0.0	90.4	87.1	0.0	125.7	77.4	769.7	302.0	349.2	0.0	524.1	275.8	0.0	55.1
0.43	95.6	0.0	97.1	87.9	0.0	126.7	77.5	770.0	301.6	376.9	0.0	348.0	257.4	0.0	54.2
0.59	99.2	0.0	97.9	90.2	0.0	124.8	77.7	769.2	300.6	315.7	0.0	335.9	212.0	0.0	56.4
0.74	102.2	0.0	103.0	92.1	0.0	125.6	77.8	768.5	299.7	278.2	0.0	269.3	185.1	0.0	55.4
0.90	105.2	0.0	106.2	92.4	0.0	124.2	77.9	767.8	299.6	248.6	0.0	239.8	182.8	0.0	57.2
1.05	106.7	0.0	107.9	93.2	0.0	123.8	78.0	767.5	299.2	236.5	0.0	227.0	174.4	0.0	57.7
1.21	110.6	0.0	113.9	93.8	0.0	119.0	78.2	766.7	298.9	208.7	0.0	189.4	168.9	0.0	64.6
1.37	113.9	0.0	117.5	94.5	0.0	130.0	78.3	765.9	298.6	189.9	0.0	172.4	162.7	0.0	51.0
1.52	114.7	0.0	115.1	95.4	0.0	150.0	78.4	765.7	298.2	186.3	0.0	184.2	155.0	0.0	36.8
1.68	104.9	0.0	0.0	94.5	0.0	0.0	78.6	767.9	298.6	257.1	0.0	0.0	165.2	0.0	0.0
1.84	116.8	0.0	0.0	95.3	0.0	0.0	78.7	765.3	298.2	177.1	0.0	0.0	158.3	0.0	0.0
1.99	119.3	0.0	0.0	96.1	0.0	0.0	78.8	764.7	297.9	166.5	0.0	0.0	151.9	0.0	0.0
2.15	117.3	0.0	0.0	97.0	0.0	0.0	78.9	765.2	297.5	175.8	0.0	0.0	145.1	0.0	0.0
2.30	116.7	0.0	0.0	97.2	0.0	0.0	79.1	765.3	297.4	179.2	0.0	0.0	144.5	0.0	0.0
2.46	116.9	0.0	0.0	98.1	0.0	0.0	79.2	765.3	297.0	178.8	0.0	0.0	138.3	0.0	0.0
2.62	118.4	0.0	0.0	100.4	0.0	0.0	79.3	764.9	296.4	172.4	0.0	0.0	123.7	0.0	0.0
2.77	120.3	0.0	0.0	100.5	0.0	0.0	79.4	764.5	295.9	164.8	0.0	0.0	123.7	0.0	0.0
2.93	120.8	0.0	0.0	99.8	0.0	0.0	79.6	764.4	296.2	163.3	0.0	0.0	128.9	0.0	0.0
3.09	113.1	0.0	0.0	100.1	0.0	0.0	79.7	766.1	297.0	201.9	0.0	0.0	127.9	0.0	0.0
3.24	106.9	0.0	0.0	101.8	0.0	0.0	79.8	767.5	295.3	249.4	0.0	0.0	118.2	0.0	0.0
3.40	124.2	0.0	0.0	102.0	0.0	0.0	79.9	763.7	295.2	151.9	0.0	0.0	117.8	0.0	0.0
3.55	123.6	0.0	0.0	102.2	0.0	0.0	80.1	763.8	295.1	154.4	0.0	0.0	117.3	0.0	0.0
3.71	119.8	0.0	0.0	102.3	0.0	0.0	80.2	764.6	294.3	169.8	0.0	0.0	117.3	0.0	0.0
3.87	120.2	0.0	0.0	103.6	0.0	0.0	80.3	764.5	294.0	168.6	0.0	0.0	111.1	0.0	0.0
4.02	121.3	0.0	0.0	105.4	0.0	0.0	80.4	764.3	293.6	164.5	0.0	0.0	103.5	0.0	0.0
4.18	123.4	0.0	0.0	107.0	0.0	0.0	80.6	763.8	292.9	156.8	0.0	0.0	97.4	0.0	0.0
4.34	125.6	0.0	0.0	108.1	0.0	0.0	80.7	763.4	292.4	149.4	0.0	0.0	93.8	0.0	0.0
4.49	126.4	0.0	0.0	109.3	0.0	0.0	80.8	763.2	291.8	147.2	0.0	0.0	90.1	0.0	0.0
4.65	120.5	0.0	0.0	110.5	0.0	0.0	80.9	764.5	291.3	169.8	0.0	0.0	86.6	0.0	0.0
4.80	114.4	0.0	0.0	112.8	0.0	0.0	81.1	765.8	290.2	201.9	0.0	0.0	80.4	0.0	0.0
4.96	130.8	0.0	0.0	114.0	0.0	0.0	81.2	762.2	289.6	135.0	0.0	0.0	77.6	0.0	0.0
5.12	130.1	0.0	0.0	115.0	0.0	0.0	81.3	762.4	289.2	137.3	0.0	0.0	75.4	0.0	0.0
5.27	124.9	0.0	0.0	115.9	0.0	0.0	81.4	763.5	288.8	154.3	0.0	0.0	73.6	0.0	0.0
5.43	124.8	0.0	0.0	116.9	0.0	0.0	81.6	763.5	288.3	155.1	0.0	0.0	71.6	0.0	0.0
5.59	125.3	0.0	0.0	117.0	0.0	0.0	81.7	763.4	288.3	153.7	0.0	0.0	71.7	0.0	0.0
5.74	125.6	0.0	0.0	117.1	0.0	0.0	81.8	763.4	288.2	153.0	0.0	0.0	71.7	0.0	0.0
5.90	126.2	0.0	0.0	117.0	0.0	0.0	82.0	763.2	288.3	151.3	0.0	0.0	72.2	0.0	0.0
6.05	128.1	0.0	0.0	115.6	0.0	0.0	82.1	762.8	288.9	145.4	0.0	0.0	75.6	0.0	0.0
6.21	122.2	0.0	0.0	115.0	0.0	0.0	82.2	764.1	289.2	167.5	0.0	0.0	77.3	0.0	0.0
6.36	126.0	0.0	0.0	114.3	0.0	0.0	82.6	763.3	289.5	154.1	0.0	0.0	80.0	0.0	0.0
6.52	134.4	0.0	0.0	119.6	0.0	0.0	83.8	761.4	287.1	131.7	0.0	0.0	70.2	0.0	0.0
6.68	128.7	0.0	0.0	119.8	0.0	0.0	84.5	762.7	287.0	150.6	0.0	0.0	71.0	0.0	0.0
6.84	128.5	0.0	0.0	121.7	0.0	0.0	85.7	762.7	286.1	155.5	0.0	0.0	69.3	0.0	0.0
7.00	129.2	0.0	0.0	123.9	0.0	0.0	87.0	762.6	285.1	157.2	0.0	0.0	67.2	0.0	0.0
7.16	130.0	0.0	0.0	124.3	0.0	0.0	88.2	762.4	284.9	158.5	0.0	0.0	68.6	0.0	0.0
7.32	120.5	137.0	140.6	124.5	125.4	125.4	88.7	764.5	284.8	208.7	137.4	127.9	69.1	67.4	67.4
7.48	134.6	133.9	147.8	124.1	125.9	125.9	88.8	761.1	284.5	144.1	146.3	111.8	69.9	66.4	66.4
7.64	129.9	128.8	147.7	124.3	126.7	126.7	88.9	762.2	284.1	161.2	165.6	112.4	69.6	65.1	65.1
7.80	126.8	135.7	139.3	124.2	124.8	124.8	89.0	762.9	284.0	175.1	141.7	131.5	70.0	68.8	68.8
7.96	127.3	138.4	140.1	124.9	125.6	125.6	89.1	762.9	283.9	173.3	134.2	129.8	68.9	67.5	67.5
8.12	130.9	138.8	140.4	124.7	124.2	124.2	89.3	762.5	283.7	158.6	133.4	129.2	69.5	70.4	70.4
8.28	132.7	126.9	141.6	125.0	123.8	123.8	89.4	763.1	283.3	152.7	176.3	126.7	69.0	71.3	71.3
8.44	133.5	123.8	145.8	124.7	119.0	119.0	89.5	761.6	284.2	150.0	192.4	117.2	70.0	83.5	83.5
8.60	137.5	138.8	144.5	124.8	130.0	130.0	89.6	762.3	283.8	137.9	134.3	120.4	70.0	60.9	60.9
8.76	130.9	134.8	145.1	124.3	150.0	150.0	89.8	763.6	284.0	160.7	146.8	119.5	71.3	40.8	40.8
8.92	132.3	0.0	0.0	126.2	0.0	0.0	90.1	762.7	285.1	156.7	0.0	0.0	68.4	0.0	0.0
9.08	134.9	0.0	0.0	128.0	0.0	0.0	93.9	761.3	283.2	159.8	0.0	0.0	71.5	0.0	0.0
9.24	138.1	0.0	0.0	130.0	0.0	0.0	95.8	760.6	282.3	154.2	0.0	0.0	70.8	0.0	0.0
9.40	141.2	0.0	0.0	141.0	0.0	0.0	97.1	759.9	277.2	147.4	0.0	0.0	54.0	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A=158.84 NU(S)A= 72.21 NU(AV)A=141.51 ST(AV)A=0.00604 ST(AV)/ST(4S)=1.71 F/F(4S)= 4.74
 (ST/ST(4S))/(F/F(4S))=0.361 (F/F(4S))/(ST/ST(4S))*3.0=0.95 (ST/ST(4S))/(F/F(4S))*(1/3)=1.02
 NU(R)A/NU(4S)=1.93 NU(S)A/NU(4S)=0.88 e+(4R)= 331.77 R(4R)= 6.77 H(4R)=18.43

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 18.11

ORIGINAL PAGE IS
OF POOR QUALITY

RUN NUMBER=179HR10-90/10 E/D=0.078 P/E=10 0 ALPHA=90 HYD DIA= 1.600 IN PR= 71 MDOT=0.0280 LBM/SEC
RE= 10775 GGE(R)= 204.8 BTU/HR-SQ FT GGE(S)= 243.7 INLET TEMP= 75.4 F TATM= 71.0 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)
1	0.12	90.3	0.0	85.8	91.3	0.0	121.0	75.5	200.5	239.6	120.4	0.0	173.3	134.8	0.0
2	0.27	90.5	0.0	87.6	92.3	0.0	121.6	75.7	200.5	239.1	119.7	0.0	148.8	127.4	0.0
3	0.43	88.7	0.0	91.3	93.3	0.0	118.4	75.8	200.9	238.7	137.8	0.0	114.7	120.7	0.0
4	0.59	90.1	0.0	91.8	94.7	0.0	119.8	75.9	200.6	238.0	125.1	0.0	111.7	112.2	0.0
5	0.74	91.6	0.0	93.7	92.5	0.0	116.3	76.0	200.2	239.0	113.8	0.0	100.3	128.5	0.0
6	0.90	93.8	0.0	96.0	104.2	0.0	121.3	76.1	199.8	233.7	100.1	0.0	89.1	73.7	0.0
7	1.05	95.6	0.0	98.1	103.9	0.0	113.2	76.3	199.4	233.8	91.2	0.0	80.8	74.9	0.0
8	1.21	97.6	0.0	100.1	103.5	0.0	119.0	76.4	198.9	234.0	83.0	0.0	74.2	76.4	0.0
9	1.37	99.5	0.0	101.1	104.1	0.0	124.2	76.5	198.5	233.7	76.4	0.0	71.4	74.9	0.0
10	1.52	101.2	0.0	99.7	99.1	0.0	150.0	76.6	198.1	236.0	71.3	0.0	75.9	92.9	0.0
11	1.68	103.0	0.0	0.0	105.3	0.0	0.0	76.7	197.7	233.2	66.6	0.0	0.0	72.2	0.0
12	1.84	104.7	0.0	0.0	103.8	0.0	0.0	76.8	197.4	233.8	62.7	0.0	0.0	76.8	0.0
13	1.99	106.5	0.0	0.0	103.7	0.0	0.0	77.0	197.0	233.9	59.0	0.0	0.0	77.4	0.0
14	2.15	107.6	0.0	0.0	105.2	0.0	0.0	77.1	196.7	233.2	57.0	0.0	0.0	73.3	0.0
15	2.30	108.1	0.0	0.0	99.2	0.0	0.0	77.2	196.6	236.0	56.3	0.0	0.0	94.8	0.0
16	2.46	109.2	0.0	0.0	108.5	0.0	0.0	77.3	196.4	231.7	54.5	0.0	0.0	65.7	0.0
17	2.62	110.0	0.0	0.0	107.0	0.0	0.0	77.4	196.2	232.7	53.3	0.0	0.0	69.6	0.0
18	2.77	110.6	0.0	0.0	106.5	0.0	0.0	77.6	196.1	232.6	52.4	0.0	0.0	71.0	0.0
19	2.93	111.1	0.0	0.0	107.0	0.0	0.0	77.7	196.0	232.4	51.8	0.0	0.0	70.0	0.0
20	3.09	112.2	0.0	0.0	100.0	0.0	0.0	77.8	195.7	235.6	50.2	0.0	0.0	93.7	0.0
21	3.24	112.6	0.0	0.0	109.0	0.0	0.0	77.9	195.6	231.5	49.8	0.0	0.0	65.8	0.0
22	3.40	113.2	0.0	0.0	107.0	0.0	0.0	78.0	195.5	232.4	49.1	0.0	0.0	70.8	0.0
23	3.55	113.6	0.0	0.0	106.6	0.0	0.0	78.2	195.4	232.6	48.7	0.0	0.0	72.2	0.0
24	3.71	114.5	0.0	0.0	107.4	0.0	0.0	78.3	195.2	232.2	47.6	0.0	0.0	70.4	0.0
25	3.87	115.1	0.0	0.0	100.3	0.0	0.0	78.4	195.1	235.5	46.9	0.0	0.0	94.8	0.0
26	4.02	115.8	0.0	0.0	110.2	0.0	0.0	78.5	194.9	230.9	46.1	0.0	0.0	64.3	0.0
27	4.18	116.3	0.0	0.0	109.0	0.0	0.0	78.6	194.8	231.5	45.6	0.0	0.0	67.2	0.0
28	4.34	116.9	0.0	0.0	107.7	0.0	0.0	78.7	194.7	232.0	45.0	0.0	0.0	70.7	0.0
29	4.49	117.3	0.0	0.0	108.6	0.0	0.0	78.9	194.6	231.6	44.6	0.0	0.0	68.7	0.0
30	4.65	118.1	0.0	0.0	102.3	0.0	0.0	79.0	194.4	234.5	43.8	0.0	0.0	88.7	0.0
31	4.80	118.5	0.0	0.0	112.3	0.0	0.0	79.1	194.3	229.9	43.5	0.0	0.0	61.0	0.0
32	4.96	118.6	0.0	0.0	110.0	0.0	0.0	79.2	194.3	231.0	43.5	0.0	0.0	66.1	0.0
33	5.12	119.2	0.0	0.0	108.5	0.0	0.0	79.3	194.2	231.7	42.9	0.0	0.0	70.0	0.0
34	5.27	119.6	0.0	0.0	109.7	0.0	0.0	79.5	194.1	231.1	42.6	0.0	0.0	67.3	0.0
35	5.43	120.0	0.0	0.0	104.8	0.0	0.0	79.6	194.0	233.4	42.3	0.0	0.0	81.5	0.0
36	5.59	120.2	0.0	0.0	113.0	0.0	0.0	79.7	193.9	229.6	42.2	0.0	0.0	60.7	0.0
37	5.74	120.3	0.0	0.0	110.0	0.0	0.0	79.8	193.9	231.0	42.2	0.0	0.0	67.4	0.0
38	5.90	119.8	0.0	0.0	110.1	0.0	0.0	79.9	194.0	230.9	42.8	0.0	0.0	67.4	0.0
39	6.05	121.1	0.0	0.0	110.2	0.0	0.0	80.1	193.8	230.9	41.5	0.0	0.0	67.4	0.0
40	6.21	121.3	0.0	0.0	111.0	0.0	0.0	80.2	193.7	230.5	41.4	0.0	0.0	65.8	0.0
41	6.38	120.4	0.0	0.0	111.2	0.0	0.0	80.5	193.9	230.4	42.8	0.0	0.0	66.1	0.0
42	6.54	123.1	0.0	0.0	113.0	0.0	0.0	81.7	193.3	229.6	41.0	0.0	0.0	64.4	0.0
43	9.02	124.0	0.0	0.0	112.9	0.0	0.0	82.3	193.1	229.7	40.6	0.0	0.0	65.8	0.0
44	10.59	124.9	0.0	0.0	115.8	0.0	0.0	83.5	192.9	228.3	40.8	0.0	0.0	61.8	0.0
45	12.15	126.3	0.0	0.0	117.4	0.0	0.0	84.7	192.6	227.6	40.4	0.0	0.0	60.8	0.0
46	13.71	127.4	0.0	0.0	118.5	0.0	0.0	85.9	192.4	227.1	40.4	0.0	0.0	60.7	0.0
47	14.30	127.4	122.4	119.9	118.0	121.0	121.0	86.3	192.4	226.6	40.8	46.4	49.9	62.3	56.9
48	14.34	127.9	122.4	120.2	119.2	121.6	121.6	86.3	192.1	226.1	40.3	46.4	49.4	59.9	55.9
49	14.49	127.9	122.3	121.1	118.3	118.4	118.4	86.5	192.1	226.2	40.4	46.7	48.3	61.9	61.7
50	14.65	127.8	123.2	120.8	119.3	119.8	119.8	86.6	192.1	225.7	40.6	45.7	48.9	60.0	59.2
51	14.80	127.8	123.1	120.8	118.9	116.3	116.3	86.7	192.1	225.9	40.7	45.9	49.0	61.1	66.4
52	14.96	127.9	122.9	120.5	119.1	121.3	121.3	86.8	192.2	225.7	40.7	46.4	49.7	60.8	57.0
53	15.12	127.7	122.0	120.2	115.6	113.2	113.2	86.9	193.0	227.1	41.2	47.9	50.5	69.0	75.3
54	15.27	128.7	123.3	121.4	118.1	119.0	119.0	87.1	191.4	226.5	39.9	45.9	48.5	63.4	61.7
55	15.43	128.3	123.0	120.6	113.8	124.2	124.2	87.2	192.0	228.1	40.6	46.6	50.0	74.4	53.6
56	15.59	127.9	122.3	121.6	118.8	150.0	150.0	87.3	192.2	225.8	41.1	47.7	48.7	62.4	31.3
57	16.05	128.6	0.0	0.0	117.5	0.0	0.0	87.7	192.4	227.2	40.8	0.0	0.0	66.2	0.0
58	20.74	132.0	0.0	0.0	122.0	0.0	0.0	91.2	191.4	225.5	40.5	0.0	0.0	63.3	0.0
59	23.09	133.5	0.0	0.0	124.2	0.0	0.0	93.0	191.0	224.5	40.6	0.0	0.0	62.0	0.0
60	24.65	135.1	0.0	0.0	124.9	0.0	0.0	94.2	190.7	224.1	40.1	0.0	0.0	62.8	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A= 41.55 NU(S)A= 65.49 NU(AV)A= 46.34 ST(AV)A=0.00604 ST(AV)/ST(4S)=1.37 F/F(4S)= 1.88
 (ST/ST(4S))/(F/F(4S))=0.730 (F/F(4S))/(ST/ST(4S))*3.0=0.73 (ST/ST(4S))/(F/F(4S))*(1/3)=1.11
 NU(R)A/NU(4S)=1.23 NU(S)A/NU(4S)=1.94 e+(4R)= 75.96 R(4R)=10.09 H(4R)=13.06

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 15.73

ORIGINAL PAGE IS
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NUMBER=180HR30-50/10 E/D=0.078 P/E=10.0 ALPHA=90 HYD DIA= 1.600 IN PR=.71 MDDT=0.0858 LBM/SEC
132954. GGE(R)= 455.3 BTU/HR-SQ FT GGE(S)= 578.6 INLET TEMP= 77.8 F TATM= 71.0 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TEBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.12	93.6	0.0	86.3	100.5	0.0	150.0	77.9	451.4	565.1	254.2	0.0	475.6	221.0	0.0	69.2
0.27	92.3	0.0	87.4	100.5	0.0	122.8	78.0	451.6	565.0	279.1	0.0	424.8	220.9	0.0	111.4
0.43	90.4	0.0	91.6	100.7	0.0	121.4	78.1	452.1	565.0	324.6	0.0	295.7	220.7	0.0	115.2
0.59	92.3	0.0	93.3	100.9	0.0	118.6	78.2	451.6	564.9	282.7	0.0	264.0	219.6	0.0	123.4
0.74	94.0	0.0	96.2	96.5	0.0	119.8	78.3	451.3	566.9	253.5	0.0	222.4	274.7	0.0	120.5
0.90	95.9	0.0	98.2	112.3	0.0	114.8	78.4	450.8	559.6	227.1	0.0	200.7	145.6	0.0	135.6
1.05	97.0	0.0	99.8	107.0	0.0	121.1	78.5	450.6	562.1	214.6	0.0	186.4	173.8	0.0	116.3
1.21	99.2	0.0	102.7	105.4	0.0	111.8	78.6	450.1	562.8	192.4	0.0	164.5	185.0	0.0	149.4
1.37	101.1	0.0	104.1	105.0	0.0	123.9	78.7	449.7	563.0	176.7	0.0	155.9	188.5	0.0	109.8
1.52	102.9	0.0	101.8	100.0	0.0	150.0	78.8	449.3	565.3	164.1	0.0	171.9	234.6	0.0	70.0
1.68	105.1	0.0	0.0	111.2	0.0	0.0	78.8	448.8	560.2	150.7	0.0	0.0	152.6	0.0	0.0
1.84	106.6	0.0	0.0	105.8	0.0	0.0	78.9	448.5	562.6	142.9	0.0	0.0	184.6	0.0	0.0
1.99	108.5	0.0	0.0	106.2	0.0	0.0	79.0	448.1	562.5	134.0	0.0	0.0	182.5	0.0	0.0
2.15	109.9	0.0	0.0	108.4	0.0	0.0	79.1	447.8	561.4	128.2	0.0	0.0	169.0	0.0	0.0
2.30	110.6	0.0	0.0	100.4	0.0	0.0	79.2	447.6	565.1	125.7	0.0	0.0	235.0	0.0	0.0
2.46	111.5	0.0	0.0	114.0	0.0	0.0	79.3	447.4	558.9	122.4	0.0	0.0	141.9	0.0	0.0
2.62	112.0	0.0	0.0	108.6	0.0	0.0	79.4	447.3	561.9	120.9	0.0	0.0	169.4	0.0	0.0
2.77	112.4	0.0	0.0	108.0	0.0	0.0	79.5	447.2	561.6	119.7	0.0	0.0	173.5	0.0	0.0
2.93	112.6	0.0	0.0	110.0	0.0	0.0	79.6	447.2	560.7	119.3	0.0	0.0	162.3	0.0	0.0
3.09	113.4	0.0	0.0	103.3	0.0	0.0	79.7	447.0	564.8	116.7	0.0	0.0	210.2	0.0	0.0
3.24	113.8	0.0	0.0	113.0	0.0	0.0	79.8	446.9	559.3	115.6	0.0	0.0	148.2	0.0	0.0
3.40	114.0	0.0	0.0	110.0	0.0	0.0	79.9	446.9	560.7	115.2	0.0	0.0	163.8	0.0	0.0
3.55	114.5	0.0	0.0	109.0	0.0	0.0	80.0	446.8	561.2	113.8	0.0	0.0	170.0	0.0	0.0
3.71	115.2	0.0	0.0	109.0	0.0	0.0	80.0	446.6	560.5	111.8	0.0	0.0	170.5	0.0	0.0
3.87	115.8	0.0	0.0	101.9	0.0	0.0	80.1	446.5	564.0	110.1	0.0	0.0	228.2	0.0	0.0
4.02	116.2	0.0	0.0	114.6	0.0	0.0	80.2	446.4	558.6	109.2	0.0	0.0	143.0	0.0	0.0
4.18	116.5	0.0	0.0	112.3	0.0	0.0	80.3	446.3	559.6	108.5	0.0	0.0	153.9	0.0	0.0
4.34	117.1	0.0	0.0	110.2	0.0	0.0	80.4	446.2	560.6	107.0	0.0	0.0	165.5	0.0	0.0
4.49	117.4	0.0	0.0	112.2	0.0	0.0	80.5	446.1	559.7	106.3	0.0	0.0	155.3	0.0	0.0
4.65	118.3	0.0	0.0	104.8	0.0	0.0	80.6	445.9	563.1	104.0	0.0	0.0	204.6	0.0	0.0
4.80	118.4	0.0	0.0	115.9	0.0	0.0	80.7	445.9	558.0	103.9	0.0	0.0	139.3	0.0	0.0
4.96	118.3	0.0	0.0	110.0	0.0	0.0	80.8	445.9	560.7	104.5	0.0	0.0	168.7	0.0	0.0
5.12	119.0	0.0	0.0	110.2	0.0	0.0	80.9	445.8	560.6	102.8	0.0	0.0	168.0	0.0	0.0
5.27	119.0	0.0	0.0	107.1	0.0	0.0	81.0	445.8	562.0	103.0	0.0	0.0	189.0	0.0	0.0
5.43	119.5	0.0	0.0	105.2	0.0	0.0	81.1	445.7	562.9	101.9	0.0	0.0	204.9	0.0	0.0
5.59	119.9	0.0	0.0	116.8	0.0	0.0	81.2	445.6	557.6	101.0	0.0	0.0	137.4	0.0	0.0
5.74	119.6	0.0	0.0	111.0	0.0	0.0	81.2	445.6	560.2	102.0	0.0	0.0	165.4	0.0	0.0
5.90	119.3	0.0	0.0	111.8	0.0	0.0	81.3	445.7	559.9	103.1	0.0	0.0	161.4	0.0	0.0
6.05	120.5	0.0	0.0	112.6	0.0	0.0	81.4	445.4	559.5	100.1	0.0	0.0	157.6	0.0	0.0
6.21	120.6	0.0	0.0	105.0	0.0	0.0	81.5	445.4	563.0	100.1	0.0	0.0	210.5	0.0	0.0
6.68	119.2	0.0	0.0	112.9	0.0	0.0	81.8	445.7	559.4	104.6	0.0	0.0	157.8	0.0	0.0
8.24	122.0	0.0	0.0	113.4	0.0	0.0	82.7	445.1	559.1	99.3	0.0	0.0	159.7	0.0	0.0
9.02	123.5	0.0	0.0	112.9	0.0	0.0	83.2	444.8	559.4	96.6	0.0	0.0	164.8	0.0	0.0
10.59	123.7	0.0	0.0	116.3	0.0	0.0	84.1	444.7	557.8	98.2	0.0	0.0	151.5	0.0	0.0
12.15	125.6	0.0	0.0	117.6	0.0	0.0	85.0	444.3	557.2	95.6	0.0	0.0	149.3	0.0	0.0
13.71	126.7	0.0	0.0	118.0	0.0	0.0	86.0	444.1	557.0	95.0	0.0	0.0	151.5	0.0	0.0
14.30	126.8	125.1	121.7	119.0	150.0	150.0	86.3	444.1	556.6	95.5	99.7	109.3	148.3	76.1	76.1
14.34	127.3	124.8	122.4	118.7	122.8	122.8	86.3	443.7	556.2	94.4	100.4	107.1	149.7	132.8	132.8
14.49	126.9	122.7	123.7	118.4	121.4	121.4	86.4	443.8	556.0	95.5	106.5	103.7	151.5	138.4	138.4
14.65	126.4	125.3	122.6	120.4	118.6	118.6	86.5	443.9	555.0	96.9	99.6	107.1	142.7	150.6	150.6
14.80	126.9	125.3	123.2	120.5	119.8	119.8	86.6	443.9	555.2	95.9	99.9	105.6	142.7	145.6	145.6
14.96	126.6	124.7	122.7	120.6	114.8	114.8	86.7	444.4	554.8	96.9	101.8	107.4	142.6	171.8	171.8
15.12	128.1	123.3	122.0	118.7	121.1	121.1	86.8	445.1	555.5	93.8	106.1	110.0	151.7	140.9	140.9
15.27	127.1	126.2	123.8	117.5	111.8	111.8	86.9	444.0	556.7	96.1	98.3	104.6	158.3	194.4	194.4
55 15.43	127.5	124.2	122.4	118.0	123.9	123.9	87.0	445.4	556.2	95.6	104.1	109.4	156.1	131.0	131.0
56 15.59	127.5	123.4	123.3	112.9	150.0	150.0	87.1	445.3	558.5	95.8	106.6	106.9	188.3	77.2	77.2
57 16.05	128.2	0.0	0.0	121.5	0.0	0.0	87.3	444.6	556.5	94.7	0.0	0.0	141.5	0.0	0.0
58 20.74	131.2	0.0	0.0	122.0	0.0	0.0	90.1	443.1	555.2	93.3	0.0	0.0	150.7	0.0	0.0
59 23.09	133.3	0.0	0.0	123.9	0.0	0.0	91.5	442.6	554.3	91.4	0.0	0.0	147.7	0.0	0.0
60 24.65	134.3	0.0	0.0	124.5	0.0	0.0	92.4	442.4	554.0	91.1	0.0	0.0	148.9	0.0	0.0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A= 98.93 NU(S)A=161.70 NU(AV)A=111.48 ST(AV)A=0.00476 ST(AV)/ST(4S)=1.35 F/F(4S)= 2.21
 (ST/ST(4S))/(F/F(4S))=0.610 (F/F(4S))/(ST/ST(4S))*3.0=0.90 (ST/ST(4S))/(F/F(4S))*(1/3)=1.04
 NU(R)A/NU(4S)=1.20 NU(S)A/NU(4S)=1.96 e+(4R)= 220.82 R(4R)=10.67 H(4R)=16.01

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 19.40

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RUN NUMBER=1R1HR60-90/10 E/D=0.078 P/F=10.0 ALPHA=90 HYD DIA= 1.600 IN PR= 71 MDOT=0.1672 LBM/SEC
RE= 64191 QGE(R)= 769.4 BTU/HR-SQ FT QGE(S)= 956.7 INLET TEMP= 79.0 F TATM= 71.6 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TOULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
1	0.12	94.2	0.0	86.2	98.8	0.0	150.0	79.1	764.5	974.2	445.1	0.0	943.9	435.0	0.0	11
2	0.27	91.9	0.0	87.7	99.0	0.0	124.6	79.1	765.0	974.1	528.5	0.0	787.8	432.3	0.0	18
3	0.43	90.6	0.0	92.2	99.2	0.0	122.3	79.2	765.2	974.0	592.8	0.0	519.7	429.7	0.0	14
4	0.59	92.9	0.0	92.8	101.4	0.0	119.2	79.3	764.7	973.0	495.6	0.0	499.3	388.0	0.0	21
5	0.74	94.6	0.0	96.4	95.4	0.0	119.5	79.4	764.4	975.8	442.6	0.0	395.8	536.8	0.0	21
6	0.90	96.4	0.0	98.0	112.6	0.0	112.7	79.5	764.0	967.9	397.5	0.0	363.1	257.3	0.0	25
7	1.05	97.1	0.0	99.1	107.5	0.0	120.7	79.5	763.8	970.2	383.3	0.0	344.1	305.7	0.0	20
8	1.21	99.3	0.0	102.8	107.1	0.0	109.7	79.6	763.3	970.4	341.8	0.0	290.1	311.1	0.0	26
9	1.37	100.9	0.0	104.7	107.6	0.0	123.6	79.7	763.0	970.2	317.1	0.0	268.9	306.3	0.0	19
10	1.52	102.8	0.0	102.8	101.0	0.0	150.0	79.8	762.6	973.2	291.8	0.0	291.8	404.0	0.0	12
11	1.68	104.9	0.0	0.0	113.7	0.0	0.0	79.9	762.1	967.4	268.1	0.0	0.0	251.8	0.0	0
12	1.84	106.8	0.0	0.0	107.8	0.0	0.0	80.0	761.7	970.1	249.7	0.0	0.0	306.7	0.0	0
13	1.99	108.7	0.0	0.0	108.0	0.0	0.0	80.0	761.3	970.0	233.7	0.0	0.0	305.3	0.0	0
14	2.15	110.3	0.0	0.0	110.7	0.0	0.0	80.1	760.9	968.7	221.8	0.0	0.0	278.7	0.0	0
15	2.30	111.1	0.0	0.0	101.7	0.0	0.0	80.2	760.7	972.9	216.6	0.0	0.0	398.1	0.0	0
16	2.46	112.3	0.0	0.0	116.8	0.0	0.0	80.3	760.5	965.9	208.9	0.0	0.0	232.7	0.0	0
17	2.62	113.1	0.0	0.0	111.6	0.0	0.0	80.4	760.3	969.3	204.3	0.0	0.0	273.0	0.0	0
18	2.77	113.8	0.0	0.0	111.6	0.0	0.0	80.4	760.1	968.6	200.4	0.0	0.0	273.4	0.0	0
19	2.93	113.8	0.0	0.0	112.8	0.0	0.0	80.5	760.1	968.4	200.9	0.0	0.0	263.9	0.0	0
20	3.09	114.3	0.0	0.0	104.4	0.0	0.0	80.6	760.0	972.6	198.3	0.0	0.0	359.6	0.0	0
21	3.24	114.9	0.0	0.0	117.3	0.0	0.0	80.7	759.9	964.7	195.3	0.0	0.0	231.6	0.0	0
22	3.40	115.1	0.0	0.0	111.1	0.0	0.0	80.8	759.9	967.6	194.6	0.0	0.0	280.3	0.0	0
23	3.55	115.8	0.0	0.0	109.5	0.0	0.0	80.9	759.7	968.6	191.0	0.0	0.0	297.1	0.0	0
24	3.71	116.2	0.0	0.0	110.1	0.0	0.0	80.9	759.6	967.7	189.3	0.0	0.0	291.4	0.0	0
25	3.87	116.8	0.0	0.0	104.3	0.0	0.0	81.0	759.5	971.1	186.5	0.0	0.0	366.4	0.0	0
26	4.02	117.1	0.0	0.0	117.5	0.0	0.0	81.1	759.4	965.6	185.3	0.0	0.0	233.0	0.0	0
27	4.18	117.4	0.0	0.0	114.0	0.0	0.0	81.2	759.3	967.2	184.1	0.0	0.0	258.9	0.0	0
28	4.34	117.8	0.0	0.0	111.4	0.0	0.0	81.3	759.3	968.4	182.5	0.0	0.0	282.2	0.0	0
29	4.49	118.0	0.0	0.0	113.5	0.0	0.0	81.3	759.2	967.5	181.9	0.0	0.0	264.2	0.0	0
30	4.65	119.0	0.0	0.0	106.2	0.0	0.0	81.4	759.0	970.8	177.3	0.0	0.0	344.0	0.0	0
31	4.80	118.6	0.0	0.0	119.8	0.0	0.0	81.5	759.1	964.6	179.6	0.0	0.0	221.1	0.0	0
32	4.96	118.9	0.0	0.0	116.6	0.0	0.0	81.6	759.0	966.0	178.6	0.0	0.0	242.2	0.0	0
33	5.12	119.6	0.0	0.0	111.8	0.0	0.0	81.7	758.9	968.2	175.6	0.0	0.0	282.0	0.0	0
34	5.27	119.5	0.0	0.0	114.5	0.0	0.0	81.7	758.9	967.0	176.4	0.0	0.0	259.1	0.0	0
35	5.43	119.9	0.0	0.0	107.0	0.0	0.0	81.8	758.8	970.4	174.9	0.0	0.0	338.3	0.0	0
36	5.59	120.4	0.0	0.0	120.6	0.0	0.0	81.9	758.7	964.2	172.9	0.0	0.0	218.6	0.0	0
37	5.74	119.7	0.0	0.0	112.2	0.0	0.0	82.0	758.8	968.1	176.5	0.0	0.0	281.1	0.0	0
38	5.90	119.8	0.0	0.0	113.5	0.0	0.0	82.1	758.8	967.5	176.4	0.0	0.0	270.0	0.0	0
39	6.05	120.9	0.0	0.0	114.7	0.0	0.0	82.2	758.6	966.9	171.7	0.0	0.0	260.6	0.0	0
40	6.21	121.0	0.0	0.0	105.0	0.0	0.0	82.2	758.6	970.9	171.6	0.0	0.0	358.3	0.0	0
41	6.38	119.2	0.0	0.0	114.3	0.0	0.0	82.5	759.0	967.1	181.2	0.0	0.0	266.4	0.0	0
42	6.54	122.0	0.0	0.0	115.0	0.0	0.0	83.3	758.3	966.8	171.5	0.0	0.0	266.9	0.0	0
43	9.02	123.9	0.0	0.0	113.6	0.0	0.0	83.7	757.9	967.4	164.9	0.0	0.0	283.1	0.0	0
44	10.59	123.9	0.0	0.0	117.2	0.0	0.0	84.5	757.9	965.8	168.1	0.0	0.0	258.1	0.0	0
45	12.15	125.9	0.0	0.0	119.0	0.0	0.0	85.3	757.5	965.4	162.9	0.0	0.0	257.8	0.0	0
46	13.71	126.4	0.0	0.0	119.0	0.0	0.0	86.1	757.4	964.9	163.9	0.0	0.0	255.9	0.0	0
47	14.30	127.3	125.4	122.8	118.1	150.0	150.0	86.5	757.2	964.5	161.4	169.3	181.4	265.3	132.2	132
48	14.34	127.2	123.9	123.5	119.2	124.6	124.6	86.5	756.9	964.0	161.8	176.1	178.0	256.4	220.2	220
49	14.49	127.4	119.5	124.7	118.0	122.3	122.3	86.6	757.0	964.0	161.3	200.1	172.8	266.8	234.8	234
50	14.65	127.0	123.3	123.1	120.2	119.2	119.2	86.6	757.3	963.1	163.3	179.8	180.8	249.7	257.5	257
51	14.80	127.1	124.7	124.3	121.9	119.5	119.5	86.7	757.6	962.6	163.3	173.6	175.5	238.1	255.6	255
52	14.96	127.4	124.1	123.6	121.6	112.7	112.7	86.8	758.2	962.3	162.6	176.9	179.3	240.6	323.4	323
53	15.12	126.7	122.9	122.6	118.4	120.7	120.7	86.9	759.7	963.4	165.8	183.5	185.1	265.8	247.9	247
54	15.27	127.0	127.1	124.0	117.4	109.7	109.7	87.0	758.8	964.8	165.1	164.5	178.3	275.7	369.2	369
55	15.43	127.7	122.8	122.9	117.8	123.6	123.6	87.0	759.2	964.7	162.6	184.7	184.2	272.8	229.6	229
56	15.59	127.6	122.7	123.6	110.0	150.0	150.0	87.1	758.7	967.8	163.2	185.5	180.9	367.8	133.9	133
57	16.05	128.1	0.0	0.0	121.4	0.0	0.0	87.4	757.9	965.5	161.9	0.0	0.0	246.8	0.0	0
58	20.74	130.9	0.0	0.0	122.0	0.0	0.0	89.8	756.4	963.5	159.4	0.0	0.0	259.3	0.0	0
59	23.09	133.1	0.0	0.0	123.6	0.0	0.0	91.0	755.9	962.8	155.3	0.0	0.0	255.5	0.0	0
60	24.65	133.8	0.0	0.0	125.0	0.0	0.0	91.8	755.7	962.2	155.5	0.0	0.0	250.5	0.0	0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A=169.24 NU(S)A=271.52 NU(AV)A=189.70 ST(AV)A=0.00416 ST(AV)/ST(4S)=1.35 F/F(4S)= 2.41
 (ST/ST(4S))/(F/F(4S))=0.559 (F/F(4S))/(ST/ST(4S))*3.0=0.99 (ST/ST(4S))/(F/F(4S))*3.0=1.00
 NU(R)A/NU(4S)=1.20 NU(S)A/NU(4S)=1.93 e+(4R)= 416.75 R(4R)=11.05 H(4R)=17.86

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 21.49

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NUMBER=1RCHR10-90/20 E/D=0.073 P/E=20.0 ALPHA=90 HYD DIA= 1.600 IN PR=.71 MDOT=0.0283 LBM/SEC
10075. QGE(R)= 209.4 BU/HR-SQ FT QGE(S)= 259.1 INLET TEMP= 75.2 F TATM= 72.2 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.12	89.9	0.0	86.1	89.6	0.0	150.0	75.3	205.5	251.1	124.8	0.0	168.7	155.7	0.0	29.8
0.27	90.0	0.0	87.7	91.1	0.0	119.4	75.4	205.5	250.4	124.9	0.0	148.3	141.6	0.0	50.5
0.43	89.0	0.0	90.7	92.5	0.0	121.7	75.5	205.9	249.8	146.5	0.0	120.4	130.6	0.0	48.0
0.59	89.6	0.0	91.6	94.5	0.0	120.5	75.7	205.6	248.9	130.7	0.0	114.3	117.1	0.0	49.2
0.74	91.1	0.0	93.4	96.5	0.0	122.4	75.8	205.3	247.9	118.7	0.0	103.2	106.1	0.0	47.1
0.90	93.3	0.0	96.1	97.7	0.0	114.8	75.9	204.8	247.4	104.3	0.0	89.8	100.6	0.0	56.4
1.05	95.1	0.0	98.3	99.0	0.0	118.2	76.0	204.4	246.8	94.9	0.0	81.3	95.2	0.0	51.8
1.21	97.2	0.0	99.8	100.3	0.0	107.9	76.1	203.9	246.2	85.8	0.0	76.4	90.3	0.0	68.7
1.37	99.0	0.0	100.4	101.6	0.0	125.1	76.3	203.5	245.6	79.3	0.0	74.7	85.9	0.0	44.5
1.52	100.6	0.0	98.5	95.8	0.0	150.0	76.4	203.2	248.3	74.3	0.0	81.4	113.3	0.0	29.9
1.68	102.4	0.0	0.0	101.5	0.0	0.0	76.5	202.8	245.6	69.3	0.0	0.0	87.0	0.0	0.0
1.84	103.9	0.0	0.0	100.5	0.0	0.0	76.6	202.4	246.1	65.7	0.0	0.0	91.3	0.0	0.0
1.99	105.7	0.0	0.0	99.6	0.0	0.0	76.8	202.0	246.5	61.8	0.0	0.0	95.5	0.0	0.0
2.15	106.7	0.0	0.0	101.1	0.0	0.0	76.9	201.8	245.8	59.9	0.0	0.0	89.8	0.0	0.0
2.30	107.1	0.0	0.0	97.8	0.0	0.0	77.0	201.7	247.3	59.3	0.0	0.0	105.2	0.0	0.0
2.46	108.2	0.0	0.0	104.4	0.0	0.0	77.1	201.5	244.3	57.3	0.0	0.0	79.2	0.0	0.0
2.62	108.9	0.0	0.0	106.4	0.0	0.0	77.2	201.3	243.8	56.2	0.0	0.0	73.9	0.0	0.0
2.77	109.3	0.0	0.0	108.0	0.0	0.0	77.4	201.3	242.7	55.7	0.0	0.0	70.0	0.0	0.0
2.93	109.7	0.0	0.0	107.8	0.0	0.0	77.5	201.2	242.7	55.2	0.0	0.0	70.8	0.0	0.0
3.09	110.9	0.0	0.0	99.0	0.0	0.0	77.6	200.9	246.8	53.3	0.0	0.0	102.0	0.0	0.0
3.24	111.2	0.0	0.0	110.0	0.0	0.0	77.7	200.8	241.7	53.0	0.0	0.0	66.2	0.0	0.0
3.40	111.7	0.0	0.0	105.0	0.0	0.0	77.9	200.7	244.0	52.4	0.0	0.0	79.4	0.0	0.0
3.55	112.1	0.0	0.0	104.6	0.0	0.0	78.0	200.6	244.2	51.9	0.0	0.0	81.0	0.0	0.0
3.71	113.1	0.0	0.0	104.5	0.0	0.0	78.1	200.4	244.3	50.6	0.0	0.0	81.7	0.0	0.0
3.87	113.6	0.0	0.0	106.0	0.0	0.0	78.2	200.3	243.6	50.0	0.0	0.0	77.4	0.0	0.0
4.02	114.3	0.0	0.0	106.9	0.0	0.0	78.3	200.2	243.2	49.1	0.0	0.0	75.2	0.0	0.0
4.18	114.8	0.0	0.0	109.0	0.0	0.0	78.5	200.0	242.2	48.6	0.0	0.0	70.0	0.0	0.0
4.34	115.4	0.0	0.0	111.2	0.0	0.0	78.6	199.9	241.2	47.9	0.0	0.0	65.3	0.0	0.0
4.49	115.8	0.0	0.0	111.9	0.0	0.0	78.7	199.8	240.9	47.5	0.0	0.0	64.0	0.0	0.0
4.65	116.5	0.0	0.0	101.0	0.0	0.0	78.8	199.7	245.9	46.8	0.0	0.0	97.8	0.0	0.0
4.80	116.8	0.0	0.0	110.1	0.0	0.0	79.0	199.6	241.7	46.5	0.0	0.0	68.4	0.0	0.0
4.96	117.0	0.0	0.0	105.5	0.0	0.0	79.1	199.6	243.8	46.4	0.0	0.0	81.4	0.0	0.0
5.12	117.5	0.0	0.0	105.7	0.0	0.0	79.2	199.5	243.7	45.9	0.0	0.0	81.1	0.0	0.0
5.27	117.9	0.0	0.0	106.2	0.0	0.0	79.3	199.4	243.5	45.5	0.0	0.0	79.6	0.0	0.0
5.43	118.3	0.0	0.0	107.1	0.0	0.0	79.5	199.3	243.1	45.2	0.0	0.0	77.4	0.0	0.0
5.59	118.7	0.0	0.0	108.2	0.0	0.0	79.6	199.2	242.6	44.8	0.0	0.0	74.6	0.0	0.0
5.74	118.5	0.0	0.0	110.1	0.0	0.0	79.7	199.2	241.7	45.2	0.0	0.0	70.0	0.0	0.0
5.90	117.8	0.0	0.0	111.3	0.0	0.0	79.8	199.4	241.1	46.2	0.0	0.0	67.4	0.0	0.0
6.05	119.4	0.0	0.0	112.4	0.0	0.0	79.9	199.0	240.6	44.4	0.0	0.0	65.2	0.0	0.0
6.21	119.5	0.0	0.0	103.6	0.0	0.0	80.1	199.0	244.7	44.4	0.0	0.0	91.5	0.0	0.0
6.36	118.7	0.0	0.0	108.0	0.0	0.0	80.4	199.2	242.7	45.8	0.0	0.0	77.4	0.0	0.0
6.52	121.5	0.0	0.0	108.8	0.0	0.0	81.7	198.6	242.3	43.7	0.0	0.0	78.3	0.0	0.0
6.67	122.1	0.0	0.0	117.2	0.0	0.0	82.3	198.4	238.4	43.7	0.0	0.0	59.8	0.0	0.0
6.83	122.9	0.0	0.0	117.3	0.0	0.0	83.5	198.3	238.4	44.0	0.0	0.0	61.7	0.0	0.0
7.00	124.0	0.0	0.0	117.6	0.0	0.0	84.7	198.0	238.2	44.0	0.0	0.0	63.3	0.0	0.0
7.16	125.2	0.0	0.0	118.0	0.0	0.0	85.9	197.8	238.1	43.9	0.0	0.0	64.7	0.0	0.0
7.32	125.3	121.5	117.7	116.7	150.0	150.0	86.4	197.7	237.9	44.3	49.1	55.0	68.4	32.6	32.6
7.48	125.8	121.5	118.3	117.1	119.4	119.4	86.4	197.5	237.8	43.7	49.0	54.0	67.5	62.8	62.8
7.64	125.8	121.9	119.7	115.1	121.7	121.7	86.5	197.5	238.4	43.8	48.6	51.9	72.8	59.1	59.1
7.80	125.8	122.6	119.7	115.3	120.5	120.5	86.7	197.5	238.3	43.9	47.8	52.0	72.5	61.3	61.3
7.96	125.8	122.9	120.5	116.4	122.4	122.4	86.8	197.5	237.8	44.1	47.6	51.0	70.0	58.1	58.1
8.12	126.0	122.5	120.5	116.9	114.8	114.8	86.9	197.5	237.4	43.9	48.3	51.2	68.8	74.1	74.1
8.28	125.3	121.1	119.2	118.9	118.2	118.2	87.0	198.5	236.4	45.2	50.7	53.7	64.6	66.0	66.0
8.44	125.7	122.6	120.4	118.8	107.9	107.9	87.2	196.9	236.9	44.4	48.3	51.5	65.1	99.3	99.3

55	15.43	126.1	121.9	118.8	119.9	125.1	125.1	87.3	197.4	236.0	44.2	49.6	54.5	62.9	54.3	54.3
56	15.59	126.0	121.0	119.1	112.2	150.0	150.0	87.4	197.5	239.5	44.4	51.1	54.2	83.9	33.3	33.3
57	16.05	126.3	0.0	0.0	117.5	0.0	0.0	87.8	197.8	238.0	44.6	0.0	0.0	69.6	0.0	0.0
58	20.74	129.4	0.0	0.0	122.5	0.0	0.0	91.4	196.8	236.0	44.8	0.0	0.0	65.6	0.0	0.0
59	23.09	131.0	0.0	0.0	125.1	0.0	0.0	93.3	196.5	234.8	44.9	0.0	0.0	63.5	0.0	0.0
60	24.65	132.4	0.0	0.0	126.0	0.0	0.0	94.5	196.2	234.4	44.5	0.0	0.0	63.9	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A= 44.83 NU(S)A= 72.66 NU(AV)A= 50.39 ST(AV)A=0.00651 ST(AV)/ST(4S)=1.48 F/F(4S)=10.43
 (ST/ST(4S))/(F/F(4S))=0.142 (F/F(4S))/(ST/ST(4S))*3.0=3.23 (ST/ST(4S))/(F/F(4S))*3.0=3.23
 NU(R)A/NU(4S)=1.32 NU(S)A/NU(4S)=2.14 e+(4R)= 189.15 R(4R)= 3.51 H(4R)=30.75

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 37.57

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RUN NUMBER=184HR30-90/20 E/D=0.078 P/E=20.0 ALPHA=90 HYD DIA= 1.600 IN PR=.71 MDDT=0.0824 LBM/SEC
RE= 31645. QGE(R)= 465.0 BTU/HR-SQ FT QGE(S)= 548.2 INLET TEMP= 77.6 F TATM= 72.3 F PATM= 14.6 PSIA

NO	X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	GGA(R)	GGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	N
1	0.12	92.6	0.0	86.7	96.3	0.0	150.0	77.7	460.6	537.2	272.6	0.0	450.7	254.8	0.0	1
2	0.27	91.8	0.0	87.0	96.4	0.0	121.0	77.8	460.8	537.1	290.1	0.0	440.9	254.7	0.0	1
3	0.43	90.2	0.0	90.4	96.5	0.0	123.4	77.9	461.1	537.1	330.2	0.0	324.9	254.6	0.0	1
4	0.59	92.1	0.0	92.8	98.2	0.0	122.2	78.0	460.7	536.3	287.7	0.0	274.2	234.0	0.0	1
5	0.74	93.9	0.0	95.6	100.7	0.0	123.5	78.1	460.3	535.2	256.5	0.0	231.7	208.7	0.0	1
6	0.90	96.0	0.0	98.4	100.6	0.0	114.3	78.2	459.8	535.2	227.5	0.0	200.5	210.5	0.0	1
7	1.05	97.3	0.0	100.2	101.4	0.0	116.5	78.3	459.5	534.8	212.9	0.0	184.8	203.9	0.0	1
8	1.21	99.7	0.0	102.4	101.8	0.0	106.9	78.3	459.0	534.7	189.7	0.0	168.4	201.2	0.0	1
9	1.37	101.6	0.0	103.7	102.6	0.0	126.6	78.4	458.6	534.3	174.8	0.0	160.2	195.2	0.0	1
10	1.52	103.5	0.0	100.9	97.1	0.0	150.0	78.5	458.2	536.8	162.0	0.0	180.8	255.2	0.0	1
11	1.68	105.6	0.0	0.0	105.1	0.0	0.0	78.6	457.7	533.1	149.7	0.0	0.0	177.7	0.0	1
12	1.84	107.2	0.0	0.0	102.3	0.0	0.0	78.7	457.4	534.4	141.7	0.0	0.0	200.0	0.0	1
13	1.99	109.2	0.0	0.0	102.3	0.0	0.0	78.8	456.9	534.4	132.7	0.0	0.0	200.8	0.0	1
14	2.15	110.6	0.0	0.0	104.2	0.0	0.0	78.9	456.6	533.6	127.1	0.0	0.0	186.1	0.0	1
15	2.30	111.1	0.0	0.0	101.5	0.0	0.0	79.0	456.5	534.8	125.5	0.0	0.0	209.7	0.0	1
16	2.46	112.1	0.0	0.0	108.4	0.0	0.0	79.1	456.3	531.6	121.9	0.0	0.0	160.0	0.0	1
17	2.62	112.5	0.0	0.0	110.6	0.0	0.0	79.2	456.2	531.1	120.8	0.0	0.0	149.3	0.0	1
18	2.77	112.9	0.0	0.0	110.5	0.0	0.0	79.3	456.1	530.7	119.7	0.0	0.0	149.9	0.0	1
19	2.93	113.0	0.0	0.0	111.0	0.0	0.0	79.4	456.1	530.4	119.6	0.0	0.0	147.9	0.0	1
20	3.09	114.0	0.0	0.0	102.4	0.0	0.0	79.5	455.9	535.3	116.4	0.0	0.0	206.4	0.0	1
21	3.24	114.5	0.0	0.0	112.4	0.0	0.0	79.6	455.8	529.8	115.0	0.0	0.0	142.3	0.0	1
22	3.40	114.7	0.0	0.0	104.9	0.0	0.0	79.7	455.7	533.2	114.6	0.0	0.0	186.3	0.0	1
23	3.55	115.2	0.0	0.0	106.1	0.0	0.0	79.8	455.6	532.7	113.3	0.0	0.0	178.3	0.0	1
24	3.71	116.0	0.0	0.0	105.8	0.0	0.0	79.9	455.4	532.1	111.0	0.0	0.0	180.6	0.0	1
25	3.87	116.5	0.0	0.0	108.2	0.0	0.0	80.0	455.3	531.3	109.8	0.0	0.0	165.6	0.0	1
26	4.02	117.1	0.0	0.0	109.4	0.0	0.0	80.1	455.2	531.2	108.2	0.0	0.0	159.4	0.0	1
27	4.18	117.5	0.0	0.0	112.1	0.0	0.0	80.2	455.1	529.9	107.3	0.0	0.0	146.1	0.0	1
28	4.34	117.9	0.0	0.0	114.7	0.0	0.0	80.3	455.0	528.7	106.4	0.0	0.0	135.1	0.0	1
29	4.49	118.2	0.0	0.0	115.4	0.0	0.0	80.4	454.9	528.4	105.8	0.0	0.0	132.7	0.0	1
30	4.65	119.0	0.0	0.0	104.5	0.0	0.0	80.5	454.8	533.4	103.8	0.0	0.0	195.2	0.0	1
31	4.80	119.1	0.0	0.0	112.4	0.0	0.0	80.6	454.7	529.8	103.8	0.0	0.0	146.3	0.0	1
32	4.96	119.1	0.0	0.0	106.0	0.0	0.0	80.7	454.7	532.7	104.0	0.0	0.0	184.9	0.0	1
33	5.12	119.8	0.0	0.0	106.4	0.0	0.0	80.8	454.6	532.5	102.4	0.0	0.0	182.6	0.0	1
34	5.27	119.9	0.0	0.0	107.7	0.0	0.0	80.9	454.6	531.9	102.3	0.0	0.0	174.2	0.0	1
35	5.43	120.4	0.0	0.0	109.5	0.0	0.0	81.0	454.5	531.1	101.2	0.0	0.0	163.5	0.0	1
36	5.59	120.8	0.0	0.0	110.9	0.0	0.0	81.1	454.4	530.5	100.4	0.0	0.0	156.1	0.0	1
37	5.74	120.3	0.0	0.0	112.5	0.0	0.0	81.1	454.5	529.7	102.0	0.0	0.0	148.4	0.0	1
38	5.90	119.7	0.0	0.0	114.0	0.0	0.0	81.2	454.6	529.0	103.8	0.0	0.0	141.9	0.0	1
39	6.05	121.3	0.0	0.0	115.9	0.0	0.0	81.3	454.3	528.2	99.8	0.0	0.0	134.2	0.0	1
40	6.21	121.4	0.0	0.0	103.3	0.0	0.0	81.4	454.2	534.0	99.8	0.0	0.0	214.4	0.0	1
41	6.68	120.2	0.0	0.0	108.7	0.0	0.0	81.7	454.5	531.5	103.7	0.0	0.0	172.9	0.0	1
42	8.24	123.1	0.0	0.0	109.0	0.0	0.0	82.7	453.9	531.3	98.4	0.0	0.0	177.0	0.0	1
43	9.02	124.6	0.0	0.0	120.0	0.0	0.0	83.2	453.5	526.3	95.9	0.0	0.0	125.1	0.0	1
44	10.59	124.6	0.0	0.0	119.4	0.0	0.0	84.1	453.5	526.6	98.0	0.0	0.0	130.5	0.0	1
45	12.15	126.4	0.0	0.0	119.4	0.0	0.0	85.1	453.1	526.6	95.8	0.0	0.0	134.0	0.0	1
46	13.71	127.8	0.0	0.0	119.0	0.0	0.0	86.1	452.8	526.7	94.6	0.0	0.0	139.4	0.0	1
47	14.30	128.2	125.8	121.3	118.0	150.0	150.0	86.4	452.7	527.2	94.4	100.2	113.1	145.5	72.2	72
48	14.34	128.7	125.7	122.6	116.2	121.0	121.0	86.5	452.4	527.5	93.2	100.4	109.0	154.3	133.0	133
49	14.49	129.3	124.2	124.3	115.2	123.4	123.4	86.6	452.3	527.7	92.1	104.6	104.3	160.1	124.7	124
50	14.65	128.5	126.4	123.1	115.8	122.2	122.2	86.7	452.5	527.3	94.1	99.1	108.1	157.2	129.1	129
51	14.80	129.3	126.3	125.1	119.0	123.5	123.5	86.7	452.4	526.1	92.5	99.6	102.7	141.8	124.6	124
52	14.96	128.8	125.2	123.7	118.9	114.3	114.3	86.8	452.9	525.8	94.0	102.8	106.9	143.0	166.7	166
53	15.12	128.4	123.1	121.3	120.8	116.5	116.5	86.9	454.0	524.7	95.4	109.2	115.0	135.0	154.5	154
54	15.27	130.0	127.0	123.5	121.1	106.9	106.9	87.0	452.3	525.3	91.6	98.5	107.9	134.1	230.1	230
55	15.43	129.6	123.5	121.5	121.7	126.6	126.6	87.1	453.9	524.7	92.9	108.6	114.9	131.9	115.6	115
56	15.59	129.9	122.6	123.0	112.4	150.0	150.0	87.2	453.7	528.9	92.6	111.6	110.3	182.4	73.3	73
57	16.05	130.0	0.0	0.0	118.8	0.0	0.0	87.5	453.1	527.9	92.7	0.0	0.0	146.5	0.0	0
58	20.74	131.9	0.0	0.0	124.0	0.0	0.0	90.4	451.9	524.4	94.3	0.0	0.0	135.1	0.0	0
59	23.09	133.9	0.0	0.0	126.6	0.0	0.0	91.9	451.5	523.2	92.7	0.0	0.0	130.0	0.0	0
60	24.65	134.7	0.0	0.0	128.0	0.0	0.0	92.8	451.3	522.6	92.9	0.0	0.0	128.1	0.0	0

FULLY DEVELOPED REGION(BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO15.6) :
 NU(R)A= 97.62 NU(S)A=156.59 NU(AV)A=109.41 ST(AV)A=0.00486 ST(AV)/ST(4S)=1.37 F/F(4S)=20.46
 (ST/ST(4S))/(F/F(4S))=0.067 (F/F(4S))/(ST/ST(4S))*3.0=8.02 (ST/ST(4S))/(F/F(4S))*(1/3)=0.50
 NU(R)A/NU(4S)=1.22 NU(S)A/NU(4S)=1.96 e+(4R)= 676.66 R(4R)= 2.68 H(4R)=51.92

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 62.28

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NUMBER=180HR=0-90/20 E/D=0.078 P/E=20.0 ALPHA=90 HYD DIA= 1.600 IN PR=.71 MDOT=0.1654 LBM/SEC
63418 QGE(R)= 749.1 RTU/HR-SQ FT QGE(S)= 874.0 INLET TEMP= 80.2 F TATM= 73.3 F PATM= 14.6 PSIA

X/D	TW(R1)	TW(R2)	TW(R3)	TW(S1)	TW(S2)	TW(S3)	TBULK	QGA(R)	QGA(S)	NU(R1)	NU(R2)	NU(R3)	NU(S1)	NU(S2)	NU(S3)
0.12	94.1	0.0	87.3	93.9	0.0	150.0	80.2	744.5	864.6	471.5	0.0	923.7	555.6	0.0	109.0
0.27	91.9	0.0	88.7	95.2	0.0	120.7	80.3	745.0	864.0	564.4	0.0	779.0	509.6	0.0	188.1
0.43	90.6	0.0	71.9	96.6	0.0	123.1	80.4	745.3	863.3	640.5	0.0	568.3	467.7	0.0	177.7
0.59	93.1	0.0	93.2	99.8	0.0	121.5	80.4	744.8	861.8	517.5	0.0	513.5	391.6	0.0	184.6
0.74	94.9	0.0	96.5	101.0	0.0	122.0	80.5	744.4	861.3	455.3	0.0	409.7	369.9	0.0	182.6
0.90	96.7	0.0	98.4	101.0	0.0	112.5	80.6	744.0	861.3	406.3	0.0	367.5	371.2	0.0	237.4
1.05	97.5	0.0	99.6	102.5	0.0	115.0	80.7	743.8	860.6	388.7	0.0	345.6	346.7	0.0	220.4
1.21	100.0	0.0	102.7	103.5	0.0	105.7	80.8	743.2	860.1	339.5	0.0	297.7	332.5	0.0	303.1
1.37	101.6	0.0	104.6	105.1	0.0	126.2	80.8	742.9	859.4	314.4	0.0	274.8	311.3	0.0	166.5
1.52	103.6	0.0	102.3	97.9	0.0	150.0	80.9	742.4	862.7	287.6	0.0	305.1	446.4	0.0	109.7
1.68	105.7	0.0	0.0	107.7	0.0	0.0	81.0	742.0	858.2	263.9	0.0	0.0	282.4	0.0	0.0
1.84	107.3	0.0	0.0	103.9	0.0	0.0	81.1	741.6	860.0	248.4	0.0	0.0	331.0	0.0	0.0
1.99	109.3	0.0	0.0	103.2	0.0	0.0	81.2	741.2	860.3	231.3	0.0	0.0	342.7	0.0	0.0
2.15	110.8	0.0	0.0	105.2	0.0	0.0	81.2	740.9	859.4	220.0	0.0	0.0	314.9	0.0	0.0
2.30	111.5	0.0	0.0	102.8	0.0	0.0	81.3	740.7	860.5	215.4	0.0	0.0	351.6	0.0	0.0
2.46	112.6	0.0	0.0	108.9	0.0	0.0	81.4	740.5	857.7	208.3	0.0	0.0	273.7	0.0	0.0
2.62	113.2	0.0	0.0	112.4	0.0	0.0	81.5	740.3	857.1	204.8	0.0	0.0	243.5	0.0	0.0
2.77	113.7	0.0	0.0	112.6	0.0	0.0	81.5	740.2	856.2	202.1	0.0	0.0	242.1	0.0	0.0
2.93	113.8	0.0	0.0	115.3	0.0	0.0	81.6	740.2	855.3	201.9	0.0	0.0	223.1	0.0	0.0
3.09	114.5	0.0	0.0	102.3	0.0	0.0	81.7	740.0	861.6	198.0	0.0	0.0	367.7	0.0	0.0
3.24	114.9	0.0	0.0	113.3	0.0	0.0	81.8	740.0	854.6	196.0	0.0	0.0	237.6	0.0	0.0
3.40	115.1	0.0	0.0	108.8	0.0	0.0	81.9	739.9	856.7	195.3	0.0	0.0	278.6	0.0	0.0
3.55	115.9	0.0	0.0	105.6	0.0	0.0	81.9	739.7	858.5	191.1	0.0	0.0	317.9	0.0	0.0
3.71	116.3	0.0	0.0	105.7	0.0	0.0	82.0	739.7	857.8	189.2	0.0	0.0	317.1	0.0	0.0
3.87	116.8	0.0	0.0	108.3	0.0	0.0	82.1	739.5	857.4	186.9	0.0	0.0	286.7	0.0	0.0
4.02	117.1	0.0	0.0	110.3	0.0	0.0	82.2	739.5	857.0	185.7	0.0	0.0	267.2	0.0	0.0
4.18	117.5	0.0	0.0	112.5	0.0	0.0	82.2	739.4	856.0	183.9	0.0	0.0	248.1	0.0	0.0
4.34	117.9	0.0	0.0	114.9	0.0	0.0	82.3	739.3	854.9	182.2	0.0	0.0	230.1	0.0	0.0
4.49	118.1	0.0	0.0	116.0	0.0	0.0	82.4	739.3	854.4	181.6	0.0	0.0	222.9	0.0	0.0
4.65	119.0	0.0	0.0	106.2	0.0	0.0	82.5	739.1	858.9	177.4	0.0	0.0	317.4	0.0	0.0
4.80	118.6	0.0	0.0	115.0	0.0	0.0	82.6	739.1	854.9	179.8	0.0	0.0	231.0	0.0	0.0
4.96	118.9	0.0	0.0	112.0	0.0	0.0	82.6	739.1	856.2	178.6	0.0	0.0	255.6	0.0	0.0
5.12	119.6	0.0	0.0	107.2	0.0	0.0	82.7	738.9	858.4	175.5	0.0	0.0	307.2	0.0	0.0
5.27	119.5	0.0	0.0	108.2	0.0	0.0	82.8	738.9	858.0	176.4	0.0	0.0	295.9	0.0	0.0
5.43	120.0	0.0	0.0	110.9	0.0	0.0	82.9	738.8	856.7	174.3	0.0	0.0	267.8	0.0	0.0
5.59	120.5	0.0	0.0	112.2	0.0	0.0	83.0	738.7	856.1	172.3	0.0	0.0	256.4	0.0	0.0
5.74	119.9	0.0	0.0	113.8	0.0	0.0	83.0	738.9	855.4	175.5	0.0	0.0	243.5	0.0	0.0
5.90	119.7	0.0	0.0	115.0	0.0	0.0	83.1	738.9	854.9	176.8	0.0	0.0	234.7	0.0	0.0
6.05	120.9	0.0	0.0	117.2	0.0	0.0	83.2	738.6	853.8	171.5	0.0	0.0	219.8	0.0	0.0
6.21	120.9	0.0	0.0	104.2	0.0	0.0	83.3	738.6	859.8	171.8	0.0	0.0	359.6	0.0	0.0
6.38	119.3	0.0	0.0	109.5	0.0	0.0	83.5	739.0	857.4	180.6	0.0	0.0	288.6	0.0	0.0
6.54	122.1	0.0	0.0	109.8	0.0	0.0	84.3	738.4	857.2	170.7	0.0	0.0	293.7	0.0	0.0
6.70	123.9	0.0	0.0	119.4	0.0	0.0	84.7	738.0	852.8	164.3	0.0	0.0	214.5	0.0	0.0
6.86	123.2	0.0	0.0	120.5	0.0	0.0	85.5	738.1	852.3	170.6	0.0	0.0	212.2	0.0	0.0
7.02	123.2	0.0	0.0	120.4	0.0	0.0	86.3	737.6	852.4	163.3	0.0	0.0	217.4	0.0	0.0
7.18	125.6	0.0	0.0	119.0	0.0	0.0	87.0	737.5	853.0	164.2	0.0	0.0	232.2	0.0	0.0
7.34	127.2	125.9	121.8	116.1	150.0	150.0	87.3	737.3	853.5	160.8	166.2	186.0	257.7	118.4	118.4
7.50	127.0	124.6	123.1	115.4	120.7	120.7	87.4	737.0	853.8	161.6	172.1	179.3	264.4	222.6	222.6
7.66	127.3	121.0	124.8	113.9	123.1	123.1	87.4	737.1	854.0	160.7	190.9	171.5	281.0	208.2	208.2
7.82	127.4	124.2	122.9	115.2	121.5	121.5	87.5	737.2	853.5	160.7	174.7	181.1	267.5	218.3	218.3
7.98	127.1	125.6	125.4	117.9	122.0	122.0	87.6	737.6	852.6	162.4	168.7	169.6	244.2	215.3	215.3
8.14	128.3	124.0	122.4	117.8	112.3	112.3	87.7	738.0	852.2	157.8	176.5	184.6	246.2	298.2	298.2
8.30	126.6	121.9	120.9	119.3	115.0	115.0	87.7	739.7	851.1	165.3	188.2	193.9	234.6	271.3	271.3
8.46	127.7	127.6	123.4	119.7	105.7	105.7	87.8	738.7	851.9	161.0	161.4	180.4	232.0	414.0	414.0
8.62	127.2	121.6	122.0	120.3	126.2	126.2	87.9	739.4	851.6	163.3	190.6	188.4	228.2	193.2	193.2
8.78	127.5	121.9	122.1	109.8	150.0	150.0	88.0	738.8	856.0	162.5	189.2	188.1	340.0	119.9	119.9
8.94	127.7	0.0	0.0	118.6	0.0	0.0	88.2	738.0	854.9	162.1	0.0	0.0	244.0	0.0	0.0
9.10	130.5	0.0	0.0	125.0	0.0	0.0	90.6	736.5	850.3	159.5	0.0	0.0	213.6	0.0	0.0
9.26	132.4	0.0	0.0	126.2	0.0	0.0	91.7	736.1	849.7	156.3	0.0	0.0	212.9	0.0	0.0
9.42	133.4	0.0	0.0	127.0	0.0	0.0	92.5	735.9	849.3	155.3	0.0	0.0	212.5	0.0	0.0

FULLY DEVELOPED REGION (BASED ON AVERAGE DATA FROM X/D= 4.8 TO 6.2 AND FROM X/D=14.2 TO 15.6) :
 NU(R)A=168.43 NU(S)A=263.36 NU(AV)A=187.42 ST(AV)A=0.00416 ST(AV)/ST(4S)=1.34 F/F(4S)=15.04
 (ST/ST(4S))/(F/F(4S))=0.089 (F/F(4S))/(ST/ST(4S))*3.0=6.21 (ST/ST(4S))/(F/F(4S))*1/3=0.54
 NU(R)A/NU(4S)=1.21 NU(S)A/NU(4S)=1.89 e+(4R)=1068.72 R(4R)= 3.66 H(4R)=47.91

BY USING ROUGH SIDE RESULTS ONLY : H(RB)= 56.89

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16. Abstract Periodic rib turbulators have been used in advanced turbine cooling designs to enhance the internal heat transfer. The objective of the present project was to investigate the combined effects of the rib angle-of-attack and the channel aspect ratio on the local heat transfer and pressure drop in rectangular channels with two opposite ribbed walls for Reynolds number varied from 10,000 to 60,000. The channel aspect ratio (W/H) was varied from 1 to 2 to 4. The rib angle-of-attack (α) was varied from 90° to 60° to 45° to 30°. The highly detailed heat transfer coefficient distribution on both the smooth side and the ribbed side walls from the channel sharp entrance to the downstream region were measured. The results showed that, in the square channel, the heat transfer for the slant ribs ($\alpha = 30^\circ-45^\circ$) was about 30 percent higher than that the transverse ribs ($\alpha = 90^\circ$) for a constant pumping power. However, in the rectangular channels (W/H = 2 and 4, ribs on W side), the heat transfer at $\alpha = 30^\circ-45^\circ$ was only about 5 percent higher than that $\alpha = 90^\circ$. The results also showed that, in the square channel, the highest heat transfer was obtained at $\alpha = 60^\circ$ accompanying with the highest pressure drop, however, in the rectangular channel with W/H = 4, both the highest heat transfer and pressure drops were obtained at $\alpha = 90^\circ$. The average heat transfer and friction correlations were developed to account for rib spacing, rib angle, and channel aspect ratio over the range of roughness Reynolds number.					
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