558
8-15-78

HR. 349
ORNL/TM-5848

MASTER

Condensation of Refrigerants on Vertical Fluted Tubes

S. K. Combs
G. S. Mailen
R. W. Murphy

OAK RIDGE NATIONAL LABORATORY
OPERATED BY UNION CARBIDE CORPORATION • FOR THE DEPARTMENT OF ENERGY

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
Price: Printed Copy \$9.25; Microfiche \$3.00

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, contractors, subcontractors, or their employees, makes any warranty, express or implied, nor assumes any legal liability or responsibility for any third party's use or the results of such use of any information, apparatus, product or process disclosed in this report, nor represents that its use by such third party would not infringe privately owned rights.

NOTICE ~~IN~~ ONLY

PORTIONS OF THIS REPORT ARE ILLEGIBLE. It has been reproduced from the best available copy to permit the broadest possible availability.

ORNL/TM-5848
Dist. Category UC-66d

Contract No. W-7405-eng-26

Engineering Technology Division
and
Energy Division

CONDENSATION OF REFRIGERANTS ON VERTICAL FLUTED TUBES

S. K. Combs
G. S. Mailen
R. W. Murphy

Date Published: August 1978

NOTICE: This document contains information of a preliminary nature. It is subject to revision or correction and therefore does not represent a final report.

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
Operated by
UNION CARBIDE CORPORATION
for the
DEPARTMENT OF ENERGY

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Dec

CONTENTS

	<u>Page</u>
ABSTRACT	v
LIST OF SYMBOLS	vi
ACKNOWLEDGEMENTS	viii
1. INTRODUCTION	1
2. BACKGROUND	2
3. DESCRIPTION OF EQUIPMENT	4
3.1 General Flow Description	6
3.2 Boiler	7
3.3 Entrainment Separator	7
3.4 Condensing Test Section	7
3.4.1 Shell and heads	7
3.4.2 Tube installation	11
3.5 Storage Tank and Pump	14
3.6 Vent and Vacuum Systems	14
3.7 Gaskets and Seals	14
4. PROCEDURES AND INSTRUMENTATION	15
4.1 Operating Procedures	16
4.1.1 Filling	16
4.1.2 Removal of noncondensable gases	16
4.1.3 Steady-state operation	17
4.2 Instrumentation	18
4.2.1 Voltage and current measurements	18
4.2.2 Pressure measurements	18
4.2.3 Temperature measurements	19
4.2.4 Flow measurements	19
5. TEST TUBES	20
6. WORKING FLUIDS	29
7. ANALYSIS	31
7.1 Overall Condensing Coefficients	31
7.2 Individual Condensing-Side Coefficients	31

8. DATA DISCUSSION	34
SUMMARY	61
REFERENCES	63
APPENDIX A — SAMPLES OF DATA REDUCTION	65
Physical Properties for Working Fluids	65
Fluted Tube	65
Smooth Tube	70
Nondimensional Quantities	73
APPENDIX B — WILSON-PLOT RESULTS	77
APPENDIX C — EXPERIMENTAL DATA	125
APPENDIX D — SI CONVERSION FACTORS	193

ABSTRACT

Experiments were run to determine heat transfer performance of single vertical fluted tubes with selected fluids condensing on the outside. Working fluids included six fluorocarbons (Refrigerants 11, 21, 22, 113, 114, and 115) and a hydrocarbon (Refrigerant 600a or isobutane). The nine test tubes were of 2.54-cm (1-in.) nominal outside diameter and 1.2 m (4 ft) in length with from 0 (smooth) to 60 axial flutes. Condensing heat transfer coefficients ranged from 620 to 7900 $\text{W/m}^2\cdot\text{K}$ (110 to 1400 $\text{Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F}$) over the heat flux range of 2000 to 43,000 W/m^2 (920–13,600 $\text{Btu/hr}\cdot\text{ft}^2$). All parameters are based on total condensing surface area. The data show that, for a given heat flux, a fluted tube can increase condensing coefficients up to 6.0 times smooth tube values. Further heat transfer enhancement was achieved by the use of drainage skirts on fluted tubes; these skirts effectively divided the 1.2-m (4-ft) tubes into two, four, and eight equal condensing lengths.

LIST OF SYMBOLS

a_0	y-intercept on the Wilson plot representing the composite resistance of the condensing side and wall, Eq. (7-11)
a_1	slope of the line on the Wilson plot
A	heat transfer surface area of test tube
A_c	cross-sectional flow area of the annulus in the test section
c_p	specific heat
D	tube diameter
D_H	hydraulic diameter of the annulus in the test section
D_r	diameter of rod inserted through center of test section
F	volume flow rate
g	local gravitational acceleration
G	mass flux
h	average or mean individual heat transfer coefficient
h_{fg}	latent heat of vaporization
h_m	mean condensing heat transfer coefficient on the vapor side
H	standard nondimensional heat transfer coefficient (average or mean)
k	thermal conductivity
L	tube length
$\dot{m}$	mass flow rate
P	pressure
P_t	outside perimeter of tube
Q	heat load
Q/A	heat flux
r	radius
R	resistance to heat flow

Re	Reynolds number
T	temperature
ΔT	temperature difference
$\overline{\Delta T}$	mean temperature difference between the condensing vapor and coolant
ΔT_f	mean condensing temperature difference across the film
U	overall condensing heat transfer coefficient
v	water velocity

Greek Symbols

Γ	condensate mass flow rate at bottom of tube per unit length of periphery
Δ	finite difference
μ	absolute viscosity
ρ	mass density
σ	surface tension

Subscripts

avg	average
b	bulk
c	condensate
f	film
i	inside
in	inlet
o	outlet
sat	saturation
v	vapor; vapor (condensing) side
w	water; water side
wall	wall; surface

ACKNOWLEDGMENTS

This investigation was performed at the Oak Ridge National Laboratory operated by the Union Carbide Corporation for the Department of Energy (formerly Energy Research and Development Administration). This study was a part of the general program on Low-Temperature Heat Utilization being performed by ORNL for the DOE Division of Geothermal Energy.

The authors wish to express their appreciation for the assistance of many of the ORNL staff members. The authors are particularly grateful for the contributions of the following persons: H. W. Hoffman, J. W. Michel (Program Manager), and R. N. Lyon (ORNL Consultant) for their helpful suggestions throughout the program; S. L. Milora for his contributions during the initial phases of this study; R. L. Linkous and C. V. Hardin (Project Technicians) for operation of the test equipment and collection of data; Dolores Eden for her assistance in organizing the materials for the report and for typing the manuscript.

1. INTRODUCTION

As with all potential energy alternatives, the case for the development of the geothermal option will ultimately depend on a cost benefit justification. As regards power production cycles, the moderate temperatures associated with many geothermal sources impose relative low limits on achievable thermodynamic efficiencies when compared to those characteristics of conventional power plant conditions. These lower efficiencies, in turn, translate into increased heat transfer rates for specified output power levels.

Three basic options are available to accommodate the greater heat loads: (1) larger driving temperature difference, (2) larger transfer surface area, and (3) larger heat transfer coefficients. The first option has a direct negative impact on the (already low) limiting thermodynamic cycle efficiency — that is, the temperature difference required for heat transfer is not available for the power cycle. The second and third options could lead to larger and/or more complex heat exchangers.

An economic optimum would strike a balance between the various options so as to provide a system in which the combined operating, amortized capital, and other costs are minimized. The project described here is oriented toward translating certain options relating to one important system component into experimentally verified engineering performance parameters. We have chosen to focus on options associated with the condenser of a binary-fluid geothermal power system.

In the study by Milora and Tester,¹ a number of comparisons between direct flashing and binary fluid power systems for liquid-dominated geothermal sources are presented. A major advantage suggested for the use of the binary arrangement is the ability to use (as a working fluid) a compound specifically tailored to the available source-sink combination. For particular examples, the reference shows that thermodynamic "utilization factors" for binary fluid cycles may be considerably higher than those associated with direct flashing cycles.

A number of the fluids which appear attractive from the thermodynamic cycle standpoint were members of the fluorocarbon family. Unfortunately,

these fluids may not be so attractive when heat transfer considerations are taken into account.

Of particular concern are the relatively low liquid thermal conductivities of the fluorocarbons. Since these low values could affect heat transfer coefficients on the hot side (evaporator, superheater, etc.) and on the cold side (desuperheater, condenser, etc.), further evaluation of the resulting contributions to optimization efforts is in order. This report is an interim summary of an experimental and analytical investigation of certain options for improving heat transfer performance during refrigerant condensation.

2. BACKGROUND

For most practical condensing situations, the major barrier to heat transfer is the liquid film which forms on the cooled surface as the vapor condenses. As a result, condensation augmentation methods depend primarily on reducing the effective thickness of the liquid film. Enhancement possibilities include turbulence and dropwise condensation promoters, extended surfaces, and improved drainage schemes.

Of the final group, one of the most attractive ideas was put forth by Gregorig² in 1954. His concept consisted of a ridged or fluted condensing surface which caused the vapor-liquid interface to take on a shape with nonuniform curvature. With a uniform pressure impressed on the vapor phase, such an interface can only achieve equilibrium if a pressure gradient exists in the liquid film. The direction of this pressure gradient is such that liquid is pushed from an area of greater curvature to an area of lesser curvature. This "surface tension" action will result in a thinning of the liquid film on the crest of the flute and a thickening of the film in the valley (see Fig. 1 for illustration of this principle). The potential for heat transfer augmentation depends on the relative sizes of the resulting improvement in crest area heat transfer and the resulting degradation in valley area heat transfer.

Experiments by a number of investigators (including Gregorig,² Alexander and Hoffman,³ Carnavos,⁴ Thomas,^{5,6} and Jansen and Owzarski⁷) indicate that relatively large performance improvements can be realized

CONDENSING SIDE
(fluted outside surface)

ORNL-DWG 77-5469A

HEAT FLOW

Fig. 1. Fluted tube principle of operation (condensation mode) — surface tension forces acting to push condensate from crests into troughs.

with water. However, no such evidence is apparent for fluids such as those of the fluorocarbon family whose members have characteristic surface tensions much smaller than that associated with water.

The potential for improving the heat transfer performance of condensers operating in geothermal binary power cycles and, thus, contributing an important component to the technical knowledge required to assess the cost-benefit position of geothermal energy within the national energy-option framework was the motivation for the project. The planned approach to the project was as follows:

1. Design, fabricate, and assemble a test loop to evaluate condensing heat transfer performance at conditions characteristic of suggested geothermal power cycles.
2. Test existing fluted condenser tubes in the loop to establish relative augmentation potentials.
3. Attempt to develop analytical models capable of predicting measured condenser tube performance.
4. Verify the model with data from a wide range of working fluids under consideration for geothermal power cycle use.
5. Consider design and fabrication of custom-made tubes for greater performance enhancement.

This report is limited to areas 1 and 2 listed above. Work is in progress on areas 3, 4, and 5 and will be reported at a later date. A similar study was presented by Combs⁸ in which the effectiveness of fluted tubes for ammonia condensation was evaluated.

3. DESCRIPTION OF EQUIPMENT

Equipment used in this investigation is shown schematically in Fig. 2. The system was designed for a maximum heat load of 5 kW and consists of three circuits — a working fluid loop, a primary cooling loop, and a secondary cooling loop. The working fluid loop was designed primarily for fluorocarbons with the maximum operating pressure and temperature set at 225 psig and 150°F. The test section, a single-tube vertical condenser, was built to handle tubes of 1-in.-nominal diameter and 4-ft length. The system was manually controlled, and the heat load

Fig. 2. Schematic diagram of experimental apparatus.

was set by the power input to the boiler. The working fluid loop was constructed of stainless steel to minimize compatibility problems. View ports on the test section permitted visual observation of the condensing surface with the aid of a light at suitable locations. Water served as the coolant in both the primary and secondary cooling loops. The primary coolant removed the heat from the test tube in the test section; and in turn, the heat was transferred to the secondary coolant.

3.1 General Flow Description

Flow directions in the system are indicated by arrows in Fig. 2. The working fluid was vaporized in the boiler and passed through an entrainment separator before entering the condensing test section. The vapor entered the top of the test section, and the liquid collected in the separator returned to the boiler. The vapor condensed on the outer surface of the test tube in the test section and formed a falling film of liquid. The liquid condensate exited at the bottom of the test section, passed through a condensate measuring station, and returned to the bottom of the boiler to complete the closed loop. A pump was not needed for the circulation of the working fluid since the liquid head in the test section side of the loop furnished the driving force required for flow through the condensate measuring station.

In the primary cooling loop, a small centrifugal pump transferred demineralized water from a storage tank to the bottom of the test section and upward through the test tube. The primary coolant flow was measured by rotameters upstream of the test section and controlled by a hand valve located downstream of the test section. From the top of the test section, the water returned to the storage tank to complete the closed loop.

The secondary cooling loop removed the heat load from the system by transferring the heat from the primary cooling water to plant process water. Primary cooling water recirculating through the storage tank dumped heat to secondary cooling water which passed through a cooling coil in the tank and then discharged to the drain. The flow rate of the secondary coolant was regulated by a hand valve located upstream of the cooling coil.

Figure 3 pictures an overall view of the system, while Fig. 4 shows the lower part of the system including the boiler and storage tank. Figure 5 gives more detail of the separator and the condensing test section. However, the photographs of the system do not show the insulation which was installed prior to operation to minimize heat losses during normal operation. Major components are described separately in succeeding sections.

3.2 Boiler

The boiler body (Fig. 4) was fabricated from a 4-ft length of 6-in. Schedule 40 stainless steel pipe. Eight tubular heaters of 4-ft active heated length were strapped to the bottom section of the pipe for electrical resistance heating. A sight glass (Fig. 4) was connected to the boiler to provide liquid level monitoring capability. The top section of the boiler was equipped with a baffle made of stainless steel sheet metal to aid in reducing liquid entrainment. The boiler held ~3 gal of liquid when half-filled for standard operation.

3.3 Entrainment Separator

The separator (Fig. 5) was constructed from a 1-ft length of 6-in. Schedule 40 stainless steel pipe. Separation of entrained liquid from the vapors was accomplished by two stainless steel mesh demistors (Otto H. York Company, 6-in. diameter by 6 in. thick) located in the body of the separator. The separator was mounted in the working fluid loop at a 30° angle to the horizontal with liquid exiting at the lowest point in the separator and vapor at the highest. Liquid returned to the boiler through a vertical drainage line.

3.4 Condensing Test Section

3.4.1 Shell and heads

The shell of the test section (Fig. 5) was fabricated from 2-in. Schedule 40 stainless steel pipe connected by two 2-in. stainless steel tees. Figure 6 is a detailed sketch of the test section including

Fig. 3. Test facility.

Fig. 4. Close-up view of bottom section of test facility.

Fig. 5. Close-up view of test section and separator.

assembly diagram. The outside (condensing) surface of the experimental test tube could be viewed at locations near the top and bottom of the test tube through the two windows. Two heads (which were mated to the shell by 2-in. 150-lb stainless steel flanges) were fabricated from stainless steel bar stock and were designed to facilitate tube installation and removal. The top head consisted of two sections, the lower and upper sections. The lower section bolted directly to the top flange and contained a radial 1-in.-diam hole for the vapor entrance. The upper section contained four 1-in.-diam O-ring seals for sealing a 1-in.-OD test tube and bolted to the lower section of the top head. The bottom head consisted of only one section containing three 1-in.-diam O-ring seals and a radial 1-in.-diam hole for exit of condensate from the test tube. Provision was made in the bottom head to collect separately the condensate forming on the inside of the shell, and this condensate was returned to the boiler downstream of the condensate measuring station. The total condensing length in the test section was 4 ft.

3.4.2 Tube installation

The heads on the test section (Fig. 6) were designed to seal around a smooth 1-in.-OD tube: therefore, experimental test tubes (other than smooth 1-in.-OD) were prepared for testing by soldering or welding a 1-in.-OD sleeve to each end of a 4-ft length of test tube. One end of a prepared test tube is shown in Fig. 7 to illustrate the sleeve connection. For installation, the upper section of the top head was removed and the test tube was inserted downward into the test section until the bottom sleeve slid through the three O-ring seals in the bottom head. The upper section of the top head was then slid over the top sleeve and bolted to the lower section to complete the shell-side sealing operation. Next, the required connections were made to the primary cooling loop.

A stainless steel rod of 0.50-in. outside diameter was installed through the center of the test section (inside the test tube) in order to decrease the hydraulic diameter and increase the velocity for a given primary cooling volume flow. Both of these variations tended to increase the heat transfer coefficients on the water side; and as a result,

Fig. 6. Details of the test section.

Fig. 7. Sleeve connection for a sample test tube.

improved the accuracy of the Wilson-plot technique⁹ used to interpret the experimental data. For example, with a smooth 0.87-in.-ID tube (designated Tube A in the following section), insertions of the 0.50-in.-OD rod decreased the hydraulic diameter by 57% and increased the velocity by 49%.

3.5 Storage Tank and Pump

The storage tank (Fig. 4) was fabricated from a 55-gal stainless steel drum. The tank served as a storage vessel for the primary cooling water while also providing the liquid head required for the centrifugal pump. The drum was equipped with 100 ft of 0.5-in.-OD copper tubing to serve as a heat exchanger. Plant process water was circulated through the copper tubing to remove heat from the primary cooling water. A small centrifugal pump (Oberdorfer Pump Division, Model No. 700D-UST) provided the circulation of the primary cooling water. The pump (Fig. 3) was rated at 20 gpm at 77 ft of head and was driven by a 1 1/2-hp motor. Adequate circulation of the process water through the cooling coils was furnished by the line pressure.

3.6 Vent and Vacuum Systems

Ports for venting the shell of the test section were provided at the top and bottom of the test section; best results were obtained by venting the top. Also, a vacuum pump was connected to the working fluid loop for evacuating the system. The vacuum pump was connected to the loop at several locations to permit evacuation of isolated sections of the loop. A liquid nitrogen cold trap was located between the loop and the vacuum pump to prevent the working fluid from contaminating the oil of the vacuum pump.

3.7 Gaskets and Seals

In early experiments, neoprene and teflon were used for gaskets and seals throughout the working fluid loop and proved very effective in the system. However, experiments with Refrigerant 21 (CHCl_2F) indicated

compatibility problems. Gaskets and seals made of neoprene displayed considerable reactivity to Refrigerant 21. Leakage problems were observed in the valves containing neoprene gaskets, plus inspection of the gaskets and O-ring seals made of neoprene in the test section revealed deterioration. During the investigation of Refrigerant 21, small particles of neoprene were found in the working fluid loop, and a distinct coloration was observed in the working fluid. Regular inspection of the neoprene O-rings in the heads of the test section confirmed the compatibility problem. The teflon in the loop showed no adverse reaction to Refrigerant 21.

The neoprene seals and gaskets in the working fluid loop were replaced by either teflon or copper wherever possible; however, it was not possible to replace the O-rings in the heads of the test section because a highly flexible material was required for that application. The new materials eliminated the leakage problems, but the neoprene O-rings continued to show deterioration with Refrigerant 21. Frequent inspections and changes of O-rings prevented any leakage in the heads of the test section. During all of the later testing, the system operated with all teflon gaskets and seals except for the neoprene O-rings in the heads of the test section. No compatibility problems were encountered between other fluids used in this investigation and the gaskets and seals (neoprene and teflon).

4. PROCEDURES AND INSTRUMENTATION

This experimental study was undertaken to evaluate heat transfer coefficients for refrigerants condensing on the outside of vertical tubes. Heat rates and temperature differences were calculated from experimental data taken during steady-state operation (see Appendix A for sample calculations). The Wilson-plot technique⁹ was used to interpret overall coefficients of heat transfer so that individual condensing-side coefficients could be evaluated. Accurate temperature measurements were critical to the evaluation of condenser performance, because it was sometimes necessary to measure very small temperature differences ($\sim 0.2^\circ\text{F}$) within $\pm 0.04^\circ\text{F}$ to obtain reliable heat balances.

Also, very small condensate flows (0.03 to 0.3 gpm) had to be measured accurately for good interpretation of the experimental data. The operating procedures and instrumentation are described in detail in the following sections.

4.1 Operating Procedures

4.1.1 Filling

Before filling operations began, the working fluid loop was evacuated (72 to 74 cm Hg) by the vacuum pump. Once evacuation was complete, the working fluid was introduced at either the top or bottom of the loop depending on the ease of operation for a particular fluid. The primary cooling water was used to cool the test section, causing the working fluid to condense on the test tube and flow to the boiler. The level in the boiler was monitored visually by the liquid level indicator. When the boiler was half filled with liquid, the vessel supplying the working fluid was valved off; and the system was ready to operate. After the investigation of a fluid was complete, the loop was drained and then evacuated while applying heat to insure removal of all the residual fluid.

4.1.2 Removal of noncondensable gases

One difficulty encountered in the operation of the system involved problems with noncondensable gases (primarily air components). The presence of noncondensable gases in the test section imposes an added resistance to the transfer of heat by blanketing the cooling surface. The working fluid vapor must diffuse through the gas, requiring a decrease in vapor partial pressure toward the liquid-vapor interface. The effect is to lower the interface saturation temperature below the temperature of the main vapor-gas mixture. Thus, a significant decrease in condensing film coefficient can result from the presence of noncondensable gases (as discussed by McAdams¹⁰ and Kern¹¹).

Two techniques were employed to remove noncondensable gases from the system. One technique was frequent venting at the top of the test section to remove the noncondensable gases (typically lighter than the

working fluid) before and during operation; however, through operating experience, it was discovered that frequent venting in itself is not always effective. In some cases, the noncondensable gases were swept into the test section by the vapor flow. The second method of removal was developed to take advantage of the noncondensable gases collecting in the test section. In this procedure, the heat rate to the boiler was set near the maximum design value, thus creating a high vapor flow which caused most noncondensable gases to be swept into the test section. At this point, the boiler was valved off from the condensing test section, and a vacuum was pulled on the test section removing all fluids from the test section. This technique was very effective in removing noncondensable gases from the system.

The standard operating procedure included frequent venting and noncondensable sweeping. This was particularly necessary when a major change (test tube or working fluid) was made or when unusual operating problems were encountered. During tests a higher-than-normal difference in temperature between the vapor at the top and the condensate at the bottom of the loop was a good indication of the presence of noncondensable gases.

4.1.3 Steady-state operation

The heat rate to the boiler is controlled by a stack of four Variacs. Each Variac regulated the voltage to two tubular heaters, and any combination of the four Variacs could be used to obtain experimental heat rates. After setting the heat rate to the boiler, the primary cooling flow rate was set by the valve downstream of the test section. The inlet temperature of the secondary cooling water was not controlled since it was determined by the process plant water conditions. The flow rate of the secondary cooling water was used to control the temperature of the primary cooling water. This, in turn, controlled the vapor temperature in the test section. Temperatures and pressures throughout the system were monitored to determine when a steady state was reached; a steady state was assumed to exist when there was no significant change in temperatures (± 0.1 to $\pm 0.2^\circ\text{F}$) through the system over a 5- to 10-minute span.

Once a steady state was achieved, the experimental data were recorded. The information recorded included the vapor temperature and pressure in both the condenser and boiler, the flow rate and temperature of the condensate, the inlet and outlet temperatures and flow rates of the primary and secondary coolants, and the voltage and current to each pair of heater rods. The experimental data were then used to calculate heat transfer rates and temperature differences in the system and to check pressure-temperature values against saturation data in the literature (see Appendix A for examples).

When the data collection for a single operating point was complete, the flow rates of the primary and secondary cooling water were adjusted until the system reached a new steady state. The experimental data were again recorded, and the same procedure was repeated until data were collected for three to five primary coolant flow rates at the same boiler heat rate. In the experiments, the five primary cooling rates ranged from 2.0 to 23.5 gpm. The heat rate to the boiler was then changed, and the procedure was repeated at the new heat rate.

4.2 Instrumentation

4.2.1 Voltage and current measurements

The power input to the boiler was monitored by voltage and current measurements for each pair of heaters.

4.2.2 Pressure measurements

The pressures in the boiler and the condenser were measured with bourdon gauges (Heise Model H-19178). The working fluid loop was also equipped with a compound gauge (Ashcroft, Model AMC 4296) for reading low pressures and subatmospheric pressures. Alternatively, subatmospheric pressures could be measured by means of a mercury manometer. with a compound gauge (Ashcroft, Model AMC 4296) for reading low pressures and subatmospheric pressures. Alternatively, subatmospheric pressures could be measured by means of a mercury manometer.

4.2.3. Temperature measurements

In initial experiments (Refrigerant 114), the system was equipped with chromel-alumel thermocouples; however, in later investigations, quartz thermometers (Hewlett Packard Model 2801A) and thermistors (Thermometrics Part No. S-10-4-wire) were added to the system at several critical locations. The thermocouples were used with a potentiometer to determine temperatures, and the temperatures were continuously recorded on two multipoint recorders. Thermocouples were located in the liquid and vapor of the boiler, in the vapor feed to the test section, in the inlet and outlet of both cooling water loops, near the condensate measuring station, and on each heater. The recorded thermocouple data were used in deciding when the system reached a steady state.

The quartz thermometers and thermistors were added to the system for greater accuracy. Both a quartz thermometer and a thermistor were located in the vapor feed to the test section and in the inlet and outlet of the primary cooling water. In addition, a quartz thermometer was located near the condensate measuring station. In later experimental investigations (after Refrigerant 114), the information from the quartz thermometers and/or thermistors were used for data reduction (see Appendix A) because of the greater accuracy attributed to these instruments. However, the experimental data from the three sets of temperature measuring instruments were checked against each other to increase the confidence in temperature measurements.

4.2.4 Flow measurements

The condensate flow in the working fluid loop could be measured by two instruments, an integral orifice meter and a turbine flow transducer. These two instruments were in parallel, and the piping permitted the routing of the flow through either device. An integral flow orifice assembly was used to adapt a pneumatic d/p cell transmitter (Foxboro Model 15A) for the measurement of low flow rates. The integral orifice meter was the only device in the system during early experiments (Refrigerants 114 and 21); however, since it was necessary to change orifice plates (bores of 0.0595, 0.0810, 0.0995, and 0.159 in.) for various flow

ranges, a turbine flow transducer (Flow Technology, Model FTM-A15-LJS) equipped with a range extending amplifier (Flow Technology, Model LFA-300A) was installed to facilitate operation. The range extending amplifier made it possible to cover the full range of interest (0.03 to 0.3 gpm) with only one instrument. In later experiments (after testing Refrigerants 114 and 21), measurements from the turbine flow transducer were used in reducing the data with the integral orifice meter used as a check. The two values always agreed within a few percent.

The primary cooling water flow was measured by one of two rotameters in parallel upstream of the test section. The rotameter (Fischer and Porter Company, Tube No. 9-35-250/70) was used to measure primary coolant flows greater than 15 gpm, and the smaller rotameter (Brooks Rotameter Company, Tube No. R-12-M-25-5) was used to measure primary coolant flows below 15 gpm.

The secondary cooling water flow in the range 0 to 4.0 gpm was measured by one of two small rotameters in parallel upstream of the cooling coil.

5. TEST TUBES

Nine tubes were tested in this investigation. Letter designations for identification of the tubes and individual tube characteristics are given in Table 1. Four additional tubes designated by D-1, F-1, F-3, and F-7 were also tested; these tubes were duplicates of Tubes D and F modified by attaching rubber skirts to the outside wall (the integer denotes the number of skirts on the tube). The skirts divided the tubes into two, four, or eight equal lengths, and aided condensate film drain-off from the outside tube surface.

Enlarged photographs of tube samples are presented in Figs. 8 through 18. Figures 17 and 18 illustrate the two types of skirts and the method of attaching them to the outside tube surface. The top half of Fig. 13 shows a closed cell sponge rubber skirt, 1/8-in. thick, clamped firmly to tube D with a plastic electric tie strap. In the bottom half of Fig. 13, a 1/32-in.-thick neoprene skirt was placed in a

Table 1. Characteristics of tubes

Cross section	Tube designation	Material	External perimeter (cm)	External surface area (m ²)	Number of external flutes	Number of internal flutes
A	Aluminum	8.00	0.0973
B	Al-brass	11.94	0.1296	12	12
C	Al-brass	8.90	0.0967	20	20
D	CuNi (90/10)	8.90	0.0967	36	36
E	Aluminum	12.71	0.1490	60	0
F	Aluminum	8.26	0.0964	48	0
G	Aluminum	9.75	0.1143	24	0
H	Aluminum	14.00	0.1522	42	34
J ^a	Aluminum	26.61/8.00 ^b	0.3110/0.0973 ^b	36	0

^aA duplicate of tube A, with 36 stainless steel blades loosely attached.

^bNumerator includes blades; denominator is base tube only.

Fig. 8. Photographs of tube samples — tubes A and B.

Fig. 9. Photographs of tube samples — tubes C and D.

Fig. 10. Photographs of tube samples — tubes E and F.

Fig. 11. Photographs of tube samples — tubes G and H.

ORNL PHOTO 6102-78

Tube J

Fig. 12. Photograph of sample tube — tube J.

Fig. 13. Photographs of tube samples with skirts — tubes D and F.

slot (1/8-in. wide X 0.004 in. deep) machined in tube F. Tube A was a smooth tube; tubes E, F, G, and J were outside fluted tubes, and all other tubes were doubly fluted. All tubes were aluminum except tube D, which was 90/10 cupro-nickel and tubes B and C, which were aluminum/brass. The flutes for tube J were stainless steel longitudinal blades loosely clamped to tube A. All tubes had rounded flutes except tubes E and J, which had square flutes.

The external perimeters listed in Table 1 for the fluted tubes are estimates which were used to calculate the surface areas for the fluted tubes. The perimeter of tube E was estimated as the product of the number of ridges and the measured perimeter of a typical ridge element. Tube J was measured in similar manner, but because of the low thermal conductivity of the attached stainless steel blades, only the base tube (same as tube A) perimeter was used for determining the surface area. External perimeters for the remaining tubes were estimated as the length of thin tape required to fit tightly around the outside surface of the tube.

The external surface areas in Table 1 apply to the tubes after preparation for testing. The area of tubes A and J were based on a 48-in. length; however, the areas of all the other tubes are based on a 46-in. effective length. This accounts for the 1-in. adaptor sleeves and installation clearances on each end of the fluted tubes.

6. WORKING FLUIDS

A total of seven working fluids in addition to R-717 (anhydrous ammonia)⁸ and R-718 (water)³ have been tested for condensation on vertical smooth and fluted tubes at ORNL. Fluids reported in this study are:

<u>Refrigerant number</u>	<u>Chemical formula</u>	<u>Molecular weight</u>	<u>Chemical Compound</u>
R-11	CCl_3F	137.38	Trichlorofluoromethane
R-21	CHCl_2F	102.93	Dichlorofluoromethane
R-22	CHClF_2	86.48	Chlorodifluoromethane
R-113	$\text{C}_2\text{Cl}_3\text{F}_3$	187.39	Trichlorotrifluoroethane
R-114	$\text{C}_2\text{Cl}_2\text{F}_4$	170.94	Dichlorotetrafluoroethane
R-115	C_2ClF_5	154.50	Chloropentafluoroethane
R-600a	$\text{i-C}_4\text{H}_{10}$	58.13	Isobutane

A comparison of fluid properties at 100°F is given in Table 2. All refrigerants tested were 98+% pure as specified by the manufacturer except R-114, which was a technical grade of 95% purity. Isobutane was the only hydrocarbon tested. Minor loop modifications and special safety precautions were required during these tests because of the flammability of isobutane.

Table 2. Comparison of fluid properties at 38°C (100°F)

Property	Units	Refrigerant number (formula)								
		11 (CCl ₃ F)	21 (CHCl ₂ F)	22 (CHClF ₂)	113 (C ₂ Cl ₃ F ₃)	114 (C ₂ Cl ₂ F ₄)	115 (C ₂ ClF ₅)	600a (1-C ₄ H ₁₀)	717 (NH ₃)	718 (H ₂ O)
Saturation pressure, P_{sat}	Pa (psia)	→ 1.618 x 10 ⁵ → (23.46)	2.761 x 10 ⁵ (40.04)	1.452 x 10 ⁶ (210.6)	7.226 x 10 ⁴ (10.48)	3.161 x 10 ⁵ (45.85)	1.260 x 10 ⁶ (182.73)	4.967 x 10 ⁵ (72.04)	1.461 x 10 ⁶ (211.9)	6550 (0.950)
Thermal conductivity, k	W/m·K (Btu/hr·ft·°F)	→ 0.0839 → (0.0485)	0.0974 (0.0563)	0.0815 (0.0471)	0.0725 (0.0419)	0.0613 (0.0354)	0.0464 (0.0268)	0.1021 (0.059)	0.452 (0.261)	0.628 (0.363)
Viscosity, μ	Pa·s (lb _m /hr·ft)	→ 3.70 x 10 ⁻⁴ → (0.894)	2.84 x 10 ⁻⁴ (0.686)	1.84 x 10 ⁻⁴ (0.444)	5.70 x 10 ⁻⁴ (1.379)	2.9 x 10 ⁻⁴ (0.71)	1.65 x 10 ⁻⁴ (0.400)	1.45 x 10 ⁻⁴ (0.35)	1.23 x 10 ⁻⁴ (0.298)	6.53 x 10 ⁻⁴ (1.58)
Density, ρ	kg·m ⁻³ (lb _m /ft ³)	→ 1445 → (90.21)	1335 (83.36)	1141 (71.23)	1534 (95.79)	1416 (88.40)	1217 (75.96)	535 (33.38)	583.1 (36.40)	993.2 (62.00)
Latent heat of vaporization, h_{fg}	J/kg (Btu/lb _m)	→ 1.749 x 10 ⁵ → (75.24)	2.211 x 10 ⁵ (95.12)	1.693 x 10 ⁵ (72.84)	1.498 x 10 ⁵ (64.46)	1.230 x 10 ⁵ (52.91)	8.315 x 10 ⁴ (35.77)	3.094 x 10 ⁵ (133.1)	1.110 x 10 ⁶ (477.8)	2.410 x 10 ⁶ (1037)
Heat capacity, c_p	J/kg·K (Btu/lb _m ·°F)	→ 895 → (0.214)	1090 (0.260)	1310 (0.313)	971 (0.232)	1040 (0.249)	1259 (0.301)	2623 (0.627)	4845 (1.158)	4175 (0.998)
Surface tension, σ	N/m (lb _f /ft)	→ 0.0167 → (1.14 x 10 ⁻³)	0.0163 (1.12 x 10 ⁻³)	0.00645 (4.42 x 10 ⁻⁴)	0.0171 (1.17 x 10 ⁻³)	0.0105 (7.20 x 10 ⁻⁴)	0.00383 (2.62 x 10 ⁻⁴)	0.00836 (5.73 x 10 ⁻⁴)	0.0175 (1.20 x 10 ⁻³)	0.0699 (4.79 x 10 ⁻³)

7. ANALYSIS

7.1 Overall Condensing Coefficients

The heat transfer rate in the condenser is given by

$$Q = UA\overline{\Delta T}, \quad (7-1)$$

where U is the overall heat transfer coefficient, $\overline{\Delta T}$ is the mean temperature difference between the condensing vapor and the primary cooling water, and A is surface area of the test tube. The heat transfer rate can be computed from either the condensate mass flow rate ($\dot{m}_c$) or from the product of mass flow rate ($\dot{m}_w$) and temperature rise (ΔT_w) of the primary cooling water; thus,

$$Q = \dot{m}_c h_{fg} \quad (7-2)$$

and

$$Q = \dot{m}_w c_{pw} \Delta T_w, \quad (7-3)$$

where h_{fg} is the latent heat of the condensing fluid, and c_{pw} is the heat capacity of water. In this analysis, all physical property data for test fluids were taken from ASHRAE handbooks,¹²⁻¹⁴ where fluids are designated by refrigerant numbers.

The arithmetic mean difference is used for $\overline{\Delta T}$, since in most cases the temperature difference between the water inlet and outlet was relatively small. Therefore, assuming saturated vapor:

$$\overline{\Delta T} = T_v - (T_{w,in} + T_{w,out})/2, \quad (7-4)$$

where T_v is the vapor temperature and the second term on the right is the average of the inlet water temperature ($T_{w,in}$) and the outlet water temperature ($T_{w,out}$).

The overall coefficient can be computed from Eq. (7-1) using either Eq. (7-2) or Eq. (7-3) to calculate Q . Defining an overall coefficient (U_o) based on the outside surface area (A_o) and rearranging Eq. (7-1):

$$U_o = \frac{Q}{A_o \overline{\Delta T}} \quad (7-5)$$

The next step in the analysis is the evaluation of individual condensing-side coefficients from the overall coefficients.

7.2 Individual Condensing-Side Coefficients

A technique introduced by Wilson⁸ in 1915 was used as the primary method of analysis in this study; this is a graphical method of interpreting overall coefficients of heat transfer in surface condensers such that individual condensing-side coefficients can be evaluated. The Wilson plot is discussed in Refs. 8 and 9. The following treatment presents the method and describes the application to the experimental data in this study.

The overall resistance to heat flow ($\Sigma R = 1/U$) in a condenser is equal to the sum of the individual resistances; thus,

$$1/U = R_v + R_{fo} + R_{wall} + R_{fi} + R_w, \quad (7-6)$$

where R_v is the resistance on the vapor (condensing) side, R_{wall} that of the wall, R_w that on the water side, and R_{fo} and R_{fi} account for any fouling on the outside and inside surfaces of the tube, respectively. Introducing individual average heat transfer coefficients (h), neglecting any fouling, and correcting for differences in area, the overall coefficient based on the outside surface area is represented by:

$$\frac{1}{U_o} = \frac{1}{h_m} + R_{wall} + \frac{A_o}{h_w A_i}, \quad (7-7)$$

where A_i is the inside surface area of the tube, h_m is the mean vapor-side heat transfer coefficient based on the outside tube area, and h_w is the water-side heat transfer coefficient based on the inside tube area. For a smooth tube, the wall resistance based on the outside tube area is given by:

$$R_{wall} = r_o \ln(r_o/r_i)/k, \quad (7-8)$$

where r_o and r_i are the outside and inside radii of the tube, respectively, and k is the thermal conductivity of the tube wall.

Neglecting the effects of changes in water temperature, the water-side resistance ($1/h_w$) can be taken as a function of the water velocity

(v). For turbulent flow of water, this can be expressed as

$$1/h_w \propto 1/v^{0.8},$$

and thus, Eq. (7-7) can be rewritten:

$$\frac{1}{U_o} = \frac{1}{h_m} + R_{wall} + a_1 v^{-0.8}. \quad (7-9)$$

If, following Wilson, the sum of the first two resistances ($1/h_v + R_{wall}$) is taken as approximately constant, Eq. (7-9) becomes:

$$\frac{1}{U_o} = a_o + a_1 v^{-0.8} \quad (7-10)$$

In this form, a plot of $1/U_o$ vs $1/v^{0.8}$ on ordinary rectangular coordinates should give a straight line from which the constants a_o and a_1 can be determined. Thus, the constant a_o is given by the y-intercept on the Wilson plot and corresponds to the sum of the first two resistances (vapor side plus wall) in Eq. (7-9):

$$a_o = \frac{1}{h_m} + R_{wall} \quad (7-11)$$

The constant a_1 is the slope of the straight line on the Wilson plot.

For a smooth tube, Eq. (7-8) can be used to calculate a wall resistance and h_m can be computed from Eq. (7-11). However, for fluted tubes, it is very difficult to estimate the contribution of the wall due to the more complicated wall geometry and heat distribution. However, for the fluids studied in this investigation, the wall resistance is not a significant fraction of the total resistance in the condenser and can be neglected with little loss in accuracy. For example, the effect of ignoring the wall resistance in evaluating the vapor-side coefficient was less than 2% for test fluids condensing on tube A (smooth aluminum 1-in.-OD tube with 0.065-in. wall). A sample calculation is presented in Appendix A for isobutane condensing on tube A. Assuming negligible wall resistance,

$$h_m = \frac{1}{a_o}, \quad (7-12)$$

which represents the y-intercept on the Wilson plot. The corresponding condensing temperature difference is given by:

$$\Delta T_f = \frac{Q}{h_m A_o}, \quad (7-13)$$

and represents the temperature difference across the condensing film.

8. DATA DISCUSSION

Table 3 shows a test matrix for vertical condensation experiments reported in this study. Seven fluids and nine tubes (plus four tubes modified with skirts) were tested; Figs. 14 through 33 present heat transfer results from the study. A total of 2464 runs were made to provide a total of 550 heat transfer data points. Test parameter ranges were as follows:

Condensing temperature	299–345 K (78–161°F)
Condensing pressure	1.1×10^5 to 1.6×10^6 Pa (16–226 psia)
Heat load	280–4100 W (960–14,000 Btu/hr)
Heat flux	2000–43,000 W/m ² (920–13,600 Btu/hr·ft ²)

The resulting condensing heat transfer coefficients (h_m) ranged from 620 to 7900 W/m²·K (110 to 1400 Btu/hr·ft²·°F); condensing temperature differences (ΔT_f) ranged from 0.7 to 39 K (13 to 70°F). Both the heat flux (Q/A) and the mean condensing heat transfer coefficient (h_m) were based on total outside tube surface area (see Table 1, p. 21).

Samples of data reduction and Wilson plots are presented in Appendix A. Wilson-plot results are tabulated in Appendix B, and raw experimental data are listed in Appendix C including overall heat transfer coefficients and heat balance checks for the condenser test section. Equipment, operating procedures, and analysis were as described in other sections of this report.

Tube A (smooth aluminum) data are presented in Fig. 14 in nondimensional form. The ordinate is the standard nondimensional heat transfer coefficient (average or mean):

Table 3. Test matrix for condensation experiments

Refrigerant number	Formula	Tube ^a												
		A	B	C	D	D-1	E	F	F-1	F-3	F-7	G	H	J
11	CCl ₃ F	b	b	b	b	c	b	c	c	c	c	c	c	c
21	CHCl ₂ F	b												
22	CHClF ₂	b			b		b							
113	C ₂ Cl ₃ F ₃	c	c	c	c		c	c	c	c	c			
114	C ₂ Cl ₂ F ₄	d	b	b	b		b							
115	C ₂ ClF ₅	c			c	c	c	c	c	c	c	c	c	c
600a	C ₄ H ₁₀	c					c	c		c				

^aFor tube characteristics, see Table 1.

^bTests completed in FY 1976.

^cTests completed in FY 1977.

^dTests completed in FY 1975.

Fig. 14. Vertical smooth-tube condensation data for refrigerants — standard nondimensional coordinates.

Fig. 15. Condensing film coefficient vs heat flux for R-11.

Fig. 16. Condensing film coefficient vs heat flux for R-11

Fig. 17. Condensing film coefficient vs heat flux for R-22.

Fig. 18. Condensing film coefficient vs heat flux for R-113.

Fig. 19. Condensing film coefficient vs heat flux for R-114.

Fig. 20. Condensing film coefficient vs heat flux for R-115.

Fig. 21. Condensing film coefficient vs heat flux for R-115.

Fig. 22. Condensing film coefficient vs heat flux for R-600a.

Fig. 23. Heat load vs condensing temperature difference for R-11.

Fig. 24. Heat load vs condensing temperature difference for R-11.

Fig. 26. Heat load vs condensing temperature difference for R-113.

Fig. 28. Heat load vs condensing temperature difference for R-114.

Fig. 29. Heat load vs condensing temperature difference for R-115.

Fig. 30. Heat load vs condensing temperature difference for R-115.

ORNL-DWG 77-21268R

Fig. 32. Heat load vs condensing temperature difference for smooth tube A.

$$H = \frac{h_m}{(k^3 \rho^2 g / \mu^2)^{1/3}} \quad (8-1)$$

The abscissa is the liquid film Reynolds number:

$$Re = 4\Gamma/\mu, \quad (8-2)$$

where Γ is the condensate mass flow rate at the bottom of the tube per unit length of periphery. All fluid properties (k , ρ , μ) were evaluated at the equivalent film temperature; the method for evaluating the equivalent film temperature is illustrated in Appendix A.

The data for the seven fluids are seen to group in a rather tight band on the coordinates of Fig. 14 and span the Reynolds number range of 450 to 4500. The position of the data band is somewhat above that predicted by the Nusslet¹⁵ laminar film analysis, but in the region of the McAdams¹⁵ and Kirkbride¹⁶ relations. A correlation by Zazuli¹⁷ seems to give improved agreement for Reynolds numbers below 2000. The present data are well within the scatter bands of similar plots by other investigators for a selection of fluids (see, for example, Ref. 18). Such a comparison gives some measure of the confidence factor characteristic of the present data.

Condensation data are presented in two dimensional forms in this section. One dimensional presentation, heat transfer coefficient vs heat flux (Figs. 15 through 22), is useful for describing experimental heat transfer ranges. Also, since both the ordinate and abscissa are based on total outside tube surface area, results are helpful in determining whether the observed augmentation is merely an area effect. The second dimensional form, heat load vs condensing temperature difference (Fig. 23 through 33), is useful for particular design considerations, since "credit" is allowed for the increased surface area of fluted tubes. Selected results which are representative of all the condensation data are discussed below.

Figures 15 and 16 present data for R-11 condensing on all of the test tubes on a heat transfer coefficient-heat flux basis. Heat transfer coefficients for smooth tube A vary little with heat flux in this test range. In contrast, coefficients for the fluted tubes are considerably higher than those for tube A and drop sharply as heat flux increases. A ratio of fluted tube coefficient to smooth tube coefficient at a given heat flux provides a means of comparing fluted tube performances for a given fluid. Ratios of up to 6.0 were achieved with the fluted tubes in the experiments. For example, this is shown in Fig. 18 for condensation of R-113 at a heat flux of 7600 W/m^2 ($2400 \text{ Btu/hr}\cdot\text{ft}^2$); the coefficients for tubes F (48 flutes) and A are $4400 \text{ W/m}^2\cdot\text{K}$ ($780 \text{ Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F}$) and $740 \text{ W/m}^2\cdot\text{K}$ ($130 \text{ Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F}$), respectively, or a ratio of 6.0. This was the highest ratio obtained in the study for a fluted tube with no skirts.

Even greater enhancements are possible using skirts on fluted tubes. Figure 18 (R-113) shows that, at a heat flux of 7600 W/m^2 ($2400 \text{ Btu/hr}\cdot\text{ft}^2$), the coefficient for tube F-7 (tube F with seven skirts) is $5300 \text{ W/m}^2\cdot\text{K}$ ($940 \text{ Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F}$) compared to $740 \text{ W/m}^2\cdot\text{K}$ ($130 \text{ Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F}$) for tube A, thus, providing an enhancement ratio of 7.2. This represents the maximum enhancement ratio achieved for any test tube on the heat transfer coefficient-heat flux basis. Also, coefficients for fluted tubes with skirts may be compared to those for nonskirted fluted tubes at a given heat flux. In Fig. 18 at a heat flux of 7600 W/m^2 (same as above), coefficients for tube F-7 compared to tube F with no skirts result in an enhancement ratio of 1.2. Higher ratios (up to 2.0) were achieved at higher heat fluxes where condensate flow rates were larger and flooding more pronounced. For example, in Fig. 22 for R-600a condensing at a heat flux of $25,000 \text{ W/m}^2$ ($7800 \text{ Btu/hr}\cdot\text{ft}^2$), the ratio of the coefficients for tube F-7 to tube F is 2.0.

In general, the highest condensing coefficients were obtained for skirted tubes F-7, F-3, and F-1, followed by nonskirted tubes E, F, D, H, G, C, B, and J, in that order, as shown in Figs. 15 and 16. Conclusions from Figs. 15 through 22 include the following:

1. The fluted test tubes can increase condensing heat transfer coefficients up to 6.0 times smooth tube values at a given heat flux.

2. Such augmentation cannot be accounted for by the increased area of the fluted tubes.

3. Even further enhancement is possible with the use of drainage skirts on fluted tubes. Coefficients of up to 7.2 times smooth tube values can be achieved on a fluted tube with skirts at a given heat flux. Also, coefficients for fluted tubes with skirts can be increased up to 2.0 times the corresponding values for fluted tubes with no skirts.

4. The magnitude of the augmentation varies greatly with both the type of fluted tube and its heat flux.

In Figs. 23 through 33, the condensation data are plotted in heat load versus condensing temperature difference form. In this form, the relative performance positions of tubes B, E, and H improve considerably because their total surface areas are so much greater than those of the other test tubes (see Table 1, p. 21). This is illustrated, for example, by comparing the relative positions of R-113 data for tubes E and F-7 in Figs. 18 and 27. The data for tube E fall below that of tube F-7 in Fig. 18 on the heat transfer coefficient-heat flux basis, but in Fig. 27 (heat load-condensing temperature difference basis), the performance rank order is switched with tube E data above that of tube F-7.

For a given condensing temperature difference, fluted tubes can accommodate heat loads up to 5.4 times smooth tube values. This is shown in Fig. 25 for condensation of R-22. At a condensing temperature difference of 2.9 K (5.3°F), tube E can accommodate a heat load of 1900 W (7000 Btu/hr) while tube A can handle only 350 W (1300 Btu/hr), thus giving a heat load ratio of 5.4. Alternatively, for a given heat load, tube A requires condensing temperature differences up to 10 times the fluted tube values. This is also illustrated in Fig. 25. For a heat load of 760 W (2800 Btu/hr), the condensing temperature difference required is 6.1 K (11.0°F) for tube A and 0.6 K (1.1°F) for tube E, thus, an enhancement ratio of 10. A similar analysis for the efficiency of skirts may be made for tubes F-7, F-3, and F-1 versus plain tube F. As shown in Fig. 27, the greatest performance improvements over tube F were achieved with tube F-7 at high heat loads and high condensing temperature differences. The enhancement was dependent on the efficiency of condensate removal from

the outside tube surface, especially at high heat loads where flooding is more pronounced.

Tube A data for all seven test fluids are shown in Fig. 32 on heat load versus condensing temperature difference coordinates. From this plot, one can judge that R-21 and R-22 are the best performing fluids — followed by R-11 and R-600a — when evaluated on this basis. For a given condensing temperature difference, the maximum heat load ratio achieved with tube A was 1.5 to 1.7 for R-21 and R-22 as compared to R-113 (the worst test fluid). Conversely, for a given heat load, the maximum condensing temperature difference ratio (R-113 to R-11 and R-22) was also 1.5 to 1.7 for tube A.

Data for all fluids tested with tube E are presented in Fig. 33 on heat load versus condensing temperature difference coordinates. In this plot it can be seen that R-22 is the best fluid at low heat loads with R-11 taking over at high heat loads; R-600a is also a good performer — all showing clear superiority to R-115. Fluid R-115 is the worst fluid due to its low heat of vaporization which promotes flooding of the flutes. For a given condensing temperature difference, the maximum heat load ratios achieved with tube E were 1.7 to 2.3 for R-11 and R-22 as compared to R-115. For a given heat load, however, the corresponding condensing temperature difference ratios (R-115 to R-11 and R-22) were 2.9 to 3.7 for tube E. This type of analysis can be used to evaluate the effect of fluid choice on the heat transfer performance of any of the enhanced tubes. Tube E data were presented as an example because it was the best tube on a heat load—condensing temperature difference basis.

Conclusions from Figs. 23 through 33 include the following:

1. The fluted tubes can increase heat load capability to 6.0 times smooth tube values for a given fluid and condensing temperature difference.
2. For a given fluid and heat load, a smooth tube may require condensing temperature differences up to 10 times fluted tube values.
3. The best fluids tested can increase heat load capacity to 1.7 times "poor" fluid values for a given tube (smooth or fluted) and condensing temperature difference.

4. For a smooth tube with a given heat load, the worst fluid tested may require condensing temperature differences up to 1.7 times the best fluids.

5. For a given fluted tube and heat load, the worst fluid tested may require condensing temperature differences up to 3.7 times the best fluids.

It is apparent from the preceding that, within the range of the experiments, heat transfer performance (as judged on the heat load—condensing temperature difference) is more sensitive to tube choice than to fluid choice. To illustrate combined tube and fluid effects, consider specified condenser situations where it is required to accommodate a heat load of 810 W (2800 Btu/hr) using tubes and fluids in the present range of experiments. The data show that tube A operating with R-113 would require a condensing temperature difference of approximately 10 K (18°F) to accommodate the given load while tube E operating with R-22 would require only about 0.70 K (1.3°F) for the same duty — giving an "augmentation factor" of 14.

By the same token, for a specified condensing temperature difference of 4.2 K (7.5°F), tube E operating with R-22 could accommodate a heat load of approximately 2400 W (8200 Btu/hr) while tube A operating with R-113 could handle only about 360 W (1200 Btu/hr) — giving an "augmentation factor" of 6.8.

SUMMARY

This study was undertaken to evaluate the performance efficacy of fluted tubes for augmenting condensation heat transfer with selected fluids. Thus, extensive experimental data for various tube and fluid combinations are presented in this report; heat transfer results are presented in forms useful for both heat exchanger design and analytical modeling. The fluted tubes were found effective in enhancing condensing film coefficients (increases of up to 6.0 over conventional smooth tubes). The magnitude of the enhancement varied with fluid properties, tube geometries, and heat flux. Even larger enhancements (up to 7.2) were achieved by the use of drainage skirts attached to the outside surface of the tubes. These skirts were effective in removing condensate from the tube surface, and therefore reduced flooding of the flutes.

The higher condensing coefficients are significant to heat exchanger design since the condensing film resistance is the dominant resistance in a heat exchanger utilizing a fluorocarbon (or isobutane) and conventional smooth tubes. A typical water-side coefficient in a condenser for a geothermal application is $5700 \text{ W/m}^2\cdot\text{K}$ ($1000 \text{ Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F}$). Condensing film coefficients that closely match or even exceed the water-side coefficient can be achieved with fluted tubes (as shown in this study). The overall effect is that less heat transfer area is required to accommodate a given load, thus, lower cost heat exchangers.

In a heat exchanger design for practical applications (for example, geothermal), tube lengths will probably be longer than 1.2 m (4 ft) as tested in this study; and flooding of the fluted surfaces will be a greater problem. The severity of the flooding depends on the fluid and the heat flux for a given tube and length — flooding is more pronounced at higher heat fluxes. The fluorocarbons with their higher molecular weights and lower heats of vaporization offer greater potential for flooding as compared to fluids like water and ammonia. However, drainage skirts can be used to minimize the flooding problem for longer tubes by dividing the tube into shorter condensing lengths. For example, three equally spaced skirts can divide a 4.8-m (16-ft) tube into four 1.2-m (4-ft) condensing lengths, and the coefficients for the 1.2-m tubes

could be safely used for design of a heat exchanger. Tradeoffs between tube length, heat flux, and the use of skirts should be considered in the design of a heat exchanger using the present data.

In conclusion, the experimental data reported in this study will aid in the design of condensers and in the development of models and correlations for condensation on fluted tubes. Also, the experimental apparatus and techniques developed for this study should be useful for future condensation experiments.

REFERENCES

1. S. L. Milora and J. W. Tester, *Geothermal Energy as a Source of Electric Power - Thermodynamic and Economic Design Criteria*, The MIT Press, Cambridge, Mass., 1976.
2. R. Gregorig, "Film Condensation on Finely Waved Surfaces with Consideration of Surface Tension," *Zeit. für ang. Math. u. Physik*, 5, 36 (1954).
3. L. G. Alexander and H. W. Hoffman, Improved Heat-Transfer Systems For Evaporators - Performance Characteristics of Advanced Evaporator Tubes for Long-Tube Vertical Evaporators, ORNL/TM-2951 (January 1971).
4. T. C. Carnavos, "Thin Film Distillation," pp. 205-218 in Proceedings of First International Symposium on Water Desalination, Washington, D.C., October 3-9, 1965, Vol. 2, 1967.
5. D. G. Thomas, "Enhancement of Film Condensation Heat Transfer Rates on Vertical Tubes by Vertical Wires," *Ind. Eng. Chem. Fundamentals*, 6, 97 (1967).
6. D. G. Thomas, "Enhancement of Film Condensation Rate on Vertical Tubes by Longitudinal Fins," *Am. Int. Chem. Eng. J.*, 14, 644 (1968).
7. G. Jansen and P. C. Owzarski, Boiling Heat Transfer in Falling Film Evaporators with Corrugated Surfaces, OSW Research and Development Progress Report No. 693 (September 1971).
8. S. K. Combs, An Experimental Study of Heat Transfer Enhancement for Ammonia Condensing on Vertical Fluted Tubes, ORNL-5356 (January 1978).
9. E. E. Wilson, "Basis for Rational Design of Heat Transfer Apparatus," *Trans. Am. Soc. Mech. Engrs.*, 37, 47 (1915).
10. W. H. McAdams, Heat Transmission, 3d ed., McGraw-Hill, New York, 1954.
11. D. Q. Kern, Process Heat Transfer, p. 281, McGraw-Hill, New York, 1950.
12. "Properties of Refrigerants," Chap. 14, ASHRAE Handbook of Fundamentals, p. 268, ASHRAE, New York, 1972.
13. Thermophysical Properties of Refrigerants, pp. 145-150, ASHRAE, New York, 1973.
14. Thermophysical Properties of Refrigerants, pp. 131-150, ASHRAE, New York, 1969.
15. W. Nusselt, "Die Oberflächenkondensation des Wasserdampfes," *Z. Ver. Deutsch. Ing.*, 60, 541, 569 (1916).

16. C. G. Kirkbride, "Heat Transfer by Condensing Vapors on Vertical Tubes," *Trans. Am. Inst. Chem. Engrs.*, 30, 170 (1933).
17. S. S. Kutateladze, Fundamentals of Heat Transfer, p. 307, Academic Press, New York, 1963.
18. U. Grigull, *Forsch. Gebiete Ingenieurw.*, 13, 49-57 (1942).

APPENDIX A

SAMPLES OF DATA REDUCTION

Physical Properties for Working Fluids

All property data for working fluids used in data reduction were taken from ASHRAE handbooks.¹²⁻¹⁴ A comparison of fluid properties was given in Table 2, p. 30, in a previous section of this report. The accuracy of thermophysical properties is discussed in Ref. 13.

Fluted Tube

A sample of the experimental data required for computing the heat transfer rates and coefficients in the condenser is listed in Table A-1. The data are for isobutane (R-600a) condensing on tube F (48 external corrugations). Experimental run R-600A-013F will be used to demonstrate the procedure followed in reducing the data for an individual run, and the series of runs R-600A-013F through R-600A-016F is used to demonstrate the Wilson plot.

For saturated vapor, the experimental pressure (P) of the vapor should agree with the saturation pressure (P_{sat}) of isobutane at the experimental vapor temperature (T_v). The saturation pressure in ASHRAE for a temperature of 97.9°F is 69.8 psia, which agrees within the experimental accuracy of the instruments to the measured pressure (P) of 70.7 psia for run R-600A-013F. This agreement also indicates the absence of appreciable amounts of noncondensables in the condenser during operation.

The heat transfer rate in the condenser can be computed both from condensate flow rate (F_c) and from the flow rate (F_w) and the temperature rise (ΔT_w) of the cooling water. To calculate the heat transfer from the condensate flow rate requires the latent heat (h_{fg}) of isobutane at the vapor temperature (T_v) and the density of liquid isobutane (ρ_c) at the temperature of the condensate (T_c) at the measuring station.

Table A-1. Sample of experimental data — isobutane condensing on tube F

Run No.	Vapor feed to test section		Condensate		Primary cooling water through test section			
	Temperature T_v , °F	Pressure P, psia	Flow rate F_c , gpm	Temperature T_c , °F	Flow rate F_w , gpm	Inlet temp. $T_{w,in}$, °F	Outlet temp. $T_{w,out}$, °F	Temp. dif. ^a ΔT_w , °F
R-600A-013F	97.92	70.7	0.1333	96.35	23.0	87.48	87.93	0.41
R-600A-014F	99.67	72.7	0.1306	97.78	7.6	87.24	88.48	1.25
R-600A-015F	100.70	73.7	0.1292	98.68	5.2	86.94	88.73	1.79
R-600A-016F	103.22	76.7	0.1279	100.52	3.0	86.53	89.53	3.00

^aCorrected for temperature offset of instruments and pressure drop effects.

For

$$T_c = 96.3^\circ\text{F} \rightarrow \rho_c = 33.5 \text{ lb}_m/\text{ft}^3 ,$$

$$T_v = 97.9^\circ\text{F} \rightarrow h_{fg} = 133.8 \text{ Btu/lb}_m .$$

The heat transfer rate can be calculated from Eq. (7-2) with the condensate mass flow rate given by

$$\dot{m}_c = F_c \rho_c , \quad (\text{A-1})$$

so that

$$\begin{aligned} Q_c &= F_c \rho_c h_{fg} \\ &= (0.133 \text{ gpm})(33.5 \text{ lb}_m/\text{ft}^3)(133.8 \text{ Btu/lb}_m)(0.1337 \text{ ft}^3/\text{gal})(60 \text{ min/hr}) \\ &= 4798 \text{ Btu/hr} . \end{aligned} \quad (\text{A-2})$$

The heat transfer rate also can be computed from the primary cooling water and is given by Eq. (7-3) where

$$\dot{m}_w = F_w \rho_w \quad (\text{A-3})$$

and, therefore,

$$Q_w = F_w \rho_w c_{pw} \Delta T_w , \quad (\text{A-4})$$

where c_{pw} and ρ_w are the heat capacity and density of the primary cooling water respectively. These values are calculated at the average temperature of the primary cooling water. In this particular example, the change in temperature is so small that the variation in properties is insignificant. The properties for water in this range ($\sim 87^\circ\text{F}$) is a density (ρ_w) of $62.2 \text{ lb}_m/\text{ft}^3$ and a heat capacity (c_{pw}) of $1.0 \text{ Btu/lb}_m \cdot ^\circ\text{F}$, with the information for run R-600A-013F,

$$\begin{aligned} Q_w &= (23 \text{ gpm})(62.2 \text{ lb}_m/\text{ft}^3)(\text{Btu}/1.0 \text{ lb}_m \cdot ^\circ\text{F})(0.411^\circ\text{F})(0.1337 \text{ ft}^3/\text{gal}) \\ &\quad (60 \text{ min/hr}) = 4708 \text{ Btu/hr} . \end{aligned}$$

The percent difference between the two heat loads is given by:

$$\begin{aligned} (\Delta Q/Q) \times 100 &= (Q_w - Q_c)/Q_c \times 100 \\ &= (4798 - 4708)/4798 \times 100 \\ &= 1.9 . \end{aligned} \quad (\text{A-5})$$

The heat balance obtained by the two different methods thus agreed within acceptable limits.

The overall condensing coefficient can be computed from Eq. (7-5) with either Q_c or Q_w . However, since the heat rate from the condensate flow (Q_c) is considered to be the more accurate of the two, it is used in the calculation. The mean temperature difference ($\overline{\Delta T}$) is given by Eq. (7-4):

$$\overline{\Delta T} = T_v - (T_{w,in} + T_{w,out})/2 , \quad (7-4)$$

and for run R-600A-013F,

$$\overline{\Delta T} = 97.9 - (87.9 + 87.5)/2 = 10.2^\circ\text{F} .$$

The outside surface area (A_o) of tube F is listed in Table 1, p. 21. Applying Eq. (7-5) and using the data for run R600A-013F,

$$U_o = \frac{Q}{A_o \overline{\Delta T}} = \frac{4798 \text{ Btu/hr}}{(1.04 \text{ ft}^2)(10.2^\circ\text{F})} = 452 \text{ Btu/hr.ft}^2.\text{°F} . \quad (7-5)$$

The same calculations illustrated for run R-600A-013F can be carried out for the other three runs in Table A-1. The results of the calculations for all four runs are shown in Table A-2. The four heat rates can be averaged to obtain a mean heat load for the series of runs so that

$$Q_{c,avg} = 4650 \text{ Btu/hr} ,$$

$$Q_{w,avg} = 4637 \text{ Btu/hr} .$$

Water velocities (v) are calculated from the volume flows of water (F_w) and the cross-sectional area of the annulus (A_c):

$$v = F_w/A_c \quad (A-6)$$

and A_c is given by

$$A_c = \frac{\pi}{4} (D_i^2 - D_r^2) , \quad (A-7)$$

Where D_i is the inside diameter of the test tube and D_r is the outside diameter of the solid rod inserted through the test tube ($D_r = 0.5 \text{ in.}$). From Table 1 (p. 21) for tube F, $D_i = 0.90 \text{ in.}$ so that

Table A-2. Sample information for the Wilson plot – isobutane condensing on tube F

Run No.	Condenser heat load			Condenser mean temp. diff., $\overline{\Delta T}$, °F	Primary cooling water velocity, v, ft/sec	$(1/v)^{0.8}$	Overall coefficient, U_o , Btu/hr·ft ² ·°F	$1/U_o$
	Q_c , ^a Btu/hr	Q_w , ^b Btu/hr	$(\Delta Q/Q) \times 100$					
R-600A-013F	4798	4708	-1.9	10.22	16.8	1.05×10^{-1}	452	2.21×10^{-3}
R-600A-014F	4673	4716	0.9	11.81	5.5	2.56×10^{-1}	381	2.62×10^{-3}
R-600A-015F	4606	4639	0.7	12.87	3.8	3.44×10^{-1}	345	2.90×10^{-3}
R-600A-016F	4521	4483	-0.9	15.19	2.2	5.32×10^{-1}	287	$3/48 \times 10^{-3}$

^aCalculated from condensate flow of isobutane.

^bCalculated from temperature rise and flow of the primary cooling water.

$$A_c = \frac{\pi}{4} [(0.90/12 \text{ ft})^2 - (0.50/12 \text{ ft})^2] = 0.00305 \text{ ft}^2$$

and from run R-600A-013F,

$$v = (23 \text{ gpm})(0.1337 \text{ ft}^2/\text{gal})(1/60 \text{ min/sec})/0.00305 \text{ ft}^2 = 16.8 \text{ ft/sec.}$$

To generate the Wilson plot, it is necessary to take the reciprocal of the overall coefficient and to raise the water velocity to the negative 0.8 power. These values are shown in Table A-2 and were used to construct the Wilson plot shown in Fig. A-1. The data points shown in Fig. A-1 were fitted by a least-squares method of the first order to determine the best linear fit to satisfy the following relationship:

$$1/U_o = a_o + a_1 v^{-0.8}, \quad (7-10)$$

where a_1 is the slope of the straight line and a_o is the y-intercept. For this particular run series,

$$a_o = 1.89 \times 10^{-3} \text{ (y-intercept)}$$

$$a_1 = 3.83 \times 10^{-3} \text{ (slope).}$$

As indicated in Fig. A-1, the data show good linearity and allow extrapolation to infinite water velocity (zero water-side resistance) with some confidence. The reciprocal ($1/a_o$) gives the composite heat transfer coefficient of the condensing film and tube wall. The tube wall resistance is insignificant (maximum of 10%) to the total overall resistance, so the intercept can be considered the condensing film coefficient. For the series of runs R-600A-013F through R-600A-016F, the film coefficient is 530 Btu/hr·ft²·°F. The corresponding condensing film temperature difference is given by Eq. (7-13):

$$\Delta T_f = \frac{Q}{h_m A_o} = \frac{4650 \text{ Btu/hr}}{(530 \text{ Btu/hr} \cdot \text{ft}^2 \cdot \text{°F})(1.04 \text{ ft}^2)} = 8.5^\circ \text{F} . \quad (7-13)$$

Smooth Tube

A Wilson plot for the series of runs R-600A-021A through R-600A-024A is shown in Fig. A-2. The data are for isobutane condensing on tube A

Fig. A-1. Wilson plot for isobutane condensing on tube F (48 external corrugations) — Runs R-600A-013F through R-600A-016F.

Fig. A-2. Wilson plot for isobutane condensing on tube A (smooth tube) — Runs R-600A-021A through R-600A-024A.

(smooth aluminum tube). The y-intercept on the Wilson plot (a_o) is 162 Btu/hr·ft²·°F, and the corresponding temperature difference ($\Delta T_f = 43.9^\circ\text{F}$) can be calculated from Eq. (7-13). The individual condensing-side coefficient can be computed by solving for h_m in Eq. (7-11):

$$h_m = \frac{1}{1/a_o - R_{\text{wall}}} , \quad (\text{A-8})$$

where R_{wall} is given by Eq. (7-8) for tube A:

$$R_{\text{wall}} = r_o \ln(r_o/r_i)/k . \quad (7-8)$$

The variables for tube A are

$$\begin{aligned} r_o &= 0.500 \text{ in.} , \\ r_i &= 0.435 \text{ in.} , \\ k &= 99 \text{ Btu/hr}\cdot\text{ft}\cdot^\circ\text{F} , \end{aligned}$$

so that

$$\begin{aligned} R_w &= [(0.500 \text{ in.})(1 \text{ ft}/12 \text{ in.})] \ln(0.50/0.435)/(99 \text{ Btu/hr}\cdot\text{ft}\cdot^\circ\text{F}) \\ &= 5.9 \times 10^{-5} (\text{Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F})^{-1} . \end{aligned}$$

From Fig. A-2, the y-intercept (a_o) is equal to 6.2×10^{-3} and from Eq. (A-8)

$$h_m = \frac{1}{6.2 \times 10^{-3} - 5.9 \times 10^{-5}} = 164 \text{ Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F} .$$

Nondimensional Quantities

The vapor-side heat transfer coefficient (h_v) is usually considered equal to the condensing film coefficient since the dominant resistance lies in the condensate film. Therefore, the condensing film heat transfer coefficient can be put into the standard nondimensional form given by Eq. (8-1):

$$H = h_m / (k^3 \rho^2 g / \mu^2)^{1/3} , \quad (8-1)$$

where all fluid properties are evaluated at the equivalent film temperature (T_f) as pointed out by McAdams where

$$T_f = T_v - 3/4 (T_v - T_{wall}) \quad (A-9)$$

and T_{wall} is the outside wall temperature. The temperature of the vapor for the purpose of evaluating film temperatures was chosen as the lowest vapor temperature for the series of runs for a given Wilson plot. For runs R-600A-021A through R-600A-028A, the vapor temperature was taken as 121°F (see Appendix B) for evaluation of the nondimensional coefficient. The temperature difference across the condensing film (ΔT_f) is given by

$$\Delta T_f = T_v - T_{wall} = Q/h_v A_o \quad (A-10)$$

for runs R-600A-021A through R-600A-024A,

$$\Delta T_f = (T_v - T_{wall}) = \frac{(7460 \text{ Btu/hr})}{(162 \text{ Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F})(1.05 \text{ ft}^2)} = 44^\circ\text{F}$$

so that

$$T_f = 121^\circ\text{F} - (3/4)(44^\circ\text{F}) = 88^\circ\text{F} .$$

Evaluating the fluid properties at the film temperature of 88°F,

$$k = 0.060 \text{ Btu/hr}\cdot\text{ft}\cdot^\circ\text{F}$$

$$\rho = 33.9 \text{ lb}_m/\text{ft}^3$$

$$\mu = 0.368 \text{ lb}_m/\text{hr}\cdot\text{ft}$$

and

$$g = 4.7 \times 10^8 \text{ ft/hr}^2$$

so that for $h_m = 162 \text{ Btu/hr}\cdot\text{ft}^2\cdot^\circ\text{F}$,

$$H = 162/[(0.060)^3(33.9)^2(4.17 \times 10^8)/(0.368)^2]^{1/3} = 0.18 .$$

The liquid film Reynolds number is given by Eq. (8-2):

$$Re = 4(\Gamma/\mu) , \quad (8-2)$$

where Γ is the mass flow of condensate per unit length of perimeter on the tube. The mass flow per unit perimeter can be computed from the heat load, latent heat of isobutane, and the perimeter of the tube:

$$\Gamma = \frac{Q}{h_{fg} P_t} , \quad (A-11)$$

where P_t is the perimeter of the tube (see Table 1, p. 21). The latent heat of isobutane is evaluated at the same vapor temperature as discussed

for Eq. (A-9). For the series of runs R-600A-021A through R-600A-024A,

$$\Gamma = \frac{(7460 \text{ Btu/hr})}{(137 \text{ Btu/lb}_m)(3.14 \text{ in.})(1 \text{ ft}/12 \text{ in.})} = 208.1 \text{ lb}_m/\text{hr}\cdot\text{ft} ,$$

so that

$$\text{Re} = \frac{4\Gamma}{\mu} = \frac{(4)(208.1 \text{ lb}_m/\text{hr}\cdot\text{ft})}{(0.368 \text{ lb}_m/\text{hr}\cdot\text{ft})} = 2262 .$$

The nondimensional heat transfer coefficients and liquid film Reynolds numbers were used to construct Fig. 14 (p. 36).

The nondimensional quantities (H and Re) were not found to be very sensitive to the temperature at which the properties were evaluated; therefore, the variation in vapor temperatures during a series of runs did not appear to have a significant effect on heat transfer results. For tube A, the vapor temperature variation ranged from 5–68°F for a given series of runs (a set heat load).

APPENDIX B

WILSON-PLOT RESULTS

Tables B-1 through B-46 summarize the experimental conditions for all series of runs used to construct Wilson plots. The results from the Wilson plots are also listed. The condenser heat load was taken as the average heat load based on the condensate flow ($Q_{c,avg}$) for a series of runs (see Appendix A for an example). Individual runs are documented in detail in Appendix C.

Table B-1 . Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube A

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w							
			W Btu/hr	W Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-037A	TO	R-11-040A	1271. (4336.)	1286. (4388.)	-1.2	315.9 (108.9)		14.1 (25.4)		923.3 (162.8)	
R-11-041A	TO	R-11-044A	774. (2642.)	797. (2722.)	-3.0	310.0 (98.4)		8.1 (14.6)		981.8 (173.2)	
R-11-045A	TO	R-11-048A	926. (3161.)	947. (3231.)	-2.2	311.7 (101.3)		10.0 (17.9)		955.1 (168.4)	
R-11-049A	TO	R-11-052A	1638. (5589.)	1644. (5611.)	-0.4	319.4 (115.3)		18.5 (33.3)		909.5 (160.4)	
R-11-053A	TO	R-11-056A	1874. (6394.)	1892. (6457.)	-1.0	322.5 (120.9)		21.6 (38.8)		891.9 (157.3)	
R-11-057A	TO	R-11-060A	2219. (7572.)	2200. (7507.)	0.9	325.5 (126.2)		25.2 (45.3)		905.6 (159.7)	
R-11-061A	TO	R-11-064A	1112. (3795.)	1145. (3908.)	-3.0	313.5 (104.6)		12.2 (22.0)		935.2 (164.9)	
R-11-065A	TO	R-11-068A	2066. (7051.)	2063. (7040.)	0.2	322.3 (120.4)		23.8 (42.9)		889.6 (156.9)	
R-11-069A	TO	R-11-072A	1495. (5101.)	1531. (5226.)	-2.4	316.5 (109.9)		16.9 (30.5)		906.6 (159.9)	
R-11-073A	TO	R-11-076A	2402. (8197.)	2425. (8276.)	-1.0	323.2 (122.2)		27.4 (49.4)		899.3 (158.6)	
R-11-077A	TO	R-11-080A	583. (1989.)	605. (2064.)	-3.8	307.9 (94.5)		6.2 (11.2)		958.6 (169.1)	

Table B-2 . Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube B

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w							
			W Btu/hr	W Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-005B	TO	R-11-008B	1590. (5428.)	1600. (5460.)	-0.6	304.4 (88.3)		6.1 (11.1)		1855.1 (327.2)	
R-11-009B	TO	R-11-012B	806. (2752.)	832. (2839.)	-3.1	304.0 (87.6)		2.9 (5.2)		2001.1 (352.9)	
R-11-013B	TO	R-11-016B	2230. (7613.)	2247. (7670.)	-0.8	308.2 (95.1)		9.6 (17.2)		1668.0 (294.2)	
R-11-017B	TO	R-11-020B	2695. (9197.)	2712. (9257.)	-0.7	310.1 (98.4)		12.3 (22.2)		1566.9 (276.3)	
R-11-021B	TO	R-11-024B	1925. (6569.)	1932. (6595.)	-0.4	306.1 (91.3)		7.9 (14.3)		1741.1 (307.1)	
R-11-025B	TO	R-11-028B	3023. (10317.)	3028. (10334.)	-0.2	310.7 (99.6)		14.4 (25.9)		1507.0 (265.8)	
R-11-029B	TO	R-11-032B	1283. (4378.)	1284. (4382.)	-0.1	305.5 (90.1)		4.7 (8.5)		1948.3 (343.6)	
R-11-033B	TO	R-11-036B	1048. (3575.)	1073. (3662.)	-2.4	304.7 (88.7)		3.7 (6.7)		2010.9 (354.7)	
R-11-037B	TO	R-11-040B	3229. (11019.)	3222. (10997.)	0.2	311.4 (100.9)		15.4 (27.8)		1497.8 (264.2)	
R-11-041B	TO	R-11-044B	3651. (12460.)	3620. (12356.)	0.8	315.7 (108.5)		18.9 (34.1)		1380.7 (243.5)	
R-11-045B	TO	R-11-048B	1159. (3955.)	1167. (3983.)	-0.7	306.0 (91.1)		4.1 (7.4)		2020.7 (356.4)	
R-11-049B	TO	R-11-052B	936. (3196.)	958. (3270.)	-2.3	305.7 (90.5)		3.3 (5.9)		2047.3 (361.1)	
R-11-053B	TO	R-11-056B	1421. (4851.)	1415. (4830.)	0.4	304.6 (88.7)		5.4 (9.7)		1879.6 (331.5)	
R-11-057B	TO	R-11-060B	2492. (8504.)	2483. (8474.)	0.4	309.7 (97.8)		11.0 (19.8)		1620.2 (285.7)	
R-11-061B	TO	R-11-064B	3476. (11864.)	3462. (11816.)	0.4	313.8 (105.3)		17.2 (30.9)		1449.1 (255.6)	

Table B-3 . Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube C

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
			W	W							
			Btu/hr	Btu/hr							
R-11-001C	TO	R-11-004C	1031. (3518.)	1052. (3591.)	-2.1	304.1 (87.6)		2.8 (5.0)		3584.5 (632.2)	
R-11-005C	TO	R-11-008C	2138. (7296.)	2136. (7292.)	0.1	309.7 (97.8)		8.9 (16.1)		2303.4 (406.2)	
R-11-009C	TO	R-11-012C	1444. (4930.)	1454. (4961.)	-0.6	306.8 (92.5)		4.6 (8.2)		3036.3 (535.5)	
R-11-013C	TO	R-11-016C	3071. (10483.)	3029. (10339.)	1.4	313.1 (103.9)		15.2 (27.3)		1944.8 (343.0)	
R-11-017C	TO	R-11-020C	1224. (4176.)	1239. (4227.)	-1.2	305.6 (90.5)		3.5 (6.3)		3362.8 (593.1)	
R-11-021C	TO	R-11-024C	2462. (8401.)	2433. (8303.)	1.2	309.9 (98.2)		11.0 (19.8)		2149.0 (379.0)	
R-11-025C	TO	R-11-028C	1740. (5940.)	1744. (5952.)	-0.2	307.6 (94.0)		6.2 (11.2)		2692.6 (474.9)	
R-11-029C	TO	R-11-032C	2700. (9217.)	2670. (9112.)	1.1	311.4 (100.8)		12.7 (22.8)		2050.4 (361.6)	
R-11-033C	TO	R-11-036C	616. (2104.)	632. (2156.)	-2.5	302.6 (85.0)		1.4 (2.6)		4132.0 (728.7)	
R-11-041C	TO	R-11-044C	817. (2788.)	844. (2881.)	-3.4	303.5 (86.6)		2.0 (3.6)		3931.2 (693.3)	
R-11-045C	TO	R-11-048C	961. (3281.)	984. (3357.)	-2.3	304.6 (88.7)		2.5 (4.5)		3726.4 (657.2)	

Table B-4 . Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube D

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w							
			W Btu/hr	W Btu/hr		K °F	K °F	K °F	W/m ² ·K Btu/hr·ft ² ·°F		
R-11-001D	TO	R-11-004D	628. (2143.)	648. (2212.)	-3.2	302.8 (85.4)	1.1 (2.0)	5458.6 (962.7)			
R-11-005D	TO	R-11-008D	2186. (7459.)	2170. (7407.)	0.7	305.6 (90.4)	6.8 (12.3)	3079.6 (543.1)			
R-11-009D	TO	R-11-012D	1445. (4933.)	1463. (4994.)	-1.2	305.7 (90.7)	3.5 (6.3)	3987.1 (703.2)			
R-11-013D	TO	R-11-016D	3228. (11017.)	3203. (10930.)	0.8	312.7 (103.3)	14.0 (25.2)	2214.0 (390.5)			
R-11-017D	TO	R-11-020D	812. (2770.)	841. (2870.)	-3.6	303.9 (87.3)	1.6 (2.8)	4941.0 (871.4)			
R-11-021D	TO	R-11-024D	2931. (10004.)	2919. (9961.)	0.4	310.7 (99.5)	11.9 (21.4)	2371.6 (418.3)			
R-11-025D	TO	R-11-028D	1170. (3992.)	1197. (4086.)	-2.4	304.7 (88.8)	2.5 (4.6)	4412.6 (778.2)			
R-11-029D	TO	R-11-032D	2458. (8388.)	2450. (8361.)	0.3	307.6 (93.9)	8.7 (15.6)	2725.9 (480.8)			
R-11-033D	TO	R-11-036D	981. (3347.)	1018. (3473.)	-3.8	303.1 (85.9)	2.1 (3.7)	4590.8 (809.7)			
R-11-037D	TO	R-11-040D	1851. (6319.)	1833. (6257.)	1.0	304.1 (87.7)	5.5 (9.9)	3235.4 (570.6)			
R-11-041D	TO	R-11-044D	1670. (5700.)	1656. (5653.)	0.8	306.8 (92.6)	4.5 (8.2)	3542.8 (624.8)			
R-11-045D	TO	R-11-048D	2696. (9200.)	2689. (9176.)	0.3	309.6 (97.7)	10.2 (18.3)	2545.8 (449.0)			

Table B-5 . Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube D1

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w							
			W Btu/hr	W Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-001D1	TO	R-11-004D1	1619. (5525.)	1611. (5497.)	0.5	309.0 (96.4)		3.9 (7.1)		3953.3 (697.2)	
R-11-005D1	TO	R-11-008D1	881. (3008.)	874. (2985.)	0.8	309.7 (97.7)		1.7 (3.0)		5019.9 (885.3)	
R-11-009D1	TO	R-11-012D1	3313. (11306.)	3234. (11036.)	2.4	306.4 (91.8)		10.5 (18.8)		3047.7 (537.5)	
R-11-013D1	TO	R-11-016D1	1908. (6512.)	1891. (6454.)	0.9	308.0 (94.7)		4.5 (8.1)		4061.0 (716.2)	
R-11-017D1	TO	R-11-020D1	1260. (4302.)	1233. (4209.)	2.2	309.3 (97.2)		2.5 (4.6)		4786.9 (844.2)	
R-11-021D1	TO	R-11-024D1	2275. (7763.)	2222. (7584.)	2.3	308.7 (96.0)		5.9 (10.7)		3679.5 (648.9)	
R-11-025D1	TO	R-11-028D1	2982. (10178.)	2906. (9920.)	2.5	307.0 (93.0)		8.9 (16.0)		3223.1 (568.4)	
R-11-029D1	TO	R-11-032D1	2729. (9313.)	2696. (9200.)	1.2	307.2 (93.2)		7.8 (14.0)		3368.9 (594.2)	

Table B-6 . Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube E

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient			
			Q_c										
			W	Btu/hr		W	Btu/hr	K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-017E	TO	R-11-020E	2517.	(8592.)	2511.	(8570.)	0.3	308.9	(96.3)	4.5	(8.2)	3720.8	(656.2)
R-11-021E	TO	R-11-024E	2251.	(7681.)	2243.	(7656.)	0.3	307.9	(94.6)	3.7	(6.7)	4061.9	(716.4)
R-11-025E	TO	R-11-028E	3978.	(13576.)	3961.	(13520.)	0.4	313.5	(104.7)	12.1	(21.7)	2207.6	(389.3)
R-11-029E	TO	R-11-032E	1453.	(4959.)	1458.	(4975.)	-0.3	305.9	(90.9)	2.0	(3.7)	4778.0	(842.7)
R-11-033E	TO	R-11-036E	2886.	(9849.)	2902.	(9904.)	-0.6	308.2	(95.2)	5.4	(9.7)	3586.7	(632.6)
R-11-037E	TO	R-11-040E	1059.	(3616.)	1089.	(3716.)	-2.8	304.7	(88.7)	1.3	(2.4)	5320.5	(938.4)
R-11-041E	TO	R-11-044E	3686.	(12582.)	3689.	(12592.)	-0.1	312.1	(102.1)	10.1	(18.2)	2435.5	(429.5)
R-11-045E	TO	R-11-048E	847.	(2891.)	865.	(2953.)	-2.2	304.1	(87.6)	1.0	(1.8)	5674.1	(1000.7)
R-11-049E	TO	R-11-052E	1825.	(6230.)	1835.	(6263.)	-0.5	306.1	(91.3)	2.8	(5.0)	4398.3	(775.7)
R-11-053E	TO	R-11-056E	1278.	(4363.)	1267.	(4324.)	0.9	305.2	(89.6)	1.7	(3.1)	4967.8	(876.1)
R-11-057E	TO	R-11-060E	3508.	(11971.)	3478.	(11869.)	0.9	310.4	(99.1)	8.7	(15.6)	2706.3	(477.3)
R-11-061E	TO	R-11-064E	2056.	(7018.)	2064.	(7043.)	-0.3	306.8	(92.6)	3.3	(5.9)	4219.9	(744.2)
R-11-065E	TO	R-11-068E	3055.	(10426.)	3012.	(10280.)	1.4	308.2	(95.0)	6.1	(10.9)	3369.3	(594.2)

Table B-7 . Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube F

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w							
			W Btu/hr	W Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-001F	TO	R-11-004F	1647. (5620.)	1629. (5559.)	1.1	308.1 (95.0)		5.0 (9.0)		3408.1 (601.1)	
R-11-009F	TO	R-11-012F	878. (2997.)	866. (2957.)	1.4	310.0 (98.3)		1.9 (3.4)		4876.8 (860.1)	
R-11-013F	TO	R-11-016F	1166. (3980.)	1137. (3882.)	2.5	309.1 (96.6)		2.8 (5.1)		4260.0 (751.3)	
R-11-017F	TO	R-11-020F	2833. (9668.)	2784. (9503.)	1.7	306.9 (92.8)		13.9 (25.0)		2110.0 (372.1)	
R-11-021F	TO	R-11-024F	1482. (5056.)	1479. (5049.)	0.2	309.1 (96.7)		4.2 (7.5)		3676.0 (648.3)	
R-11-025F	TO	R-11-028F	2066. (7050.)	2040. (6963.)	1.2	307.5 (93.8)		8.3 (14.9)		2592.8 (457.3)	
R-11-029F	TO	R-11-032F	3049. (10405.)	2996. (10227.)	1.7	309.2 (96.9)		15.5 (28.0)		2032.9 (358.5)	
R-11-033F	TO	R-11-036F	1831. (6248.)	1806. (6163.)	1.4	307.5 (93.9)		6.3 (11.4)		3005.0 (530.0)	
R-11-037F	TO	R-11-040F	2479. (8461.)	2417. (8250.)	2.5	307.4 (93.7)		11.4 (20.5)		2250.1 (396.8)	
R-11-041F	TO	R-11-044F	1009. (3445.)	985. (3362.)	2.4	309.7 (97.8)		2.3 (4.2)		4503.4 (794.3)	
R-11-045F	TO	R-11-048F	709. (2419.)	710. (2422.)	-0.1	310.1 (98.6)		1.5 (2.7)		4960.1 (874.8)	

Table B-8 . Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube F1

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	W	Q_c Btu/hr	W	Q_w Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-001F1 TO R-11-004F1		843. (2877.)		832. (2840.)	1.3	309.9 (98.2)		1.5 (2.7)		5782.2 (1019.8)	
R-11-005F1 TO R-11-008F1		1193. (4071.)		1152. (3931.)	3.4	309.4 (97.3)		2.4 (4.3)		5166.8 (911.2)	
R-11-009F1 TO R-11-012F1		3016. (10294.)		2963. (10114.)	1.8	307.3 (93.4)		11.4 (20.6)		2730.5 (481.6)	
R-11-013F1 TO R-11-016F1		1502. (5125.)		1484. (5064.)	1.2	309.4 (97.3)		3.6 (6.4)		4340.7 (765.6)	
R-11-017F1 TO R-11-020F1		2697. (9206.)		2617. (8931.)	3.0	307.7 (94.2)		9.3 (16.7)		3010.7 (531.0)	
R-11-021F1 TO R-11-024F1		1811. (6181.)		1793. (6121.)	1.0	309.0 (96.6)		4.5 (8.1)		4158.3 (733.4)	
R-11-025F1 TO R-11-028F1		2116. (7220.)		2075. (7083.)	1.9	308.4 (95.5)		5.7 (10.3)		3843.0 (677.8)	
R-11-029F1 TO R-11-032F1		2448. (8355.)		2391. (8162.)	2.3	307.8 (94.4)		7.6 (13.6)		3347.1 (590.3)	

Table B-9 . Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube F3

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_C		Q_W								
			W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-001F3	TO	R-11-004F3	1502.	(5128.)	1469.	(5015.)	2.2	309.9	(98.2)	3.0	(5.4)	5177.2	(913.1)
R-11-005F3	TO	R-11-008F3	871.	(2973.)	865.	(2951.)	0.7	310.0	(98.3)	1.5	(2.6)	6218.2	(1096.7)
R-11-009F3	TO	R-11-012F3	2885.	(9845.)	2831.	(9661.)	1.9	306.7	(92.4)	7.7	(13.8)	3884.7	(685.1)
R-11-013F3	TO	R-11-015F3	1164.	(3974.)	1151.	(3928.)	1.2	309.5	(97.5)	2.1	(3.8)	5671.0	(1000.2)
R-11-017F3	TO	R-11-020F3	2077.	(7088.)	2053.	(7006.)	1.2	308.8	(96.2)	4.9	(8.7)	4425.9	(780.6)
R-11-021F3	TO	R-11-024F3	1796.	(6128.)	1764.	(6021.)	1.7	308.7	(96.0)	3.8	(6.8)	4898.8	(864.0)
R-11-025F3	TO	R-11-028F3	2521.	(8604.)	2462.	(8403.)	2.3	307.5	(93.9)	6.1	(11.0)	4281.5	(755.1)
R-11-029F3	TO	R-11-032F3	3447.	(11765.)	3368.	(11496.)	2.3	306.4	(91.8)	9.8	(17.6)	3643.8	(642.6)

Table B-10. Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube F7

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	W	Q_c Btu/hr	W	Q_w Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-005F7 TO R-11-008F7		1531. (5225.)		1515. (5169.)	1.1	308.6 (95.7)		2.9 (5.2)		5477.4 (966.0)	
R-11-009F7 TO R-11-012F7		874. (2984.)		874. (2984.)	-0.0	310.2 (98.7)		1.3 (2.3)		6940.8 (1224.1)	
R-11-013F7 TO R-11-016F7		3056. (10432.)		2974. (10151.)	2.7	307.2 (93.3)		7.6 (13.7)		4155.7 (732.9)	
R-11-017F7 TO R-11-020F7		1178. (4020.)		1151. (3930.)	2.2	309.6 (97.7)		1.8 (3.2)		6794.2 (1198.3)	
R-11-021F7 TO R-11-024F7		2730. (9317.)		2664. (9092.)	2.4	307.7 (94.1)		6.4 (11.6)		4388.6 (774.0)	
R-11-025F7 TO R-11-028F7		2137. (7292.)		2108. (7195.)	1.3	308.7 (96.1)		4.6 (8.3)		4820.1 (850.1)	
R-11-029F7 TO R-11-032F7		1837. (6271.)		1821. (6217.)	0.9	308.7 (96.0)		3.8 (6.8)		5019.2 (885.2)	
R-11-033F7 TO R-11-036F7		2465. (8412.)		2425. (8277.)	1.6	307.8 (94.3)		5.5 (10.0)		4603.1 (811.8)	
R-11-037F7 TO R-11-040F7		1183. (4036.)		1162. (3965.)	1.8	309.9 (98.2)		1.9 (3.4)		6532.7 (1152.2)	
R-11-041F7 TO R-11-044F7		3441. (11745.)		3390. (11571.)	1.5	306.4 (91.8)		9.2 (16.5)		3894.5 (686.9)	

Table B-11. Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube G

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w							
			W	W		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-005G	TO	R-11-008G	847. (2890.)	846. (2888.)	0.0	310.5 (99.2)		2.3 (4.1)		3261.9 (575.3)	
R-11-009G	TO	R-11-012G	1051. (3586.)	1022. (3488.)	2.7	309.3 (97.0)		2.9 (5.3)		3135.8 (553.1)	
R-11-013G	TO	R-11-016G	2891. (9866.)	2847. (9718.)	1.5	304.7 (88.9)		12.4 (22.4)		2035.7 (359.0)	
R-11-017G	TO	R-11-020G	1386. (4729.)	1358. (4635.)	2.0	308.6 (95.8)		4.2 (7.6)		2880.1 (507.9)	
R-11-021G	TO	R-11-024G	2531. (8639.)	2479. (8460.)	2.1	306.8 (92.6)		10.2 (18.4)		2171.6 (383.0)	
R-11-025G	TO	R-11-028G	1725. (5886.)	1688. (5760.)	2.1	308.2 (95.0)		5.9 (10.5)		2576.9 (454.5)	
R-11-029G	TO	R-11-032G	2108. (7195.)	2067. (7055.)	1.9	307.9 (94.6)		7.8 (14.0)		2373.9 (418.7)	
R-11-033G	TO	R-11-036G	662. (2261.)	660. (2252.)	0.4	310.8 (99.8)		1.7 (3.0)		3509.7 (619.0)	
R-11-037G	TO	R-11-040G	3017. (10297.)	2962. (10108.)	1.8	305.7 (90.7)		13.0 (23.5)		2027.4 (357.6)	

Table B-12. Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube H

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient			
			Q_c										
			W	Btu/hr		W	Btu/hr	K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-11-001H	TO	R-11-004H	878.	(2997.)	905.	(3089.)	-3.1	310.6	(99.5)	1.5	(2.8)	3508.8	(618.8)
R-11-009H	TO	R-11-012H	1350.	(4608.)	1362.	(4648.)	-0.9	310.0	(98.4)	2.3	(4.2)	3524.3	(621.6)
R-11-013H	TO	R-11-016H	4096.	(13980.)	4034.	(13769.)	1.5	308.4	(95.4)	9.4	(16.9)	2663.1	(469.7)
R-11-017H	TO	R-11-020H	1799.	(6141.)	1747.	(5961.)	2.9	309.7	(97.8)	3.4	(6.1)	3231.1	(569.9)
R-11-021H	TO	R-11-024H	3112.	(10620.)	3049.	(10407.)	2.0	309.4	(97.2)	6.6	(11.9)	2886.7	(509.1)
R-11-025H	TO	R-11-028H	745.	(2541.)	758.	(2588.)	-1.8	310.6	(99.5)	1.2	(2.2)	3654.2	(644.5)
R-11-029H	TO	R-11-032H	2568.	(8766.)	2502.	(8541.)	2.6	309.6	(97.6)	5.3	(9.5)	2957.2	(521.6)
R-11-033H	TO	R-11-036H	2163.	(7381.)	2154.	(7351.)	0.4	309.1	(96.7)	4.2	(7.5)	3160.8	(557.5)
R-11-037H	TO	R-11-040H	1140.	(3890.)	1125.	(3838.)	1.3	310.5	(99.2)	2.0	(3.5)	3543.1	(624.9)
R-11-041H	TO	R-11-044H	3521.	(12016.)	3478.	(11872.)	1.2	309.0	(96.6)	7.8	(14.0)	2761.1	(487.0)

Table B-13. Summary of experimental conditions and results from Wilson plots
for R-11 condensing on vertical tube J

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
			W	Btu/hr	W	Btu/hr							
R-11-005J	TO	R-11-008J	859.	(2933.)	859.	(2933.)	-0.0	310.6	(99.3)	2.2	(4.0)	3937.3	(694.4)
R-11-009J	TO	R-11-012J	1362.	(4647.)	1358.	(4635.)	0.3	308.9	(96.3)	4.5	(8.2)	3073.0	(542.0)
R-11-013J	TO	R-11-016J	2827.	(9648.)	2786.	(9508.)	1.5	307.0	(92.9)	15.1	(27.2)	1919.9	(338.6)
R-11-017J	TO	R-11-020J	1005.	(3431.)	991.	(3383.)	1.4	309.6	(97.6)	2.7	(4.9)	3759.9	(663.1)
R-11-021J	TO	R-11-024J	1005.	(3431.)	991.	(3383.)	1.4	309.6	(97.6)	2.7	(4.9)	3759.9	(663.1)
R-11-025J	TO	R-11-028J	1226.	(4185.)	1213.	(4138.)	1.1	308.4	(95.5)	3.8	(6.8)	3343.7	(589.7)
R-11-029J	TO	R-11-032J	1835.	(6264.)	1818.	(6204.)	1.0	308.5	(95.6)	7.6	(13.6)	2493.5	(439.8)
R-11-033J	TO	R-11-036J	2547.	(8693.)	2517.	(8591.)	1.2	307.9	(94.5)	12.8	(23.1)	2036.9	(359.3)
R-11-037J	TO	R-11-040J	719.	(2454.)	711.	(2428.)	1.1	311.3	(100.7)	1.7	(3.1)	4281.7	(755.2)
R-11-041J	TO	R-11-044J	1571.	(5361.)	1562.	(5331.)	0.6	308.2	(95.2)	5.9	(10.7)	2711.5	(478.2)

Table B-14. Summary of experimental conditions and results from Wilson plots
for R-21 condensing on vertical tube A

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient			
			Q_c	Q_w		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F		
			W	Btu/hr								W	Btu/hr
R-21-001A	TO	R-21-004A	2897.	(9888.)	2871.	(9799.)	0.9	326.1	(127.3)	26.2	(47.2)	1134.7	(200.1)
R-21-008A	TO	R-21-011A	1597.	(5451.)	1561.	(5328.)	2.2	311.5	(101.0)	13.9	(25.0)	1180.4	(208.2)
R-21-012A	TO	R-21-015A	2035.	(6944.)	1988.	(6786.)	2.3	316.0	(109.2)	18.3	(32.9)	1141.7	(201.4)
R-21-016A	TO	R-21-019A	2597.	(8862.)	2549.	(8699.)	1.8	321.7	(119.3)	23.3	(42.0)	1143.3	(201.6)
R-21-020A	TO	R-21-023A	2334.	(7966.)	2343.	(7997.)	-0.4	317.9	(112.6)	21.0	(37.8)	1141.6	(201.3)
R-21-024A	TO	R-21-027A	2442.	(8335.)	2392.	(8163.)	2.1	319.2	(114.9)	22.2	(40.0)	1128.5	(199.0)
R-21-028A	TO	R-21-031A	1878.	(6411.)	1886.	(6436.)	-0.4	312.9	(103.5)	16.8	(30.3)	1146.1	(202.1)
R-21-032A	TO	R-21-035A	1132.	(3864.)	1115.	(3806.)	1.5	309.8	(97.9)	9.9	(17.8)	1174.6	(207.2)
R-21-036A	TO	R-21-039A	896.	(3056.)	872.	(2977.)	2.6	307.0	(93.0)	7.6	(13.7)	1211.4	(213.7)
R-21-040A	TO	R-21-043A	746.	(2546.)	724.	(2470.)	3.0	305.4	(90.1)	6.0	(10.8)	1278.4	(225.5)
R-21-044A	TO	R-21-047A	1253.	(4275.)	1224.	(4176.)	2.3	311.5	(101.0)	10.8	(19.4)	1192.7	(210.4)
R-21-048A	TO	R-21-051A	644.	(2200.)	620.	(2116.)	3.8	303.1	(86.0)	5.0	(9.0)	1329.5	(234.5)
R-21-052A	TO	R-21-055A	1394.	(4759.)	1371.	(4679.)	1.7	310.4	(99.1)	12.2	(22.0)	1170.5	(206.4)
R-21-056A	TO	R-21-059A	1036.	(3534.)	1014.	(3462.)	2.0	308.1	(94.9)	8.7	(15.7)	1217.5	(214.7)

Table B-15. Summary of experimental conditions and results from Wilson plots
for R-22 condensing on vertical tube A

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w							
			W	W		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-22-001A	TO	R-22-004A	689. (2352.)	683. (2333.)	0.8	302.9 (85.6)		5.4 (9.8)		1301.4 (229.5)	
R-22-005A	TO	R-22-008A	403. (1375.)	401. (1367.)	0.5	301.9 (83.8)		3.0 (5.4)		1368.6 (241.4)	
R-22-009A	TO	R-22-011A	1026. (3501.)	1008. (3440.)	1.7	305.2 (89.6)		8.4 (15.2)		1246.9 (219.9)	
R-22-012A	TO	R-22-015A	902. (3079.)	899. (3069.)	0.3	305.0 (89.4)		7.3 (13.1)		1269.2 (223.8)	
R-22-016A	TO	R-22-019A	1165. (3976.)	1151. (3929.)	1.2	304.9 (89.1)		9.6 (17.3)		1243.6 (219.3)	
R-22-020A	TO	R-22-023A	1374. (4690.)	1381. (4715.)	-0.5	305.1 (89.5)		11.3 (20.4)		1246.8 (219.9)	
R-22-024A	TO	R-22-026A	1611. (5498.)	1594. (5439.)	1.1	304.1 (87.8)		13.9 (25.0)		1189.9 (209.9)	
R-22-027A	TO	R-22-030A	1840. (6280.)	1825. (6229.)	0.8	306.1 (91.3)		15.5 (28.0)		1215.6 (214.4)	
R-22-031A	TO	R-22-033A	1999. (6821.)	1996. (6812.)	0.1	307.2 (93.3)		16.8 (30.3)		1218.1 (214.8)	
R-22-034A	TO	R-22-036A	2201. (7513.)	2189. (7470.)	0.6	309.9 (98.2)		18.8 (33.8)		1204.4 (212.4)	
R-22-037A	TO	R-22-040A	559. (1906.)	541. (1848.)	3.1	302.2 (84.2)		4.1 (7.5)		1382.4 (243.8)	
R-22-041A	TO	R-22-044A	1529. (5220.)	1494. (5100.)	2.3	305.2 (89.6)		12.9 (23.2)		1218.4 (214.9)	

Table B-16. Summary of experimental conditions and results from Wilson plots
for R-22 condensing on vertical tube D

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w							
			W Btu/hr	W Btu/hr		K °F	K °F	K °F	W/m ² ·K Btu/hr·ft ² ·°F		
R-22-001D	TO	R-22-004D	925. (3157.)	900. (3070.)	2.7	301.5 (83.1)	2.2 (3.9)	4100.1 (723.1)			
R-22-005E	TO	R-22-008D	700. (2388.)	683. (2329.)	2.5	301.6 (83.2)	1.3 (2.4)	5059.8 (892.4)			
R-22-009E	TO	R-22-012D	1058. (3611.)	1032. (3523.)	2.4	301.2 (82.6)	2.7 (4.8)	3781.3 (666.9)			
R-22-013E	TO	R-22-016D	540. (1844.)	524. (1788.)	3.0	301.1 (82.3)	0.9 (1.6)	5901.8 (1040.9)			
R-22-017E	TO	R-22-020D	1178. (4021.)	1143. (3900.)	3.0	300.6 (81.3)	3.2 (5.7)	3548.7 (625.9)			
F-22-021E	TO	R-22-024D	651. (2220.)	654. (2232.)	-0.5	301.1 (82.4)	1.2 (2.1)	5423.2 (956.5)			
F-22-025E	TO	R-22-028D	846. (2887.)	833. (2844.)	1.5	301.6 (83.2)	1.9 (3.3)	4385.5 (773.5)			
F-22-033E	TO	R-22-036D	1372. (4681.)	1326. (4527.)	3.3	302.4 (84.6)	4.1 (7.3)	3233.0 (570.2)			
F-22-037D	TC	F-22-040D	1896. (6472.)	1841. (6283.)	2.9	302.8 (85.3)	6.7 (12.0)	2730.5 (481.6)			
F-22-041D	TC	F-22-044D	1582. (5398.)	1544. (5269.)	2.4	300.4 (81.0)	5.1 (9.1)	2998.1 (528.8)			
F-22-045D	TC	F-22-048D	1732. (5910.)	1681. (5739.)	2.9	301.8 (83.6)	5.8 (10.5)	2853.0 (503.2)			
F-22-049E	TC	F-22-052D	2543. (8679.)	2534. (8648.)	0.4	303.4 (86.5)	10.0 (18.1)	2437.4 (429.9)			
F-22-053D	TC	F-22-056E	773. (2637.)	748. (2554.)	3.2	302.0 (84.0)	1.6 (2.9)	4639.2 (818.2)			
F-22-057D	TC	F-22-060D	2137. (7294.)	2067. (7054.)	3.3	300.8 (81.8)	7.7 (13.9)	2654.1 (468.1)			
F-22-061D	TC	F-22-064D	2390. (8159.)	2331. (7957.)	2.5	302.7 (85.3)	9.2 (16.6)	2499.3 (440.8)			
F-22-065D	TO	F-22-068D	2808. (9582.)	2773. (9464.)	1.2	304.0 (87.6)	11.4 (20.5)	2365.1 (417.1)			
F-22-069D	TC	F-22-072D	2325. (7935.)	2214. (7556.)	4.8	304.7 (88.9)	8.5 (15.4)	2619.8 (462.0)			

Table B-17. Summary of experimental conditions and results from Wilson plots
for R-22 condensing on vertical tube E

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w							
			W Btu/hr	W Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-22-009E	TO	R-22-012E	811. (2768.)	803. (2740.)	1.0	301.2 (82.5)		0.7 (1.3)		7765.6 (1369.6)	
R-22-021E	TO	R-22-024E	1979. (6754.)	1904. (6498.)	3.8	301.2 (82.5)		2.9 (5.1)		4638.6 (818.1)	
R-22-025E	TO	R-22-028E	2715. (9267.)	2702. (9222.)	0.5	301.6 (83.1)		5.5 (9.9)		3304.6 (582.8)	
R-22-029E	TO	R-22-032E	1690. (5768.)	1635. (5581.)	3.2	301.6 (83.2)		2.1 (3.8)		5367.2 (946.6)	
R-22-033E	TO	R-22-036E	2450. (8362.)	2427. (8285.)	0.9	303.8 (87.2)		4.3 (7.7)		3818.6 (673.5)	
R-22-037E	TO	R-22-040E	2249. (7677.)	2203. (7520.)	2.0	302.8 (85.3)		3.7 (6.6)		4078.4 (719.3)	
R-22-042E	TO	R-22-044E	1521. (5193.)	1485. (5069.)	2.4	302.5 (84.9)		1.8 (3.2)		5787.6 (1020.7)	
R-22-045E	TO	R-22-048E	1373. (4685.)	1330. (4539.)	3.1	302.2 (84.3)		1.6 (2.8)		5810.1 (1024.7)	
R-22-049E	TO	R-22-052E	1206. (4116.)	1171. (3996.)	2.9	302.8 (85.4)		1.3 (2.3)		6267.1 (1105.3)	
R-22-053E	TO	R-22-056E	1870. (6381.)	1814. (6190.)	3.0	302.0 (83.9)		2.4 (4.3)		5272.5 (929.9)	
R-22-057E	TO	R-22-059E	2648. (9037.)	2640. (9009.)	0.3	302.4 (84.6)		5.5 (9.9)		3225.8 (568.9)	
R-22-061E	TO	R-22-064E	2127. (7259.)	2087. (7122.)	1.9	302.0 (83.9)		3.1 (5.5)		4644.3 (819.1)	
R-22-065E	TO	R-22-068E	2896. (9883.)	2883. (9840.)	0.4	303.2 (86.1)		6.5 (11.6)		2999.5 (529.0)	
R-22-069E	TO	R-22-071E	3222. (10998.)	3263. (11137.)	-1.3	304.8 (88.9)		8.5 (15.2)		2553.2 (450.3)	
R-22-072E	TO	R-22-075E	1542. (5262.)	1508. (5145.)	2.2	301.2 (82.5)		1.8 (3.3)		5715.8 (1008.1)	
R-22-076E	TO	R-22-079E	1255. (4285.)	1210. (4129.)	3.6	302.9 (85.6)		1.3 (2.4)		6230.9 (1098.9)	
R-22-080E	TO	R-22-082E	3510. (11981.)	3554. (12130.)	-1.2	306.5 (92.0)		9.9 (17.9)		2365.9 (417.3)	
R-22-083E	TO	R-22-086E	1547. (5281.)	1501. (5124.)	3.0	301.7 (83.4)		1.8 (3.3)		5657.7 (997.8)	
R-22-087E	TO	R-22-090E	875. (2985.)	845. (2884.)	3.4	301.3 (82.7)		0.8 (1.4)		7348.4 (1296.0)	

Table B-18. Summary of experimental conditions and results from Wilson plots for R-113 condensing on vertical tube A

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c		Q_w								
			W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-113-001A	TO	R-113-004A	1920.	(6553.)	1955.	(6672.)	-1.8	338.9	(150.3)	31.0	(55.8)	635.6	(112.1)
R-113-005A	TO	R-113-008A	2013.	(6870.)	1962.	(6696.)	2.5	332.4	(138.6)	30.8	(55.4)	671.8	(118.5)
R-113-009A	TO	R-113-012A	1326.	(4527.)	1309.	(4467.)	1.3	331.3	(136.7)	20.0	(36.0)	681.3	(120.2)
R-113-013A	TO	R-113-016A	2478.	(8458.)	2362.	(8063.)	4.7	337.5	(147.9)	35.7	(64.2)	713.1	(125.8)
R-113-017A	TO	R-113-020A	900.	(3073.)	900.	(3071.)	0.1	330.1	(134.5)	12.4	(22.3)	746.2	(131.6)
R-113-021A	TO	R-113-024A	1698.	(5795.)	1704.	(5817.)	-0.4	330.0	(134.3)	26.3	(47.4)	662.7	(116.9)
R-113-025A	TO	R-113-028A	2274.	(7762.)	2154.	(7351.)	5.3	332.6	(139.0)	33.0	(59.4)	708.1	(124.9)
R-113-029A	TO	R-113-032A	2705.	(9231.)	2584.	(8819.)	4.5	337.5	(147.8)	37.9	(68.3)	732.4	(129.2)
R-113-033A	TO	R-113-036A	777.	(2653.)	769.	(2625.)	1.0	329.7	(133.9)	10.2	(18.3)	784.2	(138.3)
R-113-037A	TO	R-113-040A	1115.	(3807.)	1118.	(3815.)	-0.2	330.6	(135.4)	16.4	(29.5)	699.2	(123.3)
R-113-041A	TO	R-113-044A	1554.	(5303.)	1506.	(5140.)	3.1	328.9	(132.4)	23.2	(41.8)	687.8	(121.3)
R-113-045A	TO	R-113-048A	2259.	(7709.)	2145.	(7322.)	5.0	331.8	(137.6)	32.9	(59.2)	705.8	(124.5)
R-113-049A	TO	R-113-051A	2654.	(9059.)	2556.	(8725.)	3.7	337.2	(147.2)	37.9	(68.2)	719.3	(126.9)
R-113-053A	TO	R-113-056A	2105.	(7184.)	2020.	(6894.)	4.0	329.8	(134.0)	31.0	(55.7)	697.9	(123.1)
R-113-057A	TO	R-113-060A	2531.	(8637.)	2424.	(8273.)	4.2	335.7	(144.6)	36.6	(65.8)	710.5	(125.3)
R-113-061A	TO	R-113-064A	2501.	(8537.)	2418.	(8251.)	3.3	337.0	(146.9)	37.1	(66.8)	692.5	(122.1)

Table B-19. Summary of experimental conditions and results from Wilson plots
for R-113 condensing on vertical tubeB

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c		Q_w								
			W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-113-001B	TO	R-113-004B	2145.	(7319.)	2080.	(7097.)	3.0	326.8	(128.6)	12.0	(21.7)	1274.9	(224.9)
R-113-005B	TO	R-113-008B	1407.	(4800.)	1399.	(4774.)	0.5	326.5	(128.0)	7.0	(12.6)	1441.0	(254.1)
R-113-009B	TO	R-113-012B	1771.	(6044.)	1714.	(5848.)	3.2	327.5	(129.9)	9.4	(17.0)	1342.5	(236.8)
R-113-013B	TO	R-113-016B	3057.	(10434.)	2959.	(10098.)	3.2	325.2	(125.8)	18.5	(33.4)	1181.7	(208.4)
R-113-017B	TO	R-113-020B	1077.	(3676.)	1055.	(3602.)	2.0	327.6	(130.0)	4.8	(8.7)	1593.3	(281.0)
R-113-021B	TO	R-113-024B	2574.	(8786.)	2508.	(8559.)	2.6	325.5	(126.3)	14.8	(26.6)	1246.2	(219.8)
R-113-025B	TO	R-113-028B	1596.	(5448.)	1555.	(5308.)	2.6	326.9	(128.7)	8.1	(14.6)	1412.4	(249.1)
R-113-029B	TO	R-113-032B	3349.	(11430.)	3259.	(11124.)	2.7	325.1	(125.5)	20.4	(36.7)	1177.9	(207.7)
R-113-033B	TO	R-113-036B	1245.	(4250.)	1208.	(4122.)	3.0	326.9	(128.8)	5.8	(10.5)	1534.9	(270.7)
R-113-037B	TO	R-113-040B	1352.	(4614.)	1304.	(4449.)	3.6	326.4	(127.8)	6.5	(11.7)	1489.2	(262.6)
R-113-041B	TO	R-113-044B	2797.	(9545.)	2696.	(9201.)	3.6	324.6	(124.6)	16.4	(29.6)	1220.0	(215.2)
R-113-045B	TO	R-113-048B	1936.	(6607.)	1864.	(6361.)	3.7	328.2	(131.2)	10.4	(18.8)	1330.6	(234.7)
R-113-049B	TO	R-113-052B	2382.	(8129.)	2324.	(7933.)	2.4	325.5	(126.3)	13.5	(24.3)	1261.8	(222.5)

Table B-20. Summary of experimental conditions and results from Wilson plots
for R-113 condensing on vertical tube C

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	Q_c		Q_w								
	W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-113-033C TO R-113-036C	2107.	(7192.)	1988.	(6786.)	5.6	324.9	(125.1)	12.1	(21.8)	1675.1	(295.4)
R-113-037C TO R-113-040C	1511.	(5158.)	1441.	(4917.)	4.7	325.6	(126.4)	7.0	(12.5)	2088.9	(368.4)
R-113-041C TO R-113-044C	2548.	(8698.)	2408.	(8218.)	5.5	326.6	(128.2)	15.8	(28.5)	1549.3	(273.2)
R-113-045C TO R-113-048C	1019.	(3478.)	986.	(3364.)	3.3	327.1	(129.2)	4.0	(7.1)	2476.6	(436.8)
R-113-049C TO R-113-052C	1407.	(4803.)	1383.	(4720.)	1.7	326.1	(127.3)	6.2	(11.2)	2178.8	(384.3)
R-113-053C TO R-113-056C	1642.	(5603.)	1614.	(5507.)	1.7	327.9	(130.5)	8.0	(14.5)	1963.1	(346.2)
R-113-057C TO R-113-060C	1226.	(4185.)	1208.	(4123.)	1.5	325.6	(126.4)	5.1	(9.1)	2332.1	(411.3)
R-113-061C TO R-113-064C	928.	(3166.)	899.	(3069.)	3.1	327.2	(129.4)	3.3	(5.9)	2743.7	(483.9)
R-113-065C TO R-113-068C	1817.	(6200.)	1774.	(6055.)	2.3	326.6	(128.2)	9.5	(17.2)	1833.4	(323.4)
R-113-069C TO R-113-072C	3047.	(10399.)	2892.	(9872.)	5.1	325.1	(125.5)	20.3	(36.5)	1446.0	(255.0)
R-113-073C TO R-113-076C	803.	(2742.)	795.	(2713.)	1.1	328.1	(130.9)	2.6	(4.6)	3012.1	(531.2)
R-113-077C TO R-113-080C	2328.	(7946.)	2238.	(7638.)	3.9	324.4	(124.3)	13.8	(24.8)	1627.1	(287.0)

Table B-21. Summary of experimental conditions and results from Wilson plots
for R-113 condensing on vertical tube

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
			W	Btu/hr	W	Btu/hr							
R-113-001D	TO	R-113-004D	2049.	(6993.)	2030.	(6927.)	0.9	327.8	(130.3)	9.7	(17.5)	2029.6	(358.0)
R-113-005D	TO	R-113-008D	2571.	(8774.)	2472.	(8438.)	3.8	327.4	(129.7)	13.7	(24.7)	1802.0	(317.8)
R-113-009D	TO	R-113-012D	1319.	(4502.)	1269.	(4331.)	3.8	328.9	(132.3)	4.3	(7.7)	2960.9	(522.2)
R-113-013D	TO	R-113-016D	1701.	(5804.)	1640.	(5598.)	3.5	328.8	(132.2)	6.7	(12.1)	2429.7	(428.5)
R-113-017D	TO	R-113-020D	3009.	(10271.)	2891.	(9867.)	3.9	326.3	(127.7)	18.3	(32.9)	1584.9	(279.5)
R-113-021D	TO	R-113-024D	1509.	(5151.)	1475.	(5035.)	2.3	327.2	(129.4)	5.5	(10.0)	2622.6	(462.5)
R-113-025D	TO	R-113-028D	1926.	(6573.)	1851.	(6318.)	3.9	326.7	(128.3)	8.3	(14.9)	2236.8	(394.5)
R-113-029D	TO	R-113-032D	1087.	(3709.)	1080.	(3685.)	0.6	326.8	(128.6)	3.3	(5.9)	3199.8	(564.3)
R-113-033D	TO	R-113-036D	1885.	(6434.)	1805.	(6162.)	4.2	326.1	(127.2)	7.8	(14.0)	2333.1	(411.5)
R-113-037D	TO	R-113-040D	943.	(3218.)	924.	(3155.)	2.0	327.8	(130.4)	2.6	(4.6)	3538.8	(624.1)
R-113-041D	TO	R-113-044D	2387.	(8148.)	2323.	(7928.)	2.7	327.3	(129.4)	12.7	(22.9)	1808.1	(318.9)
R-113-045D	TO	R-113-048D	2880.	(9831.)	2804.	(9569.)	2.7	325.8	(126.7)	16.8	(30.3)	1644.9	(290.1)
R-113-049D	TO	R-113-052D	1687.	(5758.)	1645.	(5616.)	2.5	327.6	(130.0)	6.5	(11.7)	2489.6	(439.1)
R-113-053D	TO	R-113-056D	2705.	(9233.)	2640.	(9011.)	2.4	325.4	(126.1)	15.3	(27.5)	1700.7	(299.9)
R-113-057D	TO	R-113-060D	1206.	(4116.)	1180.	(4027.)	2.2	327.8	(130.3)	3.7	(6.6)	3156.5	(556.7)
R-113-061D	TO	R-113-064D	2248.	(7674.)	2176.	(7426.)	3.2	326.5	(128.0)	10.9	(19.6)	1983.9	(349.9)

Table B-22. Summary of experimental conditions and results from Wilson plots
for R-113 condensing on vertical tube E

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
	W	Btu/hr	W	Btu/hr							
R-113-001E TO R-113-004E	2122.	(7244.)	2051.	(7001.)	3.4	328.1	(130.8)	5.0	(9.0)	2843.9	(501.6)
R-113-005E TO R-113-008E	1674.	(5713.)	1617.	(5519.)	3.4	326.9	(128.7)	3.4	(6.1)	3331.1	(587.5)
R-113-009E TO R-113-012E	1332.	(4546.)	1295.	(4418.)	2.8	326.5	(128.0)	2.5	(4.5)	3576.6	(630.8)
R-113-013E TO R-113-016E	2574.	(8785.)	2475.	(8449.)	3.8	326.2	(127.5)	6.9	(12.5)	2492.6	(439.6)
R-113-017E TO R-113-020E	3058.	(10436.)	2963.	(10111.)	3.1	325.6	(126.5)	10.3	(18.5)	1991.4	(351.2)
R-113-021E TO R-113-024E	1935.	(6604.)	1862.	(6353.)	3.8	327.5	(129.9)	4.5	(8.0)	2902.2	(511.8)
R-113-025E TO R-113-028E	3444.	(11756.)	3370.	(11502.)	2.2	327.1	(129.1)	14.5	(26.1)	1592.2	(280.8)
R-113-029E TO R-113-032E	1479.	(5048.)	1405.	(4796.)	5.0	327.8	(130.4)	2.9	(5.3)	3396.6	(599.0)
R-113-033E TO R-113-036E	1156.	(3947.)	1114.	(3802.)	3.7	327.9	(130.5)	2.0	(3.7)	3804.7	(671.0)
R-113-037E TO R-113-040E	2795.	(9540.)	2709.	(9246.)	3.1	326.3	(127.7)	8.1	(14.5)	2324.2	(409.9)
R-113-041E TO R-113-044E	3748.	(12793.)	3658.	(12484.)	2.4	326.0	(127.2)	17.4	(31.3)	1442.6	(254.4)
R-113-045E TO R-113-048E	2339.	(7983.)	2288.	(7808.)	2.2	327.0	(128.9)	5.7	(10.3)	2743.7	(483.9)
R-113-049E TO R-113-052E	4043.	(13800.)	3936.	(13432.)	2.7	326.8	(128.6)	20.7	(37.3)	1308.0	(230.7)
R-113-053E TO R-113-056E	1872.	(6390.)	1803.	(6152.)	3.7	326.9	(128.8)	3.9	(7.0)	3204.8	(565.2)
R-113-057E TO R-113-060E	3210.	(10954.)	3095.	(10561.)	3.6	325.4	(126.1)	11.6	(20.8)	1859.7	(328.0)

Table B-23. Summary of experimental conditions and results from Wilson plots
for R-113 condensing on vertical tube F

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
			W	Btu/hr	W	Btu/hr							
R-113-005F	TO	R-113-008F	2062.	(7039.)	2028.	(6923.)	1.7	326.2	(127.5)	14.1	(25.3)	1518.8	(267.9)
R-113-009F	TO	R-113-012F	1188.	(4055.)	1177.	(4017.)	1.0	328.1	(130.9)	4.3	(7.8)	2856.9	(503.9)
R-113-013F	TO	R-113-016F	1085.	(3704.)	1069.	(3647.)	1.5	328.5	(131.5)	3.6	(6.4)	3141.4	(554.0)
R-113-017F	TO	R-113-020F	1507.	(5143.)	1464.	(4998.)	2.8	326.8	(128.5)	6.9	(12.5)	2246.9	(396.3)
R-113-021F	TO	R-113-024F	1706.	(5824.)	1673.	(5708.)	2.0	328.2	(131.1)	9.6	(17.3)	1837.7	(324.1)
R-113-025F	TO	R-113-028F	1350.	(4607.)	1314.	(4485.)	2.7	327.9	(130.5)	5.2	(9.4)	2669.2	(470.8)
R-113-029F	TO	R-113-032F	948.	(3234.)	929.	(3169.)	2.0	328.1	(131.0)	2.7	(4.9)	3597.6	(634.5)
R-113-033F	TO	R-113-036F	1890.	(6452.)	1870.	(6384.)	1.1	327.1	(129.1)	12.3	(22.2)	1585.9	(279.7)
R-113-037F	TO	R-113-040F	2442.	(8336.)	2393.	(8166.)	2.0	327.7	(130.1)	19.2	(34.6)	1315.7	(232.0)
R-113-041F	TO	R-113-044F	822.	(2804.)	802.	(2738.)	2.3	328.0	(130.6)	2.1	(3.8)	3989.9	(703.7)
R-113-045F	TO	R-113-048F	701.	(2393.)	686.	(2340.)	2.2	328.6	(131.9)	1.7	(3.0)	4347.6	(766.8)
R-113-049F	TO	R-113-052F	2294.	(7828.)	2217.	(7566.)	3.3	325.2	(125.7)	16.6	(29.9)	1432.0	(252.6)
R-113-053F	TO	R-113-056F	2680.	(9146.)	2594.	(8852.)	3.2	328.0	(130.7)	20.8	(37.4)	1335.5	(235.5)
R-113-057F	TO	R-113-060F	1407.	(4801.)	1344.	(4588.)	4.4	328.2	(131.0)	5.6	(10.0)	2618.6	(461.8)

Table B-24. Summary of experimental conditions and results from Wilson plots
for R-113 condensing on vertical tube F1

Series of runs		Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
		Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
		W	Btu/hr	W	Btu/hr							
R-113-001F1 TO	R-113-004F1	1974.	(6736.)	1976.	(6743.)	-0.1	324.5	(124.5)	8.0	(14.5)	2539.9	(447.9)
R-113-005F1 TO	R-113-008F1	759.	(2591.)	771.	(2632.)	-1.6	326.2	(127.4)	1.8	(3.2)	4388.4	(774.0)
R-113-009F1 TO	R-113-012F1	1306.	(4457.)	1288.	(4396.)	1.4	326.3	(127.7)	4.1	(7.3)	3318.1	(585.2)
R-113-013F1 TC	R-113-016F1	1025.	(3499.)	1037.	(3538.)	-1.1	325.3	(125.9)	2.9	(5.2)	3708.0	(654.0)
R-113-017F1 TC	R-113-020F1	2464.	(8408.)	2518.	(8593.)	-2.2	323.0	(121.8)	13.3	(23.9)	1918.6	(338.4)
R-113-021F1 TC	R-113-024F1	1673.	(5709.)	1665.	(5682.)	0.5	324.6	(124.6)	6.0	(10.9)	2872.1	(506.5)
R-113-025F1 TO	R-113-028F1	2257.	(7702.)	2206.	(7530.)	2.2	322.6	(121.0)	10.8	(19.4)	2167.1	(382.2)
R-113-029F1 TO	R-113-032F1	852.	(2907.)	862.	(2943.)	-1.2	327.7	(130.2)	2.1	(3.8)	4141.7	(730.5)
R-113-033F1 TO	R-113-036F1	2700.	(9213.)	2687.	(9171.)	0.5	322.6	(120.9)	17.0	(30.6)	1645.4	(290.2)
R-113-037F1 TC	R-113-040F1	1016.	(3469.)	937.	(3197.)	7.8	326.2	(127.5)	2.9	(5.2)	3616.7	(637.9)
R-113-041F1 TC	R-113-044F1	1476.	(5037.)	1519.	(5186.)	-3.0	326.5	(128.1)	5.0	(9.0)	3049.0	(537.7)

Table B-25. Summary of experimental conditions and results from Wilson plots
for R-113 condensing on vertical tube F3

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	W	Q_c Btu/hr	W	Q_w Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-113-001F3 TO R-113-004F3	20C1.	(6831.)	1994.	(6806.)	0.4	325.2	(125.6)	6.6	(11.9)	2911.5	(513.5)
R-113-005F3 TO R-113-008F3	2441.	(8330.)	2398.	(8183.)	1.8	327.1	(129.1)	8.7	(15.6)	2706.0	(477.3)
R-113-009F3 TO R-113-012F3	1241.	(4236.)	1254.	(4280.)	-1.1	326.1	(127.2)	3.4	(6.1)	3514.7	(619.9)
R-113-013F3 TO R-113-016F3	986.	(3364.)	1003.	(3425.)	-1.8	326.3	(127.6)	2.6	(4.7)	3606.4	(636.1)
R-113-017F3 TO R-113-020F3	1672.	(5707.)	1643.	(5607.)	1.8	326.3	(127.7)	5.2	(9.3)	3113.9	(549.2)
R-113-021F3 TO R-113-024F3	1463.	(4993.)	1476.	(5038.)	-0.9	326.0	(127.1)	4.3	(7.8)	3265.8	(576.0)
R-113-025F3 TO R-113-028F3	2866.	(9780.)	2845.	(9710.)	0.7	324.2	(123.9)	11.9	(21.4)	2323.1	(409.7)
R-113-029F3 TO R-113-032F3	738.	(2519.)	741.	(2530.)	-0.4	326.8	(128.5)	1.7	(3.1)	4122.2	(727.0)
R-113-033F3 TO R-113-036F3	846.	(2887.)	850.	(2902.)	-0.5	327.2	(129.3)	2.0	(3.7)	3970.0	(700.2)
R-113-037F3 TO R-113-040F3	971.	(3314.)	951.	(3247.)	2.0	326.2	(127.5)	2.4	(4.3)	3887.2	(685.6)
R-113-041F3 TO R-113-044F3	1079.	(3682.)	1100.	(3755.)	-2.0	326.8	(128.6)	2.7	(4.9)	3776.9	(666.1)

Table B-26. Summary of experimental conditions and results from Wilson plots
for R-113 condensing on vertical tube F7

Series of runs		Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
		Q_c		Q_w								
		W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-113-001F7 TO	R-113-004F7	1975.	(6742.)	1955.	(6672.)	1.0	325.5 (126.3)	6.0 (10.7)		3430.9 (605.1)		
R-113-005F7 TO	R-113-008F7	2401.	(8195.)	2410.	(8224.)	-0.4	326.2 (127.5)	8.2 (14.7)		3038.5 (535.9)		
R-113-009F7 TO	R-113-012F7	1289.	(4400.)	1282.	(4374.)	0.6	325.5 (126.2)	3.3 (5.9)		4041.6 (712.8)		
R-113-013F7 TO	R-113-016F7	993.	(3389.)	1002.	(3420.)	-0.9	326.4 (127.8)	2.2 (4.0)		4596.2 (810.7)		
R-113-017F7 TO	R-113-020F7	1654.	(5645.)	1662.	(5674.)	-0.5	325.6 (126.4)	4.5 (8.1)		3804.9 (671.1)		
R-113-021F7 TO	R-113-024F7	749.	(2557.)	742.	(2534.)	0.9	326.3 (127.7)	1.5 (2.7)		5267.1 (928.9)		
R-113-025F7 TO	R-113-028F7	892.	(3044.)	908.	(3098.)	-1.8	325.8 (126.8)	1.9 (3.4)		4928.4 (869.2)		
R-113-029F7 TO	R-113-032F7	1164.	(3972.)	1178.	(4021.)	-1.2	325.9 (127.0)	2.8 (5.0)		4350.3 (767.2)		
R-113-033F7 TO	R-113-036F7	2235.	(7628.)	2205.	(7526.)	1.3	325.7 (126.5)	6.9 (12.4)		3360.6 (592.7)		
R-113-037F7 TO	R-113-040F7	2948.	(10062.)	2909.	(9927.)	1.3	324.3 (124.1)	10.6 (19.0)		2888.7 (509.5)		
R-113-041F7 TO	R-113-044F7	2460.	(8397.)	2441.	(8330.)	0.8	325.3 (125.9)	8.1 (14.6)		3142.4 (554.2)		
R-113-045F7 TO	R-113-048F7	2049.	(6992.)	2033.	(6937.)	0.8	326.1 (127.4)	6.3 (11.4)		3364.9 (593.5)		

Table B-27. Summary of experimental conditions and results from Wilson plots
for R-114 condensing on vertical tube A

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
			W	Btu/hr	W	Btu/hr							
R-114-001A	TO	R-114-005A	652.	(2224.)	0.	(0.)	0.0	310.6	(99.5)	7.8	(14.0)	862.0	(152.0)
R-114-006A	TO	R-114-010A	820.	(2800.)	0.	(0.)	0.0	308.8	(96.2)	10.1	(18.2)	834.8	(147.2)
R-114-011A	TO	R-114-015A	731.	(2496.)	0.	(0.)	0.0	307.7	(94.1)	8.9	(16.0)	844.2	(148.9)
R-114-016A	TO	R-114-020A	394.	(1343.)	0.	(0.)	0.0	307.4	(93.7)	4.2	(7.5)	964.5	(170.1)
R-114-021A	TO	R-114-025A	511.	(1744.)	0.	(0.)	0.0	308.1	(95.0)	6.0	(10.8)	878.3	(154.9)
R-114-026A	TO	R-114-029A	1976.	(6745.)	0.	(0.)	0.0	325.3	(125.8)	25.8	(46.4)	787.6	(138.9)
R-114-030A	TO	R-114-033A	1756.	(5992.)	0.	(0.)	0.0	323.1	(121.9)	23.1	(41.5)	781.9	(137.9)
R-114-034A	TO	R-114-038A	983.	(3355.)	0.	(0.)	0.0	310.3	(98.8)	12.9	(23.3)	781.3	(137.8)
R-114-039A	TO	R-114-043A	1326.	(4524.)	0.	(0.)	0.0	315.7	(108.6)	17.3	(31.2)	785.3	(138.5)
R-114-044A	TO	R-114-048A	1171.	(3997.)	0.	(0.)	0.0	313.2	(104.1)	15.6	(28.1)	770.8	(135.9)
R-114-049A	TO	R-114-053A	1500.	(5120.)	0.	(0.)	0.0	318.5	(113.7)	19.9	(35.7)	775.7	(136.8)
R-114-054A	TO	R-114-057A	1616.	(5514.)	0.	(0.)	0.0	319.7	(115.8)	21.5	(38.6)	773.2	(136.4)
R-114-058A	TO	R-114-061A	1878.	(6410.)	0.	(0.)	0.0	323.6	(122.7)	24.6	(44.3)	783.9	(138.2)
R-114-062A	TO	R-114-065A	2116.	(7222.)	0.	(0.)	0.0	327.3	(129.5)	27.7	(49.9)	784.1	(138.3)
R-114-066A	TO	R-114-069A	1606.	(5481.)	0.	(0.)	0.0	317.9	(112.5)	21.5	(38.7)	767.7	(135.4)

Table B-28. Summary of experimental conditions and results from Wilson plots
for R-114 condensing on vertical tube B

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
	W	Btu/hr	W	Btu/hr							
R-114-001B TO R-114-005B	418.	(1427.)	0.	(0.)	0.0	303.0	(85.7)	2.1	(3.9)	1397.1	(246.4)
R-114-006B TO R-114-010B	755.	(2577.)	0.	(0.)	0.0	305.0	(89.3)	4.1	(7.4)	1323.7	(233.5)
R-114-011B TO R-114-015B	592.	(2021.)	0.	(0.)	0.0	303.8	(87.1)	3.3	(5.9)	1304.7	(230.1)
R-114-016B TO R-114-020B	815.	(2782.)	0.	(0.)	0.0	310.0	(98.4)	4.5	(8.0)	1308.9	(230.8)
R-114-021B TO R-114-023B	1024.	(3494.)	0.	(0.)	0.0	310.5	(99.3)	5.2	(9.4)	1405.7	(247.9)
R-114-024B TO R-114-028B	1840.	(6281.)	0.	(0.)	0.0	317.8	(112.3)	11.9	(21.4)	1109.4	(195.7)
R-114-029B TO R-114-032B	2189.	(7469.)	0.	(0.)	0.0	310.1	(98.5)	14.3	(25.8)	1095.7	(193.2)
R-114-033B TO R-114-037B	1596.	(5446.)	0.	(0.)	0.0	308.0	(94.7)	9.4	(16.9)	1216.6	(214.6)
R-114-038B TO R-114-042B	1177.	(4017.)	0.	(0.)	0.0	305.1	(89.5)	6.4	(11.4)	1325.5	(233.8)
R-114-043B TO R-114-047B	1418.	(4838.)	0.	(0.)	0.0	307.2	(93.3)	8.1	(14.5)	1258.9	(222.0)
R-114-048B TO R-114-052B	722.	(2464.)	0.	(0.)	0.0	304.5	(88.5)	3.6	(6.5)	1428.2	(251.9)
R-114-053B TO R-114-057B	909.	(3102.)	0.	(0.)	0.0	307.6	(94.1)	4.9	(8.7)	1340.8	(236.5)
R-114-058B TO R-114-062B	683.	(2331.)	0.	(0.)	0.0	305.7	(90.7)	3.4	(6.1)	1449.3	(255.6)
R-114-063B TO R-114-067B	514.	(1753.)	0.	(0.)	0.0	307.7	(94.2)	2.5	(4.5)	1483.0	(261.6)
R-114-068B TO R-114-072B	1142.	(3899.)	0.	(0.)	0.0	306.9	(92.7)	6.6	(11.9)	1240.1	(218.7)
R-114-073B TO R-114-077B	1017.	(3470.)	0.	(0.)	0.0	306.7	(92.4)	5.6	(10.2)	1289.9	(227.5)
R-114-078B TO R-114-082B	901.	(3076.)	0.	(0.)	0.0	307.3	(93.5)	4.8	(8.7)	1337.1	(235.8)
R-114-083B TO R-114-087B	2782.	(9495.)	0.	(0.)	0.0	321.2	(118.5)	20.9	(37.7)	952.3	(167.9)
R-114-088B TO R-114-092B	2251.	(7683.)	0.	(0.)	0.0	314.9	(107.2)	15.7	(28.3)	1025.1	(180.8)
R-114-093B TO R-114-096B	2624.	(8956.)	0.	(0.)	0.0	318.4	(113.4)	18.9	(34.0)	993.9	(175.3)
R-114-097B TO R-114-100B	2919.	(9963.)	0.	(0.)	0.0	320.9	(118.0)	21.5	(38.6)	973.8	(171.8)

Table B-29. Summary of experimental conditions and results from Wilson plots
for R-114 condensing on vertical tube C

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
			W	Btu/hr	W	Btu/hr							
R-114-001C	TO	R-114-004C	644.	(2197.)	0.	(0.)	0.0	305.7	(90.5)	2.8	(5.0)	2246.6	(396.2)
R-114-005C	TO	R-114-008C	742.	(2534.)	0.	(0.)	0.0	307.3	(93.4)	3.3	(5.9)	2184.5	(385.3)
R-114-009C	TO	R-114-012C	357.	(1218.)	0.	(0.)	0.0	307.3	(93.5)	1.2	(2.2)	2845.5	(501.9)
R-114-013C	TO	R-114-016C	487.	(1660.)	0.	(0.)	0.0	305.9	(90.9)	1.8	(3.2)	2648.6	(467.1)
R-114-017C	TO	R-114-020C	817.	(2789.)	0.	(0.)	0.0	309.1	(96.8)	3.8	(6.9)	2059.8	(363.3)
R-114-021C	TO	R-114-024C	1526.	(5210.)	0.	(0.)	0.0	308.6	(95.8)	9.8	(17.7)	1496.5	(263.9)
R-114-027C	TO	R-114-030C	2125.	(7254.)	0.	(0.)	0.0	315.3	(107.9)	15.0	(26.9)	1365.6	(240.8)
R-114-031C	TO	R-114-034C	1848.	(6306.)	0.	(0.)	0.0	312.0	(101.9)	12.6	(22.7)	1410.5	(248.8)
R-114-035C	TO	R-114-038C	1226.	(4185.)	0.	(0.)	0.0	306.5	(92.0)	7.1	(12.8)	1663.2	(293.3)
R-114-039C	TO	R-114-042C	975.	(3327.)	0.	(0.)	0.0	308.1	(94.9)	5.2	(9.4)	1793.8	(316.4)
R-114-043C	TO	R-114-046C	3042.	(10382.)	0.	(0.)	0.0	322.4	(120.6)	22.7	(40.8)	1289.9	(227.5)
R-114-047C	TO	R-114-050C	2382.	(8129.)	0.	(0.)	0.0	316.1	(109.3)	17.2	(31.0)	1330.0	(234.6)
R-114-051C	TO	R-114-054C	2678.	(9142.)	0.	(0.)	0.0	319.1	(114.7)	19.5	(35.0)	1322.7	(233.3)

Table B-30. Summary of experimental conditions and results from Wilson plots
for R-114 condensing on vertical tube D

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	W	Q_c Btu/hr	W	Q_w Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-114-001D TO R-114-005D		984. (3359.)	0. (0.)	0.0	0.0	306.5 (92.0)		3.3 (5.9)		2882.9 (508.5)	
R-114-006D TO R-114-010D		1203. (4106.)	0. (0.)	0.0	0.0	307.2 (93.3)		4.5 (8.1)		2570.1 (453.3)	
R-114-011D TO R-114-014D		1565. (5340.)	0. (0.)	0.0	0.0	306.6 (92.1)		7.4 (13.4)		2023.6 (356.9)	
R-114-015D TO R-114-018D		2105. (7186.)	0. (0.)	0.0	0.0	311.7 (101.3)		11.8 (21.3)		1712.0 (301.9)	
R-114-019D TO R-114-022D		1871. (6386.)	0. (0.)	0.0	0.0	309.8 (97.9)		10.2 (18.3)		1766.7 (311.6)	
R-114-023D TO R-114-026D		1413. (4823.)	0. (0.)	0.0	0.0	303.8 (87.2)		6.2 (11.1)		2202.8 (388.5)	
R-114-027D TO R-114-030D		1705. (5819.)	0. (0.)	0.0	0.0	307.3 (93.5)		8.6 (15.5)		1898.1 (334.8)	
R-114-031D TO R-114-034D		1719. (5868.)	0. (0.)	0.0	0.0	307.9 (94.5)		8.8 (15.8)		1887.0 (332.8)	
R-114-035D TO R-114-038D		1446. (4934.)	0. (0.)	0.0	0.0	307.1 (93.1)		6.7 (12.0)		2090.4 (368.7)	
R-114-039D TO R-114-042D		601. (2053.)	0. (0.)	0.0	0.0	307.2 (93.4)		1.6 (2.8)		3683.7 (649.7)	
R-114-043D TO R-114-046D		454. (1548.)	0. (0.)	0.0	0.0	306.0 (91.2)		1.0 (1.8)		4317.9 (761.5)	
R-114-047D TO R-114-050D		747. (2550.)	0. (0.)	0.0	0.0	307.7 (94.2)		2.2 (3.9)		3341.2 (589.3)	
R-114-051D TO R-114-054D		835. (2850.)	0. (0.)	0.0	0.0	307.2 (93.3)		2.7 (4.9)		2928.3 (516.5)	
R-114-055D TO R-114-058D		3068. (10471.)	0. (0.)	0.0	0.0	320.1 (116.5)		20.1 (36.2)		1467.0 (258.7)	
R-114-059D TO R-114-062D		2710. (9250.)	0. (0.)	0.0	0.0	317.9 (112.6)		17.2 (31.0)		1514.5 (267.1)	
R-114-063D TO R-114-066D		1907. (6510.)	0. (0.)	0.0	0.0	308.9 (96.3)		10.2 (18.4)		1797.6 (317.0)	
R-114-067D TO R-114-070D		2349. (8018.)	0. (0.)	0.0	0.0	313.3 (104.3)		13.8 (24.9)		1634.6 (288.3)	

Table B-31. Summary of experimental conditions and results from Wilson plots
for R-114 condensing on vertical tube E

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
			W	Btu/hr	W	Btu/hr							
R-114-001E	TO	R-114-004E	835.	(2851.)	0.	(0.)	0.0	306.3	(91.7)	1.4	(2.6)	3924.0	(692.1)
R-114-005E	TO	R-114-008E	638.	(2176.)	0.	(0.)	0.0	304.9	(89.1)	1.0	(1.8)	4176.1	(736.5)
R-114-009E	TO	R-114-012E	762.	(2601.)	0.	(0.)	0.0	305.7	(90.5)	1.3	(2.4)	3864.6	(681.6)
R-114-013E	TO	R-114-016E	1597.	(5451.)	0.	(0.)	0.0	302.3	(84.5)	3.3	(6.0)	3202.6	(564.8)
R-114-017E	TO	R-114-020E	1951.	(6660.)	0.	(0.)	0.0	304.0	(87.6)	4.8	(8.6)	2751.8	(485.3)
R-114-021E	TO	R-114-024E	1006.	(3432.)	0.	(0.)	0.0	302.1	(84.1)	1.7	(3.1)	3884.9	(685.2)
R-114-025E	TO	R-114-028E	1327.	(4530.)	0.	(0.)	0.0	302.8	(85.4)	2.5	(4.5)	3541.9	(624.7)
R-114-029E	TO	R-114-032E	1771.	(6046.)	0.	(0.)	0.0	303.9	(87.3)	4.0	(7.2)	2953.6	(520.9)
R-114-033E	TO	R-114-036E	2176.	(7427.)	0.	(0.)	0.0	306.9	(92.7)	5.8	(10.5)	2496.3	(440.3)
R-114-037E	TO	R-114-040E	2067.	(7053.)	0.	(0.)	0.0	305.6	(90.3)	5.1	(9.2)	2718.3	(479.4)
R-114-041E	TO	R-114-044E	1170.	(3993.)	0.	(0.)	0.0	300.8	(81.7)	2.2	(4.0)	3524.8	(621.7)
R-114-045E	TO	R-114-048E	1464.	(4995.)	0.	(0.)	0.0	302.3	(84.5)	2.9	(5.2)	3381.0	(596.3)
R-114-049E	TO	R-114-052E	3299.	(11258.)	0.	(0.)	0.0	316.7	(110.3)	14.4	(25.9)	1538.0	(271.2)
R-114-053E	TO	R-114-056E	2727.	(9308.)	0.	(0.)	0.0	312.1	(102.0)	10.3	(18.6)	1770.0	(312.2)
R-114-057E	TO	R-114-060E	3037.	(10367.)	0.	(0.)	0.0	314.2	(105.9)	12.3	(22.2)	1650.1	(291.0)
R-114-061E	TO	R-114-064E	2246.	(7666.)	0.	(0.)	0.0	307.0	(92.9)	6.5	(11.7)	2311.2	(407.6)
R-114-065E	TO	R-114-068E	2563.	(8748.)	0.	(0.)	0.0	309.5	(97.4)	8.5	(15.3)	2013.7	(355.1)
R-114-069E	TO	R-114-071E	3665.	(12510.)	0.	(0.)	0.0	319.5	(115.5)	16.9	(30.5)	1450.3	(255.8)
R-114-072E	TO	R-114-075E	2442.	(8334.)	0.	(0.)	0.0	307.6	(94.1)	7.6	(13.7)	2147.9	(378.8)
R-114-076E	TO	R-114-079E	2635.	(8992.)	0.	(0.)	0.0	309.6	(97.6)	9.2	(16.5)	1924.7	(339.5)
R-114-080E	TO	R-114-082E	3979.	(13582.)	0.	(0.)	0.0	321.9	(119.8)	19.6	(35.2)	1363.0	(240.4)

Table B-32. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube A

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c	Q_w		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
			W	Btu/hr							
R-115-009A	TO	R-115-012A	481. (1643.)	479. (1636.)	0.5	303.0 (85.8)	5.7 (10.3)	859.8 (151.6)			
R-115-017A	TO	R-115-020A	362. (1236.)	358. (1222.)	1.2	302.7 (85.2)	4.3 (7.7)	867.7 (153.0)			
R-115-033A	TO	R-115-036A	1311. (4474.)	1322. (4514.)	-0.9	309.8 (97.9)	16.0 (28.9)	839.4 (148.0)			
R-115-037A	TO	R-115-039A	1623. (5538.)	1649. (5628.)	-1.6	312.1 (102.1)	19.7 (35.5)	844.2 (148.9)			
R-115-040A	TO	R-115-043A	858. (2929.)	857. (2925.)	0.1	310.1 (98.5)	10.6 (19.2)	827.8 (146.0)			
R-115-044A	TO	R-115-047A	1097. (3742.)	1096. (3741.)	0.0	309.5 (97.4)	13.6 (24.4)	830.2 (146.4)			
R-115-048A	TO	R-115-051A	667. (2276.)	673. (2298.)	-1.0	310.8 (99.8)	8.1 (14.6)	842.7 (148.6)			

Table B-33. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube D

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_c		Q_w								
			W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-115-005D	TO	R-115-008D	522.	(1781.)	527.	(1799.)	-1.0	311.2	(100.5)	3.1	(5.6)	1623.0	(286.2)
R-115-009D	TO	R-115-012D	394.	(1345.)	411.	(1403.)	-4.3	311.5	(101.1)	2.1	(3.8)	1796.0	(316.8)
R-115-013D	TO	R-115-016D	1336.	(4560.)	1360.	(4640.)	-1.8	308.8	(96.2)	9.7	(17.5)	1321.0	(233.0)
R-115-017D	TO	R-115-020D	809.	(2759.)	800.	(2729.)	1.1	310.6	(99.4)	5.4	(9.8)	1429.9	(252.2)
R-115-021D	TO	R-115-024D	1598.	(5452.)	1638.	(5589.)	-2.5	308.3	(95.2)	12.0	(21.6)	1281.7	(226.1)
R-115-025D	TO	R-115-028D	311.	(1061.)	333.	(1137.)	-7.2	311.9	(101.7)	1.5	(2.7)	1982.1	(349.6)
R-115-029D	TO	R-115-032D	1121.	(3827.)	1130.	(3855.)	-0.7	309.8	(98.0)	8.1	(14.6)	1332.9	(235.1)
R-115-033D	TO	R-115-036D	668.	(2281.)	641.	(2189.)	4.1	311.1	(100.3)	4.2	(7.5)	1535.1	(270.7)
R-115-037D	TO	R-115-040D	1744.	(5952.)	1779.	(6071.)	-2.0	308.5	(95.6)	13.2	(23.7)	1274.0	(224.7)
R-115-041D	TO	R-115-044D	977.	(3334.)	972.	(3318.)	0.5	310.5	(99.3)	6.7	(12.1)	1397.9	(246.5)
R-115-045D	TO	R-115-048D	1948.	(6649.)	1959.	(6687.)	-0.6	310.7	(99.5)	14.9	(26.8)	1257.9	(221.9)

Table B-34. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube D1

Series of runs		Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
		Q_c		Q_w								
		W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-115-001D1 TO	R-115-004D1	954.	(3255.)	948.	(3236.)	0.6	310.5 (99.2)	6.5 (11.7)		1414.8 (249.5)		
R-115-005D1 TO	R-115-008D1	404.	(1377.)	420.	(1432.)	-3.9	311.4 (100.8)	2.0 (3.5)		1981.1 (349.4)		
R-115-009D1 TO	R-115-012D1	1987.	(6783.)	1980.	(6758.)	0.4	310.2 (98.6)	15.1 (27.1)		1268.4 (223.7)		
R-115-013D1 TO	R-115-016D1	613.	(2092.)	618.	(2111.)	-0.9	311.3 (100.7)	3.6 (6.6)		1619.7 (285.7)		
R-115-017D1 TO	R-115-020D1	1266.	(4322.)	1245.	(4248.)	1.7	309.4 (97.2)	9.0 (16.2)		1357.0 (239.3)		
R-115-021D1 TO	R-115-024D1	814.	(2780.)	808.	(2757.)	0.8	311.1 (100.3)	5.3 (9.6)		1470.1 (259.3)		
R-115-025D1 TO	R-115-028D1	1630.	(5564.)	1636.	(5582.)	-0.3	308.6 (95.9)	12.0 (21.6)		1308.4 (230.8)		
R-115-029D1 TO	R-115-032D1	283.	(965.)	303.	(1034.)	-7.1	311.8 (101.6)	1.1 (2.0)		2462.0 (434.2)		
R-115-033D1 TO	R-115-036D1	478.	(1632.)	488.	(1665.)	-2.0	311.3 (100.7)	2.6 (4.7)		1760.4 (310.5)		

Table B-35. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube E

Series of runs			Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
			Q_C		Q_W								
			W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-115-005E	TO	R-115-008E	1657.	(5655.)	1678.	(5729.)	-1.3	310.1	(98.4)	7.3	(13.1)	1529.3	(269.7)
R-115-009E	TO	R-115-012E	635.	(2166.)	614.	(2096.)	3.3	311.3	(100.7)	1.7	(3.0)	2532.6	(446.7)
R-115-017E	TO	R-115-020E	1189.	(4058.)	1190.	(4061.)	-0.1	310.8	(99.8)	4.4	(7.9)	1814.2	(320.0)
R-115-021E	TO	R-115-024E	1869.	(6378.)	1891.	(6452.)	-1.2	309.2	(96.9)	8.6	(15.4)	1462.9	(258.0)
R-115-025E	TO	R-115-028E	890.	(3038.)	879.	(2999.)	1.3	311.9	(101.7)	2.9	(5.1)	2088.2	(368.3)
R-115-029E	TO	R-115-032E	2257.	(7704.)	2292.	(7822.)	-1.5	308.4	(95.5)	11.2	(20.1)	1354.4	(238.9)
R-115-033E	TO	R-115-036E	1383.	(4720.)	1386.	(4729.)	-0.2	310.5	(99.2)	5.5	(9.8)	1695.6	(299.1)
R-115-037E	TO	R-115-040E	2382.	(8128.)	2414.	(8239.)	-1.4	308.1	(94.9)	12.0	(21.6)	1329.1	(234.4)
R-115-041E	TO	R-115-044E	2636.	(8997.)	2647.	(9034.)	-0.4	308.9	(96.3)	13.6	(24.5)	1299.1	(229.1)

Table B-36. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube F

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	W	Q_c Btu/hr	W	Q_w Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-115-001F TO R-115-004F		420. (1435.)		406. (1384.)	3.5	311.6 (101.2)		1.5 (2.8)		2812.8 (496.1)	
R-115-009F TO R-115-012F		901. (3075.)		900. (3070.)	0.1	311.5 (101.0)		5.7 (10.2)		1650.8 (291.1)	
R-115-013F TO R-115-016F		1561. (5327.)		1558. (5317.)	0.2	309.6 (97.6)		11.5 (20.7)		1402.7 (247.4)	
R-115-017F TO R-115-020F		572. (1954.)		551. (1880.)	3.8	311.7 (101.4)		2.9 (5.2)		2053.1 (362.1)	
R-115-021F TO R-115-024F		1360. (4643.)		1381. (4713.)	-1.5	309.7 (97.8)		9.7 (17.5)		1450.4 (255.8)	
R-115-025F TO R-115-028F		709. (2421.)		681. (2325.)	4.0	311.8 (101.7)		3.9 (7.1)		1865.8 (329.1)	
R-115-029F TO R-115-032F		1228. (4192.)		1235. (4214.)	-0.5	310.3 (98.9)		8.7 (15.6)		1464.4 (258.3)	
R-115-033F TO R-115-036F		2029. (6923.)		2117. (7227.)	-4.4	308.8 (96.1)		15.6 (28.1)		1347.1 (237.6)	
R-115-037F TO R-115-039F		1851. (6318.)		1854. (6327.)	-0.1	310.8 (99.9)		14.2 (25.6)		1349.1 (237.9)	
R-115-040F TO R-115-043F		474. (1618.)		482. (1644.)	-1.6	311.7 (101.4)		2.1 (3.7)		2391.1 (421.7)	
R-115-044F TO R-115-047F		1052. (3590.)		1070. (3652.)	-1.7	310.8 (99.7)		7.1 (12.8)		1530.7 (270.0)	
R-115-048F TO R-115-051F		1751. (5976.)		1801. (6146.)	-2.8	308.4 (95.5)		13.2 (23.7)		1377.3 (242.9)	

Table B-37. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube F1

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	W	Q_c	W	Q_w		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
		Btu/hr		Btu/hr							
R-115-001F1 TO R-115-004F1		1427. (4871.)		1464. (4997.)	-2.6	309.5 (97.3)		9.7 (17.4)		1527.9 (269.5)	
R-115-005F1 TO R-115-008F1		2068. (7057.)		2081. (7103.)	-0.7	310.9 (100.0)		15.6 (28.0)		1374.8 (242.5)	
R-115-009F1 TO R-115-012F1		449. (1532.)		458. (1564.)	-2.1	311.7 (101.4)		1.9 (3.5)		2405.5 (424.2)	
R-115-013F1 TO R-115-016F1		1179. (4023.)		1211. (4133.)	-2.7	310.8 (99.8)		7.7 (13.9)		1580.6 (278.8)	
R-115-017F1 TO R-115-020F1		585. (1995.)		593. (2022.)	-1.4	312.0 (101.9)		2.9 (5.2)		2115.1 (373.0)	
R-115-021F1 TO R-115-024F1		1793. (6120.)		1811. (6183.)	-1.0	308.1 (94.9)		13.0 (23.3)		1433.7 (252.9)	
R-115-025F1 TO R-115-028F1		885. (3020.)		880. (3004.)	0.5	311.8 (101.5)		5.3 (9.5)		1735.3 (306.0)	
R-115-029F1 TO R-115-032F1		2129. (7265.)		2135. (7286.)	-0.3	312.2 (102.3)		16.1 (29.0)		1368.5 (241.4)	
R-115-033F1 TO R-115-036F1		361. (1232.)		383. (1307.)	-6.0	312.1 (102.1)		1.3 (2.3)		2888.9 (509.5)	
R-115-037F1 TO R-115-040F1		732. (2498.)		734. (2507.)	-0.3	311.9 (101.7)		4.1 (7.4)		1842.1 (324.9)	

Table B-38. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube F3

Series of runs		Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
		Q_c		Q_w								
		W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-115-001F3 TO	R-115-004F3	882.	(3012.)	895.	(3055.)	-1.4	311.2	(100.5)	4.3	(7.7)	2135.6	(376.6)
R-115-005F3 TO	R-115-008F3	1846.	(6299.)	1883.	(6427.)	-2.0	308.6	(95.8)	11.1	(20.0)	1720.6	(303.5)
R-115-009F3 TO	R-115-012F3	438.	(1494.)	449.	(1533.)	-2.6	311.7	(101.4)	1.5	(2.7)	2983.3	(526.1)
R-115-013F3 TO	R-115-016F3	1182.	(4035.)	1178.	(4020.)	0.4	311.0	(100.1)	6.3	(11.3)	1952.4	(344.3)
R-115-017F3 TO	R-115-020F3	348.	(1187.)	358.	(1221.)	-2.9	312.0	(102.0)	1.1	(2.0)	3311.5	(584.0)
R-115-021F3 TO	R-115-024F3	773.	(2638.)	766.	(2616.)	0.8	311.7	(101.3)	3.7	(6.6)	2176.9	(383.9)
R-115-025F3 TO	R-115-028F3	587.	(2003.)	582.	(1986.)	0.8	311.7	(101.4)	2.4	(4.2)	2582.1	(455.4)
R-115-029F3 TO	R-115-032F3	1463.	(4992.)	1483.	(5061.)	-1.4	309.8	(97.9)	8.2	(14.8)	1845.1	(325.4)
R-115-033F3 TO	R-115-035F3	2062.	(7038.)	2126.	(7257.)	-3.1	309.1	(96.7)	12.7	(22.9)	1679.0	(296.1)

Table B-39. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube F7

Series of runs		Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
		Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
		W	Btu/hr	W	Btu/hr							
R-115-001F7 TO	R-115-004F7	2084.	(7113.)	2097.	(7156.)	-0.6	306.8	(92.5)	10.3	(18.6)	2088.8	(368.4)
R-115-005F7 TO	R-115-008F7	349.	(1190.)	378.	(1290.)	-8.4	311.5	(101.1)	0.9	(1.7)	3837.1	(676.7)
R-115-009F7 TO	R-115-012F7	1194.	(4076.)	1225.	(4183.)	-2.6	310.0	(98.3)	5.1	(9.2)	2429.6	(428.5)
R-115-013F7 TO	R-115-016F7	589.	(2009.)	614.	(2096.)	-4.3	311.1	(100.3)	1.9	(3.4)	3215.8	(567.2)
R-115-017F7 TO	R-115-020F7	1793.	(6118.)	1836.	(6266.)	-2.4	307.4	(93.7)	8.9	(16.0)	2083.8	(367.5)
R-115-021F7 TO	R-115-024F7	441.	(1507.)	469.	(1602.)	-6.4	311.1	(100.4)	1.3	(2.3)	3541.2	(624.6)
R-115-025F7 TO	R-115-028F7	900.	(3073.)	926.	(3162.)	-2.9	310.5	(99.3)	3.5	(6.2)	2702.9	(476.7)
R-115-029F7 TO	R-115-032F7	748.	(2551.)	771.	(2630.)	-3.1	310.9	(100.0)	2.7	(4.9)	2855.3	(503.6)
R-115-033F7 TO	R-115-036F7	1472.	(5024.)	1531.	(5225.)	-4.0	308.9	(96.4)	6.8	(12.2)	2254.3	(397.6)

Table B-40. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube G

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient			
			Q_c	Q_w									
			W	Btu/hr		W	Btu/hr	K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-115-005G	TO	R-115-008G	379.	(1292.)	401.	(1368.)	-5.8	311.9	(101.7)	2.5	(4.5)	1315.1	(231.9)
R-115-009G	TO	R-115-012G	751.	(2563.)	739.	(2521.)	1.7	311.3	(100.7)	6.1	(11.0)	1075.2	(189.6)
R-115-013G	TO	R-115-016G	1713.	(5845.)	1700.	(5802.)	0.7	310.5	(99.2)	14.9	(26.8)	1006.1	(177.4)
R-115-017G	TO	R-115-020G	494.	(1686.)	491.	(1676.)	0.6	311.6	(101.2)	3.5	(6.4)	1220.1	(215.2)
R-115-021G	TO	R-115-024G	1032.	(3522.)	1018.	(3473.)	1.4	310.2	(98.7)	8.6	(15.5)	1049.8	(185.2)
R-115-025G	TO	R-115-028G	1385.	(4726.)	1390.	(4743.)	-0.4	309.2	(97.0)	11.8	(21.3)	1024.1	(180.6)
R-115-029G	TO	R-115-032G	1178.	(4022.)	1181.	(4032.)	-0.2	310.0	(98.3)	9.9	(17.9)	1039.7	(183.4)
R-115-033G	TO	R-115-035G	1841.	(6284.)	1845.	(6299.)	-0.2	311.4	(100.8)	15.9	(28.7)	1011.9	(178.5)

Table B-41. Summary of experimental conditions and results from Wilson plots
for R-115 condensing on vertical tube H

Series of runs			Condenser heat load		% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient			
			Q_c	Q_w		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F		
			W	Btu/hr									
R-115-005H	TO	R-115-008H	523.	(1783.)	541.	(1845.)	-3.5	311.4	(100.8)	1.7	(3.1)	1844.5	(325.3)
R-115-009H	TO	R-115-012H	842.	(2872.)	852.	(2909.)	-1.3	311.1	(100.3)	3.4	(6.1)	1517.7	(267.7)
R-115-013H	TO	R-115-016H	2113.	(7211.)	2169.	(7404.)	-2.7	308.9	(96.4)	10.0	(18.1)	1286.7	(226.9)
R-115-017H	TO	R-115-020H	1206.	(4116.)	1212.	(4135.)	-0.5	310.7	(99.7)	5.3	(9.6)	1387.9	(244.8)
R-115-021H	TO	R-115-024H	2435.	(8311.)	2461.	(8399.)	-1.1	308.7	(96.0)	11.7	(21.0)	1276.8	(225.2)
R-115-025H	TO	R-115-028H	1536.	(5243.)	1561.	(5328.)	-1.6	310.6	(99.4)	7.2	(12.9)	1310.8	(231.2)
R-115-029H	TO	R-115-032H	2875.	(9812.)	2889.	(9860.)	-0.5	309.6	(97.6)	14.0	(25.2)	1256.6	(221.6)
R-115-033H	TO	R-115-036H	715.	(2441.)	697.	(2377.)	2.6	311.3	(100.6)	2.6	(4.7)	1656.6	(292.2)
R-115-037H	TO	R-115-040H	1822.	(6218.)	1867.	(6373.)	-2.5	309.7	(97.8)	8.6	(15.5)	1296.3	(228.6)
R-115-041H	TO	R-115-045H	1217.	(4153.)	1227.	(4187.)	-0.8	310.9	(99.9)	5.4	(9.8)	1371.9	(241.9)
R-115-046H	TO	R-115-049H	715.	(2440.)	709.	(2419.)	0.8	311.3	(100.7)	2.6	(4.7)	1663.6	(293.4)
R-115-050H	TO	R-115-053H	2990.	(10203.)	3006.	(10260.)	-0.6	309.5	(97.4)	14.5	(26.1)	1259.7	(222.2)

Table B-42. Summary of experimental conditions and results from Wilson plots for R-115 condensing on vertical tube J

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	W	Q_c Btu/hr	W	Q_w Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-115-001J TO R-115-004J		429. (1463.)		434. (1482.)	-1.3	311.1 (100.3)		2.5 (4.5)		1777.4 (313.5)	
R-115-009J TO R-115-012J		318. (1085.)		334. (1139.)	-5.0	311.5 (101.0)		1.6 (2.8)		2083.0 (367.4)	
R-115-013J TO R-115-016J		793. (2707.)		791. (2700.)	0.3	310.7 (99.5)		6.0 (10.9)		1345.8 (237.3)	
R-115-017J TO R-115-020J		1469. (5014.)		1461. (4985.)	0.6	308.2 (95.0)		12.8 (23.1)		1176.4 (207.5)	
R-115-021J TO R-115-024J		959. (3274.)		954. (3257.)	0.5	310.5 (99.2)		7.5 (13.5)		1311.7 (231.3)	
R-115-025J TO R-115-028J		1711. (5840.)		1724. (5883.)	-0.7	311.4 (100.8)		15.3 (27.6)		1145.3 (202.0)	
R-115-029J TO R-115-032J		1187. (4052.)		1200. (4094.)	-1.0	310.1 (98.5)		9.8 (17.6)		1242.2 (219.1)	
R-115-033J TO R-115-036J		1885. (6432.)		1859. (6346.)	1.3	312.6 (103.0)		17.0 (30.7)		1134.6 (200.1)	
R-115-037J TO R-115-040J		578. (1974.)		567. (1935.)	2.0	310.9 (100.0)		3.7 (6.7)		1582.2 (279.0)	

Table B-43. Summary of experimental conditions and results from Wilson plots
for R-600a condensing on vertical tube A

Series of runs		Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
		Q_c		Q_w								
		W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
R-600A-001A TO	R-600A-004A	491.	(1674.)	515.	(1758.)	-5.0	301.9	(83.8)	4.5	(8.1)	1125.7	(198.5)
R-600A-005A TO	R-600A-008A	828.	(2828.)	864.	(2949.)	-4.3	306.4	(91.9)	8.5	(15.4)	996.7	(175.8)
R-600A-009A TO	R-600A-012A	1159.	(3954.)	1194.	(4077.)	-3.1	310.4	(99.0)	12.4	(22.4)	957.8	(168.9)
R-600A-013A TO	R-600A-016A	1355.	(4625.)	1372.	(4682.)	-1.2	312.5	(102.9)	14.8	(26.6)	940.1	(165.8)
R-600A-017A TO	R-600A-020A	1705.	(5819.)	1725.	(5889.)	-1.2	317.5	(111.9)	18.8	(33.9)	928.9	(163.8)
R-600A-021A TO	R-600A-024A	2187.	(7464.)	2211.	(7545.)	-1.1	322.7	(121.1)	24.4	(43.9)	920.7	(162.4)

TableB-44 . Summary of experimental conditions and results from Wilson plots
for R-600a condensing on vertical tube E

Series of runs		Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
		Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
		W	Btu/hr	W	Btu/hr							
R-600A-001E TO	R-600A-004E	895.	(3053.)	914.	(3120.)	-2.2	298.7	(78.0)	1.0	(1.8)	5898.0	(1040.2)
R-600A-005E TO	R-600A-008E	1376.	(4696.)	1394.	(4757.)	-1.3	299.9	(80.1)	1.8	(3.3)	4988.6	(879.8)
R-600A-009E TO	R-600A-012E	1720.	(5870.)	1736.	(5925.)	-0.9	303.1	(86.0)	2.5	(4.6)	4535.0	(799.8)
R-600A-013E TO	R-600A-016E	2196.	(7496.)	2182.	(7446.)	0.7	301.1	(82.3)	3.7	(6.7)	3923.6	(692.0)
R-600A-017E TO	R-600A-020E	2685.	(9162.)	2681.	(9149.)	0.1	304.1	(87.8)	6.3	(11.3)	2863.3	(505.0)
R-600A-021E TO	R-600A-024E	3009.	(10269.)	2995.	(10222.)	0.5	307.9	(94.5)	8.5	(15.2)	2385.0	(420.6)
R-600A-025E TO	R-600A-028E	3678.	(12553.)	3724.	(12711.)	-1.3	313.9	(105.4)	12.8	(23.0)	1931.7	(340.7)
R-600A-029E TO	R-600A-032E	3338.	(11392.)	3332.	(11372.)	0.2	311.7	(101.4)	10.9	(19.7)	2047.9	(361.2)
R-600A-033E TO	R-600A-036E	2459.	(8393.)	2453.	(8372.)	0.2	303.6	(86.9)	4.9	(8.8)	3366.7	(593.8)

Table B-45. Summary of experimental conditions and results from Wilson plots
for R-600a condensing on vertical tube F

Series of runs	Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
	Q_c		Q_w								
	W	Btu/hr	W	Btu/hr		K	°F	K	°F	W/m ² -K	Btu/hr·ft ² ·°F
R-600A-001F TO R-600A-004F	634.	(2164.)	604.	(2060.)	4.8	310.9 (100.0)	1.1 (2.0)	6049.8 (1067.0)			
R-600A-005F TO R-600A-008F	1031.	(3520.)	1003.	(3425.)	2.7	310.4 (99.1)	2.5 (4.5)	4319.3 (761.8)			
R-600A-013F TO R-600A-016F	1362.	(4649.)	1358.	(4636.)	0.3	309.8 (97.9)	4.7 (8.4)	3010.4 (530.9)			
R-600A-017F TO R-600A-020F	1565.	(5341.)	1549.	(5287.)	1.0	308.4 (95.4)	6.1 (11.0)	2643.4 (466.2)			
R-600A-021F TO R-600A-024F	1966.	(6710.)	1961.	(6694.)	0.2	310.3 (98.8)	9.2 (16.6)	2209.0 (389.6)			
R-600A-025F TO R-600A-028F	2358.	(8047.)	2353.	(8030.)	0.2	308.7 (95.9)	12.5 (22.5)	1956.7 (345.1)			

Table B-46. Summary of experimental conditions and results from Wilson plots
for R-600a condensing on vertical tube F3

Series of runs		Condenser heat load				% Diff.	Vapor temperature		Condensing temp. diff.		Condensing heat transfer coefficient	
		Q_c		Q_w			K	°F	K	°F	W/m ² ·K	Btu/hr·ft ² ·°F
		W	Btu/hr	W	Btu/hr							
R-600A-001F3TO	R-600A-004F3	616.	(2103.)	616.	(2103.)	0.0	311.0 (100.1)	0.8 (1.5)		7788.5 (1373.6)		
R-600A-005F3TO	R-600A-008F3	913.	(3115.)	910.	(3107.)	0.2	310.7 (99.5)	1.5 (2.8)		6179.3 (1089.8)		
R-600A-009F3TO	R-600A-012F3	1217.	(4154.)	1218.	(4156.)	-0.0	310.2 (98.7)	2.3 (4.2)		5445.7 (960.4)		
R-600A-013F3TO	R-600A-016F3	1531.	(5225.)	1535.	(5238.)	-0.3	308.6 (95.9)	3.2 (5.7)		4993.5 (880.7)		
R-600A-017F3TO	R-600A-020F3	1826.	(6232.)	1819.	(6208.)	0.4	309.1 (96.7)	4.0 (7.2)		4752.6 (838.2)		
R-600A-021F3TO	R-600A-024F3	2182.	(7448.)	2172.	(7412.)	0.5	308.6 (95.8)	5.4 (9.6)		4221.6 (744.6)		
R-600A-025F3TO	R-600A-028F3	2458.	(8390.)	2422.	(8266.)	1.5	308.1 (94.9)	6.5 (11.6)		3940.0 (694.9)		
R-600A-029F3TO	R-600A-032F3	2830.	(9660.)	2819.	(9621.)	0.4	305.9 (90.9)	8.3 (14.9)		3536.2 (623.7)		

APPENDIX C

EXPERIMENTAL DATA

Tables C-1 through C-46 document 2464 runs which yielded 550 data points or Wilson plots. The tables summarize the experimental data used in data reduction. In addition, the tables list saturation pressures and heat balance checks. Velocities are presented along with Reynolds numbers for the water flows. Also, overall heat transfer coefficients are tabulated. The information was generated by a computer code used for data reduction, and the runs are grouped in series corresponding to Wilson plots. Several series of runs were discarded because of problems with operation and/or instrumentation.

Table C-1. Experimental data for R-11 condensing on tube A

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\bar{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-11-037A	108.87	27.2	27.4	0.0807	97.63	58.57	21.8	17.6	59687.	81.80	82.27	0.41	26.84	4357.	4470.	2.6	155.
R-11-038A	110.40	28.0	28.1	0.0807	99.78	58.45	7.6	6.1	20743.	81.18	82.38	1.18	28.63	4340.	4478.	3.2	145.
R-11-039A	111.42	28.5	28.6	0.0815	101.54	58.92	5.2	4.2	14195.	80.93	82.65	1.70	29.63	4369.	4400.	0.7	141.
R-11-040A	113.86	29.9	29.8	0.0803	104.02	57.90	3.0	2.4	8254.	81.01	83.86	2.81	31.42	4279.	4205.	-1.7	130.
R-11-041A	98.40	23.0	22.8	0.0483	88.24	35.37	21.8	17.6	60307.	82.72	83.04	0.26	15.53	2665.	2806.	5.3	164.
R-11-042A	99.07	23.4	23.1	0.0483	88.73	35.35	7.6	6.1	20971.	82.29	83.05	0.72	16.40	2662.	2749.	3.3	155.
R-11-043A	99.47	23.7	23.2	0.0479	89.07	35.02	5.2	4.2	14338.	82.09	83.13	1.04	16.87	2636.	2698.	2.3	149.
R-11-044A	100.88	24.0	23.8	0.0475	90.10	34.67	3.0	2.4	8292.	81.89	83.73	1.76	18.07	2605.	2634.	1.1	138.
R-11-045A	101.33	24.0	24.0	0.0575	89.67	42.00	21.8	17.6	59997.	82.27	82.64	0.30	18.88	3154.	3317.	5.2	160.
R-11-046A	102.12	24.4	24.3	0.0583	91.34	42.53	7.6	6.1	20762.	81.41	82.30	0.86	20.26	3191.	3257.	2.1	150.
R-11-047A	102.79	24.7	24.6	0.0581	92.14	42.34	5.2	4.2	14191.	81.14	82.40	1.25	21.02	3174.	3232.	1.8	144.
R-11-048A	104.57	25.4	25.4	0.0574	93.92	41.80	3.0	2.4	8231.	81.14	83.27	2.08	22.36	3126.	3117.	-0.3	134.
R-11-049A	115.28	30.0	30.5	0.1054	105.88	75.89	21.8	17.6	58363.	79.92	80.51	0.53	35.07	5599.	5720.	2.2	152.
R-11-050A	117.69	31.2	31.7	0.1064	109.06	76.35	7.6	6.1	20396.	79.63	81.18	1.52	37.28	5615.	5782.	3.0	144.
R-11-051A	119.17	32.2	32.5	0.1064	110.79	76.22	5.2	4.2	13996.	79.54	81.76	2.17	38.52	5595.	5634.	0.7	139.
R-11-052A	122.11	33.7	34.1	0.1062	113.57	75.86	3.0	2.4	8104.	79.64	82.23	3.55	41.17	5548.	5307.	-4.3	129.
R-11-053A	120.86	32.9	33.4	0.1228	110.05	88.01	21.8	17.6	58313.	79.82	80.47	0.61	40.71	6446.	6612.	2.6	151.
R-11-054A	123.40	34.2	34.8	0.1223	113.37	87.37	7.6	6.1	20419.	79.63	81.38	1.74	42.90	6378.	6612.	3.7	142.
R-11-055A	125.42	35.4	36.0	0.1231	116.26	87.68	5.2	4.2	14075.	79.83	82.37	2.48	44.31	6383.	6446.	1.0	138.
R-11-056A	129.34	37.7	38.3	0.1240	120.59	87.95	3.0	2.4	8248.	80.30	84.45	4.11	46.96	6370.	6157.	-3.3	130.
R-11-057A	126.17	35.7	36.4	0.1482	119.35	105.26	21.5	17.3	56182.	77.90	78.67	0.71	47.88	7656.	7658.	0.0	153.
R-11-058A	128.84	37.4	38.0	0.1474	121.87	104.42	7.6	6.1	19992.	77.78	79.84	2.00	50.03	7568.	7598.	0.4	144.
R-11-059A	130.90	38.7	39.2	0.1478	124.07	104.52	5.2	4.2	13799.	78.04	80.98	2.90	51.40	7554.	7515.	-0.5	140.
R-11-060A	135.99	41.9	42.4	0.1488	128.97	104.65	3.0	2.4	8127.	78.71	83.63	4.85	54.82	7511.	7258.	-3.4	131.
R-11-061A	104.57	25.0	25.4	0.0698	92.99	50.82	21.8	17.6	59124.	81.05	81.48	0.36	23.30	3801.	3926.	3.3	156.
R-11-062A	105.81	25.7	26.0	0.0700	94.67	50.90	7.6	6.1	20540.	80.44	81.52	1.03	24.83	3801.	3924.	3.2	146.
R-11-063A	106.53	26.2	26.3	0.0702	95.63	51.01	5.2	4.2	14020.	80.03	81.54	1.51	25.75	3806.	3925.	3.1	141.
R-11-064A	108.74	27.2	27.3	0.0700	98.04	50.73	3.0	2.4	8097.	79.57	82.18	2.58	27.87	3775.	3858.	2.2	129.
R-11-065A	120.42	32.7	33.2	0.1349	111.38	96.57	21.8	17.6	54906.	75.03	75.77	0.67	45.02	7078.	7308.	3.3	150.
R-11-066A	123.21	34.2	34.7	0.1355	114.67	96.67	7.6	6.1	19226.	74.79	76.69	1.87	47.47	7059.	7090.	0.4	142.
R-11-067A	125.37	35.4	35.9	0.1362	117.41	96.96	5.2	4.2	13277.	75.08	77.84	2.72	48.91	7060.	7059.	-0.0	138.
R-11-068A	130.13	38.2	38.7	0.1368	122.41	96.87	3.0	2.4	7824.	75.87	80.39	4.48	52.00	7008.	6703.	-4.4	129.
R-11-069A	109.94	27.5	27.9	0.0945	98.40	68.52	21.8	17.6	56716.	77.66	78.20	0.48	32.01	5090.	5209.	2.3	152.
R-11-070A	112.42	28.7	29.1	0.0958	102.26	69.21	7.6	6.1	19825.	77.42	78.86	1.39	34.28	5125.	5278.	3.0	143.
R-11-071A	114.13	29.7	29.9	0.0962	104.63	69.33	5.2	4.2	13630.	77.50	79.56	2.00	35.61	5123.	5201.	1.5	137.
R-11-072A	117.81	31.5	31.8	0.0960	108.39	68.90	3.0	2.4	7995.	78.11	81.59	3.48	37.97	5067.	5214.	2.9	127.
R-11-073A	122.18	33.7	34.1	0.1570	113.72	112.13	21.8	17.6	51308.	69.72	70.55	0.77	52.04	8199.	8387.	2.3	150.
R-11-074A	124.19	34.9	35.3	0.1577	116.42	112.37	7.6	6.1	17643.	67.99	70.25	2.20	55.07	8195.	8347.	1.9	142.
R-11-075A	126.26	36.0	36.4	0.1582	118.70	112.42	5.2	4.2	12136.	67.92	71.11	3.14	56.75	8176.	8148.	-0.3	138.
R-11-076A	132.93	39.9	40.5	0.1616	126.03	114.02	3.0	2.4	7148.	68.27	73.82	5.48	61.88	8218.	8222.	0.1	127.
R-11-077A	94.54	21.0	21.3	0.0359	83.28	26.39	21.8	17.6	60257.	82.68	82.94	0.20	11.73	1998.	2175.	8.9	163.
R-11-078A	94.90	21.4	21.4	0.0359	83.68	26.38	7.6	6.1	20925.	82.20	82.78	0.56	12.41	1997.	2131.	6.7	154.
R-11-079A	95.27	21.4	21.6	0.0357	83.89	26.21	5.2	4.2	14338.	82.20	83.02	0.79	12.67	1983.	2039.	2.8	150.
R-11-080A	96.43	21.9	22.0	0.0357	84.62	26.20	3.0	2.4	8311.	82.34	83.65	1.28	13.44	1979.	1911.	-3.4	141.

Table C-2 . Experimental data for R-11 condensing on tube B

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT̄, °F	Q _c , Btu/hr	Q _w , Btu/hr	ΔQ Q × 100	U _o , Btu hr·ft ² ·°F
R-11-005B	88.27	19.2	19.0	0.0981	83.50	72.13	22.5	16.4	55678.	75.43	75.98	0.50	12.56	5502.	5612.	2.0	292.
R-11-006B	90.38	19.9	19.7	0.0981	85.35	71.98	7.6	5.5	18834.	75.06	76.58	1.47	14.56	5478.	5588.	2.0	251.
R-11-007B	91.91	20.2	20.3	0.0971	86.98	71.13	5.2	3.8	12966.	75.23	77.36	2.10	15.61	5403.	5437.	0.6	231.
R-11-008B	95.34	21.4	21.6	0.0964	90.12	70.43	3.0	2.2	7611.	75.87	79.44	3.48	17.69	5328.	5202.	-2.4	201.
R-11-009B	87.59	18.7	18.7	0.0496	82.62	36.48	22.5	16.4	60080.	81.60	81.92	0.26	5.83	2785.	2941.	5.6	318.
R-11-010B	87.81	18.9	18.8	0.0492	82.67	36.16	7.6	5.5	20139.	80.73	81.54	0.77	6.67	2760.	2908.	5.3	276.
R-11-011B	88.34	19.0	19.0	0.0490	82.75	36.02	5.2	3.8	13802.	80.71	81.82	1.07	7.07	2748.	2786.	1.4	259.
R-11-012B	89.95	19.5	19.6	0.0485	84.16	35.65	3.0	2.2	8026.	81.00	82.83	1.82	8.04	2714.	2719.	0.2	225.
R-11-013B	95.06	21.2	21.5	0.1395	90.04	101.93	22.5	16.4	55737.	75.41	76.18	0.70	19.27	7713.	7812.	1.3	267.
R-11-014B	98.48	22.5	22.8	0.1394	93.68	101.51	7.6	5.5	19006.	75.48	77.58	2.05	21.95	7650.	7757.	1.4	232.
R-11-015B	100.99	23.7	23.9	0.1390	96.38	100.92	5.2	3.8	13160.	75.96	78.96	2.91	23.52	7582.	7544.	-0.5	215.
R-11-016B	105.37	25.4	25.8	0.1389	100.53	100.46	3.0	2.2	7748.	76.54	81.60	5.06	26.30	7506.	7568.	0.8	190.
R-11-017B	98.45	22.9	22.8	0.1701	94.53	123.78	22.5	16.4	54287.	73.31	74.21	0.85	24.69	9327.	9496.	1.8	252.
R-11-018B	102.74	24.7	24.6	0.1688	98.56	122.37	7.6	5.5	18651.	73.79	76.34	2.48	27.68	9173.	9403.	2.5	221.
R-11-019B	105.73	25.9	25.9	0.1688	101.36	122.05	5.2	3.8	12964.	74.55	78.03	3.42	29.44	9115.	8872.	-2.7	206.
R-11-020B	111.33	28.4	28.5	0.1721	107.05	123.70	3.0	2.2	7629.	74.73	80.95	6.19	33.49	9173.	9258.	0.9	182.
R-11-021B	91.32	19.9	20.1	0.1197	86.35	87.72	22.5	16.4	55381.	74.96	75.63	0.61	16.03	6668.	6813.	2.2	277.
R-11-022B	94.39	21.0	21.2	0.1194	89.50	87.25	7.6	5.5	18883.	75.12	76.93	1.77	18.37	6607.	6703.	1.4	240.
R-11-023B	96.40	21.9	22.0	0.1185	91.40	86.49	5.2	3.8	13038.	75.45	78.01	2.52	19.67	6534.	6527.	-0.1	221.
R-11-024B	100.70	23.7	23.7	0.1185	95.81	86.08	3.0	2.2	7703.	76.44	80.77	4.23	22.10	6468.	6338.	-2.0	195.
R-11-025B	99.64	23.2	23.3	0.1911	95.74	138.90	22.5	16.4	52485.	70.58	71.59	0.95	28.55	10452.	10635.	1.8	244.
R-11-026B	104.14	25.2	25.2	0.1901	100.08	137.60	7.6	5.5	17960.	70.81	73.55	2.72	31.96	10296.	10297.	0.0	215.
R-11-027B	107.50	26.7	26.7	0.1906	103.25	137.53	5.2	3.8	12381.	71.28	74.22	3.91	34.75	10248.	10156.	-0.9	196.
R-11-028B	113.88	29.4	29.8	0.1938	109.54	139.00	3.0	2.2	7403.	72.06	78.92	6.85	38.39	10274.	10249.	-0.2	178.
R-11-029B	90.15	19.7	19.6	0.0789	85.15	57.91	22.5	16.4	59217.	80.35	80.82	0.40	9.56	4408.	4467.	1.4	307.
R-11-030B	91.71	20.2	20.2	0.0789	86.57	57.83	7.6	5.5	20021.	80.07	81.25	1.18	11.05	4394.	4481.	2.0	265.
R-11-031B	92.78	20.7	20.6	0.0786	87.58	57.57	5.2	3.8	13735.	80.03	81.73	1.66	11.91	4368.	4301.	-1.5	244.
R-11-032B	95.52	21.7	21.7	0.0786	90.25	57.43	3.0	2.2	8027.	80.47	83.37	2.86	13.60	4343.	4280.	-1.5	213.
R-11-033B	88.74	19.0	19.1	0.0643	84.03	47.23	22.5	16.4	59603.	80.91	81.31	0.33	7.63	3601.	3760.	4.4	315.
R-11-034B	89.87	19.7	19.5	0.0645	85.40	47.32	7.6	5.5	20099.	80.47	81.48	0.99	8.89	3603.	3742.	3.9	270.
R-11-035B	90.72	19.9	19.8	0.0643	86.03	47.14	5.2	3.8	13787.	80.48	81.88	1.39	9.54	3586.	3603.	0.5	250.
R-11-036B	92.69	20.7	20.6	0.0632	87.65	46.28	3.0	2.2	8016.	80.58	83.03	2.37	10.88	3512.	3542.	0.9	215.
R-11-037B	100.86	23.7	23.8	0.2032	95.84	147.64	22.5	16.4	51962.	69.82	70.86	1.00	30.52	11093.	11197.	0.9	242.
R-11-038B	106.72	26.2	26.4	0.2047	101.87	147.92	7.6	5.5	17923.	70.41	73.39	2.94	34.82	11033.	11176.	1.3	211.
R-11-039B	110.61	27.7	28.2	0.2054	105.82	147.85	5.2	3.8	12508.	71.41	75.65	4.22	37.08	10974.	10942.	-0.3	197.
R-11-040B	117.64	31.4	31.7	0.2087	112.80	149.22	3.0	2.2	7461.	72.43	79.76	7.13	41.55	10976.	10674.	-2.8	176.
R-11-041B	108.54	26.7	27.2	0.2338	103.70	168.62	22.5	16.4	52645.	70.73	71.90	1.12	37.23	12549.	12625.	0.6	225.
R-11-042B	114.30	29.7	30.0	0.2369	110.39	169.78	7.6	5.5	18249.	71.75	75.04	3.30	40.90	12542.	12511.	-0.2	204.
R-11-043B	118.28	31.7	32.0	0.2362	113.97	168.63	5.2	3.8	12767.	72.70	77.50	4.74	43.18	12394.	12296.	-0.8	191.
R-11-044B	125.52	35.5	36.0	0.2393	120.81	169.70	3.0	2.2	7614.	73.74	81.64	8.01	47.83	12354.	11992.	-2.9	172.
R-11-045B	91.14	20.2	20.0	0.0722	85.91	52.92	22.5	16.4	60736.	82.43	82.85	0.36	8.49	4023.	4052.	0.7	316.
R-11-046B	92.27	20.5	20.4	0.0713	87.07	52.24	7.6	5.5	20465.	81.89	83.00	1.06	9.83	3966.	4038.	1.8	269.
R-11-047B	93.20	20.9	20.8	0.0713	87.89	52.20	5.2	3.8	14020.	81.76	83.33	1.54	10.65	3959.	3987.	0.7	248.
R-11-048B	95.32	21.7	21.6	0.0700	89.75	51.17	3.0	2.2	8157.	81.94	84.53	2.58	12.09	3870.	3855.	-0.4	213.

Table C-2 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-11-049B	90.51	19.9	19.8	0.0575	85.34	42.17	22.5	16.4	61667.	83.72	84.07	0.30	6.62	3208.	3322.	3.6	323.
R-11-050B	91.60	20.2	20.2	0.0577	86.36	42.28	7.6	5.5	20808.	83.35	84.27	0.89	7.79	3213.	3374.	5.0	275.
R-11-051B	92.26	20.4	20.4	0.0575	86.71	42.11	5.2	3.8	14248.	83.23	84.51	1.26	8.38	3197.	3271.	2.3	254.
R-11-052B	93.66	21.0	20.9	0.0570	88.08	41.75	3.0	2.2	8244.	83.07	85.17	2.08	9.54	3164.	3113.	-1.6	221.
R-11-053B	88.70	19.2	19.1	0.0876	83.49	64.42	22.5	16.4	57142.	77.49	77.99	0.44	10.96	4912.	4972.	1.2	299.
R-11-054B	90.52	19.7	19.8	0.0872	85.28	64.00	7.6	5.5	19331.	77.19	78.54	1.30	12.66	4870.	4948.	1.6	256.
R-11-055B	92.06	20.4	20.3	0.0870	86.86	63.75	5.2	3.8	13314.	77.43	79.34	1.86	13.67	4841.	4838.	-0.1	236.
R-11-056B	94.77	21.2	21.4	0.0864	89.44	63.14	3.0	2.2	7785.	77.90	81.01	3.05	15.31	4779.	4563.	-4.5	208.
R-11-057B	97.80	22.4	22.6	0.1575	93.66	114.69	22.5	16.4	55553.	75.11	75.95	0.78	22.27	8650.	8710.	0.7	259.
R-11-058B	101.46	23.5	24.1	0.1561	97.01	113.28	7.6	5.5	18982.	75.27	77.59	2.24	25.03	8505.	8508.	0.0	226.
R-11-059B	104.25	24.9	25.3	0.1566	99.70	113.36	5.2	3.8	13170.	75.89	79.15	3.23	26.73	8482.	8379.	-1.2	211.
R-11-060B	110.05	27.4	27.9	0.1566	105.28	112.80	3.0	2.2	7837.	77.15	82.82	5.54	30.07	8378.	8299.	-0.9	186.
R-11-061B	105.25	25.2	25.7	0.2221	100.07	160.74	22.5	16.4	52525.	70.56	71.72	1.09	34.11	12012.	12221.	1.7	235.
R-11-062B	111.30	28.0	28.5	0.2225	106.59	160.03	7.6	5.5	18188.	71.54	74.73	3.16	38.16	11868.	11981.	1.0	207.
R-11-063B	115.36	29.9	30.5	0.2237	110.68	160.26	5.2	3.8	12699.	72.47	76.91	4.49	40.67	11823.	11637.	-1.6	194.
R-11-064B	122.84	34.2	34.5	0.2262	117.73	160.90	3.0	2.2	7607.	73.73	81.50	7.63	45.22	11755.	11425.	-2.8	173.

Table C-3 . Experimental data for R-11 condensing on tube C

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-11-001C	87.64	19.0	18.8	0.0632	85.23	46.38	21.7	20.3	61080.	81.57	81.98	0.34	5.87	3541.	3691.	4.2	540.
R-11-002C	88.50	19.0	19.1	0.0632	86.16	46.34	7.6	7.1	21303.	80.95	81.92	0.96	7.06	3534.	3659.	3.5	448.
R-11-003C	89.24	19.2	19.3	0.0628	86.69	46.01	5.2	4.9	14596.	80.85	82.25	1.38	7.69	3506.	3572.	1.9	408.
R-11-004C	91.41	20.0	20.1	0.0628	88.56	45.93	3.0	2.8	8495.	81.11	83.41	2.30	9.15	3491.	3441.	-1.4	341.
R-11-005C	97.77	22.4	22.5	0.1347	95.55	97.89	21.7	20.3	59554.	79.36	80.11	0.69	18.04	7383.	7448.	0.9	366.
R-11-006C	100.60	23.4	23.7	0.1339	98.04	97.06	7.6	7.1	21005.	79.29	81.30	1.95	20.31	7295.	7386.	1.2	321.
R-11-007C	102.70	24.2	24.6	0.1342	99.83	97.14	5.2	4.9	14510.	79.66	82.47	2.80	21.63	7282.	7266.	-0.2	301.
R-11-008C	107.78	26.4	26.9	0.1346	104.52	97.01	3.0	2.8	8592.	80.86	85.53	4.72	24.59	7226.	7067.	-2.2	263.
R-11-009C	92.53	20.4	20.5	0.0898	89.88	65.60	21.7	20.3	62050.	82.80	83.32	0.47	9.47	4979.	5099.	2.4	470.
R-11-010C	94.11	21.2	21.1	0.0894	91.39	65.21	7.5	7.0	21437.	82.35	83.71	1.35	11.08	4940.	5047.	2.2	399.
R-11-011C	95.33	21.7	21.6	0.0889	92.51	64.82	5.2	4.9	14918.	82.37	84.30	1.89	11.99	4904.	4913.	0.2	366.
R-11-012C	98.29	22.5	22.8	0.0893	94.98	64.96	3.0	2.8	8718.	82.78	86.01	3.20	13.90	4896.	4785.	-2.3	315.
R-11-013C	103.86	24.9	25.1	0.1947	101.56	140.70	21.7	20.3	55332.	73.45	74.49	0.98	29.89	10532.	10620.	0.8	315.
R-11-014C	108.85	26.9	27.4	0.1967	106.24	141.54	7.6	7.1	19701.	73.83	76.65	2.79	33.62	10529.	10563.	0.3	280.
R-11-015C	111.89	28.4	28.8	0.1969	109.16	141.30	5.2	4.9	13664.	74.29	78.30	3.97	35.59	10470.	10293.	-1.7	263.
R-11-016C	117.68	31.2	31.7	0.1981	114.45	141.39	3.0	2.8	8077.	74.87	81.53	6.60	39.48	10399.	9882.	-5.0	236.
R-11-017C	90.48	19.7	19.8	0.0754	87.82	55.20	21.7	20.3	62089.	82.88	83.35	0.40	7.37	4200.	4308.	2.6	510.
R-11-018C	91.88	20.2	20.3	0.0756	89.14	55.25	7.6	7.1	21746.	82.54	83.69	1.14	8.76	4196.	4315.	2.8	428.
R-11-019C	92.96	20.7	20.7	0.0754	90.16	55.05	5.2	4.9	14920.	82.51	84.18	1.63	9.62	4176.	4241.	1.6	388.
R-11-020C	95.35	21.5	21.6	0.0749	92.20	54.62	3.0	2.8	8687.	82.74	85.47	2.70	11.25	4132.	4045.	-2.1	329.
R-11-021C	98.24	22.7	22.7	0.1548	96.10	112.49	21.7	20.3	56926.	75.74	76.58	0.79	22.07	8479.	8509.	0.4	344.
R-11-022C	101.39	23.9	24.0	0.1552	99.03	112.43	7.5	7.0	19742.	75.28	77.58	2.25	24.96	8442.	8437.	-0.1	302.
R-11-023C	103.82	24.9	25.1	0.1548	101.07	111.92	5.2	4.9	13854.	75.75	79.00	3.21	26.85	8378.	8324.	-0.6	283.
R-11-024C	108.76	27.2	27.3	0.1551	105.59	111.66	3.0	2.8	8161.	76.31	81.74	5.31	29.73	8307.	7941.	-4.4	250.
R-11-025C	93.95	21.0	21.1	0.1081	91.12	78.92	21.7	20.3	60591.	80.81	81.43	0.55	12.83	5980.	6008.	0.5	417.
R-11-026C	96.03	21.9	21.9	0.1086	93.23	79.14	7.6	7.1	21246.	80.40	82.04	1.59	14.81	5981.	6032.	0.8	361.
R-11-027C	97.47	22.4	22.4	0.1078	94.53	78.44	5.2	4.9	14591.	80.35	82.70	2.31	15.95	5918.	5992.	1.3	332.
R-11-028C	101.52	23.9	24.1	0.1080	98.27	78.31	3.0	2.8	8575.	81.08	84.98	3.86	18.49	5879.	5775.	-1.8	284.
R-11-029C	100.82	23.5	23.8	0.1717	98.71	124.46	21.7	20.3	56330.	74.88	75.81	0.86	25.47	9351.	9364.	0.1	328.
R-11-030C	105.27	25.5	25.7	0.1717	102.77	123.93	7.6	7.1	20141.	75.73	78.19	2.46	28.31	9261.	9327.	0.7	293.
R-11-031C	107.88	26.7	26.9	0.1712	105.28	123.30	5.2	4.9	13918.	75.95	79.52	3.49	30.15	9183.	9064.	-1.3	272.
R-11-032C	112.16	28.7	28.9	0.1707	109.18	122.46	3.0	2.8	8114.	75.68	81.46	5.81	33.60	9071.	8694.	-4.2	242.
R-11-033C	85.24	17.9	17.9	0.0373	82.85	27.46	21.7	20.3	61375.	82.03	82.30	0.20	3.07	2102.	2187.	4.0	613.
R-11-034C	84.99	17.9	17.8	0.0373	82.70	27.46	7.6	7.1	21235.	80.87	81.48	0.58	3.82	2103.	2214.	5.3	493.
R-11-035C	85.55	18.0	18.0	0.0377	82.92	27.76	5.2	4.9	14549.	80.84	81.72	0.84	4.27	2124.	2174.	2.3	445.
R-11-036C	86.78	18.5	18.5	0.0371	83.56	27.29	3.0	2.8	8440.	81.06	82.42	1.37	5.04	2085.	2050.	-1.7	370.
R-11-041C	86.63	18.4	18.4	0.0494	83.92	36.30	21.7	20.3	61470.	82.13	82.46	0.27	4.33	2775.	2912.	5.0	573.
R-11-042C	87.35	18.7	18.7	0.0502	84.65	36.89	7.6	7.1	21462.	81.65	82.43	0.77	5.31	2817.	2904.	3.1	475.
R-11-043C	87.97	18.9	18.9	0.0498	85.02	36.56	5.2	4.9	14695.	81.54	82.66	1.13	5.87	2790.	2918.	4.6	425.
R-11-044C	89.84	19.4	19.5	0.0496	86.68	36.35	3.0	2.8	8543.	81.78	83.68	1.86	7.11	2768.	2790.	0.8	348.
R-11-045C	88.67	19.2	19.1	0.0589	86.02	43.22	21.7	20.3	62251.	83.14	83.52	0.31	5.34	3296.	3410.	3.5	552.
R-11-046C	89.49	19.5	19.4	0.0596	86.93	43.66	7.6	7.1	21715.	82.53	83.47	0.90	6.49	3326.	3420.	2.8	458.
R-11-047C	90.18	19.7	19.7	0.0587	87.43	43.02	5.2	4.9	14864.	82.37	83.70	1.30	7.15	3274.	3375.	3.1	410.
R-11-048C	91.98	20.4	20.3	0.0581	88.66	42.49	3.0	2.8	8627.	82.44	84.63	2.15	8.45	3227.	3222.	-0.2	342.

Table C-4 . Experimental data for R-11 condensing on tube D

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _C , gpm	T _C , °F	m _C , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _C , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-11-001D	85.40	17.9	18.0	0.0380	82.96	27.93	23.3	14.6	60839.	82.65	82.90	0.19	2.62	2138.	2267.	6.0	729.
R-11-002D	85.87	18.2	18.1	0.0382	83.60	28.07	7.6	4.8	19733.	82.01	82.63	0.59	3.56	2148.	2252.	4.9	540.
R-11-003D	86.06	18.2	18.2	0.0382	83.91	28.06	5.2	3.3	13454.	81.60	82.46	0.85	4.02	2147.	2200.	2.5	477.
R-11-004D	87.51	18.5	18.7	0.0382	84.92	28.04	3.0	1.9	7785.	81.54	82.99	1.42	5.25	2141.	2130.	-0.5	365.
R-11-005D	90.37	19.7	19.7	0.1358	88.76	99.31	23.3	14.6	55600.	75.25	75.94	0.65	14.78	7557.	7579.	0.3	458.
R-11-006D	93.51	20.9	20.9	0.1354	91.63	98.74	7.6	4.8	18184.	74.78	76.82	1.99	17.71	7486.	7552.	0.9	378.
R-11-007D	96.21	21.7	21.9	0.1351	94.14	98.33	5.2	3.3	12599.	75.33	78.24	2.81	19.43	7430.	7302.	-1.7	342.
R-11-008D	101.29	23.7	24.0	0.1353	98.76	98.07	3.0	1.9	7366.	75.41	80.25	4.81	23.46	7364.	7194.	-2.3	281.
R-11-009D	90.68	19.9	19.8	0.0902	88.33	66.01	23.3	14.6	60879.	82.58	83.08	0.43	7.85	5021.	5033.	0.2	572.
R-11-010D	92.55	20.5	20.5	0.0886	89.79	64.73	7.6	4.8	19833.	82.06	83.40	1.36	9.82	4913.	5164.	5.1	447.
R-11-011D	93.95	21.0	21.1	0.0888	90.99	64.79	5.2	3.3	13616.	82.03	83.99	1.91	10.94	4909.	4960.	1.0	401.
R-11-012D	96.60	22.0	22.1	0.0889	93.58	64.74	3.0	1.9	7854.	81.37	84.62	3.22	13.60	4890.	4821.	-1.4	322.
R-11-013D	103.25	24.5	24.8	0.2052	101.19	148.32	23.3	14.6	54964.	74.20	75.21	0.96	28.55	11111.	11147.	0.3	348.
R-11-014D	108.79	27.2	27.3	0.2062	106.43	148.35	7.6	4.8	18197.	74.36	77.35	2.96	32.94	11036.	11207.	1.5	300.
R-11-015D	112.69	28.7	29.2	0.2075	110.10	148.74	5.2	3.3	12670.	75.06	79.38	4.20	35.47	11011.	10908.	-0.9	278.
R-11-016D	120.73	32.9	33.3	0.2093	117.65	148.93	3.0	1.9	7564.	76.42	83.46	6.99	40.79	10911.	10460.	-4.1	239.
R-11-017D	87.29	18.5	18.6	0.0490	84.23	35.98	23.3	14.6	61489.	83.50	83.80	0.25	3.64	2748.	2929.	6.6	676.
R-11-018D	88.21	18.9	19.0	0.0500	85.09	36.72	7.6	4.8	19990.	82.98	83.78	0.76	4.83	2802.	2893.	3.3	519.
R-11-019D	88.97	19.2	19.2	0.0496	86.39	36.36	5.2	3.3	13699.	82.94	84.07	1.12	5.47	2771.	2911.	5.0	454.
R-11-020D	91.15	20.0	20.0	0.0496	88.42	36.29	3.0	1.9	7970.	83.28	85.13	1.84	6.95	2759.	2748.	-0.4	355.
R-11-021D	99.53	22.9	23.3	0.1861	97.68	134.97	23.3	14.6	55064.	74.38	75.31	0.88	24.69	10158.	10205.	0.5	368.
R-11-022D	104.48	25.2	25.4	0.1851	102.30	133.69	7.6	4.8	18232.	74.66	77.35	2.65	28.47	10000.	10036.	0.4	314.
R-11-023D	107.92	26.7	26.9	0.1860	105.54	133.94	5.2	3.3	12641.	75.11	78.98	3.81	30.88	9975.	9891.	-0.8	289.
R-11-024D	114.86	29.9	30.3	0.1871	111.91	133.86	3.0	1.9	7472.	75.69	82.23	6.49	35.90	9881.	9711.	-1.7	246.
R-11-025D	88.77	19.2	19.1	0.0724	86.32	53.06	23.3	14.6	60969.	82.74	83.16	0.37	5.82	4045.	4254.	5.2	622.
R-11-026D	90.26	19.7	19.7	0.0719	87.89	52.67	7.6	4.8	19850.	82.25	83.35	1.09	7.46	4008.	4152.	3.6	480.
R-11-027D	91.39	20.0	20.1	0.0722	89.07	52.76	5.2	3.3	13617.	82.22	83.82	1.57	8.38	4010.	4070.	1.5	428.
R-11-028D	94.17	21.2	21.1	0.0707	91.57	51.55	3.0	1.9	7939.	82.58	85.17	2.58	10.29	3905.	3869.	-0.9	339.
R-11-029D	93.93	21.0	21.0	0.1525	92.26	111.20	23.3	14.6	55724.	75.38	76.16	0.72	18.16	8426.	8427.	0.0	415.
R-11-030D	98.26	22.7	22.7	0.1544	96.48	112.14	7.6	4.8	18352.	75.35	77.69	2.27	21.74	8453.	8595.	1.7	348.
R-11-031D	100.87	23.7	23.8	0.1546	98.75	112.02	5.2	3.3	12678.	75.64	78.91	3.25	23.60	8416.	8431.	0.2	319.
R-11-032D	106.61	26.0	26.3	0.1535	104.08	110.66	3.0	1.9	7464.	76.22	81.53	5.34	27.74	8255.	7990.	-3.2	266.
R-11-033D	85.94	18.2	18.2	0.0598	83.52	43.94	23.3	14.6	59642.	80.98	81.34	0.30	4.78	3361.	3522.	4.8	629.
R-11-034D	87.03	18.7	18.5	0.0596	84.85	43.73	7.6	4.8	19409.	80.50	81.44	0.92	6.06	3341.	3492.	4.5	493.
R-11-035D	88.08	18.9	18.9	0.0600	85.81	44.00	5.2	3.3	13300.	80.40	81.79	1.35	6.99	3358.	3515.	4.7	430.
R-11-036D	90.95	19.9	19.9	0.0598	88.40	43.74	3.0	1.9	7770.	80.98	83.25	2.25	8.83	3327.	3364.	1.1	337.
R-11-037D	87.65	18.7	18.8	0.1152	85.80	84.51	23.3	14.6	55519.	75.17	75.79	0.56	12.17	6452.	6486.	0.5	474.
R-11-038D	90.15	19.7	19.6	0.1136	88.34	83.12	7.6	4.8	18295.	75.41	77.14	1.66	13.88	6327.	6297.	-0.5	408.
R-11-039D	92.97	20.7	20.7	0.1144	90.96	83.47	5.2	3.3	12715.	76.28	78.73	2.43	15.47	6332.	6296.	-0.6	366.
R-11-040D	98.02	22.5	22.6	0.1125	95.47	81.75	3.0	1.9	7516.	77.41	81.45	3.98	18.59	6164.	5950.	-3.5	297.
R-11-041D	92.61	20.5	20.5	0.1043	90.91	76.11	23.3	14.6	60846.	82.51	83.07	0.49	9.82	5776.	5742.	-0.6	526.
R-11-042D	95.17	21.4	21.5	0.1041	93.21	75.80	7.5	4.7	19663.	82.31	83.92	1.56	12.06	5735.	5848.	2.0	425.
R-11-043D	96.88	22.2	22.2	0.1032	94.76	75.08	5.2	3.3	13722.	82.54	84.75	2.18	13.23	5668.	5655.	-0.2	383.
R-11-044D	100.92	23.5	23.8	0.1032	98.28	74.83	3.0	1.9	8051.	83.23	86.86	3.58	15.88	5622.	5365.	-4.6	317.

Table C-4 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-11-045D	97.70	22.2	22.5	0.1707	95.93	124.01	23.3	14.6	55978.	75.69	76.55	0.80	21.58	9354.	9299.	-0.6	388.
R-11-046D	102.48	24.2	24.5	0.1702	100.38	123.16	7.6	4.8	18559.	76.18	78.62	2.44	25.08	9235.	9270.	0.4	329.
R-11-047D	105.74	25.5	25.9	0.1698	103.51	122.45	5.2	3.3	12890.	76.78	80.39	3.54	27.16	9145.	9196.	0.6	301.
R-11-048D	113.12	29.0	29.4	0.1710	110.41	122.57	3.0	1.9	7656.	77.92	83.91	5.97	32.20	9068.	8941.	-1.4	252.

Table C-5 . Experimental data for R-11 condensing on tube D1

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-11-001D1	96.45	21.7	22.0	0.1003	93.16	73.03	23.2	14.5	64280.	87.61	88.13	0.47	8.57	5517.	5466.	-0.9	575.
F-11-002D1	98.84	22.7	23.0	0.1019	95.23	74.09	7.6	4.8	21101.	87.30	88.79	1.51	10.79	5580.	5712.	2.4	463.
F-11-003D1	100.28	23.2	23.6	0.1013	96.53	73.54	5.2	3.3	14488.	87.28	89.41	2.14	11.93	5529.	5532.	0.0	415.
R-11-004D1	103.24	24.5	24.8	0.1009	99.23	73.05	3.0	1.9	8392.	86.91	90.46	3.53	14.55	5472.	5279.	-3.5	336.
F-11-005D1	97.71	22.0	22.5	0.0551	92.53	40.17	23.2	14.5	68873.	93.73	94.02	0.25	3.84	3030.	2947.	-2.8	706.
F-11-006D1	98.41	22.4	22.8	0.0545	92.67	39.70	7.6	4.8	22474.	93.12	93.93	0.81	4.88	2992.	3066.	2.5	548.
R-11-007D1	99.15	22.7	23.1	0.0549	93.37	39.98	5.2	3.3	15382.	92.97	94.14	1.17	5.60	3010.	3043.	1.1	481.
R-11-008D1	100.66	23.2	23.7	0.0549	94.60	39.93	3.0	1.9	8888.	92.73	94.66	1.93	6.97	3001.	2882.	-4.0	385.
F-11-009D1	91.83	19.9	20.3	0.2068	90.14	151.08	23.0	14.4	50353.	68.46	69.47	0.97	22.87	11477.	11113.	-3.2	449.
F-11-010D1	96.84	21.7	22.2	0.2069	94.76	150.47	7.6	4.8	16806.	68.21	71.20	2.98	27.13	11361.	11328.	-0.3	375.
F-11-011D1	100.19	23.0	23.5	0.2063	97.97	149.61	5.2	3.3	11614.	68.30	72.58	4.27	29.75	11250.	11092.	-1.4	336.
F-11-012D1	107.92	26.5	26.9	0.2076	105.10	149.52	3.0	1.9	6821.	68.24	75.33	7.08	36.13	11136.	10613.	-4.7	276.
F-11-013D1	94.73	21.0	21.4	0.1175	91.99	85.72	23.2	14.5	62051.	84.47	85.06	0.55	9.97	6489.	6319.	-2.6	582.
F-11-014D1	97.31	22.0	22.4	0.1189	94.26	86.50	7.6	4.8	20331.	83.90	85.66	1.77	12.53	6528.	6730.	3.1	466.
F-11-015D1	98.86	22.7	23.0	0.1195	95.72	86.84	5.2	3.3	13915.	83.56	86.05	2.51	14.05	6541.	6509.	-0.5	416.
F-11-016D1	102.98	24.4	24.7	0.1196	99.33	86.60	3.0	1.9	8102.	83.48	87.67	4.18	17.40	6490.	6259.	-3.6	334.
F-11-017D1	97.16	21.9	22.3	0.0787	93.03	57.31	23.2	14.5	66960.	91.19	91.59	0.35	5.77	4326.	4090.	-5.4	671.
F-11-018D1	98.80	22.7	23.0	0.0782	94.05	56.95	7.6	4.8	21943.	90.85	91.99	1.13	7.38	4289.	4277.	-0.3	520.
F-11-019D1	100.44	23.4	23.6	0.0791	95.90	57.44	5.2	3.3	15119.	91.19	92.88	1.67	8.40	4318.	4323.	0.1	460.
R-11-020D1	103.00	24.4	24.7	0.0786	97.88	57.03	3.0	1.9	8771.	91.13	93.92	2.77	10.48	4274.	4146.	-3.0	365.
F-11-021D1	96.00	21.7	21.8	0.1422	93.53	103.57	23.2	14.5	60781.	82.71	83.40	0.65	12.95	7828.	7500.	-4.2	541.
F-11-022D1	99.17	23.2	23.1	0.1426	96.46	103.53	7.6	4.8	19957.	82.21	84.27	2.07	15.93	7795.	7844.	0.6	438.
F-11-023D1	101.22	23.8	24.0	0.1426	98.28	103.35	5.2	3.3	13717.	82.13	85.10	2.98	17.60	7762.	7730.	-0.4	394.
R-11-024D1	105.61	25.7	25.9	0.1421	102.18	102.66	3.0	1.9	7977.	81.85	86.71	4.85	21.33	7668.	7263.	-5.3	322.
F-11-025D1	92.97	20.7	20.7	0.1852	91.24	135.11	23.2	14.5	54071.	73.32	74.23	0.88	19.19	10250.	10127.	-1.2	478.
F-11-026D1	97.88	22.3	22.6	0.1862	95.79	135.29	7.6	4.8	17927.	73.36	76.04	2.67	23.19	10202.	10138.	-0.6	394.
F-11-027D1	100.91	23.6	23.8	0.1872	98.62	135.65	5.2	3.3	12359.	73.36	77.21	3.84	25.63	10192.	9974.	-2.1	356.
F-11-028D1	106.75	26.2	26.4	0.1872	103.70	135.00	3.0	1.9	7185.	72.71	79.04	6.31	30.87	10069.	9439.	-6.3	292.
R-11-029D1	93.24	20.3	20.8	0.1702	91.59	124.16	23.2	14.5	55685.	75.63	76.47	0.80	17.19	9415.	9317.	-1.0	490.
F-11-030D1	96.09	21.7	21.9	0.1696	93.93	123.43	7.6	4.8	18119.	76.29	76.76	2.45	20.57	9329.	9304.	-0.3	406.
F-11-031D1	98.33	22.3	22.8	0.1692	95.90	122.93	5.2	3.3	12424.	73.92	77.46	3.53	22.64	9265.	9147.	-1.3	366.
R-11-032D1	104.63	25.1	25.4	0.1710	101.74	123.58	3.0	1.9	7246.	73.50	79.56	6.03	28.10	9242.	9032.	-2.3	294.

Table C-6 . Experimental data for R-11 condensing on tube E

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-11-017E	96.34	21.9	22.0	0.1586	93.50	115.46	22.5	18.1	64062.	84.83	85.69	0.77	11.08	8723.	8688.	-0.4	490.
R-11-018E	99.84	23.2	23.4	0.1577	97.00	114.44	7.6	6.1	21684.	84.30	86.57	2.30	14.40	8610.	8713.	1.2	373.
R-11-019E	102.65	24.4	24.6	0.1576	99.64	114.12	5.2	4.2	14940.	84.53	87.78	3.27	16.49	8555.	8466.	-1.0	323.
R-11-020E	109.25	27.2	27.5	0.1585	105.92	114.05	3.0	2.4	8812.	85.22	90.84	5.63	21.23	8480.	8414.	-0.8	249.
R-11-021E	94.55	21.2	21.3	0.1406	91.25	102.62	22.5	18.1	64076.	84.90	85.66	0.69	9.27	7770.	7711.	-0.8	522.
R-11-022E	97.99	22.4	22.6	0.1406	94.63	102.26	7.6	6.1	21695.	84.44	86.52	2.05	12.51	7710.	7776.	0.9	384.
R-11-023E	100.63	23.4	23.7	0.1405	97.24	101.97	5.2	4.2	14930.	84.60	87.59	3.00	14.53	7664.	7780.	1.5	329.
R-11-024E	106.20	25.9	26.1	0.1406	102.49	101.55	3.0	2.4	8755.	84.98	89.98	4.92	18.72	7579.	7356.	-2.9	252.
R-11-025E	104.66	24.5	25.4	0.2552	100.61	184.58	22.5	18.1	58770.	77.59	78.90	1.24	26.41	13803.	13907.	0.8	326.
R-11-026E	109.48	26.7	27.6	0.2537	105.76	182.59	7.6	6.1	19861.	76.44	80.13	3.64	31.20	13572.	13789.	1.6	271.
R-11-027E	113.38	28.7	29.5	0.2553	109.87	183.01	5.2	4.2	13730.	76.51	81.71	5.16	34.27	13536.	13375.	-1.2	246.
R-11-028E	122.05	33.7	34.1	0.2577	118.94	183.15	3.0	2.4	8059.	76.16	84.83	8.69	41.56	13394.	13010.	-2.9	201.
R-11-029E	90.92	19.9	19.9	0.0900	88.08	65.87	22.5	18.1	64320.	85.34	85.86	0.45	5.32	5009.	5096.	1.7	587.
R-11-030E	92.71	20.5	20.6	0.0894	89.82	65.30	7.6	6.1	21647.	84.61	85.98	1.33	7.42	4955.	5050.	1.9	416.
R-11-031E	94.06	21.0	21.1	0.0898	90.96	65.54	5.2	4.2	14812.	84.33	86.28	1.91	8.76	4965.	4965.	-0.0	353.
R-11-032E	97.61	22.5	22.5	0.0894	94.25	65.03	3.0	2.4	8616.	84.48	87.77	3.21	11.48	4906.	4790.	-2.4	266.
R-11-033E	95.15	21.4	21.5	0.1813	92.86	132.14	22.5	18.1	61505.	81.12	82.69	0.89	13.25	9997.	10035.	0.4	470.
R-11-034E	99.74	23.0	23.3	0.1813	97.41	131.53	7.6	6.1	20872.	80.93	83.64	2.66	17.46	9896.	10081.	1.9	353.
R-11-035E	103.32	24.7	24.9	0.1808	100.74	130.78	5.2	4.2	14479.	81.54	85.28	3.78	19.91	9796.	9795.	-0.0	307.
R-11-036E	110.22	27.7	28.0	0.1819	107.20	130.72	3.0	2.4	8466.	81.32	87.72	6.48	25.70	9707.	9704.	-0.0	235.
R-11-037E	88.74	19.0	19.1	0.0651	85.88	47.74	22.5	18.1	63892.	84.85	85.24	0.34	3.70	3640.	3771.	3.6	613.
R-11-038E	90.00	19.5	19.6	0.0659	87.13	48.29	7.6	6.1	21493.	84.19	85.21	1.00	5.30	3677.	3780.	2.8	432.
R-11-039E	90.76	19.9	19.9	0.0647	87.90	47.34	5.2	4.2	14675.	83.80	85.26	1.43	6.23	3601.	3704.	2.9	360.
R-11-040E	93.41	20.7	20.8	0.0640	90.06	46.78	3.0	2.4	8520.	83.84	86.27	2.41	8.35	3547.	3610.	1.8	265.
R-11-041E	102.07	23.5	24.3	0.2334	98.63	169.16	22.5	18.1	60073.	79.41	80.58	1.14	22.08	12691.	12818.	1.0	358.
R-11-042E	106.34	25.5	26.2	0.2340	103.05	168.87	7.6	6.1	20072.	77.44	80.81	3.38	27.21	12602.	12807.	1.6	289.
R-11-043E	109.88	27.4	27.8	0.2351	107.01	168.99	5.2	4.2	13898.	77.66	82.50	4.83	29.80	12554.	12522.	-0.3	262.
R-11-044E	118.32	31.5	32.0	0.2381	115.19	169.82	3.0	2.4	8205.	77.90	85.99	8.16	36.37	12480.	12220.	-2.1	214.
R-11-045E	87.64	18.7	18.8	0.0512	84.94	37.61	22.5	18.1	63745.	84.69	85.01	0.26	2.79	2871.	2963.	3.2	640.
R-11-046E	89.04	19.2	19.2	0.0523	86.06	38.33	7.5	6.0	21272.	84.53	85.36	0.81	4.10	2922.	3038.	4.0	444.
R-11-047E	89.97	19.5	19.6	0.0521	87.04	38.14	5.2	4.2	14791.	84.60	85.76	1.13	4.79	2904.	2926.	0.8	377.
R-11-048E	92.37	20.4	20.5	0.0516	89.17	37.75	3.0	2.4	8597.	84.83	86.77	1.93	6.57	2866.	2884.	0.6	272.
R-11-049E	91.28	20.0	20.1	0.1141	89.35	83.44	22.5	18.1	63174.	83.79	84.41	0.57	7.18	6343.	6387.	0.7	550.
R-11-050E	94.04	21.2	21.1	0.1136	91.85	82.89	7.6	6.1	21373.	83.39	85.08	1.69	9.80	6280.	6396.	1.9	399.
R-11-051E	95.85	21.9	21.8	0.1123	93.46	81.75	5.2	4.2	14660.	83.21	85.67	2.42	11.41	6180.	6288.	1.7	338.
R-11-052E	100.51	23.7	23.7	0.1122	97.61	81.38	3.0	2.4	8585.	83.68	87.70	4.00	14.82	6117.	5982.	-2.2	257.
R-11-053E	89.60	19.5	19.4	0.0793	86.84	58.11	22.5	18.1	63866.	84.78	85.23	0.39	4.59	4426.	4378.	-1.1	600.
R-11-054E	91.44	20.0	20.1	0.0791	88.91	57.84	7.6	6.1	21574.	84.42	85.61	1.18	6.43	4396.	4489.	2.1	426.
R-11-055E	92.84	20.5	20.6	0.0784	90.11	57.31	5.2	4.2	14816.	84.48	86.16	1.67	7.52	4348.	4327.	-0.5	360.
R-11-056E	96.19	21.9	21.9	0.0778	93.31	56.68	3.0	2.4	8632.	84.90	87.65	2.74	9.91	4283.	4102.	-4.2	269.
R-11-057E	99.13	22.5	23.1	0.2217	96.39	160.98	22.5	18.1	59669.	78.88	80.03	1.07	19.67	12121.	12033.	-0.7	384.
R-11-058E	104.40	24.9	25.3	0.2198	101.70	158.84	7.6	6.1	20372.	78.70	81.93	3.17	24.09	11882.	12026.	1.2	367.
R-11-059E	108.49	26.9	27.2	0.2198	105.89	158.19	5.2	4.2	14177.	79.39	83.98	4.55	26.81	11773.	11793.	0.2	274.
R-11-060E	118.62	31.7	32.2	0.2312	115.57	164.83	3.0	2.4	8424.	80.17	88.05	7.77	34.51	12108.	11625.	-4.0	219.

Table C-6 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-11-061E	92.63	20.5	20.6	0.1286	90.64	93.91	22.5	18.1	63340.	83.97	84.67	0.63	8.31	7127.	7071.	-0.8	535.
R-11-062E	96.11	21.9	21.9	0.1274	93.73	92.73	7.6	6.1	21544.	83.93	85.87	1.88	11.21	7008.	7128.	1.7	390.
R-11-063E	98.96	22.9	23.0	0.1288	96.58	93.56	5.2	4.2	14898.	84.41	87.16	2.76	13.17	7046.	7149.	1.5	333.
R-11-064E	104.56	25.2	25.4	0.1275	101.62	92.15	3.0	2.4	8770.	85.35	89.90	4.57	16.93	6892.	6822.	-1.0	254.
R-11-065E	95.01	21.4	21.5	0.1913	92.56	139.40	22.5	18.1	60438.	79.99	80.98	0.93	14.52	10549.	10439.	-1.0	453.
R-11-066E	99.28	22.9	23.2	0.1915	96.82	139.01	7.6	6.1	20337.	78.76	81.60	2.79	19.10	10465.	10563.	0.9	341.
R-11-067E	102.33	24.2	24.4	0.1919	99.73	138.92	5.2	4.2	13945.	78.32	82.39	4.01	21.98	10419.	10402.	-0.2	295.
R-11-068E	109.09	27.2	27.5	0.1920	106.26	138.12	3.0	2.4	8157.	78.21	84.72	6.49	27.62	10271.	9717.	-5.4	232.

Table C-7. Experimental data for R-11 condensing on tube F

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-11-001F	94.98	21.5	21.4	0.1018	92.72	74.18	23.0	16.8	63219.	83.87	84.40	0.49	10.85	5613.	5588.	-0.5	498.
R-11-002F	97.48	22.2	22.4	0.1022	94.67	74.32	7.5	5.5	20656.	83.54	85.06	1.50	13.18	5607.	5620.	0.2	410.
R-11-003F	99.81	23.2	23.4	0.1029	96.72	74.73	5.0	3.6	13859.	83.71	85.95	2.23	14.98	5622.	5570.	-0.9	362.
R-11-004F	103.55	24.9	25.0	0.1040	100.07	75.30	3.0	2.2	8373.	83.58	87.24	3.65	18.13	5639.	5458.	-3.2	300.
R-11-009F	98.25	22.4	22.7	0.0553	94.37	40.24	23.0	16.8	70745.	93.78	94.07	0.25	4.32	3033.	2921.	-3.7	676.
R-11-010F	99.29	22.9	23.2	0.0547	95.17	39.75	7.6	5.5	23338.	93.38	94.18	0.80	5.51	2992.	3021.	0.9	523.
R-11-011F	100.24	23.2	23.6	0.0547	95.79	39.72	5.2	3.8	15996.	93.35	94.52	1.17	6.30	2987.	3030.	1.4	456.
R-11-012F	101.95	24.0	24.3	0.0547	97.13	39.67	3.0	2.2	9240.	93.09	95.00	1.91	7.91	2977.	2855.	-4.1	363.
R-11-013F	96.63	21.7	22.1	0.0728	92.82	53.02	23.0	16.8	67844.	90.06	90.44	0.34	6.38	4004.	3872.	-3.3	605.
R-11-014F	97.90	22.2	22.6	0.0725	93.84	52.81	7.6	5.5	22318.	89.33	90.40	1.05	8.04	3983.	3971.	-0.3	477.
R-11-015F	98.92	22.7	23.0	0.0725	94.48	52.78	5.2	3.8	15265.	89.07	90.61	1.53	9.08	3975.	3952.	-0.6	422.
R-11-016F	101.14	23.5	23.9	0.0725	96.65	52.67	3.0	2.2	8811.	88.62	91.13	2.50	11.26	3956.	3732.	-5.7	338.
R-11-017F	92.79	20.2	20.6	0.1750	90.69	127.78	22.8	16.6	48536.	63.99	64.86	0.86	28.37	9696.	9820.	1.3	329.
R-11-018F	98.54	22.4	22.9	0.1762	95.81	128.04	7.5	5.5	16365.	64.91	67.46	2.54	32.36	9647.	9534.	-1.2	287.
R-11-019F	101.70	23.7	24.2	0.1777	98.95	128.72	5.2	3.8	11392.	64.66	68.29	3.63	35.22	9661.	9429.	-2.4	264.
R-11-020F	108.75	26.9	27.3	0.1804	105.20	129.94	3.0	2.2	6694.	64.73	70.89	6.16	40.94	9667.	9229.	-4.5	228.
R-11-021F	96.75	21.7	22.1	0.0924	93.39	67.29	23.0	16.8	65789.	87.37	87.86	0.44	9.13	5082.	5017.	-1.3	536.
R-11-022F	98.94	21.5	23.0	0.0924	95.07	67.19	7.6	5.5	21760.	87.01	88.38	1.37	11.24	5060.	5201.	2.8	434.
R-11-023F	100.70	23.2	23.7	0.0930	96.76	67.54	5.2	3.8	14951.	87.06	89.04	2.00	12.65	5075.	5172.	1.9	386.
R-11-024F	103.85	24.7	25.1	0.0924	99.49	66.91	3.0	2.2	8678.	86.96	90.19	3.21	15.28	5008.	4804.	-4.1	316.
R-11-025F	93.76	20.7	21.0	0.1290	91.26	94.11	23.0	16.8	57505.	76.18	76.84	0.62	17.25	7133.	7125.	-0.1	398.
R-11-026F	96.91	21.9	22.2	0.1289	93.93	93.84	7.6	5.5	19113.	76.02	77.91	1.88	19.95	7085.	7116.	0.4	342.
R-11-027F	98.92	22.7	23.0	0.1283	95.83	93.22	5.2	3.8	13118.	75.86	78.57	2.69	21.70	7021.	6970.	-0.7	312.
R-11-028F	103.50	24.7	24.9	0.1285	99.93	92.98	3.0	2.2	7658.	75.91	80.37	4.44	25.36	6963.	6639.	-4.7	264.
R-11-029F	96.86	21.9	22.2	0.1900	94.56	138.25	22.8	16.6	49175.	64.89	65.82	0.92	31.50	10438.	10538.	1.0	319.
R-11-030F	102.59	24.2	24.5	0.1914	99.77	138.56	7.6	5.5	16740.	65.51	68.22	2.71	35.73	10389.	10299.	-0.9	280.
R-11-031F	106.28	25.9	26.2	0.1935	103.17	139.64	5.2	3.8	11562.	65.59	69.51	3.93	38.73	10421.	10214.	-2.0	259.
R-11-032F	113.75	29.7	29.7	0.1958	110.28	140.30	3.0	2.2	6810.	65.78	72.35	6.57	44.68	10372.	9856.	-5.0	224.
R-11-033F	93.88	20.7	21.0	0.1137	90.43	83.02	23.0	16.8	60362.	80.06	80.65	0.55	13.53	6291.	6276.	-0.2	448.
R-11-034F	96.19	21.7	21.9	0.1128	91.97	82.29	7.6	5.5	19960.	79.59	81.24	1.64	15.77	6219.	6203.	-0.3	380.
R-11-035F	98.76	22.7	22.9	0.1136	95.16	82.60	5.2	3.8	13784.	79.96	82.36	2.38	17.60	6222.	6184.	-0.6	341.
R-11-036F	103.39	24.7	24.9	0.1154	99.51	83.60	3.0	2.2	8039.	80.04	84.05	4.00	21.35	6261.	5989.	-4.3	283.
R-11-037F	93.66	20.7	20.9	0.1542	91.41	112.52	22.8	16.6	52602.	69.88	70.65	0.74	23.39	8529.	8385.	-1.7	351.
R-11-038F	97.75	22.2	22.5	0.1546	94.81	112.42	7.6	5.5	17703.	69.87	72.08	2.21	26.77	8479.	8377.	-1.2	305.
R-11-039F	100.89	23.5	23.8	0.1551	97.86	112.51	5.2	3.8	12229.	70.07	73.31	3.23	29.20	8453.	8392.	-0.7	279.
R-11-040F	106.12	25.7	26.1	0.1556	102.83	112.31	3.0	2.2	7129.	69.98	75.23	5.24	33.51	8383.	7847.	-6.4	241.
R-11-041F	97.81	22.2	22.6	0.0633	93.68	46.10	23.0	16.8	69644.	92.37	92.70	0.29	5.27	3477.	3276.	-5.8	636.
R-11-042F	98.48	22.4	22.8	0.0629	93.54	45.79	7.6	5.5	22807.	91.29	92.21	0.91	6.73	3451.	3433.	-0.5	494.
R-11-043F	99.31	22.7	23.2	0.0625	94.14	45.46	5.2	3.8	15594.	91.01	92.36	1.34	7.62	3422.	3465.	1.3	433.
R-11-044F	101.26	23.7	24.0	0.0629	96.16	45.68	3.0	2.2	9005.	90.67	92.88	2.19	9.49	3431.	3272.	-4.6	348.
R-11-045F	98.58	22.9	22.9	0.0445	93.51	32.39	23.0	16.8	71761.	95.07	95.33	0.22	3.38	2440.	2474.	1.4	695.
R-11-046F	99.19	23.0	23.1	0.0447	93.74	32.54	7.6	5.5	23587.	94.39	95.05	0.66	4.47	2450.	2494.	1.8	528.
R-11-047F	98.88	23.0	23.0	0.0436	92.77	31.79	5.2	3.8	15984.	93.40	94.34	0.94	5.01	2394.	2435.	1.7	461.
R-11-048F	99.93	23.4	23.4	0.0436	92.77	31.79	3.0	2.2	9206.	92.95	94.48	1.53	6.22	2391.	2285.	-4.4	371.

Table C-8 . Experimental data for R-11 condensing on tube F1

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-11-001F1	98.17	22.5	22.7	0.0528	93.32	38.47	23.2	16.9	71864.	94.41	94.70	0.24	3.62	2900.	2831.	-2.4	772.
R-11-002F1	99.53	23.0	23.3	0.0524	94.25	38.12	7.6	5.5	23587.	94.34	95.11	0.77	4.81	2869.	2903.	1.2	575.
R-11-003F1	100.64	23.5	23.7	0.0526	95.08	38.25	5.2	3.8	16202.	94.52	95.64	1.12	5.57	2875.	2890.	0.5	498.
R-11-004F1	102.46	24.2	24.5	0.0526	96.33	38.21	3.0	2.2	9374.	94.41	96.24	1.83	7.14	2865.	2734.	-4.6	387.
R-11-005F1	97.29	21.7	22.4	0.0747	93.53	54.38	23.2	16.9	69488.	91.39	91.78	0.34	5.71	4104.	3929.	-4.3	692.
R-11-006F1	98.58	22.2	22.9	0.0742	94.48	54.02	7.6	5.5	22670.	90.69	91.76	1.06	7.36	4070.	4005.	-1.6	533.
R-11-007F1	99.65	22.7	23.3	0.0742	95.36	53.97	5.2	3.8	15509.	90.45	91.98	1.52	8.44	4061.	3931.	-3.2	464.
R-11-008F1	102.31	23.9	24.4	0.0745	97.67	54.01	3.0	2.2	8969.	90.13	92.72	2.58	10.89	4051.	3859.	-4.7	358.
R-11-009F1	93.40	20.4	20.8	0.1881	91.69	137.21	23.0	16.8	52218.	88.60	89.54	0.90	24.32	10404.	10401.	-0.0	412.
R-11-010F1	98.72	22.5	22.9	0.1876	96.59	136.21	7.4	5.4	16992.	88.53	71.29	2.76	28.81	10261.	10190.	-0.7	343.
R-11-011F1	101.91	23.7	24.3	0.1885	99.37	136.54	5.2	3.8	12022.	88.47	72.36	3.88	31.49	10246.	10084.	-1.6	313.
R-11-012F1	109.42	27.4	27.6	0.1921	106.84	138.13	3.0	2.2	7045.	88.31	74.85	6.53	37.84	10268.	9782.	-4.7	261.
R-11-013F1	97.25	22.0	22.3	0.0939	93.93	68.36	23.2	16.9	67578.	88.93	89.41	0.43	8.09	5159.	5003.	-3.0	614.
R-11-014F1	99.17	22.7	23.1	0.0933	95.61	67.79	7.6	5.5	22057.	88.16	89.55	1.38	10.32	5104.	5212.	2.1	476.
R-11-015F1	100.48	23.2	23.7	0.0939	96.59	68.19	5.2	3.8	15089.	87.84	89.83	1.99	11.64	5126.	5133.	0.1	424.
R-11-016F1	103.76	24.7	25.1	0.0943	99.53	68.28	3.0	2.2	8740.	87.54	90.83	3.28	14.58	5112.	4907.	-4.0	338.
R-11-017F1	94.18	20.9	21.1	0.1678	92.33	122.33	23.0	16.8	55869.	73.86	74.69	0.80	19.91	5267.	5179.	-0.9	446.
R-11-018F1	98.95	22.7	23.0	0.1688	96.63	122.54	7.6	5.5	18589.	73.60	76.01	2.39	24.15	9228.	9077.	-1.6	368.
R-11-019F1	102.12	24.0	24.3	0.1697	99.57	122.90	5.2	3.8	12809.	73.62	77.08	3.45	26.77	9220.	8947.	-3.0	332.
R-11-020F1	108.21	26.7	27.1	0.1699	105.06	122.34	3.0	2.2	7475.	73.39	79.10	5.69	31.96	9108.	8522.	-6.4	275.
R-11-021F1	96.60	22.0	22.1	0.1141	94.16	83.01	23.2	16.9	65367.	86.05	86.63	0.53	10.26	6270.	6170.	-1.6	565.
R-11-022F1	99.39	23.2	23.2	0.1132	96.38	82.23	7.6	5.5	21466.	85.71	87.37	1.67	12.85	6190.	6318.	2.1	464.
R-11-023F1	101.64	24.2	24.1	0.1132	98.46	82.04	5.2	3.8	14801.	86.02	88.38	2.37	14.44	6158.	6141.	-0.3	411.
R-11-024F1	105.84	25.9	26.0	0.1132	101.99	81.80	3.0	2.2	8610.	85.93	89.87	3.92	17.94	6108.	5856.	-4.1	326.
R-11-025F1	95.53	21.4	21.7	0.1322	93.16	96.30	23.2	16.9	62681.	82.39	83.05	0.62	12.81	7283.	7210.	-1.0	548.
R-11-026F1	98.76	22.7	22.9	0.1316	96.01	95.58	7.6	5.5	20609.	82.07	83.96	1.88	15.74	7200.	7132.	-1.0	441.
R-11-027F1	101.20	23.7	24.0	0.1328	98.26	96.25	5.2	3.8	14142.	81.89	84.63	2.74	17.94	7229.	7103.	-1.7	368.
R-11-028F1	105.72	25.7	25.9	0.1330	102.38	96.01	3.0	2.2	8193.	81.30	85.91	4.60	22.12	7170.	6889.	-3.9	312.
R-11-029F1	94.38	20.7	21.2	0.1526	92.31	111.26	23.0	16.8	58416.	77.37	78.12	0.71	16.63	8426.	8135.	-3.5	488.
R-11-030F1	98.31	22.4	22.8	0.1531	95.63	111.29	7.6	5.5	19369.	76.92	79.12	2.19	20.29	8388.	8284.	-1.2	398.
R-11-031F1	101.41	23.7	24.0	0.1521	98.65	110.19	5.2	3.8	13341.	76.93	80.15	3.21	22.87	8274.	8324.	0.6	349.
R-11-032F1	107.10	26.2	26.5	0.1550	103.85	111.75	3.0	2.2	7767.	76.62	81.92	5.28	27.83	8331.	7905.	-5.1	286.

Table C-9. Experimental data for R-11 condensing on tube F3

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{Q_c}{Q_w} \times 100$	U _o , Btu hr·ft ² ·°F
R-11-001F3	98.23	22.2	22.7	0.0937	94.07	68.17	23.2	16.9	69278.	91.08	91.56	0.44	6.91	5138.	5038.	-2.0	716.
R-11-002F3	100.28	23.2	23.6	0.0939	95.78	68.21	7.6	5.5	22679.	90.57	91.94	1.35	9.02	5129.	5129.	0.0	546.
R-11-003F3	101.91	23.9	24.3	0.0943	97.21	68.40	5.2	3.8	15568.	90.56	92.53	1.96	10.37	5133.	5081.	-1.0	477.
R-11-004F3	104.92	25.2	25.6	0.0944	98.67	68.37	3.0	2.2	9022.	90.32	93.55	3.22	12.99	5111.	4810.	-5.9	379.
R-11-005F3	98.35	22.4	22.8	0.0540	92.77	39.39	23.2	16.9	72094.	94.69	94.98	0.25	3.51	2968.	2866.	-3.5	815.
R-11-006F3	99.51	22.9	23.3	0.0545	93.68	39.66	7.6	5.5	23592.	94.34	95.14	0.80	4.77	2985.	3040.	1.8	803.
R-11-007F3	100.30	23.2	23.6	0.0540	94.32	39.33	5.2	3.8	16152.	94.22	95.38	1.16	5.50	2957.	3009.	1.8	818.
R-11-008F3	102.04	24.0	24.3	0.0547	96.01	39.73	3.0	2.2	9324.	93.88	95.82	1.93	7.19	2981.	2888.	-3.1	400.
R-11-009F3	92.35	20.2	20.4	0.1797	90.14	131.27	23.2	16.9	56853.	74.51	75.40	0.85	17.40	9965.	9861.	-1.0	852.
R-11-010F3	96.60	21.7	22.1	0.1792	93.65	130.50	7.6	5.5	18672.	73.85	76.46	2.60	21.44	9856.	9842.	-0.1	443.
R-11-011F3	99.71	23.2	23.3	0.1797	96.70	130.48	5.2	3.8	12852.	73.75	77.47	3.71	24.10	9817.	9621.	-2.0	392.
R-11-012F3	106.61	26.0	26.3	0.1810	103.15	130.59	3.0	2.2	7514.	73.53	79.77	6.23	29.96	9742.	9318.	-4.4	313.
R-11-013F3	97.46	22.0	22.4	0.0726	92.72	52.88	23.2	16.9	70189.	92.27	92.65	0.33	5.00	3990.	3871.	-3.0	769.
R-11-014F3	99.17	22.7	23.1	0.0724	94.02	52.67	7.6	5.5	23029.	92.07	93.13	1.05	6.57	3966.	3971.	0.1	802.
R-11-015F3	100.56	23.2	23.7	0.0726	95.25	52.76	5.2	3.8	15820.	92.19	93.72	1.52	7.61	3965.	3942.	-0.6	802.
R-11-017F3	96.19	21.4	21.9	0.1297	91.76	94.64	23.2	16.9	64549.	84.82	85.47	0.61	11.04	7151.	7071.	-1.1	624.
R-11-018F3	99.39	22.7	23.2	0.1301	94.81	94.64	7.6	5.5	21221.	84.50	86.39	1.91	13.95	7123.	7230.	1.5	492.
R-11-019F3	101.30	23.4	24.0	0.1293	96.57	93.88	5.2	3.8	14563.	84.34	87.04	2.71	15.61	7050.	7035.	-0.2	435.
R-11-020F3	105.70	25.5	25.9	0.1301	100.56	94.10	3.0	2.2	8433.	83.90	88.39	4.48	19.55	7027.	6688.	-4.8	346.
R-11-021F3	95.57	21.2	21.8	0.1122	92.63	81.79	23.2	16.9	66045.	86.93	87.49	0.52	8.76	6182.	6020.	-2.6	680.
R-11-022F3	98.52	22.2	22.8	0.1120	94.40	81.50	7.6	5.5	21647.	86.44	88.07	1.64	11.27	6141.	6215.	1.2	525.
R-11-023F3	100.40	23.0	23.6	0.1120	96.25	81.36	5.2	3.8	14861.	86.37	88.72	2.36	12.86	6117.	6117.	0.0	458.
R-11-024F3	103.90	24.7	25.1	0.1120	99.29	81.13	3.0	2.2	8603.	85.90	89.75	3.84	16.07	6073.	5732.	-5.6	364.
R-11-025F3	93.87	20.9	21.0	0.1570	91.54	114.57	23.2	16.9	60658.	75.67	80.44	0.74	13.81	8682.	8588.	-1.1	606.
R-11-026F3	98.00	22.4	22.6	0.1568	95.17	114.03	7.6	5.5	20007.	79.47	81.74	2.26	17.40	8598.	8553.	-0.5	476.
R-11-027F3	100.81	23.5	23.8	0.1580	97.71	114.58	5.2	3.8	13781.	79.52	82.77	3.25	19.66	8609.	8423.	-2.2	422.
R-11-028F3	106.33	26.0	26.2	0.1583	102.80	114.27	3.0	2.2	8025.	79.21	84.59	5.38	24.42	8528.	8049.	-5.6	336.
R-11-029F3	91.82	20.1	20.2	0.2134	89.85	155.93	23.0	16.8	52835.	69.41	70.47	1.02	21.87	11845.	11734.	-0.9	522.
R-11-030F3	97.86	22.4	22.6	0.2149	95.30	156.22	7.6	5.5	17703.	69.44	72.51	3.06	26.89	11781.	11616.	-1.4	422.
R-11-031F3	102.19	24.2	24.4	0.2172	99.59	157.25	5.2	3.8	12247.	69.58	74.04	4.45	30.38	11796.	11557.	-2.0	374.
R-11-032F3	110.22	27.9	28.0	0.2180	107.01	156.75	3.0	2.2	7166.	69.29	76.70	7.40	37.23	11640.	11076.	-4.8	301.

Table C-10. Experimental data for R-11 condensing on tube F7

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT̄, °F	Q _c , Btu/hr	Q _w , Btu/hr	ΔQ Q × 100	U _o , Btu hr·ft ² ·°F
R-11-005F7	95.73	21.2	21.7	0.0949	92.51	69.18	23.2	16.9	67400.	88.70	89.18	0.44	6.79	5231.	5142.	-1.7	742.
R-11-006F7	97.77	22.2	22.5	0.0947	93.81	68.95	7.6	5.5	22043.	88.10	89.50	1.39	8.97	5200.	5262.	1.2	555.
R-11-007F7	99.33	22.7	23.2	0.0949	95.21	69.01	5.2	3.8	15113.	87.96	89.99	2.02	10.35	5195.	5232.	0.7	483.
R-11-008F7	102.53	24.2	24.5	0.0970	97.92	70.33	3.0	2.2	8737.	87.46	90.85	3.38	13.37	5274.	5043.	-4.4	380.
R-11-009F7	98.70	22.4	22.9	0.0545	93.44	39.67	23.2	16.9	72604.	95.32	95.62	0.25	3.23	2989.	2947.	-1.4	892.
R-11-010F7	99.19	22.7	23.1	0.0545	93.95	39.66	7.6	5.5	23571.	94.25	95.07	0.82	4.53	2986.	3100.	3.8	635.
R-11-011F7	99.43	22.9	23.2	0.0545	94.23	39.64	5.2	3.8	16029.	93.54	94.70	1.16	5.32	2984.	2999.	0.5	541.
R-11-012F7	100.70	23.2	23.7	0.0545	95.07	39.61	3.0	2.2	9216.	92.85	94.79	1.93	6.89	2977.	2891.	-2.9	416.
R-11-013F7	93.28	20.4	20.8	0.1899	90.75	138.63	23.0	16.8	57111.	75.50	76.44	0.90	17.30	10513.	10384.	-1.2	585.
R-11-014F7	98.37	22.2	22.8	0.1913	95.37	139.04	7.6	5.5	19025.	75.22	77.99	2.75	21.76	10479.	10415.	-0.6	464.
R-11-015F7	101.18	23.5	23.9	0.1913	98.09	138.68	5.2	3.8	13075.	75.01	78.89	3.87	24.23	10416.	10031.	-3.7	414.
R-11-016F7	108.40	26.7	27.1	0.1925	105.06	138.65	3.0	2.2	7646.	74.74	81.29	6.53	30.39	10320.	9776.	-5.3	327.
R-11-017F7	97.67	22.0	22.5	0.0726	93.04	52.87	23.2	16.9	70804.	93.04	93.43	0.35	4.44	3988.	3998.	0.3	865.
R-11-018F7	99.27	22.7	23.2	0.0726	94.37	52.80	7.6	5.5	23218.	92.80	93.85	1.04	5.95	3975.	3922.	-1.3	644.
R-11-019F7	100.58	23.4	23.7	0.0740	95.74	53.78	5.2	3.8	15908.	92.68	94.22	1.52	7.13	4042.	3947.	-2.4	546.
R-11-020F7	101.81	23.9	24.2	0.0748	97.17	54.30	3.0	2.2	9065.	91.06	93.65	2.58	9.45	4075.	3852.	-5.5	416.
R-11-021F7	94.13	20.7	21.1	0.1689	91.37	123.23	23.0	16.8	59767.	79.15	79.98	0.79	14.57	9335.	9087.	-2.7	617.
R-11-022F7	98.06	22.4	22.7	0.1694	94.96	123.22	7.6	5.5	19778.	78.44	80.92	2.46	18.38	9290.	9331.	0.4	487.
R-11-023F7	101.10	23.5	23.9	0.1716	97.84	124.44	5.2	3.8	13605.	78.33	81.88	3.54	20.99	9347.	9175.	-1.8	429.
R-11-024F7	107.10	26.2	26.5	0.1728	103.54	124.66	3.0	2.2	7930.	78.00	83.87	5.86	26.17	9294.	8773.	-5.6	342.
R-11-025F7	96.06	21.5	21.9	0.1326	93.09	96.60	23.2	16.9	64959.	85.34	86.01	0.62	10.38	7301.	7199.	-1.4	677.
R-11-026F7	99.15	22.7	23.1	0.1328	95.83	96.47	7.6	5.5	21288.	84.73	86.68	1.96	13.44	7264.	7446.	2.5	521.
R-11-027F7	101.70	24.0	24.2	0.1341	98.19	97.21	5.2	3.8	14635.	84.83	87.66	2.84	15.46	7297.	7353.	0.8	455.
R-11-028F7	106.63	25.9	26.3	0.1357	102.93	97.95	3.0	2.2	8556.	85.09	89.64	4.54	19.26	7307.	6784.	-7.2	365.
R-11-029F7	96.02	21.5	21.9	0.1149	92.85	83.69	23.2	16.9	66121.	87.01	87.60	0.54	8.72	6325.	6217.	-1.7	699.
R-11-030F7	98.29	22.4	22.8	0.1150	95.14	83.64	7.6	5.5	21551.	86.03	87.72	1.70	11.41	6304.	6431.	2.0	532.
R-11-031F7	100.68	23.2	23.7	0.1144	97.06	83.03	5.2	3.8	14919.	86.66	89.08	2.43	12.82	6240.	6288.	0.8	469.
R-11-032F7	104.21	25.0	25.2	0.1147	99.65	83.07	3.0	2.2	8630.	86.10	90.09	3.97	16.11	6216.	5930.	-4.6	372.
R-11-033F7	94.29	20.9	21.2	0.1526	91.82	111.31	23.0	16.8	61281.	81.20	81.96	0.73	12.71	8431.	8364.	-0.8	639.
R-11-034F7	97.88	22.2	22.6	0.1531	95.17	111.33	7.6	5.5	20274.	80.57	82.79	2.20	16.21	8396.	8360.	-0.4	499.
R-11-035F7	100.26	23.4	23.6	0.1541	97.34	111.82	5.2	3.8	13895.	80.20	83.43	3.21	18.44	8408.	8335.	-0.9	439.
R-11-036F7	105.86	25.7	26.0	0.1561	102.50	112.71	3.0	2.2	8082.	79.79	85.17	5.38	23.38	8416.	8049.	-4.4	347.
R-11-037F7	98.15	22.4	22.7	0.0736	94.28	53.56	23.2	16.9	71088.	93.40	93.78	0.33	4.57	4038.	3848.	-4.7	852.
R-11-038F7	99.29	22.9	23.2	0.0740	95.23	53.83	7.6	5.5	23148.	92.51	93.60	1.08	6.24	4052.	4084.	0.8	626.
R-11-039F7	99.91	23.2	23.4	0.0736	95.87	53.48	5.2	3.8	15761.	91.84	93.41	1.56	7.29	4023.	4038.	0.4	532.
R-11-040F7	101.66	23.9	24.2	0.0740	97.32	53.72	3.0	2.2	9053.	90.93	93.55	2.60	9.42	4032.	3891.	-3.5	412.
R-11-041F7	91.85	19.9	20.3	0.2126	89.47	155.39	23.0	16.8	53661.	70.57	71.63	1.03	20.75	11804.	11837.	0.3	548.
R-11-042F7	97.56	22.0	22.5	0.2145	94.69	156.02	7.6	5.5	17869.	70.13	73.22	3.08	25.88	11770.	11689.	-0.7	438.
R-11-043F7	101.35	23.7	24.0	0.2156	98.38	156.25	5.2	3.8	12311.	70.10	74.54	4.43	29.02	11733.	11484.	-2.1	389.
R-11-044F7	110.30	27.7	28.0	0.2186	106.91	157.18	3.0	2.2	7242.	70.03	77.57	7.53	36.50	11671.	11275.	-3.4	308.

Table C-11. Experimental data for R-11 condensing on tube G

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT̄, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
E-11-005G	99.21	22.9	23.1	0.0533	93.96	38.80	24.0	13.1	69057.	93.99	94.27	0.24	5.08	2921.	2869.	-1.8	468.
E-11-006G	100.21	23.2	23.5	0.0533	94.81	38.77	7.6	4.1	21770.	93.33	94.13	0.80	6.49	2915.	3017.	3.5	366.
E-11-007G	100.81	23.5	23.8	0.0525	95.36	38.13	5.2	2.8	14875.	93.05	94.16	1.11	7.20	2865.	2867.	0.1	324.
E-11-008G	102.55	24.2	24.5	0.0525	96.51	38.09	3.0	1.6	8584.	92.70	94.57	1.87	8.92	2856.	2800.	-2.0	261.
E-11-009G	97.01	21.9	22.2	0.0652	92.99	47.49	23.8	13.0	65695.	90.32	90.64	0.28	6.53	3585.	3284.	-8.4	447.
E-11-010G	98.58	22.7	22.9	0.0654	93.98	47.59	7.6	4.1	20958.	89.90	90.88	0.97	8.19	3586.	3668.	2.3	357.
E-11-011G	99.81	23.2	23.4	0.0658	94.96	47.86	5.2	2.8	14367.	89.87	91.24	1.36	9.25	3601.	3527.	-2.0	317.
E-11-012G	102.21	24.2	24.4	0.0656	97.19	47.61	3.0	1.6	8301.	89.52	91.86	2.32	11.52	3571.	3472.	-2.8	253.
E-11-013G	88.87	18.9	19.2	0.1785	87.34	130.71	23.8	13.0	45753.	61.68	62.54	0.85	26.76	9965.	10096.	1.3	303.
E-11-014G	95.15	21.2	21.5	0.1789	92.92	130.35	7.5	4.1	14659.	61.96	64.58	2.62	31.88	9863.	9815.	-0.5	252.
E-11-015G	98.99	22.7	23.0	0.1804	96.46	131.02	5.2	2.8	10246.	61.98	65.69	3.71	35.16	9867.	9653.	-2.2	229.
E-11-016G	107.48	26.5	26.7	0.1819	104.29	131.11	3.0	1.6	6014.	61.95	68.16	6.21	42.43	9770.	9310.	-4.7	187.
E-11-017G	95.84	21.5	21.8	0.0863	92.17	62.91	23.8	13.0	62778.	86.38	86.80	0.38	9.25	4756.	4469.	-6.0	419.
E-11-018G	98.23	22.5	22.7	0.0865	94.16	62.95	7.6	4.1	20080.	86.10	87.36	1.26	11.50	4745.	4785.	0.8	336.
E-11-019G	99.91	23.2	23.4	0.0861	95.54	62.56	5.1	2.8	13518.	86.08	87.93	1.87	12.91	4706.	4747.	0.9	297.
E-11-020G	103.13	24.5	24.8	0.0867	98.17	62.87	3.0	1.6	7982.	85.80	88.86	3.04	15.80	4710.	4541.	-3.6	243.
E-11-021G	92.59	20.2	20.5	0.1563	90.52	114.15	23.8	13.0	51596.	70.39	71.14	0.72	21.83	8663.	8550.	-1.3	323.
E-11-022G	97.69	22.2	22.5	0.1576	94.90	114.61	7.5	4.1	16403.	70.27	72.57	2.29	26.27	8645.	8600.	-0.5	268.
E-11-023G	100.99	23.7	23.9	0.1585	98.01	114.91	5.2	2.8	11433.	70.17	73.46	3.28	29.18	8632.	8527.	-1.2	241.
E-11-024G	107.96	26.7	26.9	0.1605	104.54	115.67	3.0	1.6	6661.	69.96	75.42	5.45	35.28	8614.	8161.	-5.3	199.
E-11-025G	95.02	21.0	21.5	0.1079	91.87	78.72	23.8	13.0	59810.	82.17	82.69	0.48	12.59	5957.	5746.	-3.5	385.
E-11-026G	97.85	22.2	22.6	0.1075	94.03	78.26	7.6	4.1	19109.	81.69	83.26	1.56	15.37	5902.	5915.	0.2	313.
E-11-027G	100.09	23.0	23.5	0.1075	96.25	78.10	5.2	2.8	13142.	81.75	84.05	2.28	17.19	5874.	5920.	0.8	278.
E-11-028G	103.68	24.7	25.0	0.1071	98.95	77.60	3.0	1.6	7622.	81.51	85.16	3.65	20.34	5810.	5458.	-6.1	233.
E-11-029G	94.57	20.9	21.3	0.1313	91.92	95.72	23.8	13.0	56410.	77.42	78.05	0.59	16.84	7248.	7005.	-3.3	350.
E-11-030G	98.48	22.4	22.8	0.1318	95.45	95.79	7.6	4.1	18086.	77.09	79.01	1.90	20.44	7218.	7200.	-0.3	288.
E-11-031G	100.95	23.4	23.9	0.1322	97.57	95.87	5.2	2.8	12423.	76.98	79.75	2.76	22.59	7202.	7160.	-0.6	260.
E-11-032G	106.37	25.7	26.2	0.1320	102.44	95.33	3.0	1.6	7223.	76.67	81.28	4.58	27.39	7114.	6857.	-3.6	211.
E-11-033G	99.79	23.0	23.4	0.0421	92.85	30.65	23.8	13.0	69914.	55.87	96.10	0.19	3.81	2306.	2217.	-3.9	493.
E-11-034G	100.97	23.5	23.9	0.0416	93.60	30.32	7.6	4.1	22328.	55.83	96.45	0.61	4.83	2278.	2320.	1.9	384.
E-11-035G	101.76	23.7	24.2	0.0408	94.19	29.67	5.2	2.8	15318.	55.94	96.82	0.88	5.38	2227.	2270.	2.0	337.
E-11-036G	103.26	24.5	24.8	0.0410	95.41	29.80	3.0	1.6	8847.	55.74	97.22	1.48	6.78	2232.	2202.	-1.4	268.
E-11-037G	90.66	19.4	19.8	0.1866	88.78	136.46	23.5	12.8	45465.	62.11	63.00	0.88	28.11	10380.	10310.	-0.7	301.
E-11-038G	97.08	21.9	22.3	0.1870	94.49	136.04	7.5	4.1	14744.	62.31	65.04	2.72	33.41	10269.	10208.	-0.6	250.
E-11-039G	101.60	23.7	24.1	0.1896	98.83	137.37	5.2	2.8	10322.	62.40	66.31	3.91	37.24	10312.	10167.	-1.4	226.
E-11-040G	110.28	27.7	28.0	0.1916	106.94	137.74	3.0	1.6	6038.	62.09	68.59	6.50	44.93	10228.	9746.	-4.7	185.

Table C-12. Experimental data for R-11 condensing on tube H

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{Q_c}{Q_w} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-11-001H	99.49	22.9	23.2	0.0551	94.87	40.08	22.2	45.0	83624.	96.14	96.47	0.28	3.19	3016.	3124.	3.6	538.
R-11-002H	99.93	23.0	23.4	0.0549	95.12	39.92	7.6	15.4	28535.	95.59	96.43	0.83	3.92	3003.	3144.	4.7	435.
R-11-003H	100.42	23.4	23.6	0.0547	95.46	39.75	5.2	10.5	19567.	95.61	96.80	1.19	4.21	2988.	3072.	2.8	403.
R-11-004H	101.58	23.9	24.1	0.0547	96.42	39.72	3.0	6.1	11336.	95.58	97.60	2.02	4.99	2981.	3015.	1.1	340.
R-11-009H	98.39	22.7	22.8	0.0848	95.17	61.63	22.2	45.0	81166.	93.26	93.72	0.42	4.89	4645.	4688.	0.9	539.
R-11-010H	99.60	23.2	23.3	0.0841	96.07	61.12	7.6	15.4	27825.	92.99	94.23	1.24	5.99	4600.	4686.	1.9	437.
R-11-011H	100.52	23.5	23.7	0.0841	96.83	61.08	5.2	10.5	19119.	93.09	94.89	1.80	6.53	4591.	4670.	1.7	399.
R-11-012H	102.36	24.2	24.4	0.0846	98.54	61.28	3.0	6.1	11112.	93.12	96.17	3.04	7.71	4596.	4550.	-1.0	339.
R-11-013H	95.42	21.2	21.6	0.2546	93.98	185.35	22.0	44.6	65610.	75.75	77.05	1.26	19.02	14019.	13850.	-1.2	419.
R-11-014H	100.32	23.2	23.6	0.2559	98.54	185.46	7.6	15.4	23150.	76.23	79.90	3.66	22.25	13944.	13873.	-0.5	356.
R-11-015H	102.98	24.4	24.7	0.2580	101.13	186.56	5.2	10.5	16031.	76.34	81.70	5.34	23.96	13981.	13858.	-0.9	332.
R-11-016H	108.77	27.0	27.3	0.2612	106.68	187.87	3.0	6.1	9488.	76.55	85.59	9.02	27.70	13977.	13496.	-3.4	287.
R-11-017H	97.77	22.2	22.5	0.1122	94.80	81.60	22.2	45.0	78622.	90.40	91.00	0.55	7.07	6155.	6137.	-0.3	495.
R-11-018H	99.41	23.0	23.2	0.1122	96.25	81.49	6.8	13.8	24130.	90.05	91.69	1.63	8.54	6134.	5534.	-9.8	408.
R-11-019H	100.66	23.4	23.7	0.1126	97.40	81.67	5.2	10.5	18575.	90.25	92.64	2.37	9.22	6138.	6138.	0.0	378.
R-11-020H	102.91	24.5	24.7	0.1131	99.61	81.87	3.0	6.1	10799.	90.09	94.14	4.04	10.80	6136.	6035.	-1.6	323.
R-11-021H	97.20	22.2	22.3	0.1889	95.16	137.33	22.2	45.0	73006.	83.79	84.75	0.91	12.93	10365.	10111.	-2.4	456.
R-11-022H	101.30	23.7	24.0	0.1967	99.05	142.46	7.6	15.4	25304.	83.90	86.70	2.81	16.00	10698.	10665.	-0.3	380.
R-11-023H	103.13	24.7	24.8	0.1977	100.62	143.03	5.2	10.5	17454.	83.93	88.02	4.11	17.15	10716.	10659.	-0.5	355.
R-11-024H	107.29	26.4	26.6	0.1992	104.65	143.56	3.0	6.1	10236.	84.08	90.92	6.82	19.79	10700.	10192.	-4.8	307.
R-11-025H	99.45	22.9	23.2	0.0468	94.46	34.08	22.2	45.0	84134.	96.72	96.99	0.23	2.60	2565.	2572.	0.3	561.
R-11-026H	99.89	23.2	23.4	0.0462	94.56	33.60	7.6	15.4	28747.	96.33	97.03	0.70	3.21	2528.	2642.	4.5	447.
R-11-027H	100.26	23.4	23.6	0.0464	94.92	33.75	5.2	10.5	19687.	96.25	97.27	1.02	3.49	2538.	2635.	3.8	413.
R-11-028H	100.97	23.7	23.9	0.0464	95.45	33.73	3.0	6.1	11369.	96.01	97.69	1.68	4.12	2534.	2503.	-1.2	350.
R-11-029H	97.56	22.2	22.5	0.1608	95.36	116.88	22.0	44.6	74444.	86.38	87.21	0.78	10.76	8818.	8536.	-3.2	465.
R-11-030H	99.93	23.2	23.4	0.1602	97.30	116.22	7.6	15.4	25844.	86.08	88.35	2.28	12.72	8742.	8638.	-1.2	390.
R-11-031H	101.37	23.9	24.0	0.1611	98.58	116.75	5.2	10.5	17770.	85.95	89.31	3.38	13.74	8766.	8749.	-0.2	363.
R-11-032H	104.50	25.2	25.4	0.1616	101.53	116.82	3.0	6.1	10383.	85.95	91.48	5.51	15.79	8738.	8240.	-5.7	314.
R-11-033H	96.65	21.7	22.1	0.1349	94.17	98.19	22.2	45.0	76082.	87.52	88.22	0.65	8.78	7415.	7242.	-2.3	480.
R-11-034H	98.28	22.7	22.8	0.1351	96.01	98.13	7.6	15.4	26183.	87.33	89.31	2.00	9.96	7397.	7555.	2.1	422.
R-11-035H	100.28	23.2	23.6	0.1349	97.40	97.85	5.2	10.5	18029.	87.42	90.32	2.91	11.41	7357.	7539.	2.5	366.
R-11-036H	102.79	24.4	24.6	0.1356	99.63	98.15	3.0	6.1	10499.	87.30	92.04	4.73	13.12	7357.	7067.	-3.9	319.
R-11-037H	99.19	22.7	23.1	0.0716	94.81	52.06	22.2	45.0	82644.	94.91	95.29	0.34	4.09	3920.	3770.	-3.8	544.
R-11-038H	100.11	23.2	23.5	0.0711	95.52	51.71	7.6	15.4	28291.	94.57	95.62	1.04	5.02	3889.	3956.	1.7	440.
R-11-039H	100.83	23.5	23.8	0.0711	96.16	51.68	5.2	10.5	19424.	94.66	96.15	1.49	5.42	3883.	3856.	-0.7	407.
R-11-040H	102.44	24.2	24.5	0.0711	97.65	51.61	3.0	6.1	11268.	94.78	97.31	2.53	6.39	3870.	3770.	-2.6	344.
R-11-041H	96.56	21.7	22.1	0.2200	94.40	160.09	22.0	44.6	69302.	80.19	81.31	1.08	15.81	12092.	11842.	-2.1	435.
R-11-042H	100.54	23.4	23.7	0.2203	98.07	159.71	7.5	15.2	23958.	80.27	83.50	3.21	18.66	12005.	12029.	0.2	366.
R-11-043H	102.89	24.4	24.7	0.2218	100.33	160.49	5.2	10.5	16802.	80.49	85.14	4.64	20.07	12028.	12037.	0.1	340.
R-11-044H	107.27	26.4	26.6	0.2223	104.45	160.19	3.0	6.1	9868.	80.42	88.16	7.74	22.98	11940.	11581.	-3.0	295.

Table C-13. Experimental data for R-11 condensing on tube J

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	V, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
B-11-005J	99.33	22.9	23.2	0.0539	93.79	39.22	22.5	18.1	71116.	94.27	94.57	0.26	4.91	2952.	2925.	-0.9	574.
B-11-006J	100.50	23.2	23.7	0.0539	94.71	39.18	7.6	6.1	24022.	94.02	94.82	0.79	6.08	2945.	3009.	2.2	462.
B-11-007J	101.41	23.7	24.0	0.0536	95.37	39.00	5.2	4.2	16476.	94.06	95.22	1.16	6.77	2928.	2997.	2.3	413.
B-11-008J	103.28	24.7	24.8	0.0534	97.08	38.78	2.9	2.3	9222.	93.99	95.93	1.94	8.32	2905.	2801.	-3.6	333.
B-11-009J	96.30	21.7	22.0	0.0846	92.55	61.66	22.5	18.1	64969.	86.35	86.80	0.41	9.72	4659.	4550.	-2.3	457.
B-11-010J	98.29	22.4	22.8	0.0848	93.82	61.74	7.6	6.1	22023.	86.25	87.51	1.27	11.41	4653.	4807.	3.3	385.
B-11-011J	99.77	23.0	23.4	0.0846	95.25	61.50	5.2	4.2	15132.	86.34	88.13	1.80	12.54	4627.	4675.	1.0	352.
B-11-012J	103.07	24.4	24.8	0.0856	98.03	62.05	2.9	2.3	8476.	86.03	89.17	3.12	15.46	4649.	4508.	-3.0	287.
B-11-013J	92.86	20.2	20.6	0.1764	90.88	128.80	22.2	17.9	46534.	61.37	62.27	0.89	31.04	9772.	9839.	0.7	300.
B-11-014J	97.62	22.2	22.5	0.1759	94.99	127.92	7.6	6.1	16175.	61.62	64.14	2.52	34.73	9649.	9554.	-1.0	265.
B-11-015J	101.03	23.5	23.9	0.1765	98.21	127.95	5.2	4.2	11183.	61.79	65.45	3.66	37.42	9612.	9507.	-1.1	245.
B-11-016J	108.09	26.5	27.0	0.1782	104.83	128.39	3.0	2.4	6570.	61.85	67.94	6.09	43.19	9560.	9130.	-4.5	211.
B-11-017J	97.58	22.0	22.5	0.0633	92.65	46.12	22.5	18.1	68816.	91.34	91.69	0.31	6.06	3479.	3429.	-1.4	548.
B-11-018J	98.72	22.4	22.9	0.0628	93.34	45.77	7.6	6.1	23205.	90.92	91.83	0.90	7.35	3448.	3395.	-1.5	446.
B-11-019J	99.77	22.7	23.4	0.0626	94.17	45.58	5.2	4.2	15914.	90.90	92.25	1.33	8.20	3429.	3455.	0.8	399.
B-11-020J	101.68	23.7	24.2	0.0618	95.89	44.89	3.0	2.4	9208.	90.74	92.93	2.18	9.85	3369.	3253.	-3.5	326.
B-11-021J	97.58	22.0	22.5	0.0633	92.65	46.12	22.5	18.1	68816.	91.34	91.69	0.31	6.06	3479.	3429.	-1.4	548.
B-11-022J	98.72	22.4	22.9	0.0628	93.34	45.77	7.6	6.1	23205.	90.92	91.83	0.90	7.35	3448.	3395.	-1.5	446.
B-11-023J	99.77	22.7	23.4	0.0626	94.17	45.58	5.2	4.2	15914.	90.90	92.25	1.33	8.20	3429.	3455.	0.8	399.
B-11-024J	101.68	23.7	24.2	0.0618	95.89	44.89	3.0	2.4	9208.	90.74	92.93	2.18	9.85	3369.	3253.	-3.5	326.
B-11-025J	95.47	21.2	21.6	0.0768	91.67	56.03	22.5	18.1	65490.	87.04	87.46	0.37	8.22	4238.	4169.	-1.6	492.
B-11-026J	96.99	21.9	22.2	0.0767	92.82	55.92	7.6	6.1	22142.	86.78	87.89	1.12	9.66	4222.	4243.	0.5	417.
B-11-027J	98.13	22.2	22.7	0.0755	93.70	55.00	5.2	4.2	15188.	86.75	88.35	1.61	10.59	4146.	4170.	0.6	374.
B-11-028J	100.75	23.4	23.8	0.0757	96.22	55.02	3.0	2.4	8797.	86.54	89.22	2.66	12.87	4135.	3972.	-3.9	307.
B-11-029J	95.64	21.5	21.7	0.1145	92.85	83.42	22.5	18.1	59966.	79.55	80.15	0.56	15.78	6308.	6308.	0.0	381.
B-11-030J	98.31	22.5	22.8	0.1144	95.25	83.21	7.6	6.1	20307.	79.22	80.89	1.66	18.25	6271.	6282.	0.2	328.
B-11-031J	100.07	23.2	23.5	0.1144	96.63	83.10	5.2	4.2	13942.	79.12	81.54	2.41	19.74	6250.	6244.	-0.1	302.
B-11-032J	104.54	25.4	25.4	0.1151	100.84	83.26	2.9	2.3	7824.	78.77	82.91	4.13	23.70	6227.	5982.	-3.9	251.
B-11-033J	94.47	21.0	21.2	0.1583	92.24	115.43	22.4	18.1	51477.	67.97	68.78	0.80	26.09	8741.	8943.	2.3	320.
B-11-034J	98.97	22.7	23.0	0.1591	96.31	115.54	7.6	6.1	17708.	68.25	70.53	2.27	29.59	8701.	8635.	-0.8	281.
B-11-035J	101.81	24.0	24.2	0.1601	98.85	115.97	5.2	4.2	12199.	68.24	71.55	3.31	31.91	8703.	8600.	-1.2	260.
B-11-036J	107.65	26.7	26.8	0.1607	104.25	115.81	3.0	2.4	7140.	68.24	73.70	5.46	36.68	8628.	8186.	-5.1	224.
B-11-037J	100.73	23.4	23.8	0.0452	94.58	32.86	22.5	18.1	72973.	96.76	97.01	0.21	3.84	2469.	2394.	-3.0	613.
B-11-038J	101.51	21.6	24.1	0.0449	94.96	32.69	7.6	6.1	24629.	96.48	97.14	0.66	4.70	2454.	2509.	2.3	496.
B-11-039J	102.19	24.2	24.4	0.0449	95.30	32.68	5.2	4.2	16874.	96.46	97.41	0.95	5.25	2451.	2451.	0.0	445.
B-11-040J	103.72	24.7	25.0	0.0449	96.59	32.64	3.0	2.4	5763.	96.40	97.98	1.58	6.53	2444.	2356.	-3.6	357.
B-11-041J	95.16	21.2	21.5	0.0983	92.39	71.66	22.5	18.1	62049.	82.36	82.88	0.49	12.54	5422.	5466.	0.8	412.
B-11-042J	97.25	22.2	22.3	0.0983	93.61	71.58	7.6	6.1	21012.	82.11	83.55	1.43	14.43	5402.	5410.	0.2	357.
B-11-043J	98.56	22.7	22.9	0.0970	95.03	70.56	5.2	4.2	14417.	82.04	84.07	2.02	15.50	5317.	5243.	-1.4	327.
B-11-044J	101.91	24.2	24.3	0.0975	97.59	70.70	3.0	2.4	8355.	81.69	85.17	3.48	18.48	5305.	5207.	-1.9	274.

Table C-14. Experimental data for R-21 condensing on tube A

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-21-001A	127.28	61.9	62.3	C.1688	119.45	110.52	22.5	18.1	57202.	75.67	76.58	0.90	51.16	10043.	10122.	0.8	188.
R-21-002A	132.03	66.0	67.0	C.1686	123.74	109.84	7.5	6.0	19242.	75.51	78.16	2.65	55.20	9898.	9907.	0.1	171.
R-21-003A	135.37	69.9	70.4	C.1701	126.66	110.49	5.2	4.2	13436.	75.52	79.27	3.75	57.97	9897.	9726.	-1.7	163.
R-21-004A	141.77	76.7	77.4	C.1700	132.31	109.72	3.0	2.4	7947.	76.22	82.52	6.31	62.40	9714.	9442.	-2.8	149.
R-21-008A	101.01	40.4	40.7	C.0871	93.27	58.64	22.5	18.1	55316.	73.28	73.79	0.51	27.47	5567.	5697.	2.4	194.
R-21-009A	103.35	41.9	42.4	C.0852	94.80	57.29	7.5	6.0	18572.	73.38	74.80	1.43	29.26	5418.	5341.	-1.4	177.
R-21-010A	105.94	43.9	44.3	C.0863	97.80	57.85	5.0	4.0	12508.	73.84	75.90	2.07	31.07	5449.	5159.	-5.3	167.
R-21-011A	109.18	46.2	46.7	C.0857	99.84	57.30	3.0	2.4	7556.	73.68	77.10	3.42	33.79	5369.	5116.	-4.7	152.
R-21-012A	109.18	45.9	46.7	C.1128	101.10	75.35	22.5	18.1	55246.	73.12	73.76	0.64	35.74	7059.	7132.	1.0	189.
R-21-013A	112.89	48.9	49.6	C.1120	103.92	74.61	7.5	6.0	18631.	73.41	75.26	1.85	38.56	6948.	6937.	-0.2	172.
R-21-014A	114.61	50.4	51.0	C.1125	105.78	74.79	5.2	4.2	12868.	72.76	75.32	2.57	40.57	6944.	6654.	-4.2	163.
R-21-015A	118.79	54.0	54.6	C.1118	109.19	74.03	3.0	2.4	7529.	72.97	77.26	4.29	43.67	6826.	6419.	-6.0	149.
R-21-016A	119.34	54.2	55.1	C.1472	111.57	97.21	22.5	18.1	55515.	73.41	74.21	0.80	45.53	8955.	8950.	-0.0	188.
R-21-017A	124.32	58.7	59.5	C.1482	115.71	97.46	7.0	5.6	17371.	73.04	75.47	2.43	50.07	8902.	8498.	-4.5	170.
R-21-018A	126.68	60.9	61.7	C.1489	118.07	97.62	5.2	4.2	12927.	72.68	76.10	3.42	52.29	8880.	8876.	-0.0	162.
R-21-019A	132.63	66.7	67.6	C.1484	122.97	96.79	3.0	2.4	7622.	73.25	78.91	5.66	56.55	8712.	8472.	-2.8	147.
R-21-020A	112.59	48.5	49.4	C.1299	104.65	86.41	22.5	18.1	54000.	71.22	71.96	0.74	41.00	8051.	8317.	3.3	188.
R-21-021A	116.51	51.7	52.6	C.1298	108.07	86.04	7.5	6.0	18089.	71.01	73.17	2.16	44.42	7963.	8082.	1.5	171.
R-21-022A	119.69	54.5	55.4	C.1313	111.74	86.72	5.2	4.2	12616.	70.99	74.07	3.08	47.16	7984.	7980.	-0.1	162.
R-21-023A	124.45	58.7	59.7	C.1310	115.53	86.12	3.0	2.4	7358.	70.81	75.90	5.08	51.10	7864.	7607.	-3.3	147.
R-21-024A	114.87	50.4	51.3	C.1371	106.82	91.04	22.5	18.1	54015.	71.23	72.00	0.76	43.26	8449.	8560.	1.3	187.
R-21-025A	118.44	53.4	54.3	C.1372	109.93	90.78	7.5	6.0	17962.	70.33	72.54	2.21	47.01	8375.	8277.	-1.2	170.
R-21-026A	121.45	56.0	56.9	C.1376	112.65	90.75	5.2	4.2	12627.	71.05	74.14	3.09	48.85	8330.	8017.	-3.8	163.
R-21-027A	126.85	61.0	61.9	C.1371	117.30	90.01	3.0	2.4	7424.	71.44	76.65	5.21	52.81	8185.	7799.	-4.7	148.
R-21-028A	103.48	42.0	42.5	C.1027	97.58	68.84	22.5	18.1	53293.	70.30	70.91	0.61	32.87	6510.	6880.	5.7	189.
R-21-029A	106.24	44.0	44.5	C.1015	98.89	67.97	7.5	6.0	17877.	70.21	71.95	1.75	35.16	6399.	6543.	2.3	174.
R-21-030A	108.66	45.7	46.3	C.1016	100.84	67.90	5.2	4.2	12533.	70.72	73.11	2.38	36.75	6367.	6197.	-2.7	165.
R-21-031A	114.48	50.2	50.9	C.1031	105.56	68.55	3.0	2.4	7432.	72.07	76.17	4.09	40.36	6367.	6126.	-3.8	151.
R-21-032A	97.88	38.5	38.6	C.0613	89.91	41.41	22.5	18.1	58984.	78.35	78.72	0.37	19.34	3951.	4162.	5.3	195.
R-21-033A	99.23	39.4	39.5	C.0605	90.56	40.83	7.5	6.0	19659.	78.01	79.05	1.04	20.70	3887.	3879.	-0.2	179.
R-21-034A	100.31	40.0	40.2	C.0602	91.35	40.65	5.2	4.2	13660.	77.99	79.41	1.42	21.61	3863.	3684.	-4.6	171.
R-21-035A	102.74	41.5	41.9	C.0589	92.70	39.68	3.0	2.4	7999.	78.72	81.06	2.34	22.85	3756.	3499.	-6.8	157.
R-21-036A	93.27	35.4	35.6	C.0478	85.05	32.49	22.5	18.1	58936.	78.33	78.61	0.29	14.80	3122.	3212.	2.9	202.
R-21-037A	92.96	34.9	35.4	C.0475	84.74	32.25	7.5	6.0	19245.	76.45	77.25	0.80	16.11	3100.	3004.	-3.1	184.
R-21-038A	93.44	35.2	35.7	C.0463	84.74	31.47	5.2	4.2	13362.	76.40	77.52	1.13	16.48	3023.	2918.	-3.5	175.
R-21-039A	95.23	36.5	36.9	C.0458	85.53	31.11	3.0	2.4	7770.	76.65	78.50	1.85	17.65	2980.	2772.	-7.0	161.
R-21-040A	90.08	33.2	33.7	C.0394	82.24	26.86	22.5	18.1	58757.	78.11	78.35	0.24	11.85	2594.	2687.	3.6	209.
R-21-041A	91.00	33.7	34.2	C.0390	82.41	26.55	7.5	6.0	19561.	77.81	78.45	0.65	12.87	2560.	2424.	-5.3	190.
R-21-042A	92.00	34.4	34.8	C.0382	82.85	25.97	5.2	4.2	13729.	78.65	79.56	0.91	12.90	2500.	2372.	-5.1	185.
R-21-043A	93.31	35.2	35.6	C.0387	83.82	26.32	3.0	2.4	7862.	77.71	79.31	1.60	14.80	2529.	2395.	-5.3	163.
R-21-044A	100.96	39.7	40.7	C.0676	92.49	45.54	22.5	18.1	60012.	79.72	80.11	0.39	21.05	4324.	4404.	1.9	196.
R-21-045A	102.61	40.7	41.9	C.0674	93.58	45.40	7.5	6.0	19962.	79.19	80.30	1.11	22.86	4299.	4135.	-3.8	180.
R-21-046A	103.78	42.2	42.7	C.0674	94.62	45.31	5.2	4.2	13834.	78.91	80.51	1.60	24.07	4283.	4156.	-3.0	170.
R-21-047A	106.29	44.2	44.5	C.0664	96.45	44.58	3.0	2.4	8046.	79.02	81.70	2.68	25.93	4196.	4008.	-4.5	155.

Table C-14 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-21-048A	85.97	31.0	31.3	0.0342	78.85	23.35	22.2	17.9	56387.	75.94	76.16	0.22	9.92	2268.	2452.	8.1	218.
R-21-049A	86.72	31.2	31.7	0.0333	78.76	22.75	7.5	6.0	19037.	75.72	76.28	0.55	10.72	2208.	2074.	-6.1	197.
R-21-050A	87.55	31.7	32.2	0.0326	78.76	22.26	5.2	4.2	13318.	76.32	77.08	0.76	10.85	2158.	1980.	-8.2	190.
R-21-051A	88.95	32.5	33.0	0.0328	79.73	22.37	3.0	2.4	7692.	76.13	77.44	1.31	12.16	2164.	1958.	-9.5	170.
R-21-052A	99.14	39.0	39.4	0.0758	91.74	51.12	22.5	18.1	56469.	74.90	75.35	0.45	24.02	4868.	5091.	4.6	194.
R-21-053A	101.18	40.4	40.8	0.0750	93.14	50.50	7.5	6.0	18857.	74.64	75.89	1.25	25.92	4793.	4667.	-2.6	177.
R-21-054A	102.70	41.4	41.9	0.0745	94.23	50.09	5.2	4.2	13164.	74.90	76.68	1.78	26.90	4743.	4627.	-2.4	168.
R-21-055A	105.86	43.7	44.2	0.0733	96.36	49.19	3.0	2.4	7716.	75.58	78.48	2.89	28.83	4634.	4332.	-6.5	154.
R-21-056A	94.88	36.2	36.6	0.0550	86.98	37.31	22.5	18.1	58360.	77.53	77.86	0.33	17.19	3577.	3718.	3.9	199.
R-21-057A	95.84	36.7	37.3	0.0551	87.68	37.30	7.5	6.0	19305.	76.63	77.55	0.91	18.75	3570.	3421.	-4.2	182.
R-21-058A	96.84	37.0	37.9	0.0537	88.07	36.37	5.2	4.2	13474.	76.97	78.27	1.30	19.22	3475.	3376.	-2.9	173.
R-21-059A	97.58	37.7	38.4	0.0545	88.90	36.84	3.0	2.4	7605.	74.78	77.01	2.23	21.68	3516.	3335.	-5.1	155.

Table C-15. Experimental data for R-22 condensing on tube A

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-22-001A	85.63	173.2	171.9	0.0505	76.71	30.21	22.5	18.1	56477.	75.00	75.27	0.20	10.49	2312.	2301.	-0.5	211.
R-22-002A	87.50	177.2	176.7	0.0523	82.77	30.96	5.2	4.2	13054.	74.67	75.61	0.89	12.36	2355.	2317.	-1.6	182.
R-22-003A	89.49	183.2	181.8	0.0515	81.87	30.53	3.0	2.4	7598.	75.04	76.61	1.53	13.66	2307.	2287.	-0.9	161.
R-22-004A	86.45	175.7	174.0	0.0537	81.07	31.89	7.6	6.1	18888.	74.03	74.71	0.64	12.08	2434.	2426.	-0.3	192.
R-22-005A	83.83	168.2	167.5	0.0291	77.18	17.42	7.6	6.1	19632.	77.18	77.57	0.36	6.45	1341.	1372.	2.4	198.
R-22-006A	85.77	172.7	172.3	0.0291	76.52	17.44	3.0	2.4	7824.	77.67	78.57	0.87	7.65	1334.	1308.	-2.0	167.
R-22-007A	84.16	168.9	168.3	0.0306	77.91	18.27	22.5	18.1	58663.	78.01	78.20	0.12	6.05	1405.	1381.	-1.7	222.
R-22-008A	84.98	171.2	170.3	0.0310	78.67	18.50	5.2	4.2	13502.	77.48	78.07	0.54	7.20	1419.	1409.	-0.7	188.
R-22-009A	89.65	182.5	182.2	0.0786	84.78	46.34	7.6	6.1	18236.	71.09	72.07	0.92	18.07	3500.	3494.	-0.2	185.
R-22-010A	93.44	192.2	192.2	0.0790	87.81	46.30	3.0	2.4	7292.	71.56	73.79	2.19	20.77	3452.	3279.	-5.0	159.
R-22-011A	90.20	184.2	183.6	0.0802	86.75	47.09	22.5	18.1	55391.	73.45	73.83	0.32	16.56	3550.	3547.	-0.1	205.
R-22-012A	89.40	181.9	181.5	0.0692	85.17	40.78	22.5	18.1	56494.	74.99	75.33	0.27	14.25	3082.	3042.	-1.3	207.
R-22-013A	90.32	184.5	183.9	0.0702	87.08	41.21	7.6	6.1	18888.	73.93	74.81	0.83	15.95	3105.	3158.	1.7	186.
R-22-014A	90.99	185.7	185.7	0.0702	87.58	41.17	5.2	4.2	12895.	73.59	74.81	1.17	16.79	3095.	3048.	-1.5	176.
R-22-015A	93.19	191.7	191.6	0.0694	87.97	40.66	3.0	2.4	7495.	73.74	75.80	2.02	18.42	3034.	3029.	-0.2	157.
R-22-016A	89.13	181.0	180.8	0.0912	87.38	53.50	22.5	18.1	52973.	69.95	70.37	0.35	18.97	4048.	3957.	-2.2	204.
R-22-017A	90.66	185.2	184.8	0.0908	88.80	53.11	7.6	6.1	17834.	69.37	70.46	1.07	20.74	3997.	4063.	1.6	184.
R-22-018A	91.85	188.2	188.0	0.0904	89.73	52.77	5.2	4.2	12226.	69.26	70.86	1.51	21.79	3955.	3921.	-0.9	173.
R-22-019A	94.84	196.2	196.1	0.0906	92.18	52.63	3.0	2.4	7153.	69.84	72.36	2.52	23.74	3904.	3776.	-3.3	157.
R-22-020A	89.53	182.2	181.9	0.1074	86.64	63.08	22.5	18.1	50779.	66.82	67.30	0.42	22.47	4766.	4756.	-0.2	203.
R-22-021A	92.00	188.7	188.4	0.1074	87.25	63.01	7.6	6.1	17236.	66.76	68.06	1.27	24.59	4721.	4815.	2.0	183.
R-22-022A	93.72	193.2	193.0	0.1072	90.02	62.54	5.2	4.2	11877.	67.02	68.83	1.79	25.79	4658.	4651.	-0.1	172.
R-22-023A	98.17	205.2	205.3	0.1091	95.29	62.98	3.0	2.4	7010.	68.04	71.17	3.09	28.56	4617.	4638.	0.5	154.
R-22-024A	87.78	175.5	177.4	0.1263	85.41	74.36	22.5	18.1	45939.	59.73	60.30	0.50	27.77	5651.	5644.	-0.1	194.
R-22-025A	90.48	184.7	184.3	0.1251	88.26	73.23	7.6	6.1	15872.	60.82	62.31	1.44	28.91	5515.	5468.	-0.8	182.
R-22-026A	97.43	202.2	203.3	0.1249	92.41	72.51	3.0	2.4	6537.	62.81	66.28	3.47	32.88	5329.	5206.	-2.3	155.
R-22-027A	91.26	186.2	186.4	0.1446	88.11	84.68	22.5	18.1	46463.	60.48	61.10	0.56	30.47	6360.	6341.	-0.3	199.
R-22-028A	98.11	205.7	205.2	0.1489	96.02	85.80	5.2	4.2	11128.	62.05	64.48	2.37	34.85	6291.	6153.	-2.2	172.
R-22-029A	101.97	216.2	216.4	0.1499	99.31	85.79	3.0	2.4	6421.	61.20	65.35	4.08	38.69	6201.	6117.	-1.3	153.
R-22-030A	95.45	196.7	197.7	0.1459	92.55	84.70	7.6	6.1	15922.	60.93	62.65	1.66	33.66	6270.	6304.	0.5	178.
R-22-031A	93.25	191.2	191.7	0.1578	90.57	91.93	22.5	18.1	46159.	60.00	60.68	0.60	32.91	6858.	6734.	-1.8	199.
R-22-032A	98.23	205.7	205.5	0.1603	95.22	92.56	7.6	6.1	16053.	61.41	63.30	1.82	35.87	6783.	6919.	2.0	181.
R-22-033A	101.17	214.7	214.0	0.1641	98.30	94.11	5.2	4.2	11095.	61.71	64.41	2.61	38.11	6822.	6781.	-0.6	171.
R-22-034A	98.18	205.2	205.4	0.1784	95.86	102.86	22.5	18.1	47160.	61.45	62.19	0.67	36.36	7539.	7487.	-0.7	198.
R-22-035A	102.33	217.2	217.4	0.1821	100.21	104.01	7.6	6.1	16168.	61.85	63.86	1.99	39.47	7507.	7519.	0.2	182.
R-22-036A	104.97	225.7	225.3	0.1842	101.84	104.87	5.2	4.2	11151.	61.97	64.86	2.85	41.55	7493.	7402.	-1.2	172.
R-22-037A	84.23	168.7	168.5	0.0422	82.41	24.97	22.5	18.1	57132.	75.92	76.14	0.16	8.20	1920.	1830.	-4.7	224.
R-22-038A	84.74	170.4	169.7	0.0422	82.69	24.96	7.6	6.1	19199.	75.36	75.90	0.50	9.12	1916.	1896.	-1.0	201.
R-22-039A	84.86	170.7	170.0	0.0422	83.00	24.94	5.2	4.2	13064.	74.81	75.60	0.73	9.66	1914.	1886.	-1.5	189.
R-22-040A	85.87	173.0	172.5	0.0415	83.80	24.53	3.0	2.4	7537.	74.59	75.82	1.19	10.67	1876.	1779.	-5.1	168.
R-22-041A	89.61	180.7	182.1	0.1211	87.22	71.03	22.5	18.1	48545.	63.58	64.11	0.47	25.77	5365.	5284.	-1.5	199.
R-22-042A	91.90	188.2	188.1	0.1193	90.16	69.58	7.6	6.1	16635.	64.16	65.57	1.37	27.03	5215.	5191.	-0.4	184.
R-22-043A	93.96	193.7	193.7	0.1193	90.65	69.51	5.2	4.2	11516.	64.72	66.68	1.93	28.27	5172.	5009.	-3.1	175.
R-22-044A	98.41	205.7	206.0	0.1215	95.97	70.01	3.0	2.4	6780.	65.50	68.81	3.28	31.26	5127.	4917.	-4.1	157.

Table C-16. Experimental data for R-22 condensing on tube D

Run No.	T_v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	V, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{Q_c}{Q_w} \times 100$	U _o , Btu hr·ft ² ·°F
R-22-001D	83.12	165.7	165.8	0.0697	81.61	41.30	22.5	14.1	55540.	78.09	78.41	0.27	4.87	3187.	3019.	-5.3	585.
R-22-002D	84.08	168.5	168.1	0.0702	82.05	41.61	7.6	4.8	18694.	77.54	78.39	0.84	6.11	3201.	3185.	-0.5	468.
R-22-003D	84.90	170.2	170.1	0.0698	83.03	41.30	5.2	3.3	12813.	77.50	78.71	1.21	6.80	3169.	3139.	-0.9	417.
R-22-004D	86.97	175.7	175.3	0.0682	83.59	40.31	3.0	1.9	7454.	77.78	79.77	1.96	8.20	3072.	2938.	-4.4	335.
R-22-005D	83.20	166.2	166.0	0.0525	78.95	31.30	22.7	14.2	57344.	79.96	80.22	0.20	3.10	2415.	2287.	-5.3	696.
R-22-006D	83.92	167.9	167.7	0.0521	79.03	31.06	7.6	4.8	19156.	79.58	80.25	0.63	4.01	2391.	2381.	-0.4	533.
R-22-007D	84.82	170.2	169.9	0.0521	78.94	31.07	5.2	3.3	13162.	79.77	80.73	0.92	4.57	2384.	2387.	0.1	466.
R-22-008D	86.61	174.7	174.4	0.0521	80.49	30.98	3.0	1.9	7653.	80.12	81.64	1.51	5.73	2363.	2263.	-4.2	369.
R-22-009D	82.56	164.7	164.4	0.0799	79.71	47.51	22.7	14.2	54830.	76.35	76.73	0.31	6.02	3673.	3533.	-3.8	546.
R-22-010D	83.55	167.2	166.8	0.0799	81.45	47.36	7.6	4.8	18255.	75.61	76.60	0.95	7.45	3649.	3587.	-1.7	438.
R-22-011D	84.25	169.0	168.5	0.0789	81.33	46.79	5.2	3.3	12484.	75.36	76.77	1.37	8.19	3597.	3549.	-1.3	393.
R-22-012D	86.58	174.7	174.3	0.0781	82.64	46.20	3.0	1.9	7255.	75.47	77.80	2.29	9.95	3525.	3423.	-2.9	317.
R-22-013D	82.32	164.2	163.8	0.0392	77.00	23.45	22.7	14.2	57485.	80.18	80.40	0.15	2.03	1814.	1721.	-5.1	799.
R-22-014D	82.57	164.9	164.4	0.0403	77.41	24.07	7.6	4.8	19108.	79.45	79.98	0.49	2.85	1861.	1854.	-0.4	584.
R-22-015D	82.99	165.7	165.5	0.0403	78.55	24.02	5.2	3.3	13084.	79.41	80.14	0.70	3.21	1854.	1813.	-2.2	516.
R-22-016D	84.34	169.2	168.8	0.0402	78.21	24.01	3.0	1.9	7592.	79.64	80.83	1.18	4.11	1846.	1764.	-4.4	402.
R-22-017D	81.34	161.7	161.5	0.0886	80.16	52.68	22.7	14.2	53269.	74.10	74.51	0.35	7.04	4087.	3918.	-4.1	520.
R-22-018D	83.96	168.2	167.8	0.0878	82.34	52.01	5.4	3.4	12735.	73.94	75.43	1.45	9.27	4002.	3906.	-2.4	386.
R-22-019D	82.94	165.7	165.3	0.0886	81.75	52.52	7.6	4.8	17841.	73.78	74.88	1.06	8.61	4055.	4015.	-1.0	421.
R-22-020D	86.68	175.0	174.6	0.0876	84.69	51.65	3.0	1.9	7132.	74.04	76.57	2.51	11.38	3940.	3762.	-4.5	310.
R-22-021D	82.40	164.5	164.0	0.0485	77.74	28.95	22.7	14.2	57035.	79.54	79.78	0.19	2.74	2239.	2140.	-4.4	731.
R-22-022D	83.09	166.2	165.7	0.0485	77.84	28.95	7.6	4.8	19056.	79.18	79.80	0.60	3.60	2234.	2271.	1.7	555.
R-22-023D	83.40	166.7	166.5	0.0485	78.90	28.89	5.2	3.3	13004.	78.83	79.73	0.89	4.12	2227.	2319.	4.1	484.
R-22-024D	84.53	169.7	169.2	0.0477	78.98	28.39	3.0	1.9	7510.	78.64	80.09	1.47	5.17	2181.	2198.	0.8	378.
R-22-025D	83.21	166.0	166.0	0.0630	79.47	37.52	22.7	14.2	56585.	78.87	79.18	0.25	4.18	2894.	2808.	-3.0	619.
R-22-026D	84.22	168.9	168.5	0.0636	79.85	37.85	7.6	4.8	18910.	78.48	79.28	0.77	5.34	2910.	2923.	0.4	488.
R-22-027D	84.80	170.2	169.9	0.0634	80.80	37.66	5.2	3.3	12921.	78.21	79.33	1.11	6.03	2890.	2877.	-0.5	429.
R-22-028D	86.48	174.5	174.1	0.0630	81.34	37.39	3.0	1.9	7483.	78.16	79.99	1.85	7.41	2854.	2766.	-3.1	345.
R-22-033D	84.61	169.7	169.4	0.1040	82.48	61.58	22.7	14.2	54320.	75.59	76.04	0.39	8.80	4729.	4371.	-7.6	481.
R-22-034D	86.65	175.0	174.5	0.1036	83.66	61.20	7.6	4.8	18228.	75.36	76.62	1.23	10.66	4669.	4667.	-0.0	392.
R-22-035D	87.70	177.9	177.2	0.1054	84.76	62.14	5.2	3.3	12450.	74.95	76.76	1.78	11.85	4724.	4628.	-2.0	357.
R-22-036D	90.90	186.2	185.5	0.1042	86.54	61.20	3.0	1.9	7276.	75.34	78.38	2.97	14.04	4603.	4440.	-3.5	293.
R-22-037D	85.30	170.9	171.1	0.1442	83.92	85.13	22.7	14.2	51234.	70.92	71.53	0.56	14.07	6523.	6352.	-2.6	415.
R-22-038D	87.80	178.2	177.4	0.1450	85.54	85.34	7.6	4.8	17211.	70.61	72.34	1.70	16.32	6485.	6456.	-0.5	355.
R-22-039D	88.88	181.0	180.2	0.1468	87.08	86.10	5.2	3.3	11697.	69.75	72.21	2.43	17.90	6520.	6309.	-3.2	326.
R-22-040D	91.97	188.9	188.3	0.1450	88.45	84.86	3.0	1.9	6754.	69.01	73.08	4.01	20.93	6358.	6015.	-5.4	272.
R-22-041D	81.03	160.7	160.8	0.1191	79.93	70.86	22.7	14.2	50418.	69.76	70.30	0.47	11.00	5503.	5342.	-2.9	447.
R-22-042D	82.99	165.9	165.5	0.1187	81.22	70.44	7.6	4.8	16919.	69.47	70.93	1.41	12.79	5437.	5339.	-1.8	380.
R-22-043D	84.88	170.5	170.1	0.1193	83.49	70.45	5.2	3.3	11677.	69.81	71.88	2.04	14.04	5405.	5303.	-1.9	344.
R-22-044D	88.97	181.2	180.4	0.1177	85.27	69.30	3.0	1.9	6872.	70.76	74.16	3.40	16.50	5246.	5091.	-2.9	284.
R-22-045D	83.55	166.9	166.8	0.1325	82.10	78.50	22.7	14.2	51096.	70.74	71.31	0.52	12.53	6049.	5898.	-2.5	432.
R-22-046D	85.84	173.2	172.5	0.1311	83.57	77.45	7.6	4.8	17208.	70.67	72.27	1.54	14.37	5924.	5833.	-1.5	369.
R-22-047D	87.78	177.9	177.4	0.1321	86.36	77.63	5.2	3.3	11855.	70.97	73.24	2.21	15.67	5900.	5741.	-2.7	337.
R-22-048D	91.92	188.5	188.2	0.1319	89.80	76.99	3.0	1.9	6969.	71.69	75.36	3.66	18.39	5770.	5483.	-5.0	281.

Table C-16 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	ΔQ Q × 100	U _o , Btu hr·ft ² ·°F
R-22-049D	86.49	174.2	174.1	0.1967	85.21	115.84	22.7	14.2	47192.	64.80	65.64	0.77	21.27	8841.	8756.	-1.0	372.
R-22-050D	90.15	184.2	183.5	0.1971	88.13	115.42	7.6	4.8	15917.	64.57	66.93	2.32	24.40	8702.	8810.	1.2	319.
R-22-051D	93.17	191.7	191.5	0.1995	92.02	115.89	5.2	3.3	11030.	64.99	68.33	3.30	26.50	8647.	8585.	-0.7	292.
R-22-052D	99.72	210.5	209.8	0.2035	97.31	116.98	3.0	1.9	6537.	65.81	71.42	5.63	31.10	8526.	8439.	-1.0	245.
R-22-053D	83.96	168.5	167.8	0.0586	82.04	34.70	22.7	14.2	57481.	80.15	80.42	0.22	3.67	2670.	2548.	-4.6	650.
R-22-054D	85.41	172.2	171.4	0.0581	82.98	34.39	7.6	4.8	19368.	80.44	81.17	0.68	4.61	2634.	2582.	-2.0	511.
R-22-055D	86.44	174.7	174.0	0.0586	83.82	34.58	5.2	3.3	13323.	80.72	81.75	0.99	5.21	2640.	2563.	-2.9	453.
R-22-056D	88.50	179.7	179.2	0.0584	85.43	34.35	3.0	1.9	7761.	81.17	82.86	1.68	6.49	2604.	2522.	-3.2	359.
R-22-057D	81.83	162.5	162.7	0.1618	80.69	96.07	22.7	14.2	47144.	64.79	65.50	0.64	16.68	7443.	7259.	-2.5	399.
R-22-058D	85.22	171.5	170.9	0.1617	83.34	95.56	7.6	4.8	16038.	65.33	67.25	1.88	18.93	7323.	7132.	-2.6	346.
R-22-059D	87.22	176.7	176.0	0.1627	84.88	95.87	5.2	3.3	10999.	65.08	67.84	2.73	20.76	7300.	7091.	-2.9	314.
R-22-060D	92.36	189.7	189.3	0.1631	90.51	95.03	3.0	1.9	6479.	65.69	70.24	4.49	24.39	7111.	6736.	-5.3	261.
R-22-061D	85.27	170.9	171.0	0.1839	83.94	108.53	22.7	14.2	47511.	65.30	66.10	0.72	19.56	8316.	8121.	-2.3	380.
R-22-062D	88.38	179.5	178.9	0.1837	86.68	107.84	7.6	4.8	16016.	65.11	67.27	2.13	22.18	8179.	8070.	-1.3	330.
R-22-063D	91.07	186.5	185.9	0.1856	88.99	108.49	5.2	3.3	11073.	65.36	68.53	3.08	24.13	8154.	7995.	-2.0	302.
R-22-064D	96.24	200.5	199.9	0.1868	93.73	108.16	3.0	1.9	6479.	65.41	70.52	5.10	28.27	7984.	7642.	-4.3	253.
R-22-065D	87.59	177.7	176.9	0.2173	86.86	127.57	22.7	14.2	46301.	63.41	64.33	0.84	23.72	9701.	9516.	-1.9	366.
R-22-066D	92.15	189.5	188.8	0.2205	91.07	128.33	7.6	4.8	15624.	63.13	65.72	2.57	27.73	9610.	9759.	1.6	310.
R-22-067D	95.36	198.0	197.5	0.2229	94.07	128.94	5.2	3.3	10840.	63.57	67.27	3.66	29.94	9547.	9517.	-0.3	285.
R-22-068D	102.42	218.2	217.7	0.2300	100.71	131.26	3.0	1.9	6441.	64.51	70.57	6.05	34.88	9471.	9063.	-4.3	243.
R-22-069D	88.87	180.7	180.2	0.1764	87.51	103.40	22.7	14.2	50996.	70.51	71.24	0.67	17.99	7830.	7656.	-2.2	389.
R-22-070D	92.49	190.5	189.7	0.1781	90.89	103.74	7.6	4.8	17219.	70.47	72.56	2.03	20.97	7759.	7713.	-0.6	331.
R-22-071D	94.53	195.9	195.2	0.1781	93.06	115.71	5.2	3.3	11848.	70.59	73.53	2.88	22.48	8593.	7481.	-12.9	342.
R-22-072D	100.13	211.5	211.0	0.1808	97.67	103.86	3.0	1.9	6965.	70.95	76.03	4.93	26.64	7558.	7372.	-2.5	254.

Table C-17. Experimental data for R-22 condensing on tube E

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT̄, °F	Q _c , Btu/hr	Q _w , Btu/hr	ΔQ Q × 100	U _o , Btu hr·ft ² ·°F
R-22-009E	82.45	164.7	164.2	0.0606	80.07	36.05	21.8	17.6	58335.	80.02	80.33	0.25	2.28	2787.	2741.	-1.7	763.
R-22-010E	83.48	167.2	166.6	0.0610	80.63	36.26	7.6	6.1	20306.	79.67	80.44	0.74	3.42	2795.	2790.	-0.2	509.
R-22-011E	84.06	168.5	168.1	0.0606	80.39	36.03	5.2	4.2	13872.	79.37	80.48	1.06	4.13	2772.	2745.	-1.0	418.
R-22-012E	86.01	173.5	172.9	0.0600	81.51	35.58	3.0	2.4	8032.	79.31	81.13	1.79	5.79	2720.	2685.	-1.3	293.
R-22-021E	82.52	163.9	164.3	0.1499	81.33	88.95	21.8	17.6	54516.	74.50	75.19	0.62	7.68	6876.	6710.	-2.4	558.
R-22-022E	85.09	171.2	170.6	0.1505	83.57	88.90	7.6	6.1	19057.	74.15	75.96	1.76	10.04	6816.	6680.	-2.0	423.
R-22-023E	87.62	177.5	177.0	0.1503	85.37	88.47	5.2	4.2	13195.	74.72	77.24	2.47	11.64	6727.	6415.	-4.6	360.
R-22-024E	92.75	191.0	190.4	0.1512	89.50	88.29	3.0	2.4	7736.	75.15	79.32	4.13	15.52	6598.	6185.	-6.3	265.
R-22-025E	83.13	164.7	165.8	0.2074	81.83	122.91	21.8	17.6	50693.	68.77	69.71	0.87	13.89	9483.	9466.	-0.2	425.
R-22-026E	87.14	176.2	175.7	0.2072	85.74	121.88	7.6	6.1	17939.	69.11	71.59	2.43	16.79	9282.	9239.	-0.5	344.
R-22-027E	89.95	183.5	183.0	0.2091	88.99	122.19	5.2	4.2	12309.	68.78	72.34	3.51	19.39	9219.	9128.	-1.0	296.
R-22-028E	97.18	202.9	202.6	0.2134	94.14	123.47	3.0	2.4	7232.	68.91	74.95	6.04	25.25	9083.	9055.	-0.3	224.
R-22-029E	83.19	166.2	165.9	0.1285	81.59	76.17	21.8	17.6	56236.	76.97	77.56	0.53	5.93	5876.	5731.	-2.5	618.
R-22-030E	84.85	170.5	170.0	0.1283	83.23	75.82	7.6	6.1	19479.	75.99	77.52	1.49	8.10	5818.	5638.	-3.1	448.
R-22-031E	86.80	175.7	174.9	0.1283	85.32	75.52	5.2	4.2	13405.	76.10	78.31	2.17	9.59	5758.	5619.	-2.4	374.
R-22-032E	91.25	187.0	186.4	0.1279	88.27	74.85	3.0	2.4	7859.	76.69	80.27	3.57	12.77	5622.	5337.	-5.1	274.
R-22-033E	87.17	175.7	175.8	0.1900	85.35	111.83	21.8	17.6	55450.	75.75	76.57	0.77	11.00	8516.	8396.	-1.4	482.
R-22-034E	90.19	183.7	183.6	0.1907	89.13	111.44	7.6	6.1	19249.	74.71	76.95	2.23	14.36	8401.	8443.	0.5	365.
R-22-035E	92.96	191.5	190.9	0.1920	91.06	111.75	5.2	4.2	13300.	74.99	78.20	3.15	16.37	8345.	8177.	-2.0	318.
R-22-036E	97.84	205.2	204.4	0.1931	94.83	111.53	3.0	2.4	7652.	73.66	79.10	5.43	21.46	8185.	8123.	-0.7	238.
R-22-037E	85.33	170.5	171.2	0.1734	82.86	102.54	21.8	17.6	55151.	75.35	76.13	0.71	9.59	7855.	7754.	-1.3	510.
R-22-038E	88.62	179.7	179.5	0.1736	86.34	101.97	7.6	6.1	19367.	75.28	77.33	2.01	12.31	7728.	7617.	-1.4	391.
R-22-039E	91.37	187.5	186.7	0.1747	89.31	102.05	5.2	4.2	13394.	75.70	78.59	2.90	14.22	7663.	7518.	-1.9	336.
R-22-040E	97.52	204.0	203.5	0.1754	93.86	101.55	3.0	2.4	7915.	76.62	81.47	4.80	18.47	7462.	7191.	-3.6	252.
R-22-042E	84.92	170.5	170.2	0.1161	83.09	68.64	7.6	6.1	19692.	76.90	78.32	1.37	7.31	5266.	5190.	-1.4	449.
R-22-043E	86.35	174.7	173.8	0.1161	84.27	68.49	5.2	4.2	13507.	76.82	78.80	1.96	8.54	5230.	5097.	-2.5	381.
R-22-044E	90.02	183.7	183.1	0.1151	88.20	67.37	3.0	2.4	7880.	77.02	80.36	3.29	11.33	5082.	4918.	-3.2	280.
R-22-045E	84.27	169.2	168.6	0.1045	81.92	61.89	21.8	17.6	58048.	79.53	80.03	0.43	4.49	4758.	4655.	-2.2	660.
R-22-046E	85.52	172.5	171.7	0.1046	84.45	61.69	7.6	6.1	20086.	78.55	79.81	1.23	6.34	4723.	4656.	-1.4	464.
R-22-047E	87.29	176.7	176.1	0.1038	84.84	61.19	5.2	4.2	13867.	79.02	80.78	1.73	7.39	4658.	4496.	-3.5	393.
R-22-048E	91.02	186.5	185.8	0.1044	87.53	61.21	3.0	2.4	8107.	79.51	82.43	2.91	10.05	4601.	4352.	-5.4	285.
R-22-049E	85.37	172.0	171.3	0.0928	83.17	54.87	21.8	17.6	59335.	81.33	81.77	0.38	3.82	4203.	4133.	-1.7	686.
R-22-050E	86.51	175.2	174.1	0.0930	84.79	54.83	7.6	6.1	20560.	80.50	81.61	1.08	5.45	4184.	4095.	-2.1	478.
R-22-051E	87.64	177.7	177.0	0.0910	83.94	53.73	5.2	4.2	14107.	80.52	82.05	1.53	6.35	4085.	3977.	-2.7	401.
R-22-052E	90.74	185.2	185.0	0.0902	85.86	53.05	3.0	2.4	8220.	80.81	83.38	2.52	8.64	3992.	3779.	-5.3	288.
R-22-053E	83.87	168.2	167.6	0.1436	82.34	85.02	21.8	17.6	56174.	76.85	77.50	0.58	6.69	6545.	6340.	-3.1	610.
R-22-054E	86.69	175.4	174.6	0.1424	84.31	84.01	7.5	6.0	19377.	76.51	78.25	1.69	9.31	6408.	6327.	-1.3	429.
R-22-055E	88.74	180.4	179.8	0.1428	86.00	83.95	5.2	4.2	13518.	76.67	79.08	2.36	10.87	6360.	6125.	-3.7	365.
R-22-056E	93.65	93.5	192.8	0.1429	90.15	83.36	3.0	2.4	7928.	77.16	81.19	3.99	14.48	6210.	5967.	-3.9	267.
R-22-057E	84.62	168.7	169.4	0.2018	83.31	119.25	21.8	17.6	52451.	71.33	72.24	0.84	12.84	9157.	9183.	0.3	444.
R-22-058E	87.99	177.9	177.9	0.2018	85.76	118.70	7.6	6.1	18298.	70.61	73.05	2.37	16.16	9014.	8992.	-0.2	348.
R-22-059E	91.42	187.5	186.8	0.2038	89.15	119.08	5.2	4.2	12701.	71.32	74.77	3.41	18.38	8940.	8854.	-1.0	303.

Table C-17 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	$\frac{U_o}{hr \cdot ft^2 \cdot ^\circ F}$
R-22-061E	83.94	168.2	167.8	0.1632	83.13	96.47	21.8	17.6	55067.	75.25	75.99	0.68	8.31	7424.	7363.	-0.8	556.
R-22-062E	87.04	176.2	175.5	0.1630	84.89	96.02	7.6	6.1	19249.	74.86	76.80	1.92	11.21	7316.	7264.	-0.7	407.
R-22-063E	89.91	183.5	182.8	0.1635	87.31	95.90	5.2	4.2	13341.	75.47	78.20	2.73	13.07	7236.	7092.	-2.0	345.
R-22-064E	96.26	200.2	200.0	0.1654	94.47	95.64	3.0	2.4	7918.	76.79	81.37	4.52	17.19	7059.	6771.	-4.1	256.
R-22-065E	86.10	172.5	173.1	0.2244	85.08	132.15	21.8	17.6	51501.	69.91	70.92	0.94	15.68	10099.	10206.	1.1	401.
R-22-066E	90.62	185.0	184.7	0.2250	89.62	131.34	7.6	6.1	18163.	69.95	72.61	2.62	19.35	9886.	9953.	0.7	318.
R-22-067E	93.78	193.7	193.2	0.2283	92.77	132.45	5.2	4.2	12539.	70.06	73.84	3.74	21.83	9863.	9723.	-1.4	282.
R-22-068E	101.97	216.9	216.4	0.2347	100.55	133.98	3.0	2.4	7423.	70.83	77.22	6.33	27.94	9684.	9479.	-2.1	216.
R-22-069E	88.89	179.7	180.2	0.2507	87.80	146.88	21.8	17.6	51181.	69.40	70.50	1.04	18.94	11122.	11350.	2.1	366.
R-22-070E	94.50	195.7	195.1	0.2550	93.63	147.68	7.6	6.1	18233.	70.08	73.04	2.93	22.94	10968.	11111.	1.3	298.
R-22-071E	98.77	207.7	207.1	0.2596	97.67	149.09	5.2	4.2	12669.	70.72	74.97	4.22	25.92	10905.	10950.	0.4	262.
R-22-072E	82.48	164.7	164.2	0.1177	81.63	69.78	21.8	17.6	56211.	76.96	77.50	0.48	5.25	5395.	5274.	-2.2	640.
R-22-073E	84.61	170.2	169.4	0.1165	82.75	68.93	7.6	6.1	19629.	76.63	78.08	1.39	7.25	5293.	5266.	-0.5	455.
R-22-074E	86.32	174.4	173.7	0.1168	84.22	68.92	5.2	4.2	13501.	76.76	78.79	1.94	8.55	5263.	5045.	-4.1	383.
R-22-075E	90.63	185.5	184.7	0.1153	86.71	67.69	3.0	2.4	7925.	77.44	80.84	3.34	11.49	5095.	4994.	-2.0	276.
R-22-076E	85.61	172.7	171.9	0.0955	82.75	56.50	21.8	17.6	59427.	81.45	81.90	0.39	3.94	4324.	4241.	-1.9	684.
R-22-077E	87.29	177.0	176.1	0.0965	84.62	56.88	7.6	6.1	20701.	81.02	82.20	1.12	5.68	4330.	4231.	-2.3	475.
R-22-078E	88.36	179.7	178.8	0.0963	85.61	56.65	5.2	4.2	14173.	80.85	82.48	1.58	6.69	4297.	4112.	-4.3	400.
R-22-079E	91.34	187.2	186.6	0.0951	87.30	55.76	3.0	2.4	8236.	80.90	83.60	2.63	9.09	4187.	3930.	-6.1	287.
R-22-080E	92.01	187.9	188.4	0.2769	90.88	161.25	21.8	17.6	51292.	69.52	70.70	1.13	21.90	12081.	12352.	2.2	344.
R-22-081E	97.92	205.0	204.6	0.2829	96.91	162.75	7.6	6.1	18259.	70.07	73.27	3.17	26.25	11940.	12042.	0.8	283.
R-22-082E	102.27	218.0	217.3	0.2897	101.19	165.13	5.2	4.2	12632.	70.30	74.96	4.62	29.64	11921.	11995.	0.6	251.
R-22-083E	83.41	166.7	166.5	0.1204	82.50	71.27	21.8	17.6	56792.	77.77	78.31	0.50	5.37	5494.	5427.	-1.2	637.
R-22-084E	85.44	172.5	171.5	0.1171	83.54	69.17	7.6	6.1	19835.	77.48	78.89	1.38	7.25	5297.	5240.	-1.1	455.
R-22-085E	86.73	175.5	174.7	0.1167	84.78	68.76	5.2	4.2	13572.	77.20	79.17	1.93	8.54	5244.	4996.	-4.7	383.
R-22-086E	90.65	185.5	184.8	0.1153	87.11	67.63	3.0	2.4	7929.	77.55	80.83	3.23	11.46	5091.	4834.	-5.0	277.
R-22-087E	82.67	165.2	164.7	0.0659	81.69	39.05	21.8	17.6	58305.	79.97	80.30	0.27	2.53	3017.	2936.	-2.7	742.
R-22-088E	83.85	168.2	167.5	0.0661	82.64	39.10	7.6	6.1	20319.	79.70	80.52	0.77	3.74	3010.	2908.	-3.4	501.
R-22-089E	84.66	170.2	169.5	0.0661	83.32	39.05	5.2	4.2	13914.	79.60	80.74	1.12	4.48	2998.	2895.	-3.4	417.
R-22-090E	86.72	175.5	174.7	0.0648	84.83	38.20	3.0	2.4	8060.	79.54	81.46	1.87	6.23	2913.	2799.	-3.9	292.

Table C-18. Experimental data for R-113 condensing on tube A

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	V , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-113-001A	150.32	25.9	26.1	0.1421	125.13	106.77	22.5	18.1	71237.	94.27	94.88	0.58	55.75	6448.	6477.	0.5	110.
R-113-002A	154.47	27.2	27.9	0.1455	130.82	108.71	7.6	6.1	24374.	94.82	96.63	1.78	58.75	6526.	6726.	3.1	106.
R-113-003A	155.41	27.9	28.3	0.1488	132.61	111.05	5.2	4.2	16326.	92.51	95.15	2.64	61.58	6657.	6843.	2.8	103.
R-113-004A	155.48	28.9	28.3	0.1475	135.30	109.80	3.0	2.4	9389.	91.35	95.73	4.44	61.93	6581.	6640.	0.9	101.
R-113-005A	138.59	21.0	21.4	0.1498	125.83	112.46	22.5	18.1	60953.	80.83	81.50	0.60	57.42	6905.	6735.	-2.5	115.
R-113-006A	140.81	21.7	22.2	0.1507	128.73	112.86	7.6	6.1	20397.	79.48	81.35	1.80	60.39	6908.	6828.	-1.2	109.
R-113-007A	142.58	22.4	22.9	0.1506	131.09	112.53	5.2	4.2	14045.	79.59	82.27	2.59	61.65	6871.	6732.	-2.0	106.
R-113-008A	146.75	24.0	24.6	0.1505	135.53	111.94	3.0	2.4	8279.	80.50	84.85	4.34	64.07	6795.	6489.	-4.5	101.
R-113-009A	136.74	20.2	20.7	0.0990	120.18	74.73	23.0	18.5	76577.	99.06	99.50	0.40	37.46	4600.	4621.	0.5	117.
R-113-010A	138.22	20.9	21.3	0.0977	122.09	73.63	7.5	6.0	25029.	98.87	100.12	1.22	38.73	4523.	4546.	0.5	112.
R-113-011A	139.66	21.5	21.8	0.0981	123.52	73.83	5.2	4.2	17524.	99.55	101.25	1.73	39.26	4526.	4473.	-1.2	110.
R-113-012A	142.54	22.7	22.9	0.0974	126.99	73.04	3.0	2.4	10285.	100.59	103.42	2.83	40.53	4460.	4226.	-5.2	105.
R-113-013A	147.89	24.5	25.0	0.1916	139.58	141.97	22.5	18.1	60504.	80.19	80.95	0.73	67.32	8604.	8250.	-4.1	122.
R-113-014A	151.43	25.7	26.5	0.1892	142.73	139.82	7.6	6.1	20679.	80.42	82.63	2.16	69.90	8431.	8193.	-2.8	115.
R-113-015A	154.60	27.0	27.9	0.1910	145.66	140.74	5.2	4.2	14369.	81.24	84.34	3.13	71.81	8447.	8130.	-3.8	112.
R-113-016A	159.48	29.2	30.2	0.1912	150.80	140.14	3.0	2.4	8504.	82.31	87.48	5.13	74.58	8350.	7677.	-8.1	107.
R-113-017A	134.54	19.0	20.0	0.0671	121.86	50.58	23.0	18.5	86315.	110.95	111.28	0.28	23.42	3123.	3181.	1.9	127.
R-113-018A	135.89	19.7	20.4	0.0669	123.37	50.34	7.5	5.0	28201.	110.90	111.74	0.84	24.57	3102.	3123.	0.7	121.
R-113-019A	136.60	19.9	20.7	0.0660	124.27	49.66	5.2	4.2	19599.	110.96	112.16	1.20	25.05	3057.	3090.	1.1	117.
R-113-020A	137.78	20.4	21.1	0.0652	125.39	48.97	3.0	2.4	11346.	110.95	112.87	1.94	25.87	3010.	2891.	-4.0	111.
R-113-021A	134.32	19.4	19.9	0.1258	121.24	94.89	22.5	18.1	63771.	84.59	85.18	0.53	49.44	5859.	5926.	1.1	113.
R-113-022A	136.06	19.9	20.5	0.1252	122.77	94.28	7.6	6.1	21568.	84.20	85.78	1.54	51.07	5808.	5858.	0.9	109.
R-113-023A	137.82	20.4	21.1	0.1254	124.70	94.23	5.2	4.2	14856.	84.39	86.71	2.26	52.27	5791.	5870.	1.4	106.
R-113-024A	141.28	21.7	22.4	0.1249	128.44	93.53	3.0	2.4	8703.	85.10	88.85	3.76	54.31	5721.	5612.	-1.9	101.
R-113-025A	138.96	21.2	21.6	0.1717	132.32	128.15	22.5	18.1	57733.	76.47	77.21	0.67	62.11	7864.	7498.	-4.7	121.
R-113-026A	142.86	22.4	23.0	0.1706	135.57	126.94	7.6	6.1	19766.	76.90	78.91	1.97	64.95	7748.	7469.	-3.6	114.
R-113-027A	145.36	23.2	24.0	0.1715	138.20	127.26	5.2	4.2	13706.	77.55	80.38	2.84	66.39	7740.	7367.	-4.8	111.
R-113-028A	150.88	25.4	26.3	0.1728	143.67	127.54	3.0	2.4	8123.	78.69	83.56	4.72	69.75	7696.	7071.	-8.1	105.
R-113-029A	147.81	24.2	25.0	0.2070	142.12	153.05	22.5	18.1	57145.	75.62	76.47	0.78	71.77	9277.	8766.	-5.5	123.
R-113-030A	152.56	26.2	27.0	0.2099	146.80	154.46	7.5	6.0	19335.	75.99	78.43	2.39	75.35	9298.	8961.	-3.6	118.
R-113-031A	155.03	27.2	28.1	0.2089	149.06	153.36	5.2	4.2	13506.	76.09	79.51	3.38	77.22	9198.	8773.	-4.6	114.
R-113-032A	160.96	30.0	30.9	0.2107	153.90	153.95	3.0	2.4	7891.	75.85	81.75	5.86	82.16	9153.	8776.	-4.1	106.
R-113-033A	133.86	19.2	19.7	0.0562	122.03	42.33	23.0	18.5	89745.	114.99	115.28	0.23	18.72	2616.	2668.	2.0	133.
R-113-034A	134.68	19.5	20.0	0.0577	123.41	43.41	7.6	6.1	29482.	114.16	114.89	0.70	20.16	2680.	2648.	-1.2	127.
R-113-035A	135.22	19.7	20.2	0.0577	124.08	43.39	5.2	4.2	20162.	113.94	115.00	1.04	20.75	2676.	2688.	0.5	123.
R-113-036A	136.15	20.0	20.5	0.0570	125.02	42.86	3.0	2.4	11634.	113.66	115.32	1.68	21.66	2640.	2497.	-5.4	116.
R-113-037A	135.40	19.9	20.3	0.0815	126.72	61.14	23.0	18.5	81647.	105.27	105.68	0.34	29.93	3770.	3894.	3.3	120.
R-113-038A	136.18	20.0	20.5	0.0822	127.50	61.65	7.6	6.1	26813.	104.36	105.41	1.03	31.30	3798.	3890.	2.4	116.
R-113-039A	136.75	20.2	20.8	0.0828	128.14	62.07	5.2	4.2	18271.	103.74	105.24	1.49	32.26	3820.	3847.	0.7	113.
R-113-040A	138.04	20.7	21.2	0.0835	129.22	62.49	3.0	2.4	10526.	103.12	105.58	2.44	33.69	3839.	3630.	-5.5	109.
R-113-041A	132.38	18.4	19.2	0.1156	124.31	86.93	22.5	18.1	66667.	88.50	89.04	0.47	43.61	5382.	5245.	-2.6	118.
R-113-042A	133.86	18.9	19.7	0.1140	125.79	85.57	7.6	6.1	22523.	88.07	89.50	1.38	45.07	5288.	5205.	-1.6	112.
R-113-043A	135.25	19.2	20.2	0.1149	127.34	86.18	5.2	4.2	15452.	88.00	90.03	2.03	46.23	5315.	5255.	-1.1	110.
R-113-044A	137.73	20.2	21.1	0.1137	129.75	85.04	3.0	2.4	9012.	88.32	91.58	3.25	47.78	5227.	4855.	-7.1	104.

Table C-18 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	ΔT , °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-113-045A	137.59	20.2	21.1	0.1689	132.38	126.03	22.5	18.1	57150.	75.69	76.41	0.66	61.53	7748.	7442.	-4.0	120.
R-113-046A	142.03	21.7	22.7	0.1710	136.47	127.10	7.4	6.0	19174.	76.61	78.62	1.99	64.42	7766.	7339.	-5.5	115.
R-113-047A	144.78	22.7	23.8	0.1705	139.09	126.42	5.2	4.2	13687.	77.42	80.29	2.89	65.92	7696.	7510.	-2.4	112.
R-113-048A	150.09	25.0	26.0	0.1711	144.16	126.24	3.0	2.4	8157.	79.08	83.85	4.68	68.63	7626.	6998.	-8.2	106.
R-113-049A	147.20	23.7	24.8	0.2036	143.12	150.38	22.5	18.1	57110.	75.59	76.41	0.78	71.21	9123.	8755.	-4.0	122.
R-113-050A	150.80	25.4	26.3	0.2027	145.90	149.32	7.6	6.1	19542.	75.85	78.17	2.30	73.79	9012.	8739.	-3.0	117.
R-113-051A	154.43	26.9	27.9	0.2052	149.50	150.64	5.2	4.2	13586.	76.58	79.96	3.35	76.16	9044.	8680.	-4.0	113.
R-113-053A	133.99	18.9	19.8	0.1567	128.88	117.32	22.5	18.1	56988.	75.49	76.17	0.62	58.16	7248.	6982.	-3.7	119.
R-113-054A	137.53	20.2	21.0	0.1558	132.18	116.30	7.6	6.1	19545.	76.10	77.94	1.83	60.51	7151.	6946.	-2.9	113.
R-113-055A	139.94	20.9	21.9	0.1570	134.48	116.89	5.2	4.2	13548.	76.71	79.38	2.61	61.90	7163.	6778.	-5.4	111.
R-113-056A	146.06	23.5	24.3	0.1595	140.80	118.05	3.0	2.4	8048.	78.10	82.65	4.59	65.69	7173.	6869.	-4.2	104.
R-113-057A	144.58	22.7	23.7	0.1934	140.20	143.21	22.5	18.1	56953.	75.37	76.19	0.75	68.79	8720.	8418.	-3.5	121.
R-113-058A	147.59	24.0	24.9	0.1935	143.00	142.93	7.6	6.1	19273.	74.81	77.04	2.22	71.66	8666.	8428.	-2.7	116.
R-113-059A	150.68	25.4	26.2	0.1930	145.80	142.18	5.2	4.2	13416.	75.63	78.91	3.20	73.41	8582.	8309.	-3.2	112.
R-113-060A	155.04	27.2	28.1	0.1949	149.50	143.02	3.0	2.4	7803.	75.26	80.57	5.30	77.12	8578.	7938.	-7.5	106.
R-113-061A	146.88	23.5	24.6	0.1897	134.31	141.30	22.5	18.1	58330.	77.25	78.06	0.73	69.23	8575.	8227.	-4.1	118.
R-113-062A	150.01	24.9	25.9	0.1898	138.04	140.86	7.6	6.1	19671.	76.38	78.68	2.23	72.49	8511.	8440.	-0.8	112.
R-113-063A	151.58	25.5	26.6	0.1899	139.45	140.77	5.2	4.2	13363.	75.31	78.62	3.20	74.61	8486.	8306.	-2.1	109.
R-113-064A	156.42	27.7	28.8	0.1942	144.68	143.25	3.0	2.4	7750.	74.66	80.09	5.37	79.04	8574.	8032.	-6.3	104.

Table C-19. Experimental data for R-113 condensing on tube B

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	V, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{Q_c}{Q_w} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-113-001B	128.63	17.4	18.0	0.1568	122.03	118.12	22.2	16.2	76848.	104.79	105.49	0.65	23.49	7350.	7120.	-3.1	208.
R-113-002B	130.73	17.9	18.7	0.1576	124.56	118.50	7.6	5.5	26276.	104.06	105.97	1.91	25.71	7353.	7225.	-1.7	191.
R-113-003B	132.14	18.2	19.2	0.1576	126.04	118.30	5.2	3.8	17997.	103.73	106.51	2.75	27.02	7326.	7099.	-3.1	181.
R-113-004B	135.60	19.4	20.3	0.1571	129.31	117.58	3.0	2.2	10466.	103.54	108.25	4.66	29.71	7249.	6945.	-4.2	163.
R-113-005B	128.00	17.2	17.8	0.1020	119.92	77.01	22.5	16.4	85317.	114.16	114.66	0.45	13.59	4796.	4996.	4.2	235.
R-113-006B	129.00	17.4	18.1	0.1022	120.98	77.07	7.6	5.5	28711.	113.38	114.66	1.26	14.97	4793.	4765.	-0.6	213.
R-113-007B	129.65	17.5	18.3	0.1030	121.60	77.64	5.2	3.8	19595.	112.83	114.69	1.85	15.89	4824.	4768.	-1.2	202.
R-113-008B	131.03	17.9	18.8	0.1026	123.17	77.21	3.0	2.2	11266.	111.89	114.91	3.07	17.63	4789.	4568.	-4.6	181.
R-113-009B	129.90	17.4	18.4	0.1307	121.36	98.54	22.5	16.4	82857.	111.10	111.70	0.54	18.50	6121.	6000.	-2.0	220.
R-113-010B	132.34	18.2	19.2	0.1302	124.11	97.94	7.5	5.5	27829.	111.37	112.98	1.57	20.17	6064.	5847.	-3.6	200.
R-113-011B	133.68	18.5	19.7	0.1304	125.59	97.93	5.2	3.8	19372.	111.43	113.72	2.28	21.10	6053.	5871.	-3.0	191.
R-113-012B	136.14	19.4	20.5	0.1287	128.28	96.42	3.0	2.2	11240.	111.26	115.06	3.82	22.98	5940.	5674.	-4.5	172.
R-113-013B	125.77	16.2	17.1	0.2235	120.03	168.70	22.2	16.2	64894.	88.98	89.96	0.93	36.30	10536.	10239.	-2.8	193.
R-113-014B	129.13	17.2	18.2	0.2228	123.50	167.66	7.6	5.5	22327.	88.51	91.29	2.73	39.23	10425.	10334.	-0.9	177.
R-113-015B	130.64	18.5	18.7	0.2239	125.15	168.21	5.2	3.8	15121.	87.06	90.99	3.90	41.62	10439.	10090.	-3.3	167.
R-113-016B	134.44	18.9	19.9	0.2236	128.99	167.40	3.0	2.2	8706.	85.58	92.12	6.51	45.59	10336.	9730.	-5.9	151.
R-113-017B	129.99	17.4	18.4	0.0803	121.33	60.52	22.5	16.4	89938.	120.09	120.49	0.34	9.71	3759.	3774.	0.4	258.
R-113-018B	131.42	18.4	18.9	0.0777	122.72	58.51	7.6	5.5	30551.	120.44	121.41	0.95	10.49	3627.	3577.	-1.4	230.
R-113-019B	131.74	18.0	19.0	0.0790	123.38	59.44	5.2	3.8	20819.	119.76	121.18	1.40	11.27	3683.	3615.	-1.8	218.
R-113-020B	132.66	18.4	19.3	0.0781	124.31	58.74	3.0	2.2	11974.	118.96	121.29	2.32	12.54	3636.	3443.	-5.3	193.
R-113-021B	126.28	16.4	17.3	0.1893	122.71	142.52	22.5	16.4	71637.	96.75	97.59	0.77	29.11	8895.	8626.	-3.0	204.
R-113-022B	128.88	17.2	18.1	0.1880	125.03	141.23	7.4	5.4	23544.	95.90	98.31	2.39	31.77	8784.	8780.	-0.1	184.
R-113-023B	130.60	17.5	18.6	0.1891	126.63	141.85	5.2	3.8	16578.	95.66	98.93	3.30	33.31	8803.	8541.	-3.0	176.
R-113-024B	135.15	19.0	20.2	0.1879	130.72	140.44	3.0	2.2	9691.	95.69	101.30	5.56	36.66	8663.	8291.	-4.3	157.
R-113-025B	128.72	17.0	18.0	0.1173	123.28	88.28	22.5	16.4	84059.	112.60	113.14	0.49	15.85	5492.	5431.	-1.1	231.
R-113-026B	130.00	17.5	18.4	0.1170	124.61	87.98	7.6	5.5	28312.	111.85	113.30	1.42	17.42	5464.	5342.	-2.2	209.
R-113-027B	131.05	17.9	18.8	0.1166	125.46	87.60	5.2	3.8	19397.	111.66	113.76	2.07	18.34	5433.	5340.	-1.7	197.
R-113-028B	133.50	18.5	19.6	0.1166	127.75	87.38	3.0	2.2	11248.	111.52	114.96	3.44	20.26	5402.	5118.	-5.3	178.
R-113-029B	125.48	16.2	17.0	0.2456	122.72	184.93	22.2	16.2	61961.	84.87	85.94	1.01	40.07	11553.	11208.	-3.0	192.
R-113-030B	130.12	17.5	18.5	0.2464	127.27	184.79	7.6	5.5	21436.	84.92	87.92	3.01	43.69	11475.	11413.	-0.5	175.
R-113-031B	133.45	18.7	19.6	0.2467	130.28	184.47	5.2	3.8	14855.	85.35	89.66	4.26	45.95	11405.	11028.	-3.3	165.
R-113-032B	140.92	21.4	22.3	0.2483	137.41	184.43	3.0	2.2	8854.	86.63	93.96	7.26	50.62	11287.	10848.	-3.9	149.
R-113-033B	128.83	17.2	18.1	0.0907	122.03	68.31	22.5	16.4	87821.	117.26	117.70	0.38	11.35	4249.	4238.	-0.3	249.
R-113-034B	129.80	17.5	18.4	0.0904	122.99	68.08	7.6	5.5	29628.	116.78	117.92	1.09	12.45	4230.	4110.	-2.8	226.
R-113-035B	130.37	17.7	18.6	0.0914	123.63	68.80	5.2	3.8	20190.	116.10	117.73	1.62	13.45	4271.	4186.	-2.0	211.
R-113-036B	131.70	18.2	19.0	0.0912	124.80	68.57	3.0	2.2	11639.	115.49	118.16	2.66	14.87	4249.	3954.	-7.0	190.
R-113-037B	127.81	16.7	17.7	0.0979	120.55	73.87	22.5	16.4	85978.	114.99	115.45	0.41	12.59	4601.	4528.	-1.6	243.
R-113-038B	129.38	17.4	18.2	0.0985	122.07	74.20	7.6	5.5	29082.	114.76	115.97	1.19	14.01	4612.	4494.	-2.6	219.
R-113-039B	130.44	17.7	18.6	0.0989	123.24	74.41	5.2	3.8	19937.	114.69	116.45	1.74	14.87	4619.	4490.	-2.8	207.
R-113-040B	132.54	18.4	19.3	0.0994	125.25	74.69	3.0	2.2	11552.	114.59	117.46	2.88	16.51	4624.	4285.	-7.3	187.
R-113-041B	124.64	16.2	16.8	0.2052	121.25	154.73	22.2	16.2	67094.	91.92	92.82	0.85	32.27	9677.	9376.	-3.1	200.
R-113-042B	127.71	16.9	17.7	0.2041	124.02	153.51	7.6	5.5	23043.	91.40	93.91	2.49	35.06	9563.	9422.	-1.5	182.
R-113-043B	129.85	17.5	18.4	0.2044	125.97	153.44	5.2	3.8	15841.	91.29	94.86	3.58	36.77	9532.	9267.	-2.8	173.
R-113-044B	134.55	19.0	20.0	0.2038	130.29	152.41	3.0	2.2	9259.	91.26	97.21	5.85	40.31	9409.	8741.	-7.1	155.

Table C-19 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-113-045B	131.17	18.2	18.8	0.1436	125.70	107.85	22.5	16.4	82290.	110.39	111.02	0.58	20.46	6688.	6513.	-2.6	218.
R-113-046B	132.96	18.5	19.4	0.1427	127.62	107.00	7.6	5.5	27807.	109.88	111.61	1.70	22.21	6620.	6396.	-3.4	199.
R-113-047B	134.14	18.9	19.8	0.1421	128.64	106.43	5.2	3.8	19044.	109.59	112.09	2.49	23.30	6574.	6428.	-2.2	188.
R-113-048B	136.90	19.4	20.8	0.1424	131.41	106.39	3.0	2.2	11019.	109.09	113.18	4.11	25.76	6547.	6107.	-6.7	169.
R-113-049B	126.30	16.4	17.3	0.1739	122.67	130.94	22.5	16.4	73828.	99.55	100.33	0.72	26.37	8172.	8112.	-0.7	206.
R-113-050B	128.56	17.2	18.0	0.1753	124.53	131.78	7.6	5.5	24843.	98.52	100.66	2.13	28.97	8200.	8042.	-1.9	189.
R-113-051B	130.27	17.1	18.5	0.1743	126.24	130.79	5.2	3.8	17043.	98.27	101.39	3.06	30.44	8121.	7923.	-2.4	178.
R-113-052B	134.00	18.9	19.8	0.1736	129.73	129.86	3.0	2.2	9928.	98.18	103.27	5.13	33.27	8023.	7654.	-4.6	161.

Table C-20. Experimental data for R-113 condensing on tube C

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-113-033C	125.85	16.9	17.1	0.1543	118.24	116.64	22.2	20.8	78915.	102.19	102.84	0.61	23.34	7284.	6756.	-7.2	279.
R-113-034C	125.14	16.8	16.9	0.1535	117.73	116.11	7.6	7.1	26277.	98.98	100.86	1.85	25.22	7257.	7010.	-3.4	257.
R-113-035C	126.03	16.9	17.2	0.1515	118.12	114.57	5.2	4.9	18042.	98.90	101.58	2.68	25.79	7153.	6922.	-3.2	248.
R-113-036C	128.95	17.7	18.1	0.1508	120.90	113.73	3.0	2.8	10506.	98.94	103.27	4.33	27.85	7073.	6456.	-8.7	227.
R-113-037C	126.36	17.2	17.3	0.1104	116.90	83.55	22.2	20.8	87298.	112.50	112.98	0.45	13.62	5214.	4974.	-4.6	342.
R-113-038C	128.66	17.5	18.0	0.1099	118.82	83.05	7.6	7.1	30145.	112.96	114.30	1.34	15.03	5167.	5067.	-1.9	307.
R-113-039C	130.33	18.0	18.6	0.1099	120.11	82.95	5.2	4.9	20804.	113.56	115.49	1.90	15.81	5150.	4910.	-4.7	291.
R-113-040C	133.59	19.2	19.6	0.1096	123.22	82.53	3.0	2.8	12200.	114.67	117.84	3.17	17.34	5101.	4717.	-7.5	263.
R-113-041C	128.24	17.5	17.9	0.1857	122.54	139.84	22.2	20.8	75210.	97.64	98.45	0.75	30.20	8705.	8257.	-5.1	258.
R-113-042C	131.02	18.3	18.8	0.1868	125.19	140.37	7.6	7.1	25823.	97.19	99.44	2.23	32.71	8707.	8412.	-3.4	238.
R-113-043C	132.88	18.9	19.4	0.1880	127.06	140.96	5.2	4.9	17693.	96.87	100.02	3.14	34.44	8722.	8127.	-6.8	227.
R-113-044C	136.33	20.2	20.6	0.1880	130.42	140.58	3.0	2.8	10303.	96.59	102.01	5.41	37.04	8658.	8075.	-6.7	209.
R-113-045C	129.16	18.4	18.2	0.0740	115.10	56.10	22.2	20.8	94317.	121.08	121.41	0.28	7.91	3488.	3109.	-10.9	394.
R-113-046C	131.73	19.2	19.0	0.0735	116.96	55.66	7.6	7.1	32833.	122.73	123.65	0.93	8.54	3449.	3501.	1.5	361.
R-113-047C	133.51	19.9	19.6	0.0748	119.16	56.50	5.2	4.9	22660.	123.54	124.90	1.35	9.29	3493.	3471.	-0.6	336.
R-113-048C	134.92	20.4	20.1	0.0748	120.55	56.43	3.0	2.8	13089.	123.23	125.50	2.27	10.55	3482.	3376.	-3.0	295.
R-113-049C	127.35	17.2	17.6	0.1027	118.52	77.62	22.2	20.8	89344.	114.92	115.37	0.43	12.20	4838.	4699.	-2.9	355.
R-113-050C	129.12	17.7	18.2	0.1020	120.36	76.98	7.6	7.1	30691.	114.86	116.15	1.29	13.61	4787.	4856.	1.4	315.
R-113-051C	129.31	17.7	18.2	0.1026	121.08	77.38	5.2	4.9	20834.	113.75	115.60	1.83	14.64	4810.	4709.	-2.1	294.
R-113-052C	130.80	18.2	18.7	0.1022	122.16	76.99	3.0	2.8	12022.	113.15	116.25	3.10	16.10	4777.	4617.	-3.3	265.
R-113-053C	130.53	18.2	18.6	0.1194	123.08	89.85	22.2	20.8	89212.	114.72	115.26	0.51	15.53	5577.	5601.	0.4	321.
R-113-054C	132.51	18.8	19.3	0.1203	125.01	90.42	7.6	7.1	30572.	114.36	115.83	1.47	17.41	5597.	5553.	-0.8	288.
R-113-055C	133.05	19.0	19.5	0.1218	125.79	91.43	5.2	4.9	20754.	113.18	115.37	2.17	18.77	5656.	5596.	-1.1	269.
R-113-056C	134.19	19.5	19.9	0.1205	126.88	90.38	3.0	2.8	11915.	112.00	115.54	3.55	20.42	5582.	5279.	-5.4	245.
R-113-057C	126.43	17.0	17.3	0.0899	118.28	67.94	22.2	20.8	90444.	116.24	116.65	0.38	9.99	4239.	4236.	-0.1	380.
R-113-058C	127.57	17.2	17.7	0.0888	118.89	67.09	7.5	7.0	30571.	115.93	117.06	1.13	11.07	4180.	4204.	0.6	338.
R-113-059C	128.39	17.7	17.9	0.0890	119.87	67.20	5.2	4.9	21236.	115.89	117.51	1.59	11.69	4182.	4111.	-1.7	320.
R-113-060C	130.17	18.3	18.5	0.0884	121.16	66.64	3.0	2.8	12314.	115.92	118.57	2.65	12.92	4138.	3942.	-4.7	286.
R-113-061C	129.35	18.1	18.2	0.0677	119.07	51.14	22.2	20.8	95712.	122.79	123.11	0.26	6.40	3179.	2911.	-8.4	444.
R-113-062C	131.00	18.4	18.8	0.0676	120.35	51.03	7.6	7.1	32991.	123.33	124.19	0.86	7.24	3165.	3231.	2.1	391.
R-113-063C	132.34	19.0	19.2	0.0680	121.26	51.31	5.2	4.9	22725.	123.95	125.18	1.22	7.78	3177.	3142.	-1.1	365.
R-113-064C	134.32	19.4	19.9	0.0676	122.88	50.89	3.0	2.8	13234.	124.71	126.73	2.01	8.60	3142.	2991.	-4.8	327.
R-113-065C	128.24	17.7	17.9	0.1317	122.31	99.21	22.2	20.8	85001.	109.75	110.32	0.53	18.21	6176.	5843.	-5.4	303.
R-113-066C	129.24	18.0	18.2	0.1343	123.42	101.06	7.6	7.1	28689.	107.64	109.29	1.65	20.77	6283.	6222.	-1.0	271.
R-113-067C	129.70	18.2	18.3	0.1331	123.90	100.11	5.2	4.9	19570.	106.97	109.36	2.39	21.53	6220.	6175.	-0.7	258.
R-113-068C	131.93	19.0	19.1	0.1316	125.64	98.82	3.0	2.8	11346.	106.66	110.63	4.02	23.28	6122.	5981.	-2.3	235.
R-113-069C	125.46	16.9	17.0	0.2250	121.65	169.59	22.2	20.8	65833.	85.75	86.70	0.87	39.24	10595.	9631.	-9.1	242.
R-113-070C	127.42	17.4	17.6	0.2217	123.35	166.84	7.6	7.1	22465.	84.44	87.19	2.71	41.60	10397.	10263.	-1.3	224.
R-113-071C	129.15	17.9	18.2	0.2203	125.08	165.52	5.2	4.9	15459.	84.97	87.90	3.89	42.72	10292.	10085.	-2.0	215.
R-113-072C	133.42	19.2	19.6	0.2228	129.01	166.78	3.0	2.8	8967.	83.69	90.09	6.36	46.54	10312.	9509.	-7.8	198.
R-113-073C	131.01	18.7	18.8	0.0585	118.89	44.21	22.2	20.8	98038.	125.70	126.00	0.26	5.16	2742.	2812.	2.6	476.
R-113-074C	130.96	18.7	18.8	0.0585	118.73	44.21	7.6	7.1	33341.	124.67	125.39	0.72	5.93	2742.	2723.	-0.7	414.
R-113-075C	130.92	18.6	18.7	0.0584	119.29	44.11	5.2	4.9	22709.	123.95	125.01	1.04	6.44	2737.	2689.	-1.7	380.
R-113-076C	131.32	19.6	18.9	0.0587	119.94	44.31	3.0	2.8	13043.	123.06	124.83	1.77	7.38	2747.	2626.	-4.4	333.

Table C-20 (continued)

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-113-077C	124.30	16.6	16.7	0.1696	119.13	128.13	22.2	20.8	74846.	97.24	97.96	0.67	26.70	8017.	7396.	-7.7	269.
R-113-078C	126.83	17.2	17.4	0.1691	121.29	127.50	7.6	7.1	25724.	96.91	99.01	2.11	28.87	7952.	7959.	0.1	286.
R-113-079C	128.24	17.6	17.9	0.1692	122.71	127.41	5.2	4.9	17633.	96.64	99.62	2.96	30.11	7931.	7654.	-3.5	236.
R-113-080C	131.42	18.5	18.9	0.1694	125.86	127.18	3.0	2.8	10207.	95.91	100.96	5.06	32.99	7884.	7542.	-4.3	214.

Table C-21. Experimental data for R-113 condensing on tube D

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT _f , °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-113-001D	130.31	18.2	18.5	0.1532	122.34	115.38	23.3	14.6	82617.	110.77	111.43	0.61	19.21	7163.	7056.	-1.5	334.
R-113-002D	132.66	18.9	19.3	0.1501	124.95	112.79	7.6	4.8	26868.	109.87	111.73	1.86	21.86	6981.	6999.	0.3	286.
R-113-003D	133.96	19.4	19.8	0.1496	126.34	112.30	5.2	3.3	18387.	109.44	112.21	2.72	23.14	6938.	7018.	1.2	268.
R-113-004D	136.83	20.4	20.8	0.1495	128.98	111.95	3.0	1.9	10678.	109.29	113.68	4.46	25.34	6890.	6633.	-3.7	243.
R-113-005D	129.65	17.9	18.3	0.1891	124.51	142.12	23.3	14.6	76277.	102.59	103.38	0.73	26.66	8831.	8493.	-3.8	296.
R-113-006D	133.04	19.0	19.5	0.1907	127.82	142.93	7.6	4.8	24942.	102.07	104.38	2.29	29.82	8841.	8654.	-2.1	265.
R-113-007D	134.72	19.5	20.0	0.1891	129.50	141.47	5.2	3.3	17161.	102.10	105.40	3.30	30.97	8731.	8533.	-2.3	252.
R-113-008D	138.86	21.0	21.5	0.1900	133.42	141.62	3.0	1.9	9977.	101.94	107.34	5.42	34.22	8692.	8071.	-7.1	227.
R-113-009D	132.28	18.9	19.2	0.0978	122.52	73.63	23.3	14.6	92491.	123.29	123.73	0.38	8.76	4560.	4439.	-2.6	465.
R-113-010D	133.41	19.2	19.6	0.0965	123.72	72.59	7.6	4.8	30065.	122.51	123.71	1.17	10.30	4488.	4385.	-2.3	390.
R-113-011D	133.98	19.4	19.8	0.0969	124.32	72.87	5.2	3.3	20513.	121.91	123.64	1.70	11.21	4502.	4367.	-3.0	359.
R-113-012D	135.55	19.9	20.3	0.0963	125.74	72.29	3.0	1.9	11828.	121.33	124.10	2.78	12.83	4457.	4134.	-7.2	311.
R-113-013D	132.24	18.9	19.2	0.1247	124.71	93.72	23.3	14.6	88967.	118.62	119.17	0.49	13.35	5804.	5717.	-1.5	389.
R-113-014D	133.57	19.2	19.6	0.1253	125.87	94.07	7.6	4.8	28860.	117.52	119.05	1.50	15.28	5815.	5662.	-2.6	340.
R-113-015D	134.14	19.5	19.8	0.1255	126.32	94.18	5.2	3.3	19659.	116.72	118.89	2.17	16.33	5818.	5588.	-3.9	319.
R-113-016D	136.09	20.2	20.5	0.1252	128.02	93.84	3.0	1.9	11317.	115.77	119.36	3.65	18.53	5781.	5427.	-6.1	279.
R-113-017D	127.70	17.7	17.7	0.2235	120.88	168.55	23.3	14.6	67414.	91.13	92.08	0.88	36.09	10500.	10177.	-3.1	260.
R-113-018D	129.88	18.4	18.4	0.2198	123.11	165.42	7.6	4.8	21984.	90.21	92.96	2.62	38.29	10276.	9921.	-3.5	240.
R-113-019D	131.77	19.0	19.0	0.2189	125.02	164.46	5.2	3.3	15125.	90.17	93.97	3.78	39.70	10190.	9780.	-4.0	230.
R-113-020D	137.94	21.0	21.2	0.2203	131.02	164.63	3.0	1.9	8916.	90.76	97.18	6.42	43.97	10117.	9588.	-5.2	206.
R-113-021D	129.37	17.7	18.2	0.1101	121.83	82.95	23.3	14.6	88563.	118.14	118.64	0.44	10.97	5156.	5128.	-0.6	420.
R-113-022D	130.91	18.2	18.7	0.1125	123.16	84.70	7.6	4.8	28766.	117.22	118.64	1.39	12.98	5254.	5247.	-0.1	362.
R-113-023D	130.57	18.2	18.6	0.1094	123.01	82.38	5.2	3.3	19552.	116.26	118.17	1.93	13.36	5113.	4969.	-2.8	342.
R-113-024D	132.48	18.9	19.3	0.1092	124.67	82.10	3.0	1.9	11281.	115.61	118.84	3.23	15.25	5082.	4797.	-5.6	298.
R-113-025D	128.33	17.5	17.9	0.1410	121.93	106.28	23.3	14.6	83343.	111.68	112.30	0.56	16.34	6615.	6502.	-1.7	362.
R-113-026D	130.05	18.0	18.5	0.1406	123.27	105.84	7.6	4.8	27048.	110.60	112.35	1.71	18.57	6573.	6438.	-2.1	317.
R-113-027D	130.96	18.4	18.8	0.1408	124.29	105.89	5.2	3.3	18457.	109.97	112.44	2.44	19.76	6568.	6289.	-4.3	297.
R-113-028D	133.66	19.3	19.7	0.1409	126.81	105.72	3.0	1.9	10692.	109.50	113.55	4.06	22.14	6534.	6042.	-7.5	264.
R-113-029D	128.58	17.4	18.0	0.0773	119.36	58.41	23.3	14.6	91335.	121.85	122.23	0.33	6.54	3634.	3770.	3.7	497.
R-113-030D	129.29	17.9	18.2	0.0807	120.14	60.93	7.6	4.8	29636.	120.93	121.94	0.97	7.85	3788.	3667.	-3.2	432.
R-113-031D	129.63	18.0	18.3	0.0780	120.39	58.84	5.2	3.3	20217.	120.37	121.82	1.43	8.53	3656.	3685.	0.8	383.
R-113-032D	130.94	18.4	18.8	0.0803	121.35	60.54	3.0	1.9	11645.	119.68	122.15	2.44	10.02	3755.	3616.	-3.7	335.
R-113-033D	127.23	17.2	17.6	0.1384	121.73	104.33	23.3	14.6	83240.	111.56	112.16	0.54	15.36	6503.	6271.	-3.6	379.
R-113-034D	128.57	17.7	18.0	0.1382	123.11	104.06	7.6	4.8	26847.	109.86	111.58	1.68	17.85	6475.	6344.	-2.0	324.
R-113-035D	129.00	17.9	18.1	0.1369	123.50	102.98	5.2	3.3	18267.	108.97	111.36	2.40	18.83	6404.	6193.	-3.3	304.
R-113-036D	131.05	18.5	18.8	0.1363	125.30	102.42	3.0	1.9	10532.	108.14	112.06	3.93	20.95	6353.	5839.	-8.1	271.
R-113-037D	130.40	18.2	18.6	0.0678	119.96	51.21	23.3	14.6	93822.	125.07	125.41	0.28	5.16	3179.	3263.	2.6	551.
R-113-038D	131.13	18.4	18.8	0.0685	120.78	51.66	7.6	4.8	30488.	124.35	125.21	0.85	6.35	3204.	3185.	-0.6	451.
R-113-039D	131.62	18.5	19.0	0.0695	121.30	52.42	5.2	3.3	20810.	123.85	125.12	1.24	7.13	3249.	3186.	-1.9	407.
R-113-040D	132.76	19.0	19.4	0.0695	122.23	52.38	3.0	1.9	12014.	123.56	125.57	2.01	8.19	3241.	2985.	-7.9	354.
R-113-041D	129.41	17.7	18.3	0.1741	119.83	131.48	23.3	14.6	77548.	104.33	105.09	0.70	24.69	8173.	8143.	-0.4	296.
R-113-042D	131.86	18.5	19.1	0.1749	122.52	131.69	7.6	4.8	25270.	103.55	105.69	2.14	27.24	8159.	8086.	-0.9	268.
R-113-043D	133.59	19.2	19.6	0.1755	124.38	131.95	5.2	3.3	17311.	103.19	106.28	3.05	28.86	8156.	7869.	-3.5	253.
R-113-044D	137.24	20.4	20.9	0.1758	128.00	131.73	3.0	1.9	10058.	102.85	107.98	5.11	31.82	8102.	7614.	-6.0	228.

Table C-21 (continued)

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-113-045D	126.75	17.2	17.4	0.2095	120.81	158.05	23.3	14.6	69434.	93.77	94.65	0.84	32.53	9858.	9702.	-1.6	271.
R-113-046D	130.67	18.5	18.7	0.2118	124.72	159.22	7.6	4.8	22735.	93.25	95.85	2.60	36.11	9880.	9838.	-0.4	245.
R-113-047D	132.67	18.9	19.3	0.2125	126.90	159.41	5.2	3.3	15600.	92.94	96.68	3.71	37.86	9866.	9603.	-2.7	233.
R-113-048D	137.42	20.7	21.0	0.2116	131.23	158.04	3.0	1.9	9118.	93.07	99.18	6.12	41.29	9719.	9133.	-6.0	211.
R-113-049D	130.01	18.0	18.4	0.1210	121.04	91.29	23.3	14.6	87576.	116.91	117.44	0.49	12.83	5670.	5613.	-1.0	395.
R-113-050D	131.99	18.7	19.1	0.1244	123.29	93.63	7.6	4.8	28447.	115.97	117.48	1.51	15.27	5800.	5681.	-2.1	340.
R-113-051D	133.57	19.2	19.6	0.1245	125.03	93.58	5.2	3.3	19547.	116.07	118.30	2.20	16.38	5784.	5678.	-1.8	316.
R-113-052D	136.80	20.2	20.8	0.1252	127.79	93.86	3.0	1.9	11362.	116.14	119.86	3.69	18.80	5777.	5493.	-4.9	275.
R-113-053D	126.12	17.0	17.2	0.1971	119.74	148.83	23.3	14.6	71046.	95.99	96.84	0.79	29.70	9290.	9141.	-1.6	280.
R-113-054D	129.11	17.9	18.2	0.1979	122.48	149.03	7.6	4.8	23175.	95.23	97.61	2.41	32.69	9267.	9108.	-1.7	254.
R-113-055D	131.13	18.4	18.8	0.1972	124.58	148.22	5.2	3.3	15911.	94.95	98.51	3.51	34.39	9192.	9081.	-1.2	239.
R-113-056D	135.68	20.0	20.4	0.1990	128.98	148.99	3.0	1.9	9291.	94.94	100.72	5.84	37.85	9184.	8713.	-5.1	217.
R-113-057D	130.35	18.0	18.6	0.0886	121.06	66.82	23.3	14.6	91765.	122.37	122.80	0.36	7.76	4148.	4185.	0.9	478.
R-113-058D	131.18	18.4	18.8	0.0880	121.98	66.29	7.6	4.8	29906.	122.43	122.53	1.10	8.70	4110.	4129.	0.5	423.
R-113-059D	131.90	18.5	19.1	0.0890	122.44	67.06	5.2	3.3	20364.	121.15	122.71	1.55	9.97	4155.	3991.	-3.9	373.
R-113-060D	133.46	19.0	19.6	0.0871	123.79	65.54	3.0	1.9	11760.	120.77	123.31	2.56	11.42	4052.	3802.	-6.2	317.
R-113-061D	128.05	17.4	17.8	0.1651	122.67	124.35	23.3	14.6	79007.	106.15	106.88	0.66	21.53	7743.	7635.	-1.4	322.
R-113-062D	129.70	18.0	18.3	0.1639	124.05	123.25	7.5	4.7	25269.	104.88	106.91	2.01	23.81	7658.	7492.	-2.2	288.
R-113-063D	131.29	18.4	18.9	0.1647	125.37	123.68	5.2	3.3	17552.	104.63	107.51	2.87	25.22	7669.	7414.	-3.3	272.
R-113-064D	134.77	19.5	20.1	0.1650	128.70	123.57	3.0	1.9	10171.	104.09	108.91	4.81	28.27	7626.	7165.	-6.0	241.

Table C-22. Experimental data for R-113 condensing on tube E

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{Q_c}{Q_w} \times 100$	U _o , Btu hr·ft ² ·°F
R-113-001E	130.82	18.2	18.7	0.1566	123.08	117.85	23.3	18.8	94856.	119.57	120.25	0.63	10.91	7311.	7218.	-1.3	416.
R-113-002E	133.04	18.9	19.5	0.1567	125.31	117.72	7.6	6.1	30792.	118.40	120.35	1.91	13.67	7282.	7191.	-1.3	332.
R-113-003E	134.40	19.4	19.9	0.1566	126.55	117.50	5.2	4.2	21036.	117.84	120.57	2.72	15.20	7255.	7007.	-3.4	297.
R-113-004E	137.36	20.2	21.0	0.1549	129.47	115.90	3.0	2.4	12127.	116.89	121.36	4.44	18.23	7128.	6587.	-7.6	244.
R-113-005E	128.67	17.4	18.0	0.1206	121.46	90.94	23.3	18.8	95953.	120.93	121.48	0.49	7.46	5658.	5673.	0.3	473.
R-113-006E	130.36	17.9	18.6	0.1230	123.39	92.58	7.6	6.1	31110.	119.76	121.29	1.49	9.84	5747.	5604.	-2.5	364.
R-113-007E	131.37	18.2	18.9	0.1231	124.36	92.59	5.2	4.2	21234.	119.16	121.34	2.15	11.12	5740.	5540.	-3.5	322.
R-113-008E	133.74	19.4	19.7	0.1231	126.61	92.34	3.0	2.4	12221.	118.22	121.74	3.54	13.76	5706.	5258.	-7.9	258.
R-113-009E	128.00	17.2	17.8	0.0960	120.11	72.43	23.3	18.8	97006.	122.24	122.69	0.40	5.53	4510.	4577.	1.5	508.
R-113-010E	129.31	17.7	18.2	0.0974	121.38	73.42	7.6	6.1	31505.	121.35	122.58	1.19	7.34	4564.	4475.	-1.9	387.
R-113-011E	129.94	17.9	18.4	0.0968	121.57	72.94	5.2	4.2	21478.	120.67	122.42	1.72	8.39	4531.	4423.	-2.4	336.
R-113-012E	131.21	18.2	18.8	0.0981	122.61	73.87	3.0	2.4	12311.	119.40	122.21	2.83	10.41	4580.	4197.	-8.4	274.
R-113-013E	127.51	17.2	17.6	0.1877	120.23	141.64	23.3	18.8	88749.	112.22	113.04	0.75	14.88	8826.	8673.	-1.7	370.
R-113-014E	129.90	17.9	18.4	0.1893	122.69	142.52	7.6	6.1	28667.	110.48	112.79	2.26	18.26	8853.	8532.	-3.6	302.
R-113-015E	131.06	18.4	18.8	0.1878	123.88	141.27	5.2	4.2	19469.	109.24	112.52	3.24	20.18	8762.	8356.	-4.6	271.
R-113-016E	134.84	19.5	20.1	0.1880	127.65	140.94	3.0	2.4	11199.	107.83	113.35	5.54	24.25	8698.	8233.	-5.3	223.
R-113-017E	126.46	16.9	17.3	0.2247	120.59	169.52	23.0	18.5	81167.	104.42	105.39	0.91	21.55	10578.	10368.	-2.0	306.
R-113-018E	129.70	17.9	18.3	0.2244	123.59	168.83	7.6	6.1	26767.	103.36	106.07	2.70	24.98	10490.	10195.	-2.8	262.
R-113-019E	132.44	18.9	19.3	0.2238	126.48	167.95	5.1	4.1	18003.	102.94	106.93	3.99	27.50	10397.	10107.	-2.8	236.
R-113-020E	137.59	20.5	21.1	0.2239	131.31	167.22	3.0	2.4	10692.	102.57	109.14	6.56	31.74	10281.	9775.	-4.9	202.
R-113-021E	129.92	17.9	18.4	0.1412	120.91	106.47	23.0	18.5	93852.	119.85	120.50	0.57	9.75	6613.	6522.	-1.4	423.
R-113-022E	131.86	18.7	19.1	0.1405	122.72	105.82	7.6	6.1	30888.	118.86	120.58	1.69	12.13	6556.	6345.	-3.2	337.
R-113-023E	133.24	19.2	19.5	0.1409	124.05	105.97	5.1	4.1	20677.	118.19	120.71	2.50	13.79	6554.	6304.	-3.8	296.
R-113-024E	136.43	20.2	20.6	0.1450	127.37	108.70	3.0	2.4	12158.	117.28	121.52	4.20	17.03	6694.	6243.	-6.7	245.
R-113-025E	129.15	17.9	18.2	0.2512	121.73	189.34	23.0	18.5	77478.	99.83	100.90	1.02	28.78	11773.	11677.	-0.8	255.
R-113-026E	132.83	18.9	19.4	0.2532	125.45	190.18	7.6	6.1	25452.	98.28	101.36	3.06	33.01	11768.	11583.	-1.6	222.
R-113-027E	135.70	20.0	20.4	0.2560	128.30	191.79	5.2	4.2	17431.	97.69	102.12	4.51	35.79	11822.	11662.	-1.4	206.
R-113-028E	141.23	21.9	22.4	0.2559	134.01	190.63	3.0	2.4	10205.	97.59	104.97	7.43	39.95	11662.	11085.	-4.9	182.
R-113-029E	130.40	18.2	18.6	0.1083	120.68	81.72	23.0	18.5	96945.	123.68	124.17	0.43	6.47	5073.	4951.	-2.4	488.
R-113-030E	132.46	18.7	19.3	0.1077	122.81	81.08	7.6	6.1	32086.	123.47	124.77	1.28	8.34	5020.	4803.	-4.3	375.
R-113-031E	133.76	19.2	19.7	0.1087	124.11	81.72	5.2	4.2	21965.	123.23	125.12	1.88	9.58	5050.	4835.	-4.3	329.
R-113-032E	135.97	20.0	20.5	0.1092	126.35	81.94	3.0	2.4	12683.	122.74	125.83	3.09	11.68	5049.	4595.	-9.0	269.
R-113-033E	130.52	18.2	18.6	0.0837	120.15	63.15	23.0	18.5	98507.	125.67	126.08	0.35	4.64	3920.	3972.	1.3	526.
R-113-034E	131.12	18.5	18.8	0.0849	121.00	64.07	7.6	6.1	32322.	124.49	125.52	1.02	6.11	3973.	3825.	-3.7	405.
R-113-035E	131.68	18.7	19.0	0.0849	121.48	64.04	5.2	4.2	22044.	123.87	125.36	1.47	7.07	3969.	3783.	-4.7	350.
R-113-036E	133.27	19.0	19.5	0.0843	122.82	63.48	3.0	2.4	12709.	123.30	125.76	2.44	8.74	3925.	3630.	-7.5	280.
R-113-037E	127.72	17.4	17.7	0.2034	121.81	153.31	23.0	18.5	85606.	109.85	110.73	0.82	17.43	9550.	9325.	-2.4	341.
R-113-038E	130.73	18.4	18.7	0.2044	124.70	153.62	7.6	6.1	28098.	108.21	110.70	2.47	21.28	9532.	9331.	-2.1	279.
R-113-039E	133.25	19.2	19.5	0.2075	127.13	155.63	5.2	4.2	19181.	107.42	111.04	3.64	24.02	9624.	9392.	-2.4	250.
R-113-040E	138.51	20.9	21.4	0.2062	132.12	153.93	3.0	2.4	11122.	106.71	112.76	6.00	28.77	9452.	8936.	-5.5	205.
R-113-041E	127.17	17.4	17.5	0.2753	122.56	207.33	23.0	18.5	71062.	91.83	92.98	1.10	34.76	12925.	12658.	-2.1	232.
R-113-042E	131.70	18.7	19.0	0.2751	126.80	206.39	7.5	6.0	23281.	91.12	94.52	3.41	38.88	12790.	12749.	-0.3	205.
R-113-043E	134.72	19.7	20.0	0.2759	129.90	206.33	5.2	4.2	16268.	91.11	95.91	4.85	41.21	12735.	12556.	-1.4	193.
R-113-044E	140.74	21.7	22.2	0.2794	135.84	207.83	3.0	2.4	9434.	89.97	97.96	8.01	46.78	12722.	11974.	-5.9	169.

Table C-22 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-113-045E	128.93	17.7	18.1	0.1703	121.93	128.35	23.0	18.5	90880.	116.10	116.84	0.68	12.46	7983.	7775.	-2.6	399.
R-113-046E	132.17	18.7	19.2	0.1731	125.25	130.02	7.6	6.1	30015.	115.36	117.48	2.09	15.75	8052.	7881.	-2.1	318.
R-113-047E	134.06	19.5	19.8	0.1707	127.39	127.95	5.1	4.1	20137.	114.84	117.95	3.14	17.67	7904.	7942.	0.5	279.
R-113-048E	138.50	20.9	21.4	0.1743	131.54	130.16	2.9	2.3	11475.	113.95	119.29	5.31	21.88	7992.	7635.	-4.5	228.
R-113-049E	128.59	17.5	18.0	0.2965	123.21	223.20	23.0	18.5	67330.	87.11	88.37	1.20	40.85	13888.	13804.	-0.6	212.
R-113-050E	133.19	19.0	19.5	0.2974	127.95	222.83	7.5	6.0	22152.	86.67	90.34	3.64	44.69	13781.	13597.	-1.3	192.
R-113-051E	136.06	20.2	20.5	0.2996	130.92	223.87	5.2	4.2	15271.	85.41	90.62	5.18	48.04	13792.	13408.	-2.8	179.
R-113-052E	142.17	22.4	22.8	0.3027	137.17	224.87	3.0	2.4	8895.	84.47	93.20	8.65	53.34	13738.	12920.	-6.0	160.
R-113-053E	128.81	17.7	18.1	0.1361	122.10	102.53	23.0	18.5	93771.	119.77	120.38	0.55	8.74	6378.	6271.	-1.7	455.
R-113-054E	130.57	18.2	18.6	0.1370	123.80	103.04	7.6	6.1	30787.	118.53	120.18	1.64	11.21	6395.	6187.	-3.3	355.
R-113-055E	131.76	18.7	19.0	0.1382	124.85	103.85	5.2	4.2	21001.	117.61	120.08	2.44	12.92	6435.	6279.	-2.4	310.
R-113-056E	134.13	19.4	19.8	0.1371	127.14	102.84	3.0	2.4	12066.	116.41	120.37	3.95	15.73	6352.	5874.	-7.5	252.
R-113-057E	126.11	16.9	17.2	0.2347	121.84	176.85	23.0	18.5	79046.	101.73	102.74	0.95	23.88	11040.	10854.	-1.7	288.
R-113-058E	129.26	17.9	18.2	0.2354	124.48	176.95	7.5	6.0	25610.	100.20	103.06	2.86	27.63	11001.	10685.	-2.9	248.
R-113-059E	131.37	18.5	18.9	0.2347	126.49	176.13	5.2	4.2	17743.	99.49	103.64	4.08	29.80	10919.	10550.	-3.4	228.
R-113-060E	137.26	20.5	20.9	0.2365	132.28	176.52	3.0	2.4	10339.	99.10	105.89	6.81	34.76	10857.	10157.	-6.4	195.

Table C-23. Experimental data for R-113 condensing on tube F

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\bar{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-113-005F	127.54	17.2	17.7	0.1511	121.36	113.91	23.5	17.1	77424.	99.98	100.64	0.60	27.23	7098.	7035.	-0.9	251.
R-113-006F	129.24	17.9	18.2	0.1500	122.98	112.96	7.6	5.5	24900.	98.85	100.74	1.85	29.44	7023.	6984.	-0.6	230.
R-113-007F	130.85	18.6	18.7	0.1506	124.43	113.24	5.2	3.8	17043.	98.47	101.19	2.69	31.02	7025.	6966.	-0.8	216.
R-113-008F	134.07	19.4	19.8	0.1514	127.63	113.49	2.9	2.1	9504.	97.45	102.19	4.65	34.25	7011.	6707.	-4.3	197.
R-113-009F	130.89	18.4	18.7	0.0855	119.92	64.52	23.5	17.1	95506.	121.97	122.39	0.35	8.71	4003.	4128.	3.1	443.
R-113-010F	131.86	18.5	19.1	0.0884	120.98	66.67	7.6	5.5	30708.	120.95	122.07	1.08	10.35	4131.	4081.	-1.2	384.
R-113-011F	132.46	18.9	19.3	0.0875	121.64	65.98	5.2	3.8	20967.	120.48	122.06	1.57	11.19	4085.	4050.	-0.8	352.
R-113-012F	134.02	19.4	19.8	0.0861	123.03	64.80	3.0	2.2	12083.	119.88	122.42	2.56	12.87	4003.	3808.	-4.9	300.
R-113-013F	131.54	18.7	19.0	0.0792	120.22	59.80	23.5	17.1	97181.	124.05	124.42	0.32	7.31	3706.	3768.	1.7	489.
R-113-014F	132.59	19.0	19.3	0.0790	121.54	59.56	7.6	5.5	31311.	123.28	124.29	0.98	8.80	3686.	3682.	-0.1	404.
R-113-015F	133.14	19.2	19.5	0.0794	121.91	59.86	5.2	3.8	21399.	122.94	124.36	1.41	9.49	3703.	3631.	-1.9	376.
R-113-016F	134.57	19.7	20.0	0.0801	123.40	60.25	3.0	2.2	12311.	122.12	124.51	2.36	11.26	3719.	3508.	-5.7	318.
R-113-017F	128.50	17.5	18.0	0.1097	120.55	82.76	23.5	17.1	89371.	114.46	114.97	0.43	13.78	5150.	5044.	-2.1	360.
R-113-018F	129.32	17.9	18.2	0.1109	121.63	83.58	7.6	5.5	28535.	112.70	114.06	1.35	15.94	5195.	5097.	-1.9	314.
R-113-019F	129.10	17.9	18.2	0.1094	121.69	82.49	5.2	3.8	19308.	111.25	113.23	1.95	16.86	5129.	5039.	-1.8	293.
R-113-020F	130.45	18.2	18.6	0.1090	122.40	82.11	3.0	2.2	11045.	109.78	112.98	3.24	19.07	5097.	4812.	-5.6	257.
R-113-021F	131.07	18.4	18.8	0.1254	123.72	94.32	23.5	17.1	87284.	111.99	112.55	0.50	18.80	5850.	5824.	-0.4	300.
R-113-022F	133.01	19.0	19.4	0.1249	125.39	93.82	7.6	5.5	28278.	111.68	113.22	1.53	20.56	5804.	5763.	-0.7	272.
R-113-023F	134.61	19.5	20.0	0.1257	127.01	94.24	5.2	3.8	19411.	111.66	113.90	2.24	21.83	5817.	5781.	-0.6	257.
R-113-024F	136.87	20.4	20.8	0.1265	129.30	94.64	3.0	2.2	11160.	110.61	114.25	3.67	24.43	5824.	5465.	-6.2	230.
R-113-025F	130.46	18.4	18.6	0.0987	121.93	74.39	23.5	17.1	93610.	119.67	120.12	0.40	10.56	4617.	4605.	-0.3	421.
R-113-026F	131.72	18.7	19.0	0.0987	123.19	74.30	7.6	5.5	30124.	118.72	119.97	1.21	12.37	4604.	4551.	-1.2	359.
R-113-027F	132.31	18.9	19.2	0.0987	123.62	74.27	5.1	3.7	20170.	118.02	119.82	1.77	13.38	4599.	4467.	-2.9	331.
R-113-028F	133.91	19.4	19.8	0.0993	125.21	74.59	3.0	2.2	11815.	117.02	119.89	2.90	15.45	4609.	4317.	-6.3	287.
R-113-029F	130.99	18.5	18.8	0.0691	120.53	52.11	23.3	17.0	97199.	125.13	125.47	0.28	5.69	3232.	3263.	0.9	547.
R-113-030F	132.00	18.9	19.1	0.0686	121.31	51.75	7.5	5.5	31240.	124.68	125.55	0.85	6.89	3206.	3170.	-1.1	449.
R-113-031F	132.75	19.0	19.4	0.0695	121.93	52.37	5.1	3.7	21239.	124.47	125.71	1.25	7.66	3241.	3147.	-2.9	407.
R-113-032F	134.33	19.7	19.9	0.0701	123.41	52.75	3.0	2.2	12505.	124.17	126.23	2.09	9.13	3257.	3098.	-4.9	344.
R-113-033F	129.13	17.7	18.2	0.1360	119.50	102.72	23.5	17.1	81549.	105.07	105.68	0.55	23.75	6387.	6428.	0.6	259.
R-113-034F	130.53	18.2	18.6	0.1369	120.98	103.23	7.6	5.5	26103.	103.53	105.24	1.70	26.14	6407.	6418.	0.2	236.
R-113-035F	131.43	18.5	18.9	0.1391	121.96	104.79	5.2	3.8	17681.	102.01	104.54	2.48	28.15	6496.	6402.	-1.4	222.
R-113-036F	133.04	19.0	19.5	0.1401	123.81	105.36	3.0	2.2	10021.	95.53	103.67	4.21	31.44	6518.	6286.	-3.5	200.
R-113-037F	130.11	18.0	18.5	0.1804	121.77	135.97	23.5	17.1	71524.	92.61	93.37	0.72	37.12	8443.	8462.	0.2	219.
R-113-038F	133.48	19.0	19.6	0.1788	125.02	134.32	7.5	5.5	23274.	93.60	95.82	2.20	38.76	8304.	8214.	-1.1	206.
R-113-039F	136.10	20.0	20.5	0.1801	127.50	135.00	5.2	3.8	16319.	94.17	97.27	3.13	40.37	8316.	8101.	-2.6	198.
R-113-040F	140.93	21.7	22.3	0.1814	132.65	135.30	3.0	2.2	9536.	94.39	99.66	5.29	43.90	8280.	7886.	-4.8	182.
R-113-041F	130.64	18.0	18.7	0.0591	119.62	44.66	23.5	17.1	98692.	125.98	126.28	0.25	4.51	2771.	2872.	3.6	592.
R-113-042F	131.06	18.2	18.8	0.0600	119.93	45.28	7.6	5.5	31747.	125.10	125.83	0.73	5.60	2808.	2734.	-2.6	483.
R-113-043F	131.26	18.4	18.9	0.0602	120.28	45.42	5.2	3.8	21645.	124.50	125.56	1.06	6.23	2817.	2730.	-3.1	435.
R-113-044F	132.10	18.5	19.1	0.0604	121.15	45.54	3.0	2.2	12434.	123.62	125.39	1.76	7.60	2821.	2617.	-7.2	358.
R-113-045F	131.89	18.5	19.1	0.0508	119.47	38.39	23.5	17.1	100407.	128.21	128.48	0.21	3.55	2378.	2500.	5.1	645.
R-113-046F	132.23	18.7	19.2	0.0515	120.06	38.86	7.6	5.5	32326.	127.42	128.08	0.63	4.48	2406.	2373.	-1.4	518.
R-113-047F	132.31	18.7	19.2	0.0513	120.28	38.69	5.2	3.8	22048.	126.88	127.80	0.90	4.96	2395.	2324.	-3.0	465.
R-113-048F	132.95	18.9	19.4	0.0513	120.76	38.67	3.0	2.2	12680.	126.21	127.67	1.46	6.00	2392.	2164.	-9.5	384.

Table C-23 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-113-049F	125.66	16.7	17.1	0.1667	121.33	125.69	23.5	17.1	72226.	93.49	94.23	0.66	31.80	7851.	7772.	-1.0	238.
R-113-050F	127.37	17.2	17.6	0.1669	122.77	125.64	7.6	5.5	23064.	91.69	93.78	2.03	34.63	7830.	7695.	-1.7	218.
R-113-051F	128.68	17.7	18.0	0.1671	123.92	125.66	5.2	3.8	15695.	90.76	93.75	2.93	36.42	7818.	7594.	-2.9	207.
R-113-052F	132.29	18.7	19.2	0.1683	127.19	126.19	3.0	2.2	9090.	90.18	95.01	4.82	39.70	7814.	7205.	-7.8	190.
R-113-053F	130.72	18.4	18.7	0.1981	126.49	148.63	23.5	17.1	69810.	90.44	91.29	0.77	39.86	9222.	9071.	-1.6	223.
R-113-054F	133.59	19.2	19.6	0.1981	129.05	148.27	7.6	5.5	22618.	89.81	92.24	2.36	42.57	9165.	8948.	-2.4	207.
R-113-055F	135.94	20.0	20.5	0.1986	131.45	148.30	5.2	3.8	15517.	89.56	92.96	3.44	44.68	9138.	8899.	-2.6	197.
R-113-056F	140.05	21.4	22.0	0.1987	135.27	147.86	3.0	2.2	9046.	89.30	95.04	5.68	47.87	9060.	8490.	-6.3	182.
R-113-057F	131.00	18.4	18.8	0.1021	122.20	76.95	23.5	17.1	93611.	119.67	120.13	0.40	11.10	4773.	4652.	-2.5	414.
R-113-058F	132.50	18.7	19.3	0.1034	123.85	77.77	7.6	5.5	30127.	118.73	119.99	1.23	13.14	4814.	4645.	-3.5	353.
R-113-059F	132.67	18.9	19.3	0.1036	124.30	77.90	5.2	3.8	20467.	117.50	119.29	1.80	14.28	4821.	4637.	-3.8	325.
R-113-060F	134.07	19.4	19.8	0.1033	125.54	77.62	3.0	2.2	11740.	116.28	119.24	2.97	16.31	4795.	4421.	-7.8	283.

Table C-24. Experimental data for R-113 condensing on tube F1

Run No.	T _y , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	ΔQ Q × 100	U _o , Btu hr·ft ² ·°F
R-113-001F1	124.48	17.0	16.7	0.1425	118.37	107.73	23.5	17.1	83915.	107.85	108.47	0.57	16.31	6739.	6708.	-0.5	398.
R-113-002F1	126.47	17.5	17.3	0.1432	120.17	108.05	7.6	5.5	27068.	107.00	108.82	1.82	18.56	6742.	6875.	2.0	350.
R-113-003F1	127.79	17.9	17.7	0.1437	121.52	108.34	5.2	3.8	18475.	106.36	108.96	2.60	20.13	6748.	6722.	-0.4	323.
R-113-004F1	131.24	18.7	18.9	0.1441	124.90	108.27	3.0	2.2	10687.	105.71	110.14	4.48	23.31	6713.	6668.	-0.7	277.
R-113-005F1	127.42	17.7	17.6	0.0568	118.24	42.98	23.5	17.1	96538.	123.30	123.58	0.23	3.98	2678.	2733.	2.0	648.
R-113-006F1	128.47	17.9	17.9	0.0547	119.38	41.33	7.6	5.5	31257.	123.23	123.93	0.70	4.89	2572.	2633.	2.4	507.
R-113-007F1	129.43	18.2	18.3	0.0549	120.29	41.46	5.2	3.8	21461.	123.47	124.52	1.03	5.44	2577.	2658.	3.2	457.
R-113-008F1	131.04	18.7	18.8	0.0543	121.45	40.93	3.0	2.2	12435.	123.67	125.36	1.69	6.53	2539.	2566.	-1.3	375.
R-113-009F1	127.72	17.9	17.7	0.0950	121.49	71.63	23.5	17.1	93103.	119.09	119.50	0.36	8.43	4462.	4198.	-5.9	510.
R-113-010F1	128.78	18.0	18.0	0.0946	122.41	71.26	7.4	5.4	29198.	118.05	119.28	1.24	10.11	4433.	4537.	2.4	422.
R-113-011F1	129.35	18.2	18.2	0.0959	123.05	72.15	5.2	3.8	20416.	117.24	119.00	1.75	11.23	4485.	4508.	0.5	385.
R-113-012F1	131.20	18.7	18.8	0.0954	124.56	71.71	3.0	2.2	11780.	116.68	119.59	2.92	13.07	4447.	4339.	-2.4	328.
R-113-013F1	126.32	17.2	17.3	0.0748	117.43	56.59	23.5	17.1	93905.	120.09	120.41	0.30	6.07	3532.	3465.	-1.9	561.
R-113-014F1	125.92	17.1	17.1	0.0741	117.79	56.09	7.6	5.5	29912.	117.90	118.88	0.98	7.54	3502.	3703.	5.7	448.
R-113-015F1	126.29	17.0	17.3	0.0739	117.87	55.91	5.2	3.8	20421.	117.45	118.85	1.37	8.14	3489.	3539.	1.4	413.
R-113-016F1	127.53	17.5	17.7	0.0737	118.51	55.74	3.0	2.2	11735.	116.56	118.88	2.32	9.81	3473.	3447.	-0.8	341.
R-113-017F1	121.80	16.2	15.9	0.1774	117.49	134.25	23.0	16.8	71748.	94.80	95.56	0.70	26.62	8427.	8053.	-4.4	305.
R-113-018F1	123.78	16.7	16.5	0.1787	119.47	134.99	7.6	5.5	23629.	93.76	96.00	2.22	28.90	8452.	8399.	-0.6	282.
R-113-019F1	125.46	17.2	17.0	0.1791	121.00	135.05	5.2	3.8	16212.	93.48	96.78	3.29	30.33	8437.	8531.	1.1	266.
R-113-020F1	129.90	18.2	18.4	0.1782	125.23	133.88	3.5	2.6	11006.	93.35	98.74	5.39	33.85	8316.	9384.	12.8	237.
R-113-021F1	124.61	16.7	16.7	0.1223	119.10	92.38	23.5	17.1	87183.	111.89	112.41	0.50	12.46	5778.	5789.	0.2	447.
R-113-022F1	125.85	16.9	17.1	0.1215	120.18	91.67	7.4	5.4	27243.	110.59	112.15	1.56	14.48	5724.	5722.	-0.0	381.
R-113-023F1	126.90	17.2	17.5	0.1210	120.87	91.30	5.2	3.8	19140.	110.23	112.47	2.21	15.55	5693.	5693.	0.0	353.
R-113-024F1	130.25	18.2	18.5	0.1208	123.97	90.84	3.0	2.2	11131.	110.31	114.02	3.71	18.08	5640.	5523.	-2.1	300.
R-113-025F1	120.96	16.2	15.7	0.1632	116.89	123.52	23.0	16.8	74877.	98.86	99.56	0.64	21.75	7762.	7274.	-6.3	344.
R-113-026F1	122.73	16.5	16.2	0.1628	118.30	123.05	7.6	5.5	24700.	97.51	100.60	2.06	23.68	7715.	7800.	1.1	314.
R-113-027F1	124.23	16.7	16.6	0.1629	119.66	123.01	5.2	3.8	16806.	97.06	100.02	2.96	25.69	7697.	7649.	-0.6	289.
R-113-028F1	128.02	17.7	17.8	0.1629	123.15	122.64	3.0	2.2	9742.	96.50	101.46	4.96	29.04	7636.	7396.	-3.1	253.
R-113-029F1	130.25	18.7	18.5	0.0608	120.39	45.89	23.5	17.1	98474.	125.70	126.00	0.25	4.39	2849.	2931.	2.9	625.
R-113-030F1	131.24	19.2	18.9	0.0625	121.85	47.08	7.6	5.5	31774.	125.17	125.97	0.80	5.67	2919.	3020.	3.4	496.
R-113-031F1	132.30	19.2	19.2	0.0627	122.79	47.20	5.2	3.8	21815.	125.42	126.58	1.15	6.30	2923.	2967.	1.5	447.
R-113-032F1	134.36	19.9	19.9	0.0633	124.63	47.56	3.0	2.2	12667.	125.85	127.76	1.92	7.56	2937.	2853.	-2.8	374.
R-113-033F1	120.92	16.4	15.7	0.1934	117.54	146.34	23.0	16.8	66203.	87.73	88.56	0.82	32.78	9196.	9382.	2.0	270.
R-113-034F1	123.96	16.7	16.5	0.1958	120.20	147.77	7.6	5.5	21888.	86.97	89.42	2.48	35.76	9250.	9387.	1.5	249.
R-113-035F1	126.00	17.2	17.2	0.1960	122.14	147.65	5.2	3.8	15043.	86.84	90.32	3.52	37.42	9218.	9124.	-1.0	237.
R-113-036F1	131.16	18.7	18.8	0.1976	127.07	148.19	3.0	2.2	8799.	86.84	92.69	5.88	41.40	9189.	8789.	-4.4	214.
R-113-037F1	127.79	17.5	17.7	0.0733	118.36	55.40	23.5	17.1	95207.	121.67	121.97	0.26	5.97	3451.	2977.	-13.7	557.
R-113-038F1	127.50	17.3	17.6	0.0752	118.18	56.85	7.4	5.4	29418.	119.24	120.11	0.79	7.82	3542.	2897.	-18.2	436.
R-113-039F1	127.76	17.7	17.7	0.0735	117.98	55.58	5.2	3.8	20675.	119.00	120.38	1.37	8.07	3462.	3536.	2.1	413.
R-113-040F1	129.45	17.9	18.3	0.0729	119.69	55.02	3.0	2.2	11946.	118.72	120.99	2.28	9.59	3419.	3380.	-1.1	343.
R-113-041F1	128.09	17.7	17.8	0.1072	120.59	80.89	23.5	17.1	92013.	117.56	118.08	0.49	10.27	5037.	5707.	13.3	472.
R-113-042F1	129.08	18.0	18.1	0.1080	121.32	81.40	7.6	5.5	29518.	116.27	117.63	1.34	12.13	5062.	5048.	-0.3	402.
R-113-043F1	129.31	18.2	18.2	0.1072	121.45	80.80	5.2	3.8	20041.	115.12	117.12	1.98	13.19	5023.	5093.	1.4	367.
R-113-044F1	131.73	18.7	19.0	0.1078	124.35	81.09	3.0	2.2	11580.	114.64	117.93	3.29	15.44	5025.	4895.	-2.6	313.

Table C-25. Experimental data for R-113 condensing on tube F3

Run No.	T_v , °F	P , psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	V , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{AQ}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-113-001F3	125.60	16.9	17.0	0.1457	119.19	110.08	23.5	14.7	83975.	111.57	112.20	0.60	13.72	6876.	6977.	1.5	448.
R-113-002F3	128.17	17.2	17.9	0.1457	121.45	109.85	7.6	4.8	27182.	111.05	112.90	1.85	16.19	6839.	6961.	1.8	378.
R-113-003F3	129.97	17.7	18.4	0.1459	123.18	109.83	5.2	3.3	18653.	110.95	113.61	2.63	17.70	6822.	6781.	-0.6	345.
R-113-004F3	133.68	19.2	19.7	0.1464	126.88	109.80	3.0	1.9	10830.	110.74	115.12	4.37	20.75	6786.	6504.	-4.2	293.
R-113-005F3	129.08	17.9	18.1	0.1781	122.84	134.06	23.5	14.7	82927.	109.74	111.49	0.72	18.47	8337.	8352.	0.2	404.
R-113-006F3	131.97	18.7	19.1	0.1793	125.54	134.66	7.6	4.8	27044.	110.85	112.07	2.22	20.51	8342.	8355.	0.2	364.
R-113-007F3	133.98	19.2	19.8	0.1801	127.70	134.95	5.2	3.3	18437.	109.50	112.68	3.16	22.88	8337.	8134.	-2.4	326.
R-113-008F3	137.97	20.7	21.2	0.1810	131.54	135.17	3.0	1.9	10555.	108.63	111.99	5.31	27.66	8306.	7890.	-5.0	269.
R-113-009F3	127.24	17.9	17.6	0.0903	119.82	68.19	23.5	14.7	90546.	119.87	120.29	0.39	7.16	4250.	4559.	7.2	531.
R-113-010F3	128.51	18.3	18.0	0.0908	120.64	68.54	7.6	4.8	29222.	119.27	120.41	1.14	8.66	4265.	4299.	0.8	440.
R-113-011F3	129.43	18.5	18.3	0.0903	121.39	68.05	5.2	3.3	19998.	119.03	120.70	1.65	9.56	4229.	4246.	0.4	396.
R-113-012F3	131.53	19.0	18.9	0.0900	123.22	67.72	3.0	1.9	11574.	118.87	121.58	2.71	11.30	4197.	4017.	-4.3	332.
R-113-013F3	127.64	17.7	17.7	0.0729	119.10	55.05	23.5	14.7	92114.	121.86	122.20	0.29	5.61	3429.	3384.	-1.3	547.
R-113-014F3	128.06	17.7	17.8	0.0722	118.14	54.62	7.6	4.8	29600.	120.82	121.78	0.96	6.76	3401.	3595.	5.7	450.
R-113-015F3	128.59	17.9	18.0	0.0701	119.29	52.97	5.2	3.3	20248.	120.60	121.94	1.33	7.32	3296.	3415.	3.6	403.
R-113-016F3	130.80	18.7	18.7	0.0712	121.16	53.67	3.0	1.9	11762.	120.95	123.18	2.23	8.74	3330.	3305.	-0.8	341.
R-113-017F3	127.72	17.9	17.7	0.1212	121.23	91.42	23.5	14.7	88248.	116.82	117.33	0.48	10.64	5695.	5579.	-2.0	479.
R-113-018F3	128.89	18.2	18.1	0.1218	122.61	91.73	7.6	4.8	28292.	115.38	116.91	1.54	12.75	5706.	5809.	1.8	400.
R-113-019F3	129.74	18.4	18.4	0.1224	123.32	92.14	5.2	3.3	19275.	114.58	116.80	2.19	14.05	5725.	5634.	-1.6	364.
R-113-020F3	132.01	18.9	19.1	0.1226	125.33	92.09	3.0	1.9	11102.	113.69	117.33	3.63	16.50	5704.	5405.	-5.2	309.
R-113-021F3	127.05	17.5	17.5	0.1067	118.79	80.65	23.5	14.7	88977.	117.73	118.20	0.44	9.08	5028.	5183.	3.1	495.
R-113-022F3	128.66	17.9	18.0	0.1066	120.39	80.47	7.6	4.8	28723.	117.09	118.45	1.36	10.89	5007.	5123.	2.3	411.
R-113-023F3	129.86	18.2	18.4	0.1060	121.62	79.91	5.2	3.3	19694.	117.03	118.97	1.91	11.86	4964.	4931.	-0.7	374.
R-113-024F3	132.71	19.2	19.3	0.1069	124.38	80.37	3.0	1.9	11412.	116.82	120.13	3.30	14.24	4974.	4914.	-1.2	312.
R-113-025F3	123.89	16.9	16.5	0.2077	118.51	156.99	23.5	14.7	74514.	99.53	100.46	0.85	23.89	9828.	9968.	1.4	368.
R-113-026F3	126.98	17.7	17.5	0.2082	122.58	156.82	7.6	4.8	24002.	98.32	100.94	2.60	27.35	9778.	9826.	0.5	320.
R-113-027F3	128.97	18.2	18.1	0.2082	123.59	156.61	5.2	3.3	16430.	97.78	101.56	3.78	29.30	9740.	9777.	0.4	297.
R-113-028F3	134.40	19.7	19.9	0.2114	128.75	158.29	3.0	1.9	9562.	97.39	103.57	6.21	33.92	9774.	9268.	-5.2	258.
R-113-029F3	128.51	17.9	18.0	0.0529	117.16	40.05	23.5	14.7	94322.	124.71	124.97	0.21	3.67	2492.	2442.	-2.0	608.
R-113-030F3	128.93	18.0	18.1	0.0540	117.73	40.83	7.6	4.8	30368.	123.95	124.66	0.71	4.63	2540.	2674.	5.3	491.
R-113-031F3	128.85	18.2	18.1	0.0535	117.91	40.50	5.2	3.3	20674.	123.20	124.20	0.99	5.15	2519.	2553.	1.3	437.
R-113-032F3	129.78	18.2	18.4	0.0538	118.88	40.63	3.0	1.9	11909.	122.69	124.34	1.65	6.26	2524.	2451.	-2.9	361.
R-113-033F3	129.31	18.2	18.2	0.0611	119.19	46.12	23.5	14.7	94443.	124.85	125.15	0.25	4.31	2867.	2861.	-0.2	595.
R-113-034F3	129.58	18.2	18.3	0.0631	119.60	47.64	7.6	4.8	30294.	123.61	124.41	0.81	5.57	2960.	3046.	2.9	475.
R-113-035F3	130.29	18.4	18.5	0.0613	119.76	46.25	5.2	3.3	20776.	123.71	124.87	1.14	6.00	2872.	2944.	2.5	428.
R-113-036F3	132.38	18.9	19.2	0.0611	121.58	46.03	3.0	1.9	12078.	124.29	126.15	1.86	7.16	2850.	2755.	-3.3	356.
R-113-037F3	127.50	17.7	17.6	0.0710	117.97	53.69	23.5	14.7	92286.	122.09	122.40	0.26	5.25	3346.	3012.	-10.0	570.
R-113-038F3	128.13	18.2	17.8	0.0716	118.73	54.13	7.6	4.8	29693.	121.21	122.10	0.90	6.47	3370.	3377.	0.2	466.
R-113-039F3	129.01	18.4	18.1	0.0706	119.35	53.30	5.2	3.3	20343.	121.15	122.47	1.31	7.20	3315.	3374.	1.8	412.
R-113-040F3	130.80	18.7	18.7	0.0689	120.52	52.00	3.0	1.9	11786.	121.21	123.38	2.17	8.51	3226.	3224.	-0.1	339.
R-113-041F3	128.59	17.7	18.0	0.0786	121.16	59.25	23.5	14.7	92657.	122.53	122.91	0.33	5.87	3687.	3838.	4.1	562.
R-113-042F3	129.86	18.2	18.4	0.0791	122.24	59.62	7.6	4.8	29936.	122.09	123.11	1.02	7.25	3704.	3829.	3.4	457.
R-113-043F3	130.76	18.5	18.7	0.0783	123.11	58.97	5.2	3.3	20509.	122.03	123.48	1.44	8.01	3659.	3705.	1.3	409.
R-113-044F3	133.01	19.2	19.4	0.0791	124.94	59.47	3.0	1.9	11886.	122.06	124.52	2.46	9.72	3679.	3648.	-0.9	339.

Table C-26. Experimental data for R-113 condensing on tube F7

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	V, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT̄, °F	Q _c , Btu/hr	Q _w , Btu/hr	ΔQ Q × 100	U _o , Btu hr·ft ² ·°F
R-113-001F7	126.29	17.2	17.3	0.1432	120.45	108.03	23.5	17.1	88711.	113.64	114.24	0.58	12.34	6742.	6732.	-0.1	526.
R-113-002F7	128.78	17.7	18.0	0.1445	122.71	108.80	7.6	5.5	28646.	112.88	114.69	1.82	14.99	6768.	6845.	1.1	435.
R-113-003F7	130.05	18.2	18.5	0.1447	123.93	108.83	5.2	3.8	19581.	112.37	115.00	2.61	16.37	6759.	6724.	-0.5	398.
R-113-004F7	133.30	19.2	19.5	0.1444	126.96	108.34	3.0	2.2	11338.	111.92	116.21	4.29	19.23	6699.	6385.	-4.7	336.
R-113-005F7	127.53	17.4	17.7	0.1750	120.71	132.01	23.5	17.1	85999.	110.38	111.15	0.74	16.77	8225.	8573.	4.2	473.
R-113-006F7	130.21	18.0	18.5	0.1758	123.49	132.30	7.6	5.5	27720.	109.33	111.54	2.22	19.78	8215.	8348.	1.6	400.
R-113-007F7	131.71	18.4	19.0	0.1761	125.08	132.31	5.2	3.8	18921.	108.58	111.80	3.19	21.51	8199.	8227.	0.3	367.
R-113-008F7	135.80	19.7	20.4	0.1765	129.10	132.08	3.0	2.2	10985.	108.22	113.43	5.21	24.97	8140.	7750.	-4.8	314.
R-113-009F7	126.18	16.9	17.2	0.0929	119.54	70.13	23.5	17.1	92999.	118.96	119.37	0.38	7.01	4377.	4442.	1.5	602.
R-113-010F7	126.79	17.1	17.4	0.0946	120.17	71.43	7.6	5.5	29816.	117.45	118.63	1.19	8.76	4455.	4471.	0.4	490.
R-113-011F7	127.68	17.2	17.7	0.0938	120.84	70.78	5.2	3.8	20401.	117.18	118.91	1.70	9.64	4409.	4389.	-0.5	441.
R-113-012F7	130.05	17.9	18.5	0.0932	122.88	70.15	3.0	2.2	11822.	117.12	119.94	2.82	11.52	4357.	4193.	-3.8	364.
R-113-013F7	127.83	17.2	17.7	0.0733	120.17	55.31	23.5	17.1	96014.	122.63	122.97	0.30	5.03	3445.	3454.	0.3	660.
R-113-014F7	128.74	17.5	18.0	0.0731	120.93	55.12	7.6	5.5	30955.	121.96	122.91	0.95	6.30	3429.	3565.	4.0	524.
R-113-015F7	129.35	17.0	18.2	0.0724	121.42	54.61	5.2	3.8	21168.	121.70	123.04	1.33	6.98	3395.	3417.	0.7	468.
R-113-016F7	131.00	18.2	18.8	0.0704	122.95	52.99	3.0	2.2	12232.	121.47	123.65	2.18	8.44	3287.	3242.	-1.4	375.
R-113-017F7	126.39	17.0	17.3	0.1207	120.90	91.01	23.5	17.1	91117.	116.50	117.03	0.50	9.63	5679.	5882.	3.6	568.
R-113-018F7	128.21	17.4	17.9	0.1208	122.48	90.97	7.6	5.5	29389.	115.72	117.24	1.52	11.73	5663.	5741.	1.4	465.
R-113-019F7	129.27	17.0	18.2	0.1206	123.66	90.71	5.2	3.8	20060.	115.12	117.33	2.18	13.05	5639.	5629.	-0.2	416.
R-113-020F7	131.73	18.4	19.0	0.1203	126.05	90.33	3.0	2.2	11566.	114.33	117.99	3.66	15.57	5597.	5442.	-2.8	346.
R-113-021F7	127.68	17.4	17.7	0.0556	119.38	41.99	23.5	17.1	97220.	124.16	124.41	0.21	3.40	2616.	2396.	-8.4	742.
R-113-022F7	129.78	17.9	18.4	0.0566	121.32	42.71	7.6	5.5	31710.	124.96	125.68	0.73	4.46	2653.	2738.	3.2	573.
R-113-023F7	129.62	18.0	18.3	0.0531	121.45	40.03	5.2	3.8	21622.	124.40	125.40	0.98	4.73	2488.	2532.	1.8	507.
R-113-024F7	130.72	18.4	18.7	0.0529	122.21	39.85	3.0	2.2	12466.	123.98	125.65	1.66	5.91	2473.	2470.	-0.1	403.
R-113-025F7	126.79	17.4	17.4	0.0647	118.54	48.93	23.5	17.1	95863.	122.46	122.77	0.26	4.18	3052.	3047.	-0.2	703.
R-113-026F7	127.53	17.7	17.7	0.0647	119.32	48.89	7.6	5.5	30888.	121.77	122.60	0.84	5.35	3046.	3170.	4.1	549.
R-113-027F7	127.91	17.7	17.8	0.0647	119.88	48.87	5.2	3.8	21080.	121.28	122.50	1.21	6.02	3043.	3124.	2.6	487.
R-113-028F7	129.39	17.9	18.2	0.0647	121.26	48.81	3.0	2.2	12164.	120.89	122.94	2.05	7.48	3034.	3049.	0.5	391.
R-113-029F7	127.02	17.3	17.5	0.0839	120.64	63.32	23.5	17.1	94573.	120.86	121.25	0.35	5.96	3948.	4035.	2.2	638.
R-113-030F7	128.02	17.5	17.8	0.0852	121.58	64.19	7.6	5.5	30431.	119.93	121.03	1.10	7.54	3997.	4129.	3.3	511.
R-113-031F7	128.51	17.7	18.0	0.0854	122.18	64.31	5.2	3.8	20745.	119.27	120.86	1.58	8.44	4002.	4055.	1.3	457.
R-113-032F7	130.21	18.2	18.5	0.0843	123.59	63.44	3.0	2.2	11966.	118.75	121.35	2.60	10.16	3939.	3864.	-1.9	373.
R-113-033F7	126.50	17.1	17.3	0.1623	122.44	122.25	23.5	17.1	87138.	111.76	112.44	0.66	14.40	7627.	7641.	0.2	510.
R-113-034F7	128.59	17.6	18.0	0.1638	124.45	123.12	7.6	5.5	27923.	110.16	112.17	2.02	17.42	7661.	7613.	-0.6	424.
R-113-035F7	129.86	17.9	18.4	0.1641	125.58	123.21	5.2	3.8	19027.	109.28	112.23	2.92	19.10	7654.	7539.	-1.5	386.
R-113-036F7	133.47	19.2	19.6	0.1636	128.94	122.47	3.0	2.2	10987.	108.39	113.31	4.92	22.62	7572.	7313.	-3.4	322.
R-113-037F7	124.13	16.7	16.6	0.2125	120.84	160.25	23.5	17.1	79202.	101.99	102.88	0.85	21.69	10029.	9886.	-1.4	445.
R-113-038F7	128.09	17.4	17.8	0.2144	124.42	161.16	7.6	5.5	25663.	101.28	103.95	2.67	25.47	10035.	10098.	0.6	379.
R-113-039F7	129.82	18.0	18.4	0.2166	126.34	162.58	5.2	3.8	17396.	99.79	103.69	3.90	28.08	10100.	10074.	-0.3	347.
R-113-040F7	135.14	19.7	20.2	0.2189	131.30	163.49	3.0	2.2	10076.	98.90	105.32	6.47	33.03	10085.	9652.	-4.3	294.
R-113-041F7	125.92	16.9	17.1	0.1791	121.19	135.08	23.5	17.1	84723.	108.73	109.49	0.73	16.81	8435.	8505.	0.8	483.
R-113-042F7	128.62	17.5	18.0	0.1791	123.80	134.72	7.6	5.5	27274.	107.52	109.79	2.27	19.97	8382.	8572.	2.3	404.
R-113-043F7	130.41	18.0	18.6	0.1805	125.47	135.58	5.2	3.8	18623.	106.83	110.07	3.21	21.96	8416.	8289.	-1.5	369.
R-113-044F7	134.40	19.5	19.9	0.1808	129.33	135.30	3.0	2.2	10767.	105.99	111.33	5.34	25.74	8354.	7953.	-4.8	313.

Table C-26 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-113-045F7	127.38	17.4	17.6	0.1496	122.34	112.69	23.5	17.1	88984.	113.94	114.58	0.61	13.12	7023.	7117.	1.3	516.
R-113-046F7	129.97	18.0	18.4	0.1495	124.77	112.36	7.6	5.5	28811.	113.45	115.32	1.87	15.59	6978.	7044.	0.9	431.
R-113-047F7	131.41	18.5	18.9	0.1512	126.23	113.46	5.2	3.8	19665.	112.77	115.49	2.69	17.28	7034.	6936.	-1.4	392.
R-113-048F7	134.62	19.5	20.0	0.1501	129.21	112.34	3.0	2.2	11382.	112.23	116.71	4.47	20.15	6934.	6651.	-4.1	332.

Table C-27. Experimental data for R-114 condensing on tube A

Run No.	T_v , °F	P , psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-114-001A	99.49	45.2	45.4	0.0587	94.32	41.96	22.5	18.1	63652.	84.70	84.76	0.0	14.76	2222.	0.	0.0	144.
R-114-002A	99.88	45.2	45.7	0.0586	94.80	41.81	7.5	6.0	21116.	84.13	84.54	0.0	15.55	2212.	0.	0.0	136.
R-114-003A	100.23	45.7	46.0	0.0588	95.41	41.97	5.2	4.2	14582.	83.64	84.36	0.0	16.23	2219.	0.	0.0	131.
R-114-004A	100.79	46.2	46.4	0.0589	95.84	42.03	3.0	2.4	8350.	82.71	84.05	0.0	17.41	2219.	0.	0.0	122.
R-114-005A	101.31	46.2	46.8	0.0598	96.32	42.59	2.1	1.7	5767.	81.29	83.26	0.0	19.03	2247.	0.	0.0	113.
R-114-006A	96.19	42.7	43.0	0.0739	91.70	52.97	22.5	18.1	57698.	76.71	76.88	0.0	19.39	2822.	0.	0.0	139.
R-114-007A	97.06	43.2	43.6	0.0736	92.53	52.67	7.5	6.0	19162.	76.18	76.84	0.0	20.55	2802.	0.	0.0	130.
R-114-008A	97.40	43.7	43.9	0.0738	93.14	52.81	5.2	4.2	13229.	75.69	76.66	0.0	21.23	2807.	0.	0.0	126.
R-114-009A	98.71	44.5	44.8	0.0736	94.10	52.62	3.0	2.4	7604.	75.11	76.66	0.0	22.82	2790.	0.	0.0	117.
R-114-010A	100.14	45.7	45.9	0.0737	95.45	52.57	2.1	1.7	5298.	74.31	76.75	0.0	24.61	2780.	0.	0.0	108.
R-114-011A	94.14	41.2	41.6	0.0670	91.48	48.03	22.5	18.1	57600.	76.62	76.71	0.0	17.47	2569.	0.	0.0	140.
R-114-012A	94.53	41.7	41.9	0.0654	91.48	46.91	7.5	6.0	19146.	76.18	76.71	0.0	18.09	2507.	0.	0.0	132.
R-114-013A	94.66	41.7	41.9	0.0653	91.61	46.78	5.2	4.2	13203.	75.69	76.35	0.0	18.64	2500.	0.	0.0	128.
R-114-014A	95.58	42.2	42.6	0.0645	92.14	46.21	3.0	2.4	7593.	75.02	76.53	0.0	19.80	2465.	0.	0.0	119.
R-114-015A	96.71	43.2	43.4	0.0641	92.96	45.87	2.1	1.7	5291.	74.35	76.49	0.0	21.29	2441.	0.	0.0	110.
R-114-016A	93.70	41.0	41.3	0.0349	87.50	25.15	22.5	18.1	64479.	85.76	85.85	0.0	7.90	1346.	0.	0.0	163.
R-114-017A	94.27	41.2	41.7	0.0351	88.03	25.26	7.5	6.0	21459.	85.54	85.81	0.0	8.60	1351.	0.	0.0	150.
R-114-018A	94.40	41.2	41.8	0.0353	88.68	25.36	5.2	4.2	14843.	85.28	85.68	0.0	8.93	1356.	0.	0.0	145.
R-114-019A	95.14	41.7	42.3	0.0349	89.12	25.13	3.0	2.4	8570.	85.19	85.90	0.0	9.60	1341.	0.	0.0	133.
R-114-020A	95.75	42.2	42.7	0.0345	89.56	24.77	2.1	1.7	6016.	85.23	86.33	0.0	9.97	1321.	0.	0.0	127.
R-114-021A	94.97	41.7	42.2	0.0468	91.09	33.57	22.5	18.1	62678.	83.46	83.44	0.0	11.52	1793.	0.	0.0	149.
R-114-022A	95.23	42.2	42.3	0.0461	90.43	33.06	7.5	6.0	20803.	82.93	83.26	0.0	12.13	1765.	0.	0.0	139.
R-114-023A	95.53	42.2	42.6	0.0457	90.70	32.79	5.2	4.2	14412.	82.75	83.31	0.0	12.50	1749.	0.	0.0	134.
R-114-024A	96.10	42.7	43.0	0.0448	91.09	32.16	3.0	2.4	8328.	82.71	83.62	0.0	12.94	1714.	0.	0.0	127.
R-114-025A	97.36	43.4	43.9	0.0447	91.74	32.01	2.1	1.7	5859.	82.89	84.27	0.0	13.78	1702.	0.	0.0	118.
R-114-026A	125.78	67.7	68.1	0.1985	119.96	137.10	22.5	18.1	57502.	76.27	76.80	0.0	49.25	6866.	0.	0.0	133.
R-114-027A	129.04	71.2	71.5	0.1969	126.96	134.66	7.5	6.0	19439.	76.80	78.47	0.0	51.40	6693.	0.	0.0	124.
R-114-028A	130.58	72.7	73.1	0.1986	124.56	136.31	5.2	4.2	13390.	75.91	78.34	0.0	53.45	6751.	0.	0.0	121.
R-114-029A	133.78	76.2	76.5	0.1985	127.22	135.70	3.0	2.4	7742.	75.20	79.40	0.0	56.49	6670.	0.	0.0	113.
R-114-030A	121.92	64.7	64.4	0.1765	117.21	122.38	22.5	18.1	57828.	76.76	77.19	0.0	44.95	6182.	0.	0.0	131.
R-114-031A	123.55	66.2	65.9	0.1726	118.46	119.46	7.5	6.0	19314.	76.36	77.90	0.0	46.42	6013.	0.	0.0	124.
R-114-032A	124.07	66.7	66.4	0.1715	119.02	118.60	5.2	4.2	13266.	75.33	77.46	0.0	47.67	5963.	0.	0.0	119.
R-114-033A	127.07	69.7	69.4	0.1688	121.30	116.36	3.0	2.4	7718.	75.20	78.91	0.0	50.01	5810.	0.	0.0	111.
R-114-034A	98.84	44.7	44.9	0.0897	93.23	64.14	22.5	18.1	55604.	73.81	74.06	0.0	24.90	3400.	0.	0.0	130.
R-114-035A	100.66	45.7	46.3	0.0898	95.14	64.06	7.5	6.0	18675.	74.13	74.90	0.0	26.15	3384.	0.	0.0	124.
R-114-036A	101.74	46.7	47.1	0.0898	96.54	64.01	5.2	4.2	13011.	74.31	75.47	0.0	26.85	3374.	0.	0.0	120.
R-114-037A	103.26	47.7	48.3	0.0895	98.06	63.63	3.0	2.4	7487.	73.68	75.69	0.0	28.57	3344.	0.	0.0	112.
R-114-038A	106.42	50.2	50.7	0.0885	100.45	62.75	2.1	1.7	5342.	74.66	77.68	0.0	30.25	3276.	0.	0.0	103.
R-114-039A	108.58	52.2	52.5	0.1253	104.26	88.41	22.5	18.1	56397.	74.88	75.16	0.0	33.55	4596.	0.	0.0	131.
R-114-040A	110.82	54.2	54.4	0.1247	105.82	87.76	7.5	6.0	18966.	75.15	76.27	0.0	35.11	4541.	0.	0.0	124.
R-114-041A	112.33	55.7	55.7	0.1256	107.38	88.23	5.2	4.2	13214.	75.33	76.84	0.0	36.25	4551.	0.	0.0	120.
R-114-042A	115.30	57.7	58.3	0.1250	109.80	87.53	3.0	2.4	7655.	75.02	77.81	0.0	38.89	4486.	0.	0.0	110.
R-114-043A	118.53	60.7	61.2	0.1252	112.65	87.36	2.1	1.7	5418.	75.24	79.31	0.0	41.25	4447.	0.	0.0	103.

Table C-27 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	V, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-114-044A	104.13	48.7	48.9	0.1097	98.71	77.97	22.5	18.1	55492.	73.68	73.88	0.0	30.34	4090.	0.	0.0	129.
R-114-045A	105.64	49.7	50.1	0.1086	100.01	77.00	7.5	6.0	18545.	73.46	74.50	0.0	31.66	4027.	0.	0.0	121.
R-114-046A	106.81	50.2	51.1	0.1083	101.19	76.68	5.2	4.2	12888.	73.46	74.85	0.0	32.65	4001.	0.	0.0	117.
R-114-047A	109.44	52.7	53.2	0.1081	103.48	76.31	3.0	2.4	7523.	73.90	76.22	0.0	34.38	3960.	0.	0.0	110.
R-114-048A	112.98	55.5	56.2	0.1079	106.64	75.90	2.1	1.7	5331.	74.13	77.90	0.0	36.97	3909.	0.	0.0	101.
R-114-049A	113.67	56.2	56.8	0.1449	108.85	101.62	22.5	18.1	56591.	75.11	75.47	0.0	38.38	5227.	0.	0.0	130.
R-114-050A	116.12	58.7	59.0	0.1430	110.71	100.03	7.5	6.0	19053.	75.46	76.66	0.0	40.06	5118.	0.	0.0	122.
R-114-051A	117.15	59.7	59.9	0.1452	111.91	101.41	5.2	4.2	13048.	74.22	76.00	0.0	42.04	5177.	0.	0.0	118.
R-114-052A	119.73	62.2	62.3	0.1440	114.07	100.30	3.0	2.4	7556.	73.72	77.06	0.0	44.34	5091.	0.	0.0	110.
R-114-053A	123.64	65.7	66.0	0.1429	117.30	99.10	2.1	1.7	5400.	74.75	79.26	0.0	46.63	4987.	0.	0.0	102.
R-114-054A	115.82	58.2	58.7	0.1564	110.62	109.41	22.5	18.1	56332.	74.80	75.07	0.0	40.88	5601.	0.	0.0	131.
R-114-055A	118.53	60.7	61.2	0.1547	112.82	107.90	7.5	6.0	18977.	75.02	76.49	0.0	42.78	5492.	0.	0.0	123.
R-114-056A	119.77	61.7	62.3	0.1561	114.07	108.71	5.2	4.2	13056.	74.13	76.18	0.0	44.62	5518.	0.	0.0	118.
R-114-057A	123.04	65.2	65.4	0.1558	117.13	108.04	3.0	2.4	7642.	74.57	77.99	0.0	46.76	5444.	0.	0.0	111.
R-114-058A	122.74	65.2	65.2	0.1861	117.77	128.91	22.5	18.1	56786.	75.29	75.82	0.0	47.18	6500.	0.	0.0	132.
R-114-059A	125.65	67.7	68.0	0.1853	120.39	127.92	7.5	6.0	19047.	75.20	76.88	0.0	49.61	6408.	0.	0.0	123.
R-114-060A	126.81	69.2	69.2	0.1865	121.38	128.59	5.2	4.2	13149.	74.53	76.88	0.0	51.10	6424.	0.	0.0	120.
R-114-061A	131.00	73.2	73.5	0.1859	125.03	127.51	3.0	2.4	7670.	74.57	78.56	0.0	54.44	6309.	0.	0.0	111.
R-114-062A	129.46	71.7	71.9	0.2121	121.38	146.26	22.5	18.1	57812.	76.67	77.24	0.0	52.51	7262.	0.	0.0	132.
R-114-063A	133.19	75.5	75.9	0.2153	125.42	147.57	7.5	6.0	19324.	76.27	78.07	0.0	56.02	7264.	0.	0.0	124.
R-114-064A	135.15	77.7	78.0	0.2156	127.69	147.33	5.2	4.2	13424.	76.04	78.60	0.0	57.83	7218.	0.	0.0	119.
R-114-065A	138.36	81.2	81.6	0.2162	131.37	146.95	3.0	2.4	7727.	74.84	79.44	0.0	61.22	7143.	0.	0.0	111.
R-114-066A	112.50	56.2	55.8	0.1555	107.25	109.27	22.5	18.1	53558.	70.77	71.18	0.0	41.53	5634.	0.	0.0	130.
R-114-067A	114.92	57.7	57.9	0.1522	108.81	106.76	7.5	6.0	18228.	71.98	73.35	0.0	42.25	5476.	0.	0.0	124.
R-114-068A	117.28	60.0	60.0	0.1525	110.96	106.60	5.2	4.2	12820.	72.79	74.72	0.0	43.53	5440.	0.	0.0	119.
R-114-069A	121.66	64.2	64.1	0.1529	115.15	106.30	3.0	2.4	7599.	74.26	77.41	0.0	45.83	5373.	0.	0.0	112.

Table C-28. Experimental data for R-114 condensing on tube B

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-114-001B	87.02	36.2	36.9	0.0362	83.29	26.23	2.1	1.5	5561.	80.45	81.73	0.0	5.94	1422.	0.	0.0	160.
R-114-002B	86.28	35.7	36.4	0.0359	82.81	26.02	3.0	2.2	7947.	80.71	81.51	0.0	5.17	1412.	0.	0.0	182.
R-114-003B	86.06	35.7	36.3	0.0364	82.72	26.41	5.2	3.8	13786.	80.93	81.42	0.0	4.88	1434.	0.	0.0	196.
R-114-004B	85.93	35.7	36.2	0.0364	82.77	26.41	7.5	5.5	19895.	81.07	81.38	0.0	4.71	1434.	0.	0.0	203.
R-114-005B	85.71	35.7	36.1	0.0364	82.68	26.35	19.0	13.9	50593.	81.47	81.59	0.0	4.18	1432.	0.	0.0	228.
R-114-006B	89.34	37.7	38.4	0.0663	83.95	47.95	19.0	13.9	50538.	81.29	81.59	0.0	7.90	2588.	0.	0.0	218.
R-114-007B	90.22	38.2	38.9	0.0663	85.18	47.88	7.5	5.5	19987.	81.33	81.86	0.0	8.62	2580.	0.	0.0	199.
R-114-008B	90.52	38.2	39.1	0.0665	85.84	47.99	5.2	3.8	13839.	81.07	81.90	0.0	9.04	2584.	0.	0.0	191.
R-114-009B	91.74	39.2	40.0	0.0662	87.06	47.74	3.0	2.2	8021.	81.11	82.61	0.0	9.88	2565.	0.	0.0	173.
R-114-010B	93.18	40.2	40.9	0.0666	88.33	47.91	2.1	1.5	5663.	81.47	83.66	0.0	10.62	2567.	0.	0.0	161.
R-114-011B	87.11	51.4	36.9	0.0512	83.21	37.06	19.0	13.9	50250.	80.93	81.02	0.0	6.13	2009.	0.	0.0	218.
R-114-012B	87.72	51.4	37.3	0.0516	83.86	37.32	7.5	5.5	19825.	80.76	81.11	0.0	6.79	2020.	0.	0.0	198.
R-114-013B	88.16	51.9	37.6	0.0517	84.30	37.39	5.2	3.8	13767.	80.76	81.38	0.0	7.09	2022.	0.	0.0	190.
R-114-014B	89.34	52.4	38.4	0.0516	85.05	37.26	3.0	2.2	7999.	81.02	82.25	0.0	7.70	2011.	0.	0.0	174.
R-114-015B	89.95	52.6	38.8	0.0523	84.04	37.86	2.1	1.5	5601.	80.76	82.56	0.0	8.29	2041.	0.	0.0	164.
R-114-016B	99.10	58.9	45.1	0.0735	92.92	52.60	7.5	5.5	21981.	89.43	89.96	0.0	9.40	2787.	0.	0.0	197.
R-114-017B	98.36	58.4	44.6	0.0735	92.09	52.68	19.0	13.9	55727.	89.65	89.88	0.0	8.60	2795.	0.	0.0	217.
R-114-018B	99.66	59.4	45.5	0.0735	93.75	52.52	5.2	3.8	15278.	89.43	90.40	0.0	9.75	2780.	0.	0.0	190.
R-114-019B	100.27	59.9	46.0	0.0736	94.45	52.55	3.0	2.2	8774.	88.72	90.31	0.0	10.75	2778.	0.	0.0	172.
R-114-020B	100.66	60.4	46.3	0.0735	94.71	52.49	2.1	1.5	6118.	87.97	90.40	0.0	11.47	2772.	0.	0.0	161.
R-114-021B	99.31	45.2	45.3	0.0919	93.92	65.66	19.0	13.9	55444.	89.21	89.44	0.0	9.99	3477.	0.	0.0	232.
R-114-022B	99.79	45.7	45.6	0.0930	95.14	66.36	7.5	5.5	21796.	88.63	89.31	0.0	10.82	3511.	0.	0.0	216.
R-114-023B	101.87	47.2	47.2	0.0931	96.71	66.30	3.0	2.2	8785.	88.68	90.57	0.0	12.25	3494.	0.	0.0	190.
R-114-024B	112.33	55.7	55.7	0.1737	107.25	122.07	19.0	13.9	55684.	89.43	89.96	0.0	22.64	6296.	0.	0.0	185.
R-114-025B	113.41	56.7	56.6	0.1748	108.33	122.63	7.8	5.7	22731.	88.50	89.92	0.0	24.20	6311.	0.	0.0	174.
R-114-026B	114.70	57.7	57.7	0.1747	109.45	122.38	5.2	3.8	15177.	88.28	90.40	0.0	25.36	6280.	0.	0.0	165.
R-114-027B	116.85	59.7	59.6	0.1758	111.40	122.86	3.0	2.2	8771.	87.57	91.40	0.0	27.36	6276.	0.	0.0	153.
R-114-028B	118.74	61.7	61.4	0.1760	112.86	122.74	2.1	1.5	6169.	87.09	92.71	0.0	28.84	6244.	0.	0.0	144.
R-114-029B	98.53	44.2	44.7	0.1968	94.36	140.57	19.0	13.9	44389.	70.82	71.58	0.0	27.33	7456.	0.	0.0	182.
R-114-030B	100.88	46.2	46.4	0.2005	97.19	142.71	7.5	5.5	17563.	70.46	72.29	0.0	29.50	7535.	0.	0.0	170.
R-114-031B	103.35	48.2	48.3	0.2008	99.49	142.51	5.2	3.8	12323.	71.09	73.70	0.0	30.95	7487.	0.	0.0	161.
R-114-032B	107.80	51.7	51.9	0.2013	103.70	142.12	3.0	2.2	7357.	72.79	77.24	0.0	32.79	7400.	0.	0.0	150.
R-114-033B	94.71	41.7	42.0	0.1430	92.14	102.42	19.0	13.9	47341.	76.00	76.49	0.0	18.46	5472.	0.	0.0	197.
R-114-034B	95.23	42.2	42.3	0.1447	91.83	103.70	7.5	5.5	18575.	75.15	76.40	0.0	19.45	5536.	0.	0.0	190.
R-114-035B	96.01	42.7	42.9	0.1428	92.83	102.18	5.2	3.8	12849.	74.62	76.57	0.0	20.42	5486.	0.	0.0	178.
R-114-036B	97.49	43.7	43.9	0.1422	94.19	101.60	3.0	2.2	7375.	73.50	76.88	0.0	22.30	5400.	0.	0.0	161.
R-114-037B	99.14	45.1	45.2	0.1423	95.75	101.50	2.1	1.5	5174.	73.06	77.68	0.0	23.77	5377.	0.	0.0	151.
R-114-038B	89.47	38.2	38.5	0.1058	86.58	76.33	19.0	13.9	47611.	76.49	76.88	0.0	12.79	4119.	0.	0.0	215.
R-114-039B	89.60	38.7	38.5	0.1040	87.11	74.97	7.5	5.5	18645.	75.60	76.53	0.0	13.54	4044.	0.	0.0	199.
R-114-040B	90.35	39.2	39.0	0.1035	87.90	74.53	5.2	3.8	12960.	75.55	76.97	0.0	14.08	4015.	0.	0.0	190.
R-114-041B	91.18	39.7	39.6	0.1026	88.68	73.81	3.0	2.2	7426.	74.57	76.88	0.0	15.45	3970.	0.	0.0	171.
R-114-042B	93.05	40.7	40.8	0.1023	90.08	73.48	2.1	1.5	5236.	74.57	78.03	0.0	16.75	3938.	0.	0.0	157.

Table C-28 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-114-043B	93.27	40.7	41.0	0.1258	90.65	90.30	19.0	13.9	48192.	77.47	77.81	0.0	15.63	4838.	0.	0.0	206.
R-114-044B	94.01	41.4	41.5	0.1268	91.44	90.92	7.5	5.5	18863.	76.36	77.59	0.0	17.04	4864.	0.	0.0	190.
R-114-045B	94.92	42.2	42.1	0.1267	92.14	90.77	5.2	3.8	13122.	76.36	78.12	0.0	17.69	4848.	0.	0.0	183.
R-114-046B	96.40	43.2	43.2	0.1268	93.49	90.69	3.0	2.2	7549.	75.60	78.43	0.0	19.39	4830.	0.	0.0	166.
R-114-047B	97.92	44.2	44.3	0.1269	94.66	90.63	2.1	1.5	5279.	74.71	79.18	0.0	20.98	4812.	0.	0.0	153.
R-114-048B	88.47	37.7	37.8	0.0633	85.97	45.67	19.0	13.9	50511.	81.33	81.46	0.0	7.07	2469.	0.	0.0	233.
R-114-049B	88.55	37.7	37.9	0.0639	86.41	46.10	7.5	5.5	19792.	80.49	81.11	0.0	7.75	2491.	0.	0.0	214.
R-114-050B	89.12	38.2	38.2	0.0633	86.85	45.64	5.2	3.8	13764.	80.62	81.46	0.0	8.08	2464.	0.	0.0	203.
R-114-051B	90.08	38.7	38.9	0.0630	87.37	45.41	3.0	2.2	7973.	80.67	82.08	0.0	8.71	2447.	0.	0.0	187.
R-114-052B	91.83	39.7	40.0	0.0634	88.86	45.59	2.1	1.5	5636.	81.16	83.18	0.0	9.66	2449.	0.	0.0	169.
R-114-053B	94.10	41.7	41.6	0.0809	90.35	58.07	19.0	13.9	52571.	84.57	84.80	0.0	9.41	3106.	0.	0.0	220.
R-114-054B	94.53	41.7	41.9	0.0812	91.09	58.27	7.5	5.5	20631.	83.82	84.58	0.0	10.33	3115.	0.	0.0	201.
R-114-055B	95.10	41.9	42.3	0.0808	91.74	57.92	5.2	3.8	14330.	83.82	84.89	0.0	10.75	3093.	0.	0.0	192.
R-114-056B	96.01	42.7	42.9	0.0805	92.53	57.66	3.0	2.2	8263.	83.37	85.24	0.0	11.71	3073.	0.	0.0	175.
R-114-057B	96.53	43.2	43.3	0.0820	93.01	58.67	2.1	1.5	5732.	82.22	84.89	0.0	12.98	3124.	0.	0.0	160.
R-114-058B	90.65	38.7	39.2	0.0609	86.58	43.90	19.0	13.9	52098.	83.82	84.05	0.0	6.72	2364.	0.	0.0	234.
R-114-059B	91.00	39.2	39.5	0.0607	87.15	43.76	7.5	5.5	20488.	83.33	83.92	0.0	7.38	2355.	0.	0.0	213.
R-114-060B	91.31	39.2	39.7	0.0606	87.59	43.63	5.2	3.8	14217.	83.33	84.05	0.0	7.62	2346.	0.	0.0	205.
R-114-061B	92.79	40.2	40.7	0.0596	88.77	42.90	3.0	2.2	8283.	83.82	85.19	0.0	8.28	2300.	0.	0.0	185.
R-114-062B	93.27	40.7	41.0	0.0595	89.30	42.75	2.1	1.5	5770.	83.02	85.19	0.0	9.16	2291.	0.	0.0	167.
R-114-063B	94.18	41.2	41.6	0.0455	90.00	32.70	19.0	13.9	55529.	89.43	89.48	0.0	4.73	1749.	0.	0.0	246.
R-114-064B	94.53	41.7	41.9	0.0461	90.30	33.11	7.5	5.5	21869.	89.07	89.44	0.0	5.28	1770.	0.	0.0	224.
R-114-065B	94.58	41.7	41.9	0.0459	90.39	32.95	5.2	3.8	15143.	88.85	89.44	0.0	5.43	1761.	0.	0.0	216.
R-114-066B	95.45	42.2	42.5	0.0456	91.04	32.68	3.0	2.2	8774.	88.99	90.05	0.0	5.93	1744.	0.	0.0	196.
R-114-067B	96.40	42.7	43.2	0.0456	91.61	32.67	2.1	1.5	6183.	89.34	90.84	0.0	6.32	1740.	0.	0.0	184.
R-114-068B	92.70	40.4	40.6	0.1010	89.03	72.61	19.0	13.9	49688.	79.87	80.28	0.0	12.63	3894.	0.	0.0	205.
R-114-069B	94.01	41.2	41.5	0.1016	90.17	72.93	7.5	5.5	19662.	79.74	80.80	0.0	13.74	3902.	0.	0.0	189.
R-114-070B	93.84	41.2	41.4	0.1024	90.30	73.49	5.2	3.8	13453.	78.49	79.92	0.0	14.63	3933.	0.	0.0	179.
R-114-071B	95.23	42.2	42.3	0.1019	91.39	73.06	3.0	2.2	7780.	78.18	80.63	0.0	15.82	3900.	0.	0.0	164.
R-114-072B	96.62	43.2	43.3	0.1015	92.57	72.64	2.1	1.5	5478.	78.00	81.73	0.0	16.76	3867.	0.	0.0	154.
R-114-073B	92.35	40.2	40.4	0.0904	89.34	64.97	19.0	13.9	50607.	81.38	81.73	0.0	10.80	3487.	0.	0.0	215.
R-114-074B	92.96	40.7	40.8	0.0906	89.69	65.12	7.5	5.5	19846.	80.58	81.46	0.0	11.94	3491.	0.	0.0	195.
R-114-075B	93.18	40.7	40.9	0.0906	90.08	65.07	5.2	3.8	13696.	79.82	81.46	0.0	12.54	3487.	0.	0.0	185.
R-114-076B	94.27	41.2	41.7	0.0900	91.00	64.57	3.0	2.2	7938.	79.96	82.08	0.0	13.25	3453.	0.	0.0	174.
R-114-077B	95.75	42.7	42.7	0.0899	92.14	64.39	2.1	1.5	5579.	79.82	82.87	0.0	14.40	3434.	0.	0.0	159.
R-114-078B	93.49	41.2	41.1	0.0805	88.99	57.88	19.0	13.9	52098.	83.77	84.10	0.0	9.55	3100.	0.	0.0	216.
R-114-079B	94.14	41.7	41.6	0.0807	90.13	57.93	7.5	5.5	20488.	83.24	84.01	0.0	10.51	3099.	0.	0.0	196.
R-114-080B	94.75	42.2	42.0	0.0806	90.87	57.81	5.2	3.8	14228.	83.24	84.27	0.0	10.99	3089.	0.	0.0	187.
R-114-081B	95.97	42.7	42.9	0.0790	91.92	56.58	3.0	2.2	8243.	83.15	85.06	0.0	11.86	3016.	0.	0.0	169.
R-114-082B	96.19	43.2	43.0	0.0807	92.53	57.75	2.1	1.5	5677.	81.25	84.27	0.0	13.43	3077.	0.	0.0	153.
R-114-083B	118.48	60.2	61.1	0.2723	114.20	189.55	19.0	13.9	48584.	77.82	78.74	0.0	40.21	9648.	0.	0.0	160.
R-114-084B	121.53	63.2	64.0	0.2741	117.38	190.00	10.0	7.3	25748.	77.56	80.10	0.0	42.71	9607.	0.	0.0	150.
R-114-085B	123.29	65.2	65.7	0.2727	119.32	188.55	5.2	3.8	13515.	77.69	81.46	0.0	43.72	9496.	0.	0.0	145.
R-114-086B	128.01	69.7	70.4	0.2736	123.79	187.97	3.0	2.2	7958.	78.09	84.36	0.0	46.78	9365.	0.	0.0	133.
R-114-087B	132.42	74.2	75.0	0.2778	127.90	189.80	2.1	1.5	5631.	77.65	86.55	0.0	50.32	9360.	0.	0.0	124.

Table C-28 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-114-088B	107.24	51.2	51.4	0.2136	103.79	150.78	19.0	13.9	47503.	76.13	76.88	0.0	30.73	7860.	0.	0.0	170.
R-114-089B	109.36	52.7	53.1	0.2114	105.87	148.84	7.5	5.5	18931.	76.27	78.25	0.0	32.10	7725.	0.	0.0	160.
R-114-090B	110.87	54.2	54.4	0.2127	107.64	149.36	5.2	3.8	13159.	76.04	78.87	0.0	33.41	7728.	0.	0.0	154.
R-114-091B	114.18	56.7	57.3	0.2116	110.45	148.04	3.0	2.2	7741.	76.71	81.29	0.0	35.18	7606.	0.	0.0	144.
R-114-092B	117.58	59.7	60.3	0.2110	113.51	147.04	2.1	1.5	5492.	76.67	83.48	0.0	37.51	7499.	0.	0.0	133.
R-114-093B	113.41	55.7	56.6	0.2508	110.27	175.54	19.0	13.9	47894.	76.71	77.59	0.0	36.26	9033.	0.	0.0	166.
R-114-094B	117.45	59.2	60.2	0.2515	114.03	175.10	7.5	5.5	19327.	77.69	80.10	0.0	38.56	8933.	0.	0.0	154.
R-114-095B	119.60	61.2	62.2	0.2547	116.09	176.90	5.2	3.8	13441.	77.51	80.76	0.0	40.47	8982.	0.	0.0	148.
R-114-096B	122.05	63.7	64.5	0.2539	118.50	175.74	3.0	2.2	7767.	76.67	81.86	0.0	42.79	8875.	0.	0.0	138.
R-114-097B	118.01	60.2	60.7	0.2879	115.49	200.12	19.0	13.9	47368.	75.82	76.75	0.0	41.73	10197.	0.	0.0	163.
R-114-098B	121.23	62.7	63.7	0.2829	118.20	195.87	7.5	5.5	19081.	76.62	79.13	0.0	43.36	9910.	0.	0.0	152.
R-114-099B	123.42	65.2	65.8	0.2859	120.31	197.40	5.2	3.8	13273.	76.40	79.88	0.0	45.28	9939.	0.	0.0	146.
R-114-100B	127.15	69.2	69.5	0.2858	123.66	196.43	3.0	2.2	7775.	76.53	82.17	0.0	47.80	9806.	0.	0.0	137.

Table C-29. Experimental data for R-114 condensing on tube C

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-114-001C	90.52	38.7	39.1	0.0572	86.58	41.22	22.0	20.6	64323.	84.88	84.93	0.0	5.62	2220.	0.	0.0	354.
R-114-002C	90.56	39.2	39.2	0.0571	87.37	41.13	7.5	7.0	21899.	84.57	85.02	0.0	5.77	2215.	0.	0.0	343.
R-114-003C	91.39	39.7	39.7	0.0566	88.38	40.72	5.2	4.9	15272.	84.97	85.59	0.0	6.12	2189.	0.	0.0	320.
R-114-004C	92.88	40.7	40.7	0.0564	93.84	40.33	3.0	2.8	8873.	85.32	86.42	0.0	7.01	2162.	0.	0.0	276.
R-114-005C	93.40	40.7	41.1	0.0658	88.99	47.29	22.0	20.6	65735.	86.78	86.95	0.0	6.54	2533.	0.	0.0	347.
R-114-006C	94.05	41.2	41.5	0.0665	89.56	47.82	7.5	7.0	22328.	86.25	86.86	0.0	7.50	2558.	0.	0.0	305.
R-114-007C	94.44	41.5	41.8	0.0661	90.08	47.50	5.2	4.9	15456.	85.98	86.86	0.0	8.02	2539.	0.	0.0	283.
R-114-008C	95.75	42.2	42.7	0.0656	91.31	47.00	3.0	2.8	8950.	85.94	87.51	0.0	9.02	2506.	0.	0.0	248.
R-114-009C	93.49	41.2	41.1	0.0317	88.68	22.84	22.0	20.6	69027.	91.06	91.05	0.0	2.43	1223.	0.	0.0	450.
R-114-010C	93.84	41.2	41.4	0.0322	88.42	23.16	7.5	7.0	23490.	90.75	91.05	0.0	2.93	1239.	0.	0.0	378.
R-114-011C	94.01	41.2	41.5	0.0317	88.25	22.84	5.2	4.9	16287.	90.75	91.05	0.0	3.11	1222.	0.	0.0	352.
R-114-012C	94.66	41.7	41.9	0.0308	88.60	22.19	3.0	2.8	9429.	90.88	91.53	0.0	3.45	1186.	0.	0.0	307.
R-114-013C	90.87	39.7	39.4	0.0436	86.71	31.42	22.0	20.6	66077.	87.26	87.34	0.0	3.57	1691.	0.	0.0	424.
R-114-014C	91.00	39.5	39.5	0.0433	86.50	31.20	7.5	7.0	22386.	86.56	86.99	0.0	4.23	1679.	0.	0.0	355.
R-114-015C	91.44	39.9	39.7	0.0426	86.67	30.72	5.2	4.9	15557.	86.73	87.21	0.0	4.47	1652.	0.	0.0	331.
R-114-016C	92.31	40.7	40.3	0.0419	87.20	30.19	3.0	2.8	9017.	86.96	87.78	0.0	4.94	1620.	0.	0.0	293.
R-114-017C	96.79	43.7	43.5	0.0742	92.35	53.17	22.0	20.6	67572.	89.12	89.31	0.0	7.58	2829.	0.	0.0	334.
R-114-018C	97.58	44.7	44.0	0.0735	92.75	52.61	7.5	7.0	22954.	88.63	89.18	0.0	8.67	2795.	0.	0.0	288.
R-114-019C	98.05	45.1	44.4	0.0733	93.18	52.46	5.2	4.9	15910.	88.41	89.35	0.0	9.17	2785.	0.	0.0	272.
R-114-020C	99.36	46.1	45.3	0.0726	93.92	51.88	3.0	2.8	9216.	88.46	90.01	0.0	10.13	2747.	0.	0.0	243.
R-114-021C	95.79	42.7	42.7	0.1363	91.09	97.76	22.0	20.6	58182.	76.58	77.02	0.0	19.00	5213.	0.	0.0	245.
R-114-022C	97.53	43.7	44.0	0.1372	93.18	98.15	7.5	7.0	19795.	76.00	77.28	0.0	20.89	5216.	0.	0.0	223.
R-114-023C	98.75	44.2	44.9	0.1376	94.36	98.28	5.2	4.9	13643.	75.24	77.10	0.0	22.58	5211.	0.	0.0	206.
R-114-024C	100.62	45.7	46.2	0.1382	96.62	98.45	3.0	2.8	7873.	74.66	77.72	0.0	24.42	5200.	0.	0.0	190.
R-114-025C	103.69	48.2	48.6	0.1705	100.27	120.91	22.0	20.6	59885.	78.85	79.31	0.0	24.61	6348.	0.	0.0	231.
R-114-026C	104.90	49.2	49.5	0.1689	101.27	119.59	7.5	7.0	20262.	77.69	79.26	0.0	26.43	6264.	0.	0.0	212.
R-114-027C	107.89	51.7	51.9	0.1983	103.48	140.04	22.0	20.6	59736.	78.58	79.18	0.0	29.01	7290.	0.	0.0	225.
R-114-028C	110.56	53.7	54.2	0.1997	106.51	140.46	7.5	7.0	20307.	77.78	79.53	0.0	31.91	7272.	0.	0.0	204.
R-114-029C	111.43	54.7	54.9	0.1993	107.51	140.02	5.2	4.9	14009.	76.93	79.57	0.0	33.17	7236.	0.	0.0	195.
R-114-030C	114.92	57.2	57.9	0.2013	111.27	140.72	3.0	2.8	8088.	76.13	80.50	0.0	36.60	7218.	0.	0.0	176.
R-114-031C	101.87	47.2	47.2	0.1710	99.10	121.41	22.0	20.6	58413.	76.89	77.32	0.0	24.77	6397.	0.	0.0	231.
R-114-032C	103.48	48.2	48.4	0.1688	100.23	119.67	7.5	7.0	19857.	76.09	77.68	0.0	26.59	6286.	0.	0.0	211.
R-114-033C	104.47	49.2	49.2	0.1700	101.14	120.43	5.2	4.9	13674.	75.24	77.46	0.0	28.12	6313.	0.	0.0	201.
R-114-034C	106.98	51.2	51.2	0.1691	103.53	119.42	3.0	2.8	7879.	74.31	78.21	0.0	30.72	6228.	0.	0.0	181.
R-114-035C	91.96	39.7	40.1	0.1092	88.33	78.60	22.0	20.6	58974.	77.69	78.03	0.0	14.10	4221.	0.	0.0	268.
R-114-036C	93.18	40.7	40.9	0.1082	89.60	77.76	7.5	7.0	20099.	77.34	78.34	0.0	15.34	4167.	0.	0.0	243.
R-114-037C	93.79	40.7	41.3	0.1092	90.21	78.38	5.2	4.9	13861.	76.67	78.16	0.0	16.38	4195.	0.	0.0	229.
R-114-038C	95.53	42.2	42.6	0.1087	91.74	77.92	3.0	2.8	7974.	76.00	78.38	0.0	18.34	4157.	0.	0.0	203.
R-114-039C	94.88	41.7	42.1	0.0880	91.52	63.10	22.0	20.6	63983.	84.35	84.58	0.0	10.42	3370.	0.	0.0	289.
R-114-040C	95.32	42.2	42.4	0.0876	91.92	62.77	7.5	7.0	21702.	83.68	84.40	0.0	11.27	3350.	0.	0.0	266.
R-114-041C	95.97	42.7	42.9	0.0872	92.49	62.42	5.2	4.9	15055.	83.51	84.67	0.0	11.88	3327.	0.	0.0	250.
R-114-042C	97.75	43.7	44.1	0.0859	93.79	61.40	3.0	2.8	8743.	83.68	85.59	0.0	13.11	3262.	0.	0.0	222.

Table C-29 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-114-043C	120.59	62.7	63.1	0.3008	116.44	208.77	22.0	20.6	57721.	75.73	76.62	0.0	44.41	10578.	0.	0.0	213.
R-114-044C	125.22	66.9	67.6	0.3007	121.25	207.35	7.5	7.0	20086.	76.44	79.13	0.0	47.44	10397.	0.	0.0	196.
R-114-045C	126.64	68.7	69.0	0.3031	122.63	208.62	5.2	4.9	13789.	75.11	78.91	0.0	49.63	10427.	0.	0.0	188.
R-114-046C	132.50	74.7	75.1	0.3007	128.03	205.38	3.0	2.8	8203.	76.40	82.47	0.0	53.06	10126.	0.	0.0	171.
R-114-047C	109.27	52.7	53.1	0.2268	105.91	159.63	21.5	20.1	55977.	75.24	75.91	0.0	33.69	8286.	0.	0.0	220.
R-114-048C	112.20	55.2	55.5	0.2249	108.93	157.68	7.5	7.0	19828.	75.78	77.77	0.0	35.43	8135.	0.	0.0	205.
R-114-049C	113.71	56.7	56.9	0.2251	110.45	157.52	5.2	4.9	13763.	75.42	78.29	0.0	36.85	8101.	0.	0.0	197.
R-114-050C	117.11	59.7	59.9	0.2246	113.21	156.57	3.0	2.8	7984.	74.84	79.75	0.0	39.82	7994.	0.	0.0	180.
R-114-051C	114.70	57.2	57.7	0.2593	111.27	181.22	22.0	20.6	58017.	76.18	76.97	0.0	38.13	9300.	0.	0.0	218.
R-114-052C	118.23	60.2	60.9	0.2586	114.63	179.95	7.5	7.0	19890.	75.82	78.21	0.0	41.21	9165.	0.	0.0	199.
R-114-053C	120.16	62.2	62.7	0.2602	116.57	180.57	5.2	4.9	13794.	75.38	78.69	0.0	43.13	9158.	0.	0.0	190.
R-114-054C	125.09	66.7	67.5	0.2585	121.04	178.31	3.0	2.8	8133.	75.91	81.59	0.0	46.34	8944.	0.	0.0	173.

Table C-30. Experimental data for R-114 condensing on tube D

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	V, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-114-001D	91.96	40.2	40.1	0.0883	88.86	63.52	23.0	14.4	61506.	84.66	84.84	0.0	7.21	3412.	0.	0.0	423.
R-114-002D	93.05	41.2	40.8	0.0888	89.78	63.80	7.5	4.7	19976.	83.99	84.84	0.0	8.63	3420.	0.	0.0	354.
R-114-003D	93.84	41.7	41.4	0.0884	90.52	63.46	5.2	3.3	13883.	83.99	85.24	0.0	9.22	3396.	0.	0.0	329.
R-114-004D	95.97	43.0	42.9	0.0874	92.14	62.60	3.0	1.9	8082.	84.35	86.38	0.0	10.61	3337.	0.	0.0	281.
R-114-005D	98.79	44.9	44.9	0.0852	94.01	60.90	2.1	1.3	5698.	84.66	87.56	0.0	12.69	3229.	0.	0.0	228.
R-114-006D	93.27	40.5	41.0	0.1079	90.08	77.48	23.0	14.4	60661.	83.46	83.75	0.0	9.66	4151.	0.	0.0	384.
R-114-007D	94.92	41.7	42.1	0.1080	91.52	77.41	7.5	4.7	19807.	83.15	84.27	0.0	11.21	4135.	0.	0.0	330.
R-114-008D	96.10	42.7	43.0	0.1081	92.62	77.36	5.2	3.3	13744.	83.06	84.49	0.0	12.32	4123.	0.	0.0	299.
R-114-009D	98.79	44.4	44.9	0.1078	94.75	77.00	3.0	1.9	8016.	83.46	85.90	0.0	14.11	4082.	0.	0.0	259.
R-114-010D	102.78	47.2	47.9	0.1081	98.49	76.82	2.1	1.3	5692.	84.13	87.91	0.0	16.77	4040.	0.	0.0	216.
R-114-011D	92.14	39.5	40.2	0.1397	89.56	100.40	23.0	14.4	55769.	76.67	77.02	0.0	15.29	5390.	0.	0.0	315.
R-114-012D	93.40	40.9	41.1	0.1392	91.31	99.78	7.5	4.7	18195.	76.22	77.55	0.0	16.52	5345.	0.	0.0	289.
R-114-013D	94.44	41.5	41.8	0.1392	92.09	99.74	5.2	3.3	12565.	75.60	77.55	0.0	17.87	5332.	0.	0.0	267.
R-114-014D	97.40	43.7	43.9	0.1394	94.62	99.58	3.0	1.9	7257.	75.11	78.21	0.0	20.75	5293.	0.	0.0	228.
R-114-015D	101.31	46.2	46.8	0.1946	97.97	138.38	23.0	14.4	55958.	76.85	77.37	0.0	24.20	7300.	0.	0.0	270.
R-114-016D	104.64	48.9	49.3	0.1940	101.40	137.36	7.5	4.7	18546.	77.47	79.31	0.0	26.26	7198.	0.	0.0	245.
R-114-017D	106.16	50.2	50.5	0.1942	102.88	137.23	5.2	3.3	12751.	76.44	79.00	0.0	28.44	7169.	0.	0.0	226.
R-114-018D	110.13	53.7	53.8	0.1941	106.34	136.56	3.0	1.9	7372.	75.69	80.10	0.0	32.24	7076.	0.	0.0	196.
R-114-019D	97.88	43.7	44.2	0.1709	95.23	121.95	23.0	14.4	56021.	76.98	77.41	0.0	20.68	6477.	0.	0.0	280.
R-114-020D	100.14	45.7	45.9	0.1702	97.54	121.12	7.5	4.7	18288.	76.44	78.12	0.0	22.86	6404.	0.	0.0	251.
R-114-021D	100.92	46.2	46.5	0.1697	98.41	120.64	5.2	3.3	12579.	75.46	77.85	0.0	24.26	6369.	0.	0.0	235.
R-114-022D	104.86	49.2	49.5	0.1699	101.88	120.21	3.0	1.9	7304.	75.24	79.09	0.0	27.70	6296.	0.	0.0	203.
R-114-023D	87.24	36.7	37.0	0.1246	84.65	90.06	23.0	14.4	54074.	74.22	74.68	0.0	12.80	4880.	0.	0.0	341.
R-114-024D	89.30	37.7	38.3	0.1248	86.80	89.95	7.5	4.7	17617.	73.81	74.94	0.0	14.92	4855.	0.	0.0	291.
R-114-025D	90.17	38.7	38.9	0.1240	87.72	89.33	5.2	3.3	12221.	73.59	75.25	0.0	15.75	4814.	0.	0.0	273.
R-114-026D	93.84	41.0	41.4	0.1235	90.78	88.60	3.0	1.9	7136.	73.81	76.88	0.0	18.49	4742.	0.	0.0	229.
R-114-027D	93.49	40.7	41.1	0.1529	91.09	109.69	23.0	14.4	55155.	75.78	76.18	0.0	17.51	5875.	0.	0.0	300.
R-114-028D	95.92	42.2	42.8	0.1528	93.23	109.27	7.5	4.7	17985.	75.24	76.71	0.0	19.95	5825.	0.	0.0	261.
R-114-029D	96.92	43.2	43.5	0.1532	94.27	109.47	5.2	3.3	12430.	74.66	76.80	0.0	21.20	5825.	0.	0.0	246.
R-114-030D	100.88	46.2	46.4	0.1532	97.71	108.96	3.0	1.9	7247.	74.75	78.34	0.0	24.33	5753.	0.	0.0	211.
R-114-031D	94.53	41.2	41.9	0.1546	92.92	110.66	23.0	14.4	55674.	76.49	76.93	0.0	17.82	5915.	0.	0.0	297.
R-114-032D	96.97	43.2	43.6	0.1551	95.01	110.70	7.5	4.7	18159.	76.00	77.46	0.0	20.24	5889.	0.	0.0	260.
R-114-033D	97.88	43.9	44.2	0.1552	95.97	110.63	5.2	3.3	12551.	75.33	77.63	0.0	21.40	5875.	0.	0.0	246.
R-114-034D	102.09	47.2	47.4	0.1550	99.67	110.01	3.0	1.9	7321.	75.55	79.13	0.0	24.75	5794.	0.	0.0	209.
R-114-035D	93.14	40.2	40.9	0.1282	91.04	91.93	23.0	14.4	57943.	79.69	80.06	0.0	13.26	4927.	0.	0.0	332.
R-114-036D	95.71	42.2	42.7	0.1284	93.49	91.79	7.5	4.7	19019.	79.74	81.07	0.0	15.31	4895.	0.	0.0	286.
R-114-037D	96.10	42.7	43.0	0.1307	94.23	93.37	5.2	3.3	13013.	78.49	80.19	0.0	16.76	4976.	0.	0.0	266.
R-114-038D	99.01	44.7	45.1	0.1309	96.67	93.23	3.0	1.9	7570.	79.16	80.85	0.0	19.01	4940.	0.	0.0	232.
R-114-039D	93.36	40.7	41.0	0.0531	90.39	38.10	23.0	14.4	65362.	90.04	90.05	0.0	3.31	2041.	0.	0.0	552.
R-114-040D	93.44	40.7	41.1	0.0541	90.91	38.84	7.5	4.7	21087.	88.94	89.31	0.0	4.32	2080.	0.	0.0	431.
R-114-041D	93.62	40.9	41.2	0.0536	91.13	38.46	5.2	3.3	14590.	88.63	89.26	0.0	4.67	2059.	0.	0.0	394.
R-114-042D	94.58	41.7	41.9	0.0530	91.70	37.99	3.0	1.9	8424.	88.41	89.61	0.0	5.56	2030.	0.	0.0	326.

Table C-30 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-114-043D	91.18	39.2	39.6	0.0385	87.55	27.73	23.0	14.4	64552.	88.94	89.00	0.0	2.20	1491.	0.	0.0	605.
R-114-044D	91.57	39.7	39.8	0.0410	89.38	29.47	7.5	4.7	20952.	88.41	88.74	0.0	2.99	1584.	0.	0.0	473.
R-114-045D	91.83	39.7	40.0	0.0409	89.47	29.37	5.2	3.3	14512.	88.24	88.74	0.0	3.34	1578.	0.	0.0	422.
R-114-046D	92.79	40.2	40.7	0.0400	89.78	28.72	3.0	1.9	8389.	88.24	89.09	0.0	4.13	1540.	0.	0.0	334.
R-114-047D	94.23	42.5	41.6	0.0662	91.13	47.47	23.0	14.4	65081.	89.65	89.70	0.0	4.55	2539.	0.	0.0	499.
R-114-048D	95.27	42.0	42.4	0.0677	92.18	48.49	7.5	4.7	21168.	89.12	89.79	0.0	5.82	2588.	0.	0.0	398.
R-114-049D	95.66	42.2	42.6	0.0669	92.70	47.87	5.2	3.3	14680.	89.03	89.92	0.0	6.19	2553.	0.	0.0	369.
R-114-050D	97.14	43.2	43.7	0.0663	93.75	47.39	3.0	1.9	8486.	88.85	90.44	0.0	7.49	2520.	0.	0.0	301.
R-114-051D	93.27	40.7	41.0	0.0746	90.96	53.48	23.0	14.4	63481.	87.44	87.65	0.0	5.73	2865.	0.	0.0	448.
R-114-052D	94.05	41.2	41.5	0.0750	91.61	53.73	7.5	4.7	20636.	86.96	87.60	0.0	6.77	2874.	0.	0.0	380.
R-114-053D	94.53	41.5	41.9	0.0744	92.05	53.31	5.2	3.3	14296.	86.69	87.73	0.0	7.32	2849.	0.	0.0	348.
R-114-054D	96.10	42.7	43.0	0.0737	93.18	52.73	3.0	1.9	8278.	86.65	88.39	0.0	8.58	2810.	0.	0.0	293.
R-114-055D	116.51	58.7	59.3	0.3003	113.98	209.12	23.0	14.4	55296.	75.78	76.57	0.0	40.33	10690.	0.	0.0	237.
R-114-056D	122.82	64.2	65.2	0.3015	119.79	208.29	7.5	4.7	18654.	77.51	80.19	0.0	43.97	10501.	0.	0.0	214.
R-114-057D	126.55	68.2	68.9	0.3040	123.40	208.99	5.2	3.3	13203.	78.58	82.43	0.0	46.05	10448.	0.	0.0	203.
R-114-058D	134.94	77.2	77.8	0.3074	131.16	209.05	3.0	1.9	7919.	80.54	86.81	0.0	51.26	10247.	0.	0.0	179.
R-114-059D	112.63	55.5	55.9	0.2620	110.66	183.28	23.0	14.4	56781.	77.96	78.56	0.0	34.37	9447.	0.	0.0	246.
R-114-060D	116.98	59.2	59.8	0.2614	114.37	181.98	7.5	4.7	18758.	78.09	80.50	0.0	37.69	9293.	0.	0.0	221.
R-114-061D	119.26	61.2	61.9	0.2630	116.44	182.57	5.2	3.3	13052.	77.87	81.29	0.0	39.68	9277.	0.	0.0	209.
R-114-062D	125.14	61.9	67.5	0.2599	121.60	179.10	3.0	1.9	7747.	79.03	84.71	0.0	43.27	8982.	0.	0.0	186.
R-114-063D	96.27	42.7	43.1	0.1732	94.71	123.68	23.0	14.4	55029.	75.55	76.05	0.0	20.47	6589.	0.	0.0	288.
R-114-064D	99.88	45.2	45.7	0.1735	97.67	123.45	7.5	4.7	18205.	76.09	77.77	0.0	22.95	6531.	0.	0.0	255.
R-114-065D	101.96	46.7	47.3	0.1738	99.67	123.30	5.2	3.3	12711.	76.36	78.60	0.0	24.48	6496.	0.	0.0	237.
R-114-066D	106.37	50.2	50.7	0.1742	103.40	123.00	3.0	1.9	7468.	76.98	80.85	0.0	27.46	6423.	0.	0.0	209.
R-114-067D	104.34	48.7	49.1	0.2216	102.40	156.69	23.0	14.4	55454.	76.13	76.66	0.0	27.94	8216.	0.	0.0	263.
R-114-068D	108.66	52.2	52.6	0.2188	106.43	153.94	7.5	4.7	18473.	77.07	79.09	0.0	30.59	8001.	0.	0.0	234.
R-114-069D	110.82	54.2	54.4	0.2201	108.24	154.43	5.2	3.3	12887.	77.16	79.97	0.0	32.26	7990.	0.	0.0	222.
R-114-070D	116.51	58.7	59.3	0.2208	113.42	153.90	3.0	1.9	7598.	78.09	82.52	0.0	36.20	7867.	0.	0.0	194.

Table C-31. Experimental data for R-114 condensing on tube E

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-114-001E	91.70	40.0	39.9	0.0742	88.86	53.33	22.2	17.9	65358.	88.15	88.30	0.0	3.47	2866.	0.	0.0	514.
R-114-002E	92.79	40.7	40.7	0.0744	89.69	53.47	7.5	6.0	22012.	87.62	88.30	0.0	4.83	2867.	0.	0.0	370.
R-114-003E	93.23	41.0	41.0	0.0742	90.04	53.30	5.2	4.2	15222.	87.26	88.21	0.0	5.49	2856.	0.	0.0	324.
R-114-004E	95.05	42.2	42.2	0.0735	91.48	52.70	3.0	2.4	8814.	87.22	88.87	0.0	7.01	2814.	0.	0.0	250.
R-114-005E	89.12	38.2	38.2	0.0559	86.36	40.34	22.2	17.9	64117.	86.51	86.68	0.0	2.52	2178.	0.	0.0	538.
R-114-006E	89.78	38.5	38.7	0.0560	86.93	40.40	7.5	6.0	21588.	86.07	86.55	0.0	3.47	2178.	0.	0.0	392.
R-114-007E	90.08	38.7	38.9	0.0567	87.24	40.85	5.2	4.2	14928.	85.76	86.42	0.0	3.99	2202.	0.	0.0	344.
R-114-008E	91.52	39.7	39.8	0.0555	88.20	39.93	3.0	2.4	8644.	85.76	87.03	0.0	5.13	2146.	0.	0.0	261.
R-114-009E	90.52	39.0	39.1	0.0679	87.98	48.88	22.2	17.9	64653.	87.22	87.38	0.0	3.22	2632.	0.	0.0	510.
R-114-010E	91.35	39.5	39.7	0.0678	88.68	48.80	7.5	6.0	21763.	86.69	87.30	0.0	4.36	2624.	0.	0.0	375.
R-114-011E	91.61	39.7	39.9	0.0671	88.95	48.29	5.2	4.2	15038.	86.29	87.12	0.0	4.90	2595.	0.	0.0	310.
R-114-012E	93.49	41.0	41.1	0.0664	90.52	47.64	3.0	2.4	8730.	86.47	88.00	0.0	6.25	2551.	0.	0.0	254.
R-114-013E	84.48	34.7	35.3	0.1402	82.33	101.64	22.0	17.7	56144.	76.18	76.66	0.0	8.06	5534.	0.	0.0	428.
R-114-014E	87.55	36.7	37.2	0.1400	85.09	101.17	7.5	6.0	19297.	76.36	77.77	0.0	10.49	5478.	0.	0.0	325.
R-114-015E	88.95	37.7	38.1	0.1397	86.28	100.80	5.2	4.2	13398.	76.13	78.21	0.0	11.78	5444.	0.	0.0	288.
R-114-016E	93.57	40.5	41.2	0.1391	90.35	99.84	3.0	2.4	7869.	76.71	80.45	0.0	14.99	5346.	0.	0.0	222.
R-114-017E	87.59	36.7	37.2	0.1728	85.88	124.70	22.0	17.7	56319.	76.40	76.93	0.0	10.93	6752.	0.	0.0	385.
R-114-018E	91.70	39.2	39.9	0.1728	89.47	124.19	7.5	6.0	19461.	76.85	78.60	0.0	13.97	6673.	0.	0.0	298.
R-114-019E	93.57	40.5	41.2	0.1733	91.31	124.29	5.2	4.2	13530.	76.71	79.18	0.0	15.63	6655.	0.	0.0	265.
R-114-020E	98.92	44.2	45.0	0.1736	95.88	123.78	3.0	2.4	7968.	77.47	81.68	0.0	19.35	6560.	0.	0.0	211.
R-114-021E	84.13	34.7	35.1	0.0873	81.45	63.33	21.8	17.6	57971.	79.51	79.84	0.0	4.46	3450.	0.	0.0	482.
R-114-022E	85.62	35.5	36.0	0.0876	82.63	63.44	7.5	6.0	20004.	79.43	80.41	0.0	5.71	3447.	0.	0.0	376.
R-114-023E	86.37	35.7	36.5	0.0876	83.60	63.41	5.2	4.2	13785.	78.80	80.06	0.0	6.94	3441.	0.	0.0	309.
R-114-024E	88.42	37.2	37.8	0.0868	85.27	62.70	3.0	2.4	7966.	78.45	80.67	0.0	8.86	3390.	0.	0.0	238.
R-114-025E	85.36	35.5	35.8	0.1161	83.51	84.06	21.8	17.6	57603.	78.94	79.40	0.0	6.19	4570.	0.	0.0	460.
R-114-026E	87.50	36.7	37.2	0.1162	85.09	83.98	7.5	6.0	19894.	78.89	80.06	0.0	8.03	4548.	0.	0.0	353.
R-114-027E	89.43	37.9	38.4	0.1153	86.67	83.18	5.2	4.2	13900.	79.25	80.94	0.0	9.34	4488.	0.	0.0	300.
R-114-028E	91.96	39.7	40.1	0.1168	88.90	84.03	3.0	2.4	8001.	78.45	81.38	0.0	12.05	4513.	0.	0.0	233.
R-114-029E	87.29	36.7	37.0	0.1567	85.14	113.18	21.8	17.6	56663.	77.56	78.16	0.0	9.43	6131.	0.	0.0	405.
R-114-030E	90.13	38.5	38.9	0.1564	87.77	112.64	7.5	6.0	19592.	77.47	79.04	0.0	11.87	6070.	0.	0.0	319.
R-114-031E	91.70	39.7	39.9	0.1565	89.17	112.54	5.2	4.2	13595.	77.20	79.44	0.0	13.38	6047.	0.	0.0	282.
R-114-032E	96.19	42.5	43.0	0.1557	93.14	111.37	3.0	2.4	7961.	77.60	81.42	0.0	16.67	5934.	0.	0.0	222.
R-114-033E	92.70	40.2	40.6	0.1957	90.83	140.44	21.8	17.6	57666.	78.85	79.66	0.0	13.45	7533.	0.	0.0	349.
R-114-034E	95.66	42.2	42.6	0.1949	93.40	139.36	7.5	6.0	19899.	78.45	80.54	0.0	16.17	7433.	0.	0.0	286.
R-114-035E	98.01	43.7	44.3	0.1968	95.62	140.38	5.2	4.2	13861.	78.45	81.29	0.0	18.14	7453.	0.	0.0	256.
R-114-036E	103.35	47.7	48.3	0.1957	100.40	138.75	3.0	2.4	8096.	78.45	83.26	0.0	22.49	7289.	0.	0.0	202.
R-114-037E	90.35	38.7	39.0	0.1833	88.33	131.92	21.8	17.6	57092.	78.05	78.87	0.0	11.89	7107.	0.	0.0	372.
R-114-038E	93.18	40.5	40.9	0.1839	90.78	131.95	7.5	6.0	19663.	77.60	79.48	0.0	14.64	7071.	0.	0.0	301.
R-114-039E	95.66	42.2	42.6	0.1845	93.05	131.99	5.0	4.0	13170.	77.60	80.23	0.0	16.75	7040.	0.	0.0	262.
R-114-040E	100.88	45.7	46.4	0.1863	98.06	132.49	3.0	2.4	8003.	77.78	82.08	0.0	20.95	6995.	0.	0.0	208.
R-114-041E	81.72	33.2	33.6	0.1026	79.91	74.62	21.8	17.6	55381.	75.82	76.31	0.0	5.65	4083.	0.	0.0	450.
R-114-042E	83.60	34.5	34.8	0.1012	81.23	73.46	7.5	6.0	19227.	76.18	77.37	0.0	6.83	4006.	0.	0.0	365.
R-114-043E	85.49	35.4	35.9	0.1007	82.68	72.98	5.2	4.2	13447.	76.67	78.25	0.0	8.03	3966.	0.	0.0	308.
R-114-044E	89.08	37.5	38.2	0.1005	86.01	72.55	3.0	2.4	7883.	77.47	79.97	0.0	10.36	3918.	0.	0.0	236.

Table C-31 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	ΔQ Q × 100	U _o , Btu hr·ft ² ·°F
R-114-045E	84.48	34.9	35.3	0.1286	84.96	92.93	21.8	17.6	56298.	77.16	77.55	0.0	7.13	5060.	0.	0.0	442.
R-114-046E	86.98	36.5	36.9	0.1283	84.87	92.71	7.5	6.0	19483.	77.16	78.47	0.0	9.17	5026.	0.	0.0	342.
R-114-047E	88.42	37.5	37.8	0.1278	86.06	92.21	5.2	4.2	13542.	77.11	78.91	0.0	10.41	4985.	0.	0.0	298.
R-114-048E	92.35	40.0	40.4	0.1273	89.17	91.49	3.0	2.4	7907.	77.38	80.54	0.0	13.39	4910.	0.	0.0	228.
R-114-049E	110.30	53.7	53.9	0.3127	107.47	219.69	21.8	17.6	58739.	80.14	81.33	0.0	29.57	11379.	0.	0.0	240.
R-114-050E	115.99	58.2	58.9	0.3172	112.73	221.26	7.5	6.0	20528.	80.40	83.62	0.0	33.98	11324.	0.	0.0	208.
R-114-051E	119.30	61.4	61.9	0.3196	116.05	221.93	5.2	4.2	14302.	80.22	84.58	0.0	36.90	11276.	0.	0.0	190.
R-114-052E	127.02	69.2	69.4	0.3218	123.06	221.32	3.0	2.4	8545.	81.73	88.87	0.0	41.72	11052.	0.	0.0	165.
R-114-053E	102.05	46.9	47.3	0.2557	99.75	181.43	21.8	17.6	58194.	79.51	80.45	0.0	22.06	9557.	0.	0.0	270.
R-114-054E	105.51	49.7	50.0	0.2529	102.44	178.80	7.5	6.0	20180.	79.29	81.95	0.0	24.89	9353.	0.	0.0	234.
R-114-055E	107.97	51.7	52.0	0.2529	104.87	178.22	5.2	4.2	14079.	79.34	82.91	0.0	26.85	9276.	0.	0.0	215.
R-114-056E	114.36	56.7	57.4	0.2517	110.40	176.12	3.0	2.4	8337.	80.36	86.16	0.0	31.10	9045.	0.	0.0	181.
R-114-057E	105.90	50.0	50.3	0.2849	103.14	201.24	21.8	17.6	58161.	79.38	80.50	0.0	25.96	10519.	0.	0.0	252.
R-114-058E	110.91	53.7	54.4	0.2857	107.68	200.65	7.5	6.0	20318.	79.69	82.65	0.0	29.74	10380.	0.	0.0	217.
R-114-059E	114.18	56.5	57.3	0.2889	110.96	202.01	5.2	4.2	14236.	80.00	84.05	0.0	32.15	10378.	0.	0.0	201.
R-114-060E	122.01	63.7	64.5	0.2915	118.37	201.76	3.0	2.4	8465.	81.25	87.78	0.0	37.50	10190.	0.	0.0	169.
R-114-061E	92.88	40.2	40.7	0.2029	90.70	145.62	21.8	17.6	57028.	78.00	78.74	0.0	14.51	7808.	0.	0.0	335.
R-114-062E	96.01	42.7	42.9	0.2023	93.58	144.63	7.5	6.0	19794.	78.05	80.10	0.0	16.94	7709.	0.	0.0	284.
R-114-063E	98.36	44.2	44.6	0.2015	95.54	143.72	5.2	4.2	13815.	78.14	81.07	0.0	18.76	7626.	0.	0.0	253.
R-114-064E	103.82	48.0	48.7	0.2021	100.23	143.30	3.0	2.4	8124.	78.89	83.40	0.0	22.68	7521.	0.	0.0	207.
R-114-065E	97.36	43.2	43.9	0.2328	94.75	166.25	21.8	17.6	57267.	78.27	79.13	0.0	18.66	8838.	0.	0.0	295.
R-114-066E	101.48	46.2	46.9	0.2339	98.67	166.16	7.5	6.0	19943.	78.40	80.94	0.0	21.81	8762.	0.	0.0	250.
R-114-067E	104.73	48.7	49.4	0.2366	101.84	167.39	5.2	4.2	13926.	78.54	81.95	0.0	24.49	8770.	0.	0.0	223.
R-114-068E	111.12	53.9	54.6	0.2375	107.64	166.76	3.0	2.4	8206.	79.11	84.80	0.0	29.17	8623.	0.	0.0	184.
R-114-069E	115.47	58.7	58.4	0.3530	112.99	246.14	21.8	17.6	58899.	80.36	81.55	0.0	34.52	12611.	0.	0.0	228.
R-114-070E	121.53	63.0	64.0	0.3564	118.50	246.67	7.5	6.0	20600.	80.54	84.05	0.0	39.24	12472.	0.	0.0	198.
R-114-071E	125.05	66.7	67.4	0.3602	121.98	248.14	5.2	4.2	14390.	80.54	85.28	0.0	42.14	12447.	0.	0.0	184.
R-114-072E	94.10	40.9	41.6	0.2206	92.05	158.05	21.8	17.6	56218.	76.80	77.68	0.0	16.86	8455.	0.	0.0	312.
R-114-073E	98.19	43.5	44.5	0.2192	95.45	156.38	7.5	6.0	19592.	77.16	79.35	0.0	19.93	8300.	0.	0.0	259.
R-114-074E	100.96	45.7	46.5	0.2224	98.36	158.09	5.2	4.2	13701.	77.34	80.54	0.0	22.03	8345.	0.	0.0	236.
R-114-075E	107.67	50.9	51.8	0.2243	104.57	158.13	3.0	2.4	8089.	78.05	83.53	0.0	26.88	8235.	0.	0.0	191.
R-114-076E	97.62	43.5	44.0	0.2409	95.84	171.75	21.9	17.6	56843.	77.38	78.12	0.0	19.87	9126.	0.	0.0	286.
R-114-077E	101.87	46.5	47.2	0.2415	99.71	171.33	7.5	6.0	19701.	77.51	79.88	0.0	23.18	9028.	0.	0.0	243.
R-114-078E	104.56	48.7	49.3	0.2427	102.18	171.67	5.2	4.2	13743.	77.51	80.85	0.0	25.38	8997.	0.	0.0	221.
R-114-079E	110.99	53.7	54.5	0.2427	107.85	170.43	3.0	2.4	8095.	78.00	83.70	0.0	30.14	8815.	0.	0.0	182.
R-114-080E	119.77	61.7	62.3	0.3894	116.65	270.18	21.8	17.6	58321.	79.47	80.85	0.0	39.62	13714.	0.	0.0	216.
R-114-081E	126.04	67.7	68.4	0.3938	122.88	270.91	7.5	6.0	20428.	79.74	83.48	0.0	44.43	13559.	0.	0.0	190.
R-114-082E	129.55	71.2	72.0	0.3964	126.32	271.38	5.2	4.2	14247.	79.38	84.80	0.0	47.46	13473.	0.	0.0	177.

Table C-32. Experimental data for R-115 condensing on tube A

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{AQ}{Q} \times 100$	U_o , $\frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}$
R-115-009A	85.79	151.2	150.1	0.0692	83.46	43.87	22.5	18.1	56120.	74.55	74.74	0.15	11.15	1678.	1684.	0.3	144.
R-115-010A	86.32	152.2	151.2	0.0678	83.99	42.93	7.6	6.1	18961.	74.44	74.88	0.42	11.65	1638.	1592.	-2.8	134.
R-115-011A	87.09	153.7	152.8	0.0671	84.57	42.47	5.2	4.2	13052.	74.80	75.45	0.64	11.96	1615.	1673.	3.6	129.
R-115-012A	88.14	156.2	155.1	0.0687	85.78	43.38	3.0	2.4	7514.	74.43	75.51	1.06	13.17	1642.	1594.	-2.9	119.
R-115-017A	85.25	150.2	148.9	0.0507	84.09	32.11	22.5	18.1	57943.	77.06	77.20	0.11	8.12	1231.	1223.	-0.6	145.
R-115-018A	85.46	150.7	149.4	0.0515	84.48	32.58	7.6	6.1	19463.	76.52	76.86	0.32	8.77	1248.	1202.	-3.7	136.
R-115-019A	85.78	151.2	150.0	0.0515	84.67	32.57	5.2	4.2	13320.	76.47	76.96	0.48	9.07	1246.	1256.	0.8	131.
R-115-020A	86.63	152.7	151.9	0.0507	85.28	32.02	3.0	2.4	7708.	76.54	77.36	0.81	9.68	1220.	1206.	-1.2	120.
R-115-033A	97.90	178.7	177.6	0.2052	97.15	125.96	22.0	17.7	49596.	66.76	67.20	0.43	30.92	4552.	4771.	4.8	141.
R-115-034A	99.71	183.2	182.0	0.2050	98.83	125.31	7.6	6.1	17229.	66.78	67.98	1.19	32.33	4487.	4530.	1.0	133.
R-115-035A	101.41	187.2	186.2	0.2061	100.43	125.47	5.2	4.2	11903.	67.23	68.95	1.73	33.32	4453.	4498.	1.0	128.
R-115-036A	105.11	196.7	195.7	0.2100	104.01	126.63	3.0	2.4	7002.	68.10	70.94	2.84	35.59	4405.	4256.	-3.4	118.
R-115-037A	102.06	189.2	187.9	0.2608	101.55	158.27	22.0	17.7	47863.	64.16	64.70	0.52	37.63	5597.	5738.	2.5	142.
R-115-038A	105.26	197.2	196.1	0.2619	104.41	157.79	7.6	6.1	16922.	65.34	66.83	1.48	39.18	5484.	5624.	2.6	134.
R-115-039A	108.33	205.2	204.2	0.2712	107.48	162.00	5.2	4.2	11795.	66.36	68.49	2.13	40.90	5533.	5521.	-0.2	129.
R-115-040A	98.50	180.2	179.1	0.1332	97.08	81.78	22.5	18.1	58947.	78.33	78.64	0.27	20.02	2946.	3008.	2.1	141.
R-115-041A	99.25	181.7	180.9	0.1328	97.88	81.36	7.6	6.1	19803.	77.66	78.46	0.79	21.20	2920.	2991.	2.4	132.
R-115-042A	100.11	183.7	183.0	0.1342	98.73	82.02	5.2	4.2	13583.	77.68	78.82	1.13	21.86	2931.	2937.	0.2	128.
R-115-043A	102.06	188.2	187.9	0.1355	100.52	82.48	3.0	2.4	7900.	77.96	79.82	1.85	23.17	2917.	2766.	-5.2	120.
R-115-044A	97.44	177.7	176.5	0.1697	96.74	104.26	22.5	18.1	54005.	71.42	71.78	0.34	25.84	3776.	3789.	0.3	140.
R-115-045A	98.94	180.7	180.1	0.1706	98.09	104.48	7.6	6.1	18283.	71.27	72.28	1.02	27.16	3756.	3862.	2.8	132.
R-115-046A	99.97	183.7	182.7	0.1714	99.05	104.71	5.2	4.2	12533.	71.19	72.64	1.44	28.06	3744.	3744.	-0.0	127.
R-115-047A	102.48	189.7	188.9	0.1723	101.32	104.67	3.0	2.4	7296.	71.52	73.91	2.38	29.77	3693.	3569.	-3.4	118.
R-115-048A	99.77	182.7	182.2	0.1040	97.74	63.74	22.5	18.1	63411.	84.29	84.54	0.21	15.36	2282.	2312.	1.3	142.
R-115-049A	100.52	184.2	184.0	0.1048	98.52	64.09	7.6	6.1	21370.	83.91	84.54	0.62	16.30	2285.	2362.	3.4	134.
R-115-050A	101.05	185.7	185.4	0.1046	99.05	63.88	5.2	4.2	14645.	83.91	84.80	0.89	16.70	2271.	2309.	1.6	130.
R-115-051A	102.72	189.7	189.5	0.1056	100.70	64.26	3.0	2.4	8493.	84.05	85.53	1.48	17.93	2265.	2209.	-2.5	121.

Table C-33. Experimental data for R-115 condensing on tube D

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-115-005D	100.54	183.7	184.1	0.0812	97.86	49.75	23.1	14.5	69109.	94.46	94.66	0.16	5.98	1774.	1795.	1.2	265.
R-115-006D	100.93	184.7	185.0	0.0820	98.19	50.19	7.6	4.8	22649.	93.97	94.46	0.49	6.71	1786.	1859.	4.1	238.
R-115-007D	101.58	186.2	186.7	0.0825	99.11	50.39	5.2	3.3	15528.	94.04	94.75	0.71	7.18	1787.	1828.	2.3	223.
R-115-008D	102.83	189.2	189.8	0.0829	100.27	50.47	3.0	1.9	9012.	94.36	95.51	1.15	7.90	1778.	1715.	-3.5	201.
R-115-009D	101.10	185.2	185.5	0.0611	97.90	37.42	23.1	14.5	70896.	96.92	97.09	0.12	4.09	1330.	1390.	4.5	291.
R-115-010D	101.41	185.7	186.2	0.0621	98.21	38.00	7.6	4.8	23262.	96.57	96.95	0.38	4.65	1349.	1444.	7.0	260.
R-115-011D	101.76	186.7	187.1	0.0627	98.62	38.33	5.2	3.3	15915.	96.48	97.03	0.55	5.01	1358.	1422.	4.7	242.
R-115-012D	102.42	188.7	188.8	0.0623	99.21	38.02	3.0	1.9	9194.	96.42	97.33	0.91	5.54	1342.	1356.	1.1	216.
R-115-013D	96.21	173.2	173.5	0.2052	95.56	126.46	23.1	14.5	56076.	76.71	77.15	0.41	19.27	4609.	4725.	2.5	214.
R-115-014D	98.12	177.7	178.1	0.2058	97.27	126.29	7.6	4.8	18524.	76.63	77.87	1.22	20.87	4559.	4641.	1.8	195.
R-115-015D	99.67	181.7	181.9	0.2090	98.81	127.77	5.2	3.3	12724.	76.66	78.46	1.78	22.11	4576.	4615.	0.9	185.
R-115-016D	102.89	189.7	190.0	0.2105	101.80	127.70	3.0	1.9	7412.	76.78	79.86	3.06	24.57	4496.	4581.	1.9	164.
R-115-017D	99.37	180.7	181.2	0.1264	97.94	77.46	23.1	14.5	64621.	88.56	88.83	0.22	10.68	2778.	2577.	-7.2	233.
R-115-018D	100.26	183.2	183.4	0.1272	98.73	77.74	7.6	4.8	21234.	88.20	88.97	0.75	11.67	2776.	2835.	2.1	213.
R-115-019D	101.10	185.2	185.5	0.1273	99.57	77.67	5.1	3.2	14273.	88.17	89.28	1.09	12.37	2761.	2776.	0.6	200.
R-115-020D	102.74	189.2	189.6	0.1272	101.09	77.27	3.0	1.9	8438.	88.23	90.07	1.83	13.59	2723.	2728.	0.2	179.
R-115-021D	95.24	171.2	171.2	0.2421	94.87	149.46	23.0	14.4	52264.	71.47	72.00	0.50	23.50	5473.	5735.	4.8	208.
R-115-022D	98.31	178.7	178.6	0.2475	97.72	151.68	7.6	4.8	17460.	71.95	73.42	1.47	25.63	5470.	5562.	1.7	191.
R-115-023D	99.99	182.7	182.7	0.2493	99.37	152.15	5.2	3.3	11988.	71.86	74.04	2.16	27.04	5440.	5608.	3.1	180.
R-115-024D	104.07	192.7	193.0	0.2566	103.17	155.10	3.0	1.9	7000.	72.04	75.69	3.64	30.21	5426.	5451.	0.5	161.
R-115-025D	101.70	186.7	187.0	0.0482	98.60	29.49	23.1	14.5	72266.	98.69	98.82	0.09	2.95	1045.	1068.	2.2	317.
R-115-026D	101.87	187.2	187.4	0.0492	98.79	30.09	7.6	4.8	23680.	98.22	98.55	0.32	3.49	1065.	1221.	14.6	273.
R-115-027D	102.06	187.7	187.9	0.0496	99.01	30.31	5.2	3.3	16185.	98.06	98.51	0.44	3.77	1072.	1140.	6.4	254.
R-115-028D	102.61	188.7	189.3	0.0494	99.55	30.14	3.0	1.9	9346.	97.99	98.74	0.75	4.25	1063.	1120.	5.4	224.
R-115-029D	97.98	177.7	177.8	0.1741	97.27	106.87	23.1	14.5	59863.	81.98	82.35	0.33	15.82	3860.	3837.	-0.6	218.
R-115-030D	99.41	181.2	181.3	0.1747	98.56	106.85	7.6	4.8	19698.	81.65	82.69	1.03	17.24	3832.	3905.	1.9	199.
R-115-031D	100.40	183.7	183.7	0.1763	99.45	107.59	5.2	3.3	13490.	81.49	83.00	1.50	18.15	3839.	3891.	1.4	189.
R-115-032D	102.44	188.7	188.8	0.1762	101.32	107.03	3.0	1.9	7808.	81.25	83.78	2.53	19.93	3778.	3788.	0.3	170.
R-115-033D	100.26	183.2	183.4	0.1051	98.25	64.36	23.1	14.5	67199.	91.97	92.20	0.18	8.17	2298.	2059.	-10.4	252.
R-115-034D	100.68	184.2	184.4	0.1043	98.79	63.78	7.6	4.8	21994.	91.32	91.93	0.59	9.06	2272.	2230.	-1.9	224.
R-115-035D	101.32	185.7	186.0	0.1051	99.31	64.17	5.2	3.3	15076.	91.34	92.23	0.88	9.54	2278.	2266.	-0.5	214.
R-115-036D	102.79	189.2	189.7	0.1062	100.82	64.59	3.0	1.9	8734.	91.41	92.89	1.47	10.64	2276.	2199.	-3.3	191.
R-115-037D	95.58	171.7	172.1	0.2657	94.98	163.98	23.0	14.4	50837.	69.39	69.95	0.53	25.91	5995.	6148.	2.6	207.
R-115-038D	98.68	179.2	179.5	0.2694	97.90	165.07	7.6	4.8	16999.	69.74	71.36	1.61	28.13	5942.	6129.	3.2	189.
R-115-039D	100.97	184.7	185.1	0.2759	100.15	168.07	5.2	3.3	11708.	69.87	72.23	2.35	29.92	5978.	6106.	2.1	179.
R-115-040D	105.06	195.2	195.6	0.2808	103.96	169.36	3.0	1.9	6833.	69.94	73.88	3.94	33.15	5893.	5902.	0.1	159.
R-115-041D	99.27	180.7	180.9	0.1516	97.72	92.92	23.1	14.5	62815.	86.12	86.45	0.28	12.99	3335.	3267.	-2.0	230.
R-115-042D	100.40	183.2	183.7	0.1535	98.85	93.82	7.6	4.8	20601.	85.57	86.46	0.90	14.38	3347.	3426.	2.3	208.
R-115-043D	101.74	186.7	187.1	0.1555	100.29	94.72	5.2	3.3	14165.	85.77	87.09	1.33	15.31	3355.	3437.	2.4	196.
R-115-044D	103.52	191.2	191.6	0.1551	101.87	94.05	3.0	1.9	8221.	85.87	87.99	2.10	16.59	3300.	3142.	-4.8	178.
R-115-045D	99.51	181.7	181.5	0.3027	98.93	184.95	23.0	14.4	51398.	70.17	70.80	0.59	29.03	6629.	6815.	2.8	204.
R-115-046D	103.22	190.2	190.8	0.3117	102.48	188.73	7.6	4.8	17217.	70.62	72.39	1.77	31.71	6633.	6729.	1.4	187.
R-115-047D	105.52	196.7	196.7	0.3184	104.65	191.67	5.2	3.3	11854.	70.81	73.38	2.55	33.42	6652.	6625.	-0.4	178.
R-115-048D	111.05	211.2	211.6	0.3351	110.05	198.77	3.0	1.9	6933.	70.93	75.34	4.40	37.91	6682.	6580.	-1.5	158.

Table C-34. Experimental data for R-115 condensing on tube D1

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-115-001D1	99.19	180.7	180.7	0.1504	98.17	92.08	23.0	14.4	62657.	86.28	86.60	0.27	12.75	3306.	3116.	-5.7	232.
R-115-002D1	100.56	184.2	184.1	0.1498	99.39	91.43	7.4	4.6	20215.	86.22	87.12	0.91	13.89	3259.	3347.	2.7	210.
R-115-003D1	101.49	186.7	186.4	0.1498	100.25	91.23	5.2	3.3	14253.	86.31	87.60	1.30	14.54	3236.	3372.	4.2	199.
R-115-004D1	103.37	191.2	191.2	0.1512	102.04	91.67	3.0	1.9	8259.	86.28	88.38	2.08	16.04	3219.	3109.	-3.4	179.
R-115-005D1	100.77	184.7	184.6	0.0627	97.71	38.45	23.1	14.5	70807.	96.81	96.97	0.12	3.87	1369.	1378.	0.7	316.
R-115-006D1	100.91	184.7	185.0	0.0631	97.99	38.65	7.6	4.8	23179.	96.24	96.63	0.40	4.48	1375.	1497.	8.8	275.
R-115-007D1	101.24	185.7	185.8	0.0634	98.32	38.82	5.2	3.3	15858.	96.14	96.71	0.56	4.81	1379.	1456.	5.6	256.
R-115-008D1	102.00	187.7	187.7	0.0642	99.17	39.19	3.0	1.9	9153.	96.00	96.93	0.94	5.53	1387.	1396.	0.7	224.
R-115-009D1	98.64	179.7	179.4	0.3027	98.25	185.27	23.0	14.4	50947.	69.52	70.14	0.59	28.81	6670.	6757.	1.3	207.
R-115-010D1	104.16	189.2	193.2	0.3259	103.67	196.68	7.6	4.8	17147.	70.29	72.11	1.82	32.96	6877.	6900.	0.3	187.
R-115-011D1	105.95	197.7	197.9	0.3285	105.31	197.38	5.2	3.3	11792.	70.26	72.90	2.63	34.37	6833.	6833.	-0.0	178.
R-115-012D1	110.48	209.7	210.0	0.3371	109.62	200.18	3.0	1.9	6865.	70.19	74.57	4.37	38.10	6752.	6543.	-3.1	159.
R-115-013D1	100.73	184.7	184.5	0.0965	98.69	58.99	23.1	14.5	68361.	93.48	93.71	0.18	7.13	2101.	2094.	-0.3	264.
R-115-014D1	101.26	185.7	185.9	0.0961	99.07	58.69	7.6	4.8	22465.	93.21	93.78	0.57	7.77	2085.	2142.	2.8	240.
R-115-015D1	101.87	187.2	187.4	0.0971	99.65	59.20	5.2	3.3	15391.	93.19	94.02	0.83	8.26	2096.	2147.	2.4	227.
R-115-016D1	103.11	190.2	190.5	0.0976	100.78	59.36	3.0	1.9	8907.	93.19	94.57	1.38	9.23	2088.	2059.	-1.4	202.
R-115-017D1	97.22	176.2	176.0	0.1963	96.55	120.70	23.0	14.4	57659.	79.27	79.69	0.38	17.74	4377.	4372.	-0.1	221.
R-115-018D1	98.86	179.7	179.9	0.1962	98.07	120.15	7.6	4.8	19120.	79.18	80.34	1.14	19.09	4321.	4337.	0.4	202.
R-115-019D1	100.17	183.2	183.2	0.1986	99.39	121.24	5.2	3.3	13095.	79.05	80.64	1.57	20.33	4331.	4086.	-5.7	191.
R-115-020D1	102.85	189.7	189.9	0.1995	101.80	121.00	3.0	1.9	7616.	79.09	81.90	2.80	22.36	4261.	4196.	-1.5	170.
R-115-021D1	100.26	183.2	183.4	0.1286	98.77	78.64	23.1	14.5	65499.	89.71	89.99	0.24	10.40	2808.	2727.	-2.9	241.
R-115-022D1	101.18	185.2	185.7	0.1282	99.57	78.23	7.6	4.8	21548.	89.47	90.22	0.73	11.33	2780.	2767.	-0.5	219.
R-115-023D1	101.91	187.7	187.5	0.1288	100.33	78.42	5.2	3.3	14757.	89.38	90.48	1.08	11.98	2776.	2805.	1.1	207.
R-115-024D1	103.28	190.7	191.0	0.1292	101.45	78.41	3.0	1.9	8535.	89.22	91.06	1.83	13.14	2755.	2730.	-0.9	188.
R-115-025D1	95.89	172.7	172.8	0.2513	95.45	154.92	23.0	14.4	52397.	71.78	72.31	0.49	23.85	5655.	5680.	0.4	212.
R-115-026D1	98.82	179.7	179.8	0.2534	98.23	155.15	7.6	4.8	17520.	72.19	73.69	1.49	25.88	5581.	5645.	1.2	193.
R-115-027D1	100.40	183.7	183.7	0.2543	99.79	155.04	5.2	3.3	12032.	72.14	74.31	2.16	27.17	5531.	5598.	1.2	182.
R-115-028D1	104.36	193.7	193.8	0.2604	103.57	157.19	3.0	1.9	7013.	72.19	75.81	3.61	30.36	5490.	5406.	-1.5	162.
R-115-029D1	101.55	186.7	186.6	0.0448	97.94	27.44	23.1	14.5	72686.	99.22	99.36	0.10	2.27	973.	1103.	13.3	384.
R-115-030D1	101.81	186.7	187.2	0.0444	98.13	27.18	7.6	4.8	23891.	99.06	99.34	0.27	2.61	962.	1032.	7.2	330.
R-115-031D1	102.17	187.7	188.1	0.0446	98.50	27.27	5.2	3.3	16364.	99.10	99.50	0.40	2.87	964.	1024.	6.2	301.
R-115-032D1	102.79	189.2	189.7	0.0447	99.09	27.33	3.0	1.9	9458.	99.14	99.80	0.65	3.32	963.	977.	1.5	259.
R-115-033D1	100.75	184.7	184.6	0.0756	98.71	46.21	23.1	14.5	69884.	95.47	95.65	0.15	5.18	1646.	1680.	2.1	284.
R-115-034D1	101.35	185.7	186.1	0.0752	99.13	45.91	7.6	4.8	23015.	95.43	95.87	0.44	5.69	1630.	1669.	2.4	256.
R-115-035D1	101.97	187.7	187.7	0.0752	99.77	45.83	5.2	3.3	15801.	95.63	96.28	0.65	6.02	1622.	1676.	3.3	241.
R-115-036D1	103.04	190.2	190.4	0.0761	100.64	46.31	3.0	1.9	9126.	95.65	96.75	1.09	6.85	1629.	1633.	0.3	213.

Table C-35. Experimental data for R-115 condensing on tube E

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-115-005E	98.45	178.7	178.9	0.2573	97.76	157.69	22.5	18.1	62742.	83.26	83.81	0.51	14.91	5683.	5736.	0.9	237.
R-115-006E	100.73	184.2	184.5	0.2617	99.91	159.53	7.6	6.1	21144.	82.57	84.12	1.54	17.38	5682.	5854.	3.0	204.
R-115-007E	102.40	188.2	188.7	0.2628	101.49	159.54	5.2	4.2	14517.	82.51	84.75	2.24	18.77	5632.	5816.	3.3	187.
R-115-008E	106.56	199.2	199.5	0.2712	105.38	162.93	3.0	2.4	8485.	82.87	86.55	3.68	21.85	5622.	5509.	-2.0	160.
R-115-009E	100.74	184.7	184.6	0.1001	98.65	61.23	22.7	18.3	73767.	96.94	97.18	0.18	3.67	2181.	2021.	-7.3	370.
R-115-010E	101.32	185.7	186.0	0.0995	99.13	60.78	7.6	6.1	24644.	96.57	97.16	0.57	4.46	2158.	2154.	-0.2	302.
R-115-011E	101.93	187.2	187.6	0.1005	99.79	61.30	5.2	4.2	16871.	96.50	97.33	0.83	5.02	2170.	2151.	-0.8	269.
R-115-012E	103.09	190.2	190.5	0.1009	100.91	61.35	3.0	2.4	9741.	96.29	97.68	1.38	6.10	2158.	2057.	-4.7	220.
R-115-017E	99.77	182.2	182.2	0.1874	98.73	114.58	22.7	18.3	68700.	90.40	90.80	0.36	9.17	4102.	4081.	-0.5	279.
R-115-018E	101.12	185.2	185.5	0.1884	100.03	114.81	7.6	6.1	22921.	89.74	90.85	1.11	10.82	4081.	4194.	2.8	235.
R-115-019E	102.08	187.7	187.9	0.1880	100.87	114.32	5.2	4.2	15698.	89.59	91.18	1.59	11.70	4043.	4128.	2.1	215.
R-115-020E	104.52	193.7	194.2	0.1900	103.17	114.83	3.0	2.4	9103.	89.54	92.11	2.57	13.69	4008.	3839.	-4.2	182.
R-115-021E	96.86	175.2	175.1	0.2866	96.37	176.29	22.5	18.1	59461.	78.87	79.49	0.58	17.68	6404.	6566.	2.5	226.
R-115-022E	99.75	182.2	182.1	0.2921	99.13	178.41	7.6	6.1	20168.	78.64	80.38	1.73	20.24	6387.	6567.	2.8	197.
R-115-023E	101.10	185.2	185.5	0.2945	100.43	179.25	5.2	4.2	13734.	77.89	80.37	2.46	21.97	6372.	6392.	0.3	181.
R-115-024E	105.88	197.2	197.7	0.3049	104.97	183.36	3.0	2.4	8019.	77.99	82.20	4.20	25.79	6351.	6284.	-1.0	153.
R-115-025E	101.70	186.7	187.0	0.1408	100.27	85.73	22.7	18.3	72765.	95.52	95.84	0.26	6.02	3038.	2906.	-4.4	314.
R-115-026E	102.27	188.2	188.4	0.1411	100.93	85.80	7.6	6.1	24184.	94.61	95.44	0.81	7.25	3031.	3055.	0.8	260.
R-115-027E	102.94	190.2	190.1	0.1424	101.55	86.45	5.2	4.2	16519.	94.27	95.47	1.20	8.07	3043.	3100.	1.9	235.
R-115-028E	104.81	194.7	194.9	0.1445	103.35	87.29	3.0	2.4	9564.	94.20	96.17	1.96	9.63	3042.	2936.	-3.5	197.
R-115-029E	95.49	171.7	171.8	0.3419	95.27	210.86	22.5	18.1	54671.	72.28	73.02	0.71	22.85	7712.	7981.	3.5	210.
R-115-030E	99.35	181.2	181.1	0.3515	98.95	214.79	7.6	6.1	18625.	72.26	74.33	2.08	26.06	7705.	7875.	2.2	184.
R-115-031E	102.19	187.7	188.2	0.3586	101.74	217.54	5.2	4.2	12837.	72.34	75.36	3.02	28.34	7688.	7847.	2.1	169.
R-115-032E	108.33	203.2	204.2	0.3781	107.68	225.72	3.0	2.4	7534.	72.64	77.71	5.07	33.15	7710.	7588.	-1.6	145.
R-115-033E	99.19	180.7	180.7	0.2165	98.48	132.46	22.5	18.1	65850.	87.49	87.95	0.41	11.47	4756.	4606.	-3.1	258.
R-115-034E	101.10	185.7	185.5	0.2184	100.33	132.99	7.6	6.1	22236.	87.04	88.35	1.30	13.40	4727.	4925.	4.2	220.
R-115-035E	102.38	188.7	188.7	0.2203	101.51	133.74	5.2	4.2	15230.	86.87	88.70	1.83	14.60	4722.	4750.	0.6	202.
R-115-036E	105.61	196.7	197.0	0.2238	104.59	134.72	3.0	2.4	8848.	86.82	89.93	3.10	17.23	4673.	4636.	-0.8	169.
R-115-037E	94.89	170.2	170.4	0.3621	94.67	223.68	22.5	18.1	53054.	69.88	70.67	0.76	24.62	8205.	8544.	4.1	208.
R-115-038E	99.37	180.7	181.2	0.3692	98.89	225.64	7.6	6.1	18278.	70.66	72.85	2.19	27.62	8093.	8328.	2.9	183.
R-115-039E	102.70	188.7	189.5	0.3806	102.16	230.65	5.2	4.2	12621.	70.98	74.13	3.15	30.14	8129.	8171.	0.5	168.
R-115-040E	109.54	206.7	207.5	0.4005	108.75	238.41	3.0	2.4	7493.	72.10	77.39	5.29	34.80	8086.	7914.	-2.1	145.
R-115-041E	96.28	173.2	173.7	0.4025	95.90	247.83	22.5	18.1	51945.	68.29	69.14	0.82	27.57	9029.	9241.	2.4	204.
R-115-042E	102.23	187.7	188.3	0.4206	101.78	255.10	7.6	6.1	17985.	69.34	71.74	2.41	31.69	9014.	9140.	1.4	177.
R-115-043E	106.07	197.7	198.2	0.4351	105.52	261.32	5.2	4.2	12487.	69.89	73.38	3.49	34.44	9041.	9065.	0.3	164.
R-115-044E	113.47	217.7	218.3	0.4568	112.74	268.85	3.0	2.4	7451.	71.42	77.23	5.81	39.15	8905.	8691.	-2.4	142.

Table C-36. Experimental data for R-115 condensing on tube F

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-115-001F	101.20	185.2	185.7	0.0667	97.17	40.93	23.0	16.8	73863.	97.87	98.04	0.11	3.24	1454.	1269.	-12.7	432.
R-115-002F	101.24	185.7	185.8	0.0665	97.48	40.77	7.6	5.5	24236.	97.11	97.52	0.39	3.92	1448.	1466.	1.3	356.
R-115-003F	101.53	186.2	186.6	0.0654	97.48	40.13	5.2	3.8	16593.	97.09	97.66	0.56	4.16	1423.	1443.	1.4	330.
R-115-004F	102.74	189.2	189.6	0.0656	98.71	40.13	3.0	2.2	9619.	97.36	98.27	0.91	4.93	1414.	1359.	-3.9	277.
R-115-009F	100.99	185.2	185.2	0.1416	99.19	86.49	23.0	16.8	67577.	89.76	90.07	0.26	11.08	3076.	3024.	-1.7	267.
R-115-010F	102.40	188.7	188.7	0.1438	100.60	87.49	7.6	5.5	22301.	89.38	90.22	0.84	12.60	3089.	3172.	2.7	236.
R-115-011F	103.46	191.2	191.4	0.1449	101.66	87.93	5.2	3.8	15283.	89.33	90.54	1.21	13.52	3086.	3129.	1.4	220.
R-115-012F	104.41	193.7	193.9	0.1441	102.27	87.29	3.0	2.2	8773.	88.51	90.49	1.98	14.91	3048.	2957.	-3.0	197.
R-115-013F	97.60	176.7	176.9	0.2421	96.68	148.78	22.8	16.6	55651.	74.39	74.90	0.48	22.95	5385.	5471.	1.6	226.
R-115-014F	100.19	183.2	183.2	0.2433	99.03	148.62	7.6	5.5	18643.	74.31	75.75	1.41	25.17	5308.	5365.	1.1	203.
R-115-015F	102.34	188.7	188.6	0.2484	101.07	150.94	5.2	3.8	12810.	74.32	76.40	2.07	26.98	5330.	5375.	0.8	190.
R-115-016F	106.37	198.7	199.0	0.2544	105.04	153.01	3.0	2.2	7469.	74.49	77.88	3.38	30.19	5285.	5057.	-4.3	169.
R-115-017F	101.43	186.2	186.3	0.0903	98.93	55.20	23.0	16.8	72117.	95.54	95.75	0.15	5.79	1959.	1684.	-14.0	326.
R-115-018F	101.83	187.2	187.3	0.0907	99.31	55.40	7.6	5.5	23693.	94.86	95.40	0.52	6.70	1962.	1972.	0.5	282.
R-115-019F	101.97	187.7	187.7	0.0903	99.27	55.15	5.2	3.8	16155.	94.43	95.20	0.77	7.16	1951.	1984.	1.7	263.
R-115-020F	102.79	189.2	189.7	0.0905	100.01	55.17	3.0	2.2	9298.	93.97	95.24	1.26	8.18	1944.	1881.	-3.2	229.
R-115-021F	97.83	177.2	177.4	0.2118	96.91	130.08	22.8	16.6	58343.	78.11	78.57	0.42	19.49	4703.	4811.	2.3	232.
R-115-022F	99.87	182.4	182.4	0.2118	98.79	129.46	7.6	5.5	19493.	77.89	79.15	1.24	21.35	4631.	4705.	1.6	209.
R-115-023F	101.62	186.7	186.8	0.2144	100.52	130.47	5.2	3.8	13369.	77.80	79.63	1.82	22.91	4625.	4729.	2.2	195.
R-115-024F	105.15	195.2	195.8	0.2200	103.96	132.65	3.0	2.2	7769.	77.74	80.83	3.08	25.87	4613.	4605.	-0.2	172.
R-115-025F	101.66	186.7	186.9	0.1134	99.13	69.26	23.0	16.8	70544.	93.55	93.79	0.18	7.99	2455.	2085.	-15.1	296.
R-115-026F	102.74	189.7	189.6	0.1132	100.41	68.91	7.6	5.5	23260.	93.16	93.81	0.63	9.26	2428.	2392.	-1.5	253.
R-115-027F	103.68	191.7	192.0	0.1136	101.26	69.00	5.2	3.8	15950.	93.19	94.16	0.97	10.00	2419.	2504.	3.5	233.
R-115-028F	105.15	195.2	195.8	0.1132	102.65	68.51	3.0	2.2	9227.	93.14	94.70	1.55	11.23	2382.	2319.	-2.7	204.
R-115-029F	98.92	179.7	180.1	0.1929	97.86	118.22	22.8	16.6	60800.	81.44	81.86	0.38	17.27	4250.	4299.	1.2	237.
R-115-030F	101.03	185.2	185.3	0.1943	99.87	118.42	7.6	5.5	20351.	81.42	82.56	1.13	19.05	4211.	4292.	1.9	213.
R-115-031F	102.42	188.7	188.8	0.1949	101.22	118.37	5.2	3.8	13967.	81.42	83.06	1.63	20.18	4178.	4234.	1.3	199.
R-115-032F	104.99	195.2	195.4	0.1964	103.57	118.60	3.0	2.2	8099.	81.30	84.01	2.69	22.34	4128.	4030.	-2.4	178.
R-115-033F	99.49	181.2	181.5	0.3253	98.81	198.82	22.8	16.6	50781.	67.33	68.01	0.66	31.82	7127.	7508.	5.3	216.
R-115-034F	103.94	192.7	192.7	0.3327	103.11	201.13	7.6	5.5	17182.	67.81	69.72	1.90	35.18	7041.	7223.	2.6	193.
R-115-035F	107.68	201.7	202.4	0.3475	106.87	207.93	5.2	3.8	11857.	68.01	70.78	2.77	38.28	7129.	7205.	1.1	179.
R-115-036F	96.09	173.2	173.3	0.2847	95.74	175.41	22.8	16.6	50745.	67.31	67.93	0.61	28.47	6396.	6972.	9.0	216.
R-115-037F	99.85	182.2	182.4	0.2899	99.23	176.99	7.6	5.5	17153.	67.78	69.50	1.71	31.21	6333.	6478.	2.3	195.
R-115-038F	102.29	188.2	188.5	0.2948	101.59	178.89	5.2	3.8	11798.	67.79	70.26	2.47	33.27	6319.	6412.	1.5	183.
R-115-039F	107.27	201.2	201.4	0.3060	106.35	183.35	3.0	2.2	6898.	67.98	72.04	4.06	37.26	6301.	6089.	-3.4	163.
R-115-040F	101.39	185.7	186.2	0.0750	98.58	45.85	23.0	16.8	73216.	97.06	97.26	0.14	4.23	1627.	1624.	-0.2	370.
R-115-041F	101.58	186.2	186.7	0.0747	98.83	45.69	7.6	5.5	24044.	96.37	96.82	0.43	4.98	1620.	1640.	1.2	313.
R-115-042F	101.72	186.7	187.0	0.0743	98.95	45.42	5.2	3.8	16405.	96.01	96.67	0.65	5.38	1609.	1686.	4.8	288.
R-115-043F	102.51	188.7	189.0	0.0751	99.67	45.82	3.0	2.2	9446.	95.61	96.71	1.09	6.35	1617.	1628.	0.7	245.
R-115-044F	99.71	181.7	182.0	0.1659	98.67	101.44	22.8	16.6	63756.	85.39	85.75	0.32	14.14	3632.	3640.	0.2	247.
R-115-045F	101.05	185.2	185.4	0.1653	99.93	100.76	7.6	5.5	21217.	84.93	85.92	0.99	15.63	3582.	3757.	4.9	221.
R-115-046F	101.91	187.7	187.5	0.1664	100.66	101.23	5.2	3.8	14489.	84.55	85.98	1.43	16.65	3583.	3707.	3.5	207.
R-115-047F	103.99	192.2	192.8	0.1681	102.52	101.79	3.0	2.2	8367.	84.18	86.52	2.34	18.64	3563.	3505.	-1.6	184.

Table C-36 (continued)

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	$\dot{m}_c$, lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-115-048P	95.49	171.7	171.8	0.2684	94.94	165.67	22.8	16.6	51739.	68.75	69.33	0.55	26.45	6059.	6311.	4.2	221.
R-115-049P	99.11	180.2	180.6	0.2718	98.40	166.34	7.6	5.5	17460.	69.13	70.77	1.66	29.17	5974.	6315.	5.7	197.
R-115-050P	101.41	185.7	186.2	0.2767	100.62	168.34	5.2	3.8	11998.	69.10	71.44	2.34	31.14	5974.	6072.	1.6	185.
R-115-051P	106.05	197.7	198.1	0.2834	105.06	170.41	3.0	2.2	6997.	69.11	73.04	3.93	34.97	5897.	5887.	-0.2	162.
R-115-052P	104.61	193.7	194.4	0.3737	104.03	225.31	22.8	16.6	51379.	68.16	68.90	0.71	36.08	7859.	8123.	3.4	210.
R-115-053P	109.27	206.2	206.7	0.3833	108.58	228.28	7.6	5.5	17397.	68.63	70.73	2.10	39.59	7755.	7959.	2.6	189.

Table C-37. Experimental data for R-115 condensing on tube F1

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	V, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , $\frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}}$
R-115-001F1	97.35	176.2	176.3	0.2213	96.57	136.05	23.0	16.8	58468.	77.57	78.06	0.45	19.53	4930.	5152.	4.5	243.
R-115-002F1	99.75	181.7	182.1	0.2222	98.77	135.86	7.4	5.4	18896.	77.49	78.85	1.34	21.58	4864.	4954.	1.9	217.
R-115-003F1	101.72	186.7	187.0	0.2254	100.64	137.11	5.0	3.6	12817.	77.47	79.49	2.01	23.24	4858.	5006.	3.1	201.
R-115-004F1	105.20	195.2	195.9	0.2303	103.90	138.93	3.0	2.2	7736.	77.30	80.58	3.26	26.25	4830.	4877.	1.0	177.
R-115-005F1	99.97	182.2	182.7	0.3241	99.35	197.83	22.8	16.6	51884.	68.91	69.58	0.64	30.73	7074.	7318.	3.4	222.
R-115-006F1	105.11	195.2	195.7	0.3400	104.41	204.82	7.6	5.5	17542.	69.33	71.26	1.93	34.81	7125.	7318.	2.7	197.
R-115-007F1	107.15	200.2	201.0	0.3414	106.28	204.61	5.2	3.8	12067.	69.33	72.06	2.72	36.45	7036.	7080.	0.6	186.
R-115-008F1	112.58	215.2	215.8	0.3554	111.44	209.95	3.0	2.2	7041.	69.31	73.79	4.47	41.03	6992.	6699.	-4.2	164.
R-115-009F1	101.39	185.7	186.2	0.0706	98.77	43.14	23.0	16.8	73430.	97.34	97.50	0.12	3.97	1531.	1418.	-7.4	372.
R-115-010F1	101.91	187.2	187.5	0.0716	99.31	43.72	7.6	5.5	24214.	97.02	97.45	0.43	4.68	1547.	1610.	4.0	319.
R-115-011F1	102.31	188.2	188.5	0.0714	99.63	43.55	5.2	3.8	16569.	96.92	97.56	0.63	5.07	1538.	1639.	6.6	292.
R-115-012F1	103.61	191.7	191.8	0.0708	100.66	43.06	3.0	2.2	9613.	97.23	98.29	1.07	5.85	1510.	1590.	5.3	249.
R-115-013F1	99.75	181.7	182.1	0.1856	98.77	113.47	23.0	16.8	63255.	83.98	84.38	0.35	15.57	4062.	4062.	-0.0	251.
R-115-014F1	101.95	187.2	187.6	0.1852	100.74	112.62	7.6	5.5	21082.	84.34	85.45	1.12	17.06	3985.	4231.	6.2	225.
R-115-015F1	103.85	191.7	192.4	0.1892	102.65	114.51	5.2	3.8	14526.	84.68	86.29	1.62	18.37	4011.	4208.	4.9	210.
R-115-016F1	105.68	196.7	197.2	0.1933	104.54	116.38	3.0	2.2	8276.	83.08	85.79	2.69	21.24	4035.	4032.	-0.1	183.
R-115-017F1	101.87	187.2	187.4	0.0927	99.43	56.59	23.0	16.8	72309.	95.92	96.13	0.17	5.84	2003.	1933.	-3.5	330.
R-115-018F1	102.36	188.2	188.6	0.0923	99.91	56.27	7.6	5.5	23842.	95.41	95.97	0.55	6.67	1987.	2086.	5.0	287.
R-115-019F1	102.89	189.7	190.0	0.0931	100.43	56.69	5.2	3.8	16297.	95.20	96.00	0.80	7.29	1996.	2082.	4.3	264.
R-115-020F1	104.01	192.2	192.8	0.0939	101.47	57.01	3.0	2.2	9396.	94.87	96.21	1.33	8.47	1995.	1989.	-0.3	227.
R-115-021F1	94.88	170.2	170.4	0.2729	94.35	168.72	22.8	16.6	51675.	68.65	69.24	0.56	25.93	6189.	6357.	2.7	230.
R-115-022F1	98.43	178.7	178.9	0.2777	97.71	170.20	7.6	5.5	17420.	68.95	70.61	1.65	28.65	6134.	6285.	2.5	206.
R-115-023F1	100.77	184.7	184.6	0.2824	99.99	172.09	5.2	3.8	11969.	68.88	71.29	2.40	30.68	6128.	6246.	1.9	192.
R-115-024F1	105.84	197.2	197.6	0.2891	104.72	173.98	2.8	2.0	6527.	68.94	73.12	4.18	34.81	6027.	5842.	-3.1	167.
R-115-025F1	101.53	186.2	186.5	0.1402	99.51	85.56	23.0	16.8	68474.	90.90	91.21	0.27	10.48	3035.	3070.	1.2	279.
R-115-026F1	102.74	189.2	189.6	0.1408	100.66	85.64	7.6	5.5	22586.	90.49	91.31	0.80	11.84	3018.	3043.	0.8	246.
R-115-027F1	103.70	191.2	192.0	0.1418	101.51	86.07	5.2	3.8	15488.	90.51	91.68	1.15	12.61	3017.	2984.	-1.1	231.
R-115-028F1	105.68	196.7	197.2	0.1437	103.30	86.81	3.0	2.2	8966.	90.41	92.38	1.95	14.28	3010.	2920.	-3.0	203.
R-115-029F1	102.31	187.7	188.5	0.3449	101.40	209.44	22.8	16.6	52418.	69.66	70.35	0.66	32.31	7397.	7519.	1.6	221.
R-115-030F1	106.37	198.7	199.0	0.3487	105.24	209.56	7.6	5.5	17701.	69.99	71.95	1.95	35.40	7238.	7424.	2.6	197.
R-115-031F1	109.19	205.7	206.5	0.3581	107.99	213.63	5.2	3.8	12170.	69.93	72.74	2.80	37.86	7260.	7286.	0.3	185.
R-115-032F1	114.41	220.2	221.0	0.3699	113.07	217.53	3.0	2.2	7093.	69.90	74.53	4.62	42.20	7163.	6916.	-3.5	164.
R-115-033F1	102.06	187.7	187.9	0.0567	98.28	34.70	23.0	16.8	74981.	99.26	99.42	0.12	2.72	1227.	1338.	9.0	434.
R-115-034F1	102.66	188.7	189.4	0.0571	98.32	34.93	7.6	5.5	24792.	99.22	99.58	0.35	3.26	1231.	1342.	9.0	364.
R-115-035F1	103.48	191.2	191.5	0.0574	99.79	35.03	5.2	3.8	17046.	99.59	100.10	0.50	3.63	1229.	1301.	5.8	326.
R-115-036F1	104.81	194.7	194.9	0.0586	101.09	35.63	3.0	2.2	9897.	100.02	100.86	0.84	4.38	1241.	1247.	0.5	273.
R-115-037F1	101.68	186.7	186.9	0.1171	99.99	71.38	23.0	16.8	70330.	93.28	93.53	0.21	8.28	2530.	2463.	-2.6	294.
R-115-038F1	102.70	189.2	189.5	0.1171	100.82	71.23	7.6	5.5	23251.	93.10	93.79	0.69	9.25	2510.	2597.	3.4	261.
R-115-039F1	103.72	191.7	192.1	0.1177	101.87	71.35	5.2	3.8	15962.	93.24	94.25	1.01	9.97	2501.	2608.	4.3	242.
R-115-040F1	105.13	195.2	195.7	0.1166	103.15	70.50	2.8	2.0	8605.	93.00	94.70	1.69	11.28	2452.	2360.	-3.8	209.

Table C-38. Experimental data for R-115 condensing on tube F3

Run No.	T_v , °F	P , psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-115-001F3	100.54	183.2	184.1	0.1402	99.23	85.63	23.0	16.8	69040.	91.62	91.93	0.26	8.77	3053.	3001.	-1.7	335.
R-115-002F3	101.58	186.7	186.7	0.1398	100.21	85.16	7.6	5.5	22747.	91.10	91.94	0.85	10.06	3020.	3210.	6.3	289.
R-115-003F3	102.25	188.7	188.4	0.1398	100.93	85.00	5.2	3.8	15539.	90.79	91.98	1.19	10.87	3003.	3085.	2.7	266.
R-115-004F3	103.99	192.7	192.8	0.1402	102.42	84.89	3.0	2.2	8984.	90.59	92.55	1.96	12.41	2971.	2923.	-1.6	231.
R-115-005F3	95.84	172.7	172.7	0.2836	95.41	174.82	23.0	16.8	54977.	72.73	73.36	0.59	22.79	6383.	6735.	5.5	270.
R-115-006F3	99.41	181.2	181.3	0.2879	98.77	175.99	7.6	5.5	18368.	73.04	74.74	1.68	25.52	6311.	6369.	0.9	238.
R-115-007F3	101.89	187.7	187.4	0.2879	101.15	174.91	5.2	3.8	12625.	73.00	75.48	2.47	27.65	6192.	6420.	3.7	216.
R-115-008F3	107.39	201.2	201.7	0.3068	106.44	183.78	3.0	2.2	7370.	73.07	77.21	4.13	32.25	6311.	6182.	-2.0	189.
R-115-009F3	101.41	186.2	186.2	0.0686	98.73	41.96	23.0	16.8	74050.	98.10	98.27	0.13	3.22	1489.	1452.	-2.5	446.
R-115-010F3	101.62	186.7	186.8	0.0690	99.11	42.16	7.6	5.5	24327.	97.45	97.87	0.41	3.96	1494.	1568.	4.9	364.
R-115-011F3	101.91	187.2	187.5	0.0692	99.31	42.26	5.2	3.8	16624.	97.24	97.85	0.60	4.36	1496.	1562.	4.4	330.
R-115-012F3	102.83	189.7	189.8	0.0698	100.17	42.52	3.0	2.2	9590.	97.02	98.06	1.04	5.29	1498.	1548.	3.4	273.
R-115-013F3	100.07	183.2	182.9	0.1858	99.23	113.43	23.0	16.8	65516.	87.06	87.46	0.36	12.81	4054.	4112.	1.5	305.
R-115-014F3	101.62	186.7	186.8	0.1881	100.72	114.41	7.0	5.1	19851.	86.32	87.45	1.12	14.73	4056.	3915.	-3.5	265.
R-115-015F3	102.42	188.7	188.8	0.1887	101.51	114.54	5.2	3.8	14690.	85.76	87.36	1.60	15.86	4043.	4139.	2.4	286.
R-115-016F3	104.79	194.7	194.9	0.1895	103.67	114.40	3.0	2.2	8487.	85.37	87.99	2.62	18.11	3987.	3912.	-1.9	212.
R-115-017F3	101.97	187.7	187.7	0.0553	98.97	33.78	23.0	16.8	75183.	99.51	99.66	0.10	2.39	1195.	1121.	-6.2	482.
R-115-018F3	102.55	188.7	189.1	0.0553	99.45	33.74	7.6	5.5	24833.	99.38	99.72	0.32	3.00	1190.	1213.	1.9	382.
R-115-019F3	103.02	189.7	190.3	0.0555	99.87	33.81	5.2	3.8	17013.	99.41	99.92	0.50	3.36	1190.	1298.	9.1	341.
R-115-020F3	103.79	191.7	192.3	0.0551	100.45	33.52	3.0	2.2	9821.	99.30	100.14	0.84	4.07	1174.	1253.	6.7	278.
R-115-021F3	101.30	185.7	186.0	0.1219	100.03	74.26	23.0	16.8	70683.	93.71	93.99	0.22	7.46	2637.	2509.	-4.9	341.
R-115-022F3	102.42	188.7	188.8	0.1226	100.97	74.55	7.6	5.5	23393.	93.62	94.36	0.71	8.43	2631.	2699.	2.6	301.
R-115-023F3	103.28	190.7	191.0	0.1236	101.74	74.96	5.2	3.8	16033.	93.62	94.66	1.03	9.14	2634.	2673.	1.5	278.
R-115-024F3	105.06	195.7	195.6	0.1260	103.39	76.11	3.0	2.2	9274.	93.50	95.24	1.73	10.69	2648.	2583.	-2.4	239.
R-115-025F3	101.41	186.2	186.2	0.0927	99.43	56.59	23.0	16.8	72680.	96.38	96.60	0.15	4.92	2008.	1773.	-11.7	393.
R-115-026F3	101.93	187.2	187.6	0.0925	99.95	56.38	7.6	5.5	23935.	95.90	96.47	0.54	5.75	1995.	2037.	2.1	334.
R-115-027F3	102.42	188.2	188.8	0.0929	100.39	56.57	5.2	3.8	16364.	95.70	96.52	0.81	6.31	1997.	2102.	5.3	305.
R-115-028F3	103.57	191.2	191.7	0.0944	101.51	57.31	3.0	2.2	9429.	95.32	96.69	1.36	7.56	2011.	2033.	1.1	256.
R-115-029F3	97.94	177.7	177.7	0.2285	97.40	140.15	23.0	16.8	60894.	80.82	81.31	0.45	16.88	5064.	5117.	1.1	289.
R-115-030F3	100.66	184.7	184.4	0.2303	99.91	140.39	7.6	5.5	20268.	80.96	82.35	1.37	19.01	5002.	5190.	3.8	254.
R-115-031F3	102.55	189.2	189.1	0.2320	101.78	140.74	5.2	3.8	13915.	80.94	82.92	1.97	20.62	4964.	5118.	3.1	232.
R-115-032F3	106.21	198.2	198.6	0.2376	105.20	142.81	3.0	2.2	8088.	80.93	84.16	3.22	23.67	4937.	4818.	-2.4	201.
R-115-033F3	96.67	174.7	174.6	0.3154	96.16	194.11	23.0	16.8	53508.	70.55	71.22	0.65	25.79	7058.	7424.	5.2	264.
R-115-034F3	101.55	186.2	186.6	0.3259	100.84	198.14	7.6	5.5	17956.	71.22	73.11	1.90	29.39	7026.	7196.	2.4	230.
R-115-035F3	104.77	194.7	194.8	0.3345	103.98	201.72	5.2	3.8	12380.	71.37	74.12	2.76	32.02	7030.	7152.	1.7	212.

Table C-39. Experimental data for R-115 condensing on tube F7

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-115-001F7	92.51	164.7	164.9	0.3093	92.29	192.18	22.3	16.3	51696.	70.28	70.96	0.64	21.89	7130.	7142.	0.2	314.
R-115-002F7	98.17	178.2	178.3	0.3227	97.80	197.77	7.6	5.5	17979.	71.30	73.23	1.93	25.91	7137.	7302.	2.3	265.
R-115-003F7	101.49	186.2	186.4	0.3304	101.09	200.76	5.2	3.8	12431.	71.66	74.45	2.79	28.44	7122.	7235.	1.6	241.
R-115-004F7	108.50	204.2	204.6	0.3469	107.89	206.99	2.8	2.1	6896.	71.53	76.42	4.88	34.53	7063.	6944.	-1.7	197.
R-115-005F7	101.05	184.7	185.4	0.0547	98.21	33.48	23.0	16.8	74675.	98.88	99.04	0.11	2.09	1190.	1304.	9.5	547.
R-115-006F7	101.58	186.2	186.7	0.0547	98.71	33.43	7.6	5.5	24659.	98.72	99.08	0.35	2.67	1185.	1319.	11.3	427.
R-115-007F7	101.66	186.7	186.9	0.0553	98.99	33.76	5.2	3.8	16811.	98.32	98.82	0.50	3.09	1197.	1301.	8.7	373.
R-115-008F7	102.21	187.7	188.2	0.0550	99.43	33.60	3.0	2.2	9686.	98.03	98.86	0.83	3.76	1187.	1238.	4.3	304.
R-115-009F7	98.33	178.7	178.6	0.1854	97.65	113.64	23.0	16.8	65783.	87.40	87.81	0.36	10.72	4098.	4147.	1.2	368.
R-115-010F7	100.28	183.2	183.4	0.1879	99.47	114.66	7.6	5.5	21763.	87.15	88.27	1.13	12.57	4093.	4289.	4.8	314.
R-115-011F7	101.66	186.7	186.9	0.1892	100.82	115.06	5.2	3.8	14927.	87.10	88.73	1.64	13.74	4078.	4250.	4.2	286.
R-115-012F7	104.65	194.2	194.5	0.1916	103.65	115.65	3.0	2.2	8658.	87.01	89.74	2.71	16.28	4033.	4045.	0.3	239.
R-115-013F7	100.30	183.2	183.5	0.0915	98.67	55.96	23.0	16.8	72479.	96.13	96.35	0.19	4.06	1998.	2162.	8.2	474.
R-115-014F7	100.97	184.7	185.1	0.0925	99.25	56.48	7.6	5.5	23891.	95.74	96.30	0.56	4.95	2009.	2101.	4.6	391.
R-115-015F7	101.60	186.2	186.7	0.0933	99.89	56.87	5.2	3.8	16367.	95.58	96.39	0.81	5.61	2016.	2106.	4.4	346.
R-115-016F7	102.83	189.7	189.8	0.0941	101.03	57.18	3.0	2.2	9436.	95.40	96.75	1.35	6.76	2014.	2014.	-0.0	287.
R-115-017F7	93.67	167.2	167.6	0.2708	93.51	167.73	22.8	16.6	55964.	74.77	75.39	0.58	18.60	6189.	6574.	6.2	321.
R-115-018F7	97.39	175.7	176.4	0.2761	97.10	169.50	7.6	5.5	18807.	74.86	76.56	1.69	21.68	6141.	6396.	4.1	273.
R-115-019F7	99.41	180.7	181.3	0.2786	98.97	170.26	5.2	3.8	12914.	74.78	77.19	2.39	23.42	6106.	6210.	1.7	251.
R-115-020F7	104.16	192.7	193.2	0.2859	103.50	172.65	3.0	2.2	7525.	74.78	78.74	3.93	27.40	6037.	5883.	-2.5	212.
R-115-021F7	100.40	183.2	183.7	0.0694	98.17	42.52	23.0	16.8	73545.	97.47	97.66	0.14	2.83	1517.	1658.	9.3	516.
R-115-022F7	100.77	183.7	184.6	0.0684	98.46	41.87	7.6	5.5	24229.	97.07	97.50	0.43	3.48	1491.	1614.	8.2	413.
R-115-023F7	101.22	185.2	185.8	0.0698	98.95	42.63	5.2	3.8	16574.	96.96	97.58	0.62	3.95	1514.	1593.	5.2	369.
R-115-024F7	102.17	187.2	188.1	0.0698	99.71	42.55	3.0	2.2	9570.	96.83	97.87	1.03	4.82	1504.	1544.	2.7	301.
R-115-025F7	99.31	180.7	181.0	0.1403	98.26	85.90	23.0	16.8	69270.	91.90	92.23	0.28	7.25	3082.	3208.	4.1	410.
R-115-026F7	100.68	183.7	184.4	0.1414	99.57	86.29	7.6	5.5	22873.	91.57	92.43	0.85	8.68	3074.	3206.	4.3	341.
R-115-027F7	101.62	186.2	186.8	0.1422	100.45	86.55	5.2	3.8	15658.	91.42	92.67	1.23	9.57	3068.	3196.	4.2	309.
R-115-028F7	103.65	191.2	191.9	0.1445	102.35	87.52	3.0	2.2	9056.	91.24	93.29	2.03	11.39	3069.	3038.	-1.0	260.
R-115-029F7	99.95	181.7	182.6	0.1175	98.85	71.84	23.0	16.8	70941.	94.04	94.30	0.22	5.78	2569.	2555.	-0.6	428.
R-115-030F7	100.81	184.2	184.7	0.1175	99.57	71.71	7.6	5.5	23382.	93.59	94.30	0.71	6.86	2553.	2703.	5.9	358.
R-115-031F7	101.35	185.7	186.1	0.1175	100.05	71.62	5.2	3.8	15972.	93.28	94.32	1.04	7.55	2543.	2701.	6.2	325.
R-115-032F7	102.68	188.7	189.4	0.1187	101.20	72.09	3.0	2.2	9192.	92.73	94.45	1.71	9.09	2541.	2563.	0.8	269.
R-115-033F7	96.41	173.7	174.0	0.2286	95.96	140.73	22.8	16.6	60982.	81.64	82.15	0.47	14.52	5124.	5391.	5.2	340.
R-115-034F7	98.97	179.7	180.2	0.2292	98.32	140.26	7.4	5.4	19856.	81.43	82.88	1.44	16.82	5041.	5316.	5.5	289.
R-115-035F7	100.85	184.2	184.8	0.2305	100.17	140.41	5.2	3.8	14009.	81.47	83.50	2.02	18.37	4998.	5230.	4.6	262.
R-115-036F7	104.79	194.2	194.9	0.2347	103.92	141.56	3.0	2.2	8146.	81.47	84.79	3.32	21.66	4933.	4964.	0.6	219.

Table C-40. Experimental data for R-115' condensing on tube f3

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	$\overline{\Delta T}$, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-115-005G	101.70	186.7	187.0	0.0592	98.81	36.20	23.8	13.0	70420.	96.70	96.86	0.12	4.92	1283.	1408.	9.8	212.
R-115-006G	102.34	188.2	188.6	0.0603	99.67	36.76	7.6	4.1	22466.	96.51	96.88	0.36	5.64	1298.	1368.	5.4	187.
R-115-007G	102.87	189.2	189.9	0.0604	100.27	36.81	5.2	2.8	15396.	96.57	97.10	0.53	6.03	1296.	1378.	6.3	175.
R-115-008G	104.10	192.7	193.1	0.0608	101.45	36.94	3.0	1.6	8929.	96.87	97.75	0.88	6.79	1292.	1316.	1.8	155.
R-115-009G	100.75	184.2	184.6	0.1190	99.53	72.58	23.8	13.0	64434.	88.68	88.93	0.21	11.94	2585.	2489.	-3.7	176.
R-115-010G	101.85	187.2	187.3	0.1193	100.50	72.62	7.6	4.1	20587.	88.51	89.20	0.68	12.99	2571.	2563.	-0.3	161.
R-115-011G	102.76	189.2	189.7	0.1193	101.30	72.44	5.2	2.8	14122.	88.57	89.58	0.99	13.69	2552.	2577.	1.0	152.
R-115-012G	104.39	193.2	193.8	0.1205	102.76	72.88	3.0	1.6	8165.	88.43	90.09	1.64	15.12	2545.	2455.	-3.5	137.
R-115-013G	99.23	180.7	180.8	0.2675	98.87	163.48	23.6	12.9	50751.	69.90	70.43	0.50	29.07	5868.	5861.	-0.1	164.
R-115-014G	102.94	189.7	190.1	0.2738	102.35	165.82	7.4	4.0	16113.	70.30	71.89	1.58	31.84	5837.	5842.	0.1	149.
R-115-015G	105.13	195.2	195.7	0.2783	104.47	167.62	5.2	2.8	11382.	70.36	72.61	2.25	33.64	5830.	5838.	0.1	141.
R-115-016G	109.79	207.7	208.1	0.2901	108.97	172.59	3.0	1.6	6622.	70.34	74.13	3.79	37.56	5845.	5666.	-3.1	127.
R-115-017G	101.20	185.2	185.7	0.0780	98.83	47.67	23.8	13.0	68618.	94.22	94.39	0.14	6.90	1694.	1612.	-4.8	200.
R-115-018G	102.06	187.2	187.9	0.0784	99.59	47.83	7.6	4.1	21929.	94.15	94.61	0.46	7.68	1691.	1734.	2.5	179.
R-115-019G	102.57	188.7	189.2	0.0786	100.05	47.90	5.2	2.8	15016.	94.11	94.79	0.67	8.12	1689.	1740.	3.0	169.
R-115-020G	103.44	190.7	191.4	0.0782	100.76	47.56	3.0	1.6	8670.	93.97	95.05	1.08	8.92	1670.	1617.	-3.2	152.
R-115-021G	98.70	179.2	179.5	0.1608	97.65	98.57	23.6	12.9	58895.	81.70	82.03	0.29	16.83	3548.	3402.	-4.1	172.
R-115-022G	100.70	184.2	184.5	0.1635	99.51	99.77	7.4	4.0	18498.	81.51	82.49	0.97	18.70	3554.	3588.	1.0	155.
R-115-023G	101.89	186.7	187.4	0.1634	100.54	99.46	4.7	2.6	11762.	81.34	82.84	1.49	19.80	3521.	3501.	-0.6	145.
R-115-024G	104.07	192.2	193.0	0.1636	102.44	99.06	2.8	1.5	7024.	81.07	83.51	2.44	21.79	3466.	3403.	-1.8	130.
R-115-025G	96.95	174.7	175.3	0.2140	96.25	131.66	23.6	12.9	53004.	73.33	73.78	0.41	23.40	4781.	4780.	-0.0	166.
R-115-026G	99.69	181.7	182.0	0.2176	98.79	133.02	7.6	4.1	17162.	73.32	74.62	1.28	25.72	4763.	4849.	1.8	151.
R-115-027G	101.37	185.7	186.1	0.2182	100.29	132.87	5.0	2.7	11333.	73.29	75.22	1.91	27.11	4716.	4767.	1.1	142.
R-115-028G	105.26	195.7	196.1	0.2216	103.90	133.66	2.8	1.5	6400.	73.25	76.55	3.28	30.37	4645.	4577.	-1.5	125.
R-115-029G	98.33	178.2	178.6	0.1839	97.38	112.84	23.6	12.9	56653.	78.55	78.93	0.34	19.59	4069.	4050.	-0.5	169.
R-115-030G	100.44	183.7	183.8	0.1850	99.39	112.91	7.2	3.9	17312.	78.30	79.44	1.13	21.57	4028.	4044.	0.4	152.
R-115-031G	102.02	187.7	187.8	0.1885	100.89	114.58	5.0	2.7	12044.	78.18	79.85	1.66	23.00	4053.	4133.	2.0	143.
R-115-032G	104.27	192.7	193.5	0.1863	102.87	112.66	3.0	1.6	7259.	78.06	80.69	2.60	24.90	3937.	3899.	-1.0	129.
R-115-033G	100.85	184.7	184.8	0.2907	100.13	177.09	23.6	12.9	50580.	69.63	70.20	0.54	30.93	6304.	6380.	1.2	166.
R-115-034G	105.38	195.7	196.4	0.3001	104.54	180.73	7.4	4.0	16137.	70.35	72.06	1.71	34.17	6277.	6308.	0.5	150.
R-115-035G	107.51	202.2	202.0	0.3051	106.54	182.71	5.0	2.7	10932.	70.15	72.65	2.48	36.11	6270.	6208.	-1.0	141.

Table C-41. Experimental data for R-115 condensing on tube H

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT _s , °F	Q _c , Btu/hr	Q _w , Btu/hr	ΔQ Q × 100	U _o , Btu hr·ft ² ·°F
R-115-005H	100.85	184.2	184.8	0.0824	97.69	50.49	22.5	45.6	85840.	97.36	97.56	0.16	3.39	1797.	1824.	1.5	301.
R-115-006H	101.12	184.7	185.5	0.0824	97.94	50.46	7.6	15.4	28941.	97.04	97.54	0.50	3.83	1793.	1901.	6.0	266.
R-115-007H	101.62	186.2	186.8	0.0815	98.40	49.89	5.2	10.5	19887.	97.32	98.04	0.72	3.94	1769.	1859.	5.1	255.
R-115-008H	102.96	189.2	190.1	0.0827	99.93	50.41	3.0	6.1	11578.	97.91	99.12	1.20	4.44	1774.	1798.	1.3	227.
R-115-009H	100.34	183.2	183.6	0.1319	98.52	80.67	22.5	45.6	82554.	93.66	93.95	0.25	6.53	2879.	2846.	-1.1	250.
R-115-010H	100.99	184.2	185.2	0.1313	99.05	80.20	7.6	15.4	27913.	93.50	94.29	0.78	7.10	2852.	2964.	3.9	228.
R-115-011H	101.74	186.2	187.1	0.1324	99.77	80.76	5.2	10.5	19180.	93.71	94.84	1.13	7.47	2861.	2921.	2.1	218.
R-115-012H	103.04	189.7	190.4	0.1354	101.01	82.31	3.0	6.1	11121.	93.74	95.69	1.94	8.33	2896.	2905.	0.3	198.
R-115-013H	96.39	173.2	174.0	0.3212	95.85	197.84	22.2	45.0	66867.	76.82	77.53	0.67	19.21	7204.	7442.	3.3	213.
R-115-014H	98.99	179.7	180.3	0.3281	98.30	200.83	7.6	15.4	23120.	76.96	78.96	1.98	21.03	7217.	7499.	3.9	195.
R-115-015H	100.46	183.2	183.9	0.3322	99.73	202.61	5.2	10.5	15930.	77.07	79.96	2.88	21.94	7227.	7471.	3.4	187.
R-115-016H	103.39	190.7	191.3	0.3385	102.59	204.92	3.0	6.1	9288.	76.94	81.78	4.81	24.03	7196.	7203.	0.1	170.
R-115-017H	99.65	181.2	181.9	0.1900	97.99	116.37	22.5	45.6	78456.	89.15	89.56	0.37	10.30	4168.	4180.	0.3	230.
R-115-018H	100.44	183.2	183.8	0.1872	98.62	114.52	7.6	15.4	26497.	88.79	89.90	1.10	11.10	4085.	4152.	1.7	209.
R-115-019H	101.43	185.7	186.3	0.1900	99.57	115.90	5.2	10.5	18211.	88.91	90.54	1.62	11.70	4113.	4185.	1.8	200.
R-115-020H	102.91	189.2	190.0	0.1915	100.97	116.41	3.0	6.1	10556.	88.79	91.49	2.69	12.77	4098.	4022.	-1.9	182.
R-115-021H	95.98	172.2	173.0	0.3700	95.45	228.11	22.2	45.0	63924.	73.29	74.09	0.76	22.29	8323.	8450.	1.5	212.
R-115-022H	99.13	179.7	180.6	0.3779	98.46	231.20	7.6	15.4	22185.	73.61	75.87	2.25	24.39	8303.	8519.	2.6	193.
R-115-023H	100.87	184.2	184.9	0.3846	100.19	234.24	5.2	10.5	15279.	73.59	76.90	3.29	25.63	8337.	8545.	2.5	185.
R-115-024H	104.12	192.2	193.1	0.3921	103.37	236.82	3.0	6.1	8940.	73.63	79.05	5.40	27.77	8283.	8080.	-2.4	169.
R-115-025H	99.35	180.7	181.1	0.2400	98.26	146.91	22.4	45.4	74891.	85.39	85.91	0.49	13.70	5270.	5442.	3.3	219.
R-115-026H	100.85	184.2	184.8	0.2422	99.69	147.73	7.6	15.4	25488.	85.19	86.63	1.43	14.94	5258.	5406.	2.8	200.
R-115-027H	101.79	186.7	187.2	0.2426	100.60	147.61	5.2	10.5	17485.	85.23	87.30	2.06	15.52	5228.	5325.	1.8	191.
R-115-028H	103.65	191.2	191.9	0.2456	102.33	148.76	3.0	6.1	10155.	85.10	88.55	3.44	16.83	5216.	5140.	-1.5	176.
R-115-029H	97.60	176.2	176.9	0.4402	97.12	270.27	22.2	45.0	61750.	70.49	71.42	0.90	26.64	9782.	10039.	2.6	209.
R-115-030H	101.39	185.7	186.2	0.4521	100.84	274.88	7.6	15.4	21479.	70.94	73.60	2.65	29.11	9756.	10055.	3.1	190.
R-115-031H	103.50	190.7	191.5	0.4637	102.91	280.40	5.2	10.5	14823.	71.03	74.82	3.77	30.58	9840.	9785.	-0.6	183.
R-115-032H	107.94	202.7	203.1	0.4823	107.25	288.32	3.0	6.1	8711.	71.13	77.53	6.39	33.61	9870.	9562.	-3.1	167.
R-115-033H	100.64	183.7	184.3	0.1119	98.26	68.48	22.5	45.6	84252.	95.50	95.75	0.20	5.02	2440.	2264.	-7.2	276.
R-115-034H	100.85	184.2	184.8	0.1104	98.40	67.58	7.6	15.4	28353.	94.96	95.62	0.65	5.56	2406.	2472.	2.8	246.
R-115-035H	101.16	184.7	185.6	0.1135	98.71	69.37	5.2	10.5	19400.	94.82	95.76	0.94	5.87	2465.	2440.	-1.0	239.
R-115-036H	101.83	186.2	187.3	0.1135	99.27	69.27	3.0	6.1	11206.	94.62	96.19	1.56	6.42	2453.	2334.	-4.9	217.
R-115-037H	97.75	176.7	177.2	0.2799	96.87	171.96	22.4	45.4	71089.	81.04	81.66	0.58	16.40	6219.	6492.	4.4	215.
R-115-038H	99.89	181.7	182.5	0.2856	98.91	174.55	7.6	15.4	24266.	80.99	82.69	1.69	18.05	6244.	6407.	2.6	197.
R-115-039H	100.85	184.2	184.8	0.2852	99.89	173.87	5.2	10.5	16676.	80.98	83.43	2.44	18.65	6189.	6324.	2.2	189.
R-115-040H	103.57	190.7	191.7	0.2929	102.44	177.36	3.0	6.1	9722.	80.96	85.16	4.19	20.51	6222.	6269.	0.8	172.
R-115-041H	99.89	181.7	182.5	0.1907	98.17	116.76	27.0	54.7	94095.	89.15	89.47	0.29	10.58	4177.	3954.	-5.3	224.
R-115-042H	100.30	182.7	183.5	0.1921	98.75	117.45	12.0	24.3	41597.	88.48	89.22	0.74	11.45	4192.	4429.	5.6	208.
R-115-043H	100.68	183.7	184.4	0.1905	99.19	116.34	7.6	15.4	26329.	88.23	89.36	1.13	11.89	4145.	4274.	3.1	198.
R-115-044H	101.62	186.2	186.8	0.1915	100.01	116.70	5.2	10.5	18058.	88.19	89.82	1.63	12.61	4137.	4232.	2.3	186.
R-115-045H	103.68	191.2	192.0	0.1935	101.93	117.33	3.0	6.1	10471.	88.10	90.79	2.71	14.23	4113.	4049.	-1.6	164.
R-115-046H	100.70	183.7	184.5	0.1089	97.82	66.73	27.0	54.7	101216.	95.63	95.82	0.17	4.98	2377.	2259.	-5.0	271.
R-115-047H	100.97	184.7	185.1	0.1133	98.21	69.34	12.0	24.3	44862.	95.27	95.69	0.42	5.49	2466.	2510.	1.8	255.
R-115-048H	101.79	186.2	187.2	0.1135	98.93	69.33	5.1	10.3	19088.	95.11	96.06	0.95	6.20	2456.	2413.	-1.7	225.
R-115-049H	101.47	185.7	186.4	0.1135	98.77	69.36	7.6	15.4	28459.	95.30	95.95	0.66	5.84	2461.	2494.	1.4	239.

Table C-42. Experimental data for R-115 condensing on tube J

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT̄, °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-115-001J	100.30	182.7	183.5	0.0670	97.29	41.11	22.5	18.1	71905.	95.32	95.49	0.13	4.89	1468.	1423.	-3.0	286.
R-115-002J	100.77	184.2	184.6	0.0670	97.67	41.07	7.2	5.8	22989.	95.11	95.54	0.44	5.44	1463.	1564.	6.9	257.
R-115-003J	101.18	185.2	185.7	0.0674	98.09	41.29	5.0	4.0	15973.	95.07	95.67	0.60	5.81	1467.	1494.	1.9	241.
R-115-004J	102.08	187.2	187.9	0.0672	98.81	41.08	3.0	2.4	9611.	95.14	96.11	0.97	6.45	1453.	1448.	-0.3	215.
R-115-009J	100.97	184.7	185.1	0.0502	97.12	30.80	22.5	18.1	73708.	97.72	97.87	0.11	3.18	1096.	1208.	10.3	329.
R-115-010J	100.97	184.7	185.1	0.0498	97.06	30.55	7.4	6.0	24138.	97.24	97.56	0.31	3.57	1087.	1155.	6.3	290.
R-115-011J	101.35	185.2	186.1	0.0493	97.40	30.26	5.2	4.2	16994.	97.36	97.79	0.43	3.77	1074.	1114.	3.7	272.
R-115-012J	102.27	187.7	188.4	0.0502	98.34	30.70	3.0	2.4	9836.	97.51	98.23	0.72	4.40	1085.	1079.	-0.6	235.
R-115-013J	99.53	181.2	181.6	0.1231	97.94	75.40	22.5	18.1	65961.	87.72	88.01	0.24	11.67	2702.	2746.	1.6	221.
R-115-014J	100.42	183.2	183.8	0.1233	98.62	75.39	7.5	6.0	21988.	87.49	88.24	0.73	12.55	2690.	2734.	1.7	204.
R-115-015J	101.35	185.7	186.1	0.1260	99.59	76.85	5.2	4.2	15259.	87.42	88.47	1.04	13.40	2728.	2688.	-1.5	194.
R-115-016J	102.85	189.2	189.9	0.1265	100.95	76.93	3.0	2.4	8824.	87.25	89.03	1.76	14.71	2709.	2633.	-2.8	176.
R-115-017J	95.04	170.2	170.8	0.2217	94.42	137.02	22.0	17.7	51652.	69.70	70.20	0.46	25.09	5022.	5090.	1.3	191.
R-115-018J	97.44	176.2	176.5	0.2229	96.55	137.03	7.6	6.1	18018.	70.01	71.34	1.33	26.77	4963.	5054.	1.8	177.
R-115-019J	99.19	180.2	180.7	0.2323	98.13	142.25	5.2	4.2	12383.	70.03	71.98	1.93	28.19	5107.	5028.	-1.6	173.
R-115-020J	103.55	191.2	191.6	0.2334	102.20	141.41	2.8	2.3	6733.	70.03	73.45	3.41	31.80	4961.	4769.	-3.9	149.
R-115-021J	99.21	180.2	180.8	0.1497	97.67	91.78	22.5	18.1	63550.	84.43	84.76	0.29	14.62	3295.	3255.	-1.2	215.
R-115-022J	100.26	182.7	183.4	0.1501	98.58	91.82	7.6	6.1	21466.	84.16	85.03	0.88	15.66	3279.	3344.	2.0	200.
R-115-023J	101.20	185.2	185.7	0.1506	99.51	91.92	5.2	4.2	14704.	84.07	85.32	1.26	16.51	3266.	3279.	0.4	189.
R-115-024J	103.07	189.7	190.4	0.1523	101.13	92.55	3.0	2.4	8504.	83.83	85.95	2.10	18.17	3256.	3149.	-3.3	171.
R-115-025J	100.81	184.2	184.7	0.2727	99.91	166.25	22.2	17.9	52584.	70.32	70.90	0.55	30.20	5919.	6057.	2.3	187.
R-115-026J	103.68	191.2	192.0	0.2745	102.48	166.20	7.6	6.1	18198.	70.64	72.21	1.56	32.25	5827.	5943.	2.0	172.
R-115-027J	105.75	196.7	197.3	0.2800	104.50	168.63	5.2	4.2	12515.	70.69	72.92	2.23	33.94	5845.	5784.	-1.1	164.
R-115-028J	109.92	207.7	208.5	0.2861	108.38	170.49	3.0	2.4	7273.	70.55	74.40	3.84	37.45	5770.	5748.	-0.4	147.
R-115-029J	98.54	178.7	179.2	0.1860	97.15	114.17	22.5	18.1	59346.	78.82	79.23	0.37	19.52	4112.	4187.	1.8	201.
R-115-030J	100.11	182.7	183.0	0.1851	98.48	113.22	7.6	6.1	20110.	78.73	79.82	1.08	20.84	4045.	4087.	1.0	185.
R-115-031J	101.26	185.2	185.9	0.1843	99.51	112.48	5.2	4.2	13798.	78.72	80.28	1.55	21.76	3995.	4013.	0.5	175.
R-115-032J	104.95	194.7	195.3	0.1927	103.00	116.52	3.0	2.4	8013.	78.66	81.40	2.73	24.92	4057.	4089.	0.8	155.
R-115-033J	103.00	189.7	190.3	0.3019	101.95	183.02	22.2	17.9	52101.	69.62	70.23	0.58	33.08	6440.	6434.	-0.1	186.
R-115-034J	106.58	199.2	199.5	0.3115	105.49	187.09	7.6	6.1	18046.	69.95	71.64	1.68	35.79	6454.	6399.	-0.9	172.
R-115-035J	108.87	205.2	205.6	0.3180	107.70	189.84	5.2	4.2	12415.	69.97	72.44	2.46	37.67	6464.	6398.	-1.1	164.
R-115-036J	113.53	218.2	218.5	0.3262	112.15	192.36	2.9	2.3	6987.	69.87	74.13	4.26	41.52	6369.	6157.	-3.3	146.
R-115-037J	99.95	182.2	182.6	0.0909	97.13	55.78	22.5	18.1	69642.	92.46	92.67	0.17	7.39	1995.	1927.	-3.4	258.
R-115-038J	100.50	183.7	184.0	0.0902	97.59	55.33	7.6	6.1	23499.	92.21	92.74	0.53	8.03	1973.	2010.	1.9	235.
R-115-039J	101.32	185.7	186.0	0.0909	98.34	55.61	5.2	4.2	16155.	92.51	93.27	0.76	8.43	1974.	1968.	-0.3	223.
R-115-040J	102.66	188.7	189.4	0.0909	99.67	55.42	2.8	2.3	8723.	92.47	93.79	1.32	9.52	1954.	1835.	-6.1	196.
R-115-050H	97.39	175.7	176.4	0.4585	96.83	281.70	27.0	54.7	73353.	68.82	69.59	0.75	28.18	10207.	10145.	-0.6	206.
R-115-051H	100.44	183.2	183.8	0.4660	99.65	284.25	12.0	24.3	33178.	69.64	71.38	1.73	29.93	10139.	10367.	2.2	192.
R-115-052H	102.74	188.7	189.6	0.4784	102.04	290.00	7.5	15.2	20827.	69.44	72.22	2.76	31.91	10219.	10362.	1.4	182.
R-115-053H	105.58	196.2	196.9	0.4910	104.90	295.37	5.2	10.5	14577.	69.58	73.50	3.91	34.05	10248.	10164.	-0.8	171.

Table C-43. Experimental data for R-600a condensing on tube E

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-600A-001A	83.80	57.3	56.3	0.0437	78.54	12.03	7.6	6.1	18936.	74.33	74.79	0.48	9.24	1660.	1820.	9.6	172.
R-600A-002A	84.27	57.7	56.7	0.0441	79.26	12.14	5.2	4.2	12955.	74.22	74.88	0.67	9.72	1673.	1728.	3.2	164.
R-600A-003A	85.26	58.8	57.6	0.0439	79.78	12.07	3.0	2.4	7483.	74.11	75.19	1.08	10.61	1660.	1624.	-2.2	149.
R-600A-004A	83.98	57.7	56.4	0.0449	79.52	12.35	22.2	17.9	55804.	75.15	75.34	0.17	8.74	1703.	1861.	9.2	166.
R-600A-005A	91.90	65.1	63.8	0.0771	86.45	21.04	22.2	17.9	55957.	75.30	75.61	0.28	16.44	2851.	3134.	9.9	166.
R-600A-006A	93.00	66.2	64.8	0.0767	87.55	20.89	7.6	6.1	19161.	75.10	75.86	0.78	17.52	2825.	2950.	4.4	154.
R-600A-007A	93.57	66.8	65.4	0.0769	88.18	20.93	5.2	4.2	13074.	74.71	75.81	1.12	18.31	2827.	2903.	2.7	147.
R-600A-009A	94.88	68.2	66.7	0.0767	89.23	20.85	3.0	2.4	7522.	74.11	75.99	1.88	19.83	2807.	2808.	0.0	135.
R-600A-009A	98.97	72.2	70.9	0.1108	93.98	29.91	22.2	17.9	55652.	74.83	75.24	0.39	23.94	3990.	4297.	7.7	159.
R-600A-010A	100.95	74.5	73.0	0.1110	95.78	29.89	7.6	6.1	19156.	74.91	76.00	1.10	25.50	3970.	4182.	5.3	149.
R-600A-011A	102.12	75.7	74.3	0.1110	96.81	29.85	5.2	4.2	13137.	74.87	76.40	1.54	26.49	3954.	3987.	0.8	143.
R-600A-012A	104.23	78.1	76.6	0.1104	98.58	29.61	3.0	2.4	7586.	74.42	76.99	2.57	28.52	3903.	3840.	-1.6	131.
R-600A-013A	102.91	76.7	75.1	0.1324	98.40	35.54	22.2	17.9	55086.	74.02	74.47	0.43	28.67	4700.	4751.	1.1	157.
R-600A-014A	104.27	78.2	76.6	0.1314	99.45	35.21	7.6	6.1	18785.	73.32	74.57	1.27	30.33	4642.	4811.	3.7	146.
R-600A-015A	105.17	79.2	77.6	0.1310	100.19	35.06	5.2	4.2	12828.	72.90	74.69	1.80	31.38	4612.	4675.	1.4	140.
R-600A-016A	107.53	82.0	80.3	0.1302	102.10	34.75	3.0	2.4	7407.	72.36	75.36	3.00	33.67	4546.	4490.	-1.2	129.
R-600A-017A	111.86	87.0	85.4	0.1710	106.94	45.33	22.2	17.9	56174.	75.47	76.04	0.55	36.10	5869.	6058.	3.2	155.
R-600A-018A	114.16	90.0	88.3	0.1705	109.00	45.09	7.6	6.1	19290.	75.21	76.78	1.59	38.16	5804.	6017.	3.7	145.
R-600A-019A	116.09	92.2	90.7	0.1730	110.69	45.63	5.2	4.2	13235.	75.08	77.34	2.27	39.88	5846.	5894.	0.8	140.
R-600A-020A	119.28	96.5	94.8	0.1724	113.50	45.28	3.0	2.4	7681.	74.80	78.54	3.73	42.61	5755.	5587.	-2.9	129.
R-600A-021A	121.12	99.2	97.2	0.2301	116.92	60.13	22.2	17.9	54834.	73.54	74.25	0.69	47.22	7607.	7675.	0.9	154.
R-600A-022A	123.96	103.2	101.1	0.2288	119.38	59.60	7.6	6.1	18834.	73.12	75.17	2.07	49.81	7485.	7848.	4.9	144.
R-600A-023A	125.71	105.7	103.5	0.2292	121.00	59.54	5.2	4.2	12955.	73.13	75.97	2.85	51.16	7443.	7393.	-0.7	139.
R-600A-024A	130.21	112.2	110.0	0.2295	125.19	59.25	3.0	2.4	7558.	72.99	77.84	4.85	54.80	7319.	7263.	-0.8	128.

Table C-44. Experimental data for R-600a condensing on tube F

Run No.	T _v , °F	P, psia	P _{sat} , psia	F _c , gpm	T _c , °F	m _c , lb _m /hr	F _w , gpm	v, ft/sec	Re	T _{w,in} , °F	T _{w,out} , °F	ΔT _w , °F	ΔT _s , °F	Q _c , Btu/hr	Q _w , Btu/hr	$\frac{\Delta Q}{Q} \times 100$	U _o , Btu hr·ft ² ·°F
R-600A-001E	78.04	52.5	51.4	0.0792	75.38	21.91	22.5	18.1	56513.	75.02	75.34	0.29	2.86	3058.	3255.	6.5	667.
R-600A-002E	79.38	53.7	52.5	0.0801	76.94	22.10	7.6	6.1	19050.	74.61	75.44	0.85	4.35	3076.	3242.	5.4	440.
R-600A-003E	80.18	54.2	53.2	0.0803	77.65	22.14	5.2	4.2	13030.	74.41	75.59	1.19	5.18	3076.	3079.	0.1	370.
R-600A-004E	82.09	56.0	54.8	0.0788	79.07	21.69	3.0	2.4	7536.	74.22	76.17	1.94	6.89	3002.	2903.	-3.3	271.
R-600A-005E	80.14	54.2	53.1	0.1265	78.49	34.84	22.5	18.1	56383.	74.77	75.24	0.44	5.13	4842.	4972.	2.7	588.
R-600A-006E	81.38	55.2	54.2	0.1240	79.48	34.11	7.6	6.1	18842.	73.55	74.82	1.29	7.20	4728.	4887.	3.4	409.
R-600A-007E	82.50	56.2	55.1	0.1225	80.39	33.66	5.2	4.2	12871.	73.15	74.96	1.81	8.44	4655.	4708.	1.1	344.
R-600A-008E	85.42	59.2	57.7	0.1210	82.82	33.16	3.0	2.4	7448.	72.80	75.78	2.98	11.13	4558.	4460.	-2.1	255.
R-600A-009E	91.77	64.5	63.6	0.1537	88.51	41.80	3.0	2.4	7793.	75.95	79.66	3.70	13.96	5668.	5543.	-2.2	253.
R-600A-010E	85.97	59.2	58.2	0.1608	83.77	43.99	22.2	17.9	58637.	78.84	79.43	0.56	6.83	6039.	6180.	2.3	551.
R-600A-011E	89.05	62.3	61.1	0.1583	86.38	43.16	7.6	6.1	20267.	79.11	80.69	1.60	9.16	5886.	6051.	2.8	401.
R-600A-012E	91.20	64.3	63.1	0.1595	88.58	43.37	5.2	4.2	13936.	79.16	81.44	2.28	10.90	5888.	5927.	0.7	336.
R-600A-013E	82.33	56.2	55.0	0.2048	81.05	56.22	22.2	17.9	53845.	72.15	72.87	0.69	9.82	7778.	7642.	-1.8	494.
R-600A-014E	85.20	58.7	57.5	0.2019	83.09	55.29	7.6	6.1	18415.	71.44	73.43	2.01	12.77	7603.	7636.	0.4	371.
R-600A-015E	87.31	60.7	59.4	0.1982	84.99	54.15	5.2	4.2	12639.	71.25	74.09	2.85	14.64	7413.	7404.	-0.1	315.
R-600A-016E	92.15	65.4	64.0	0.1953	89.36	53.06	3.0	2.4	7365.	71.05	75.80	4.74	18.72	7189.	7101.	-1.2	239.
R-600A-017E	87.79	61.2	59.9	0.2524	86.05	68.84	22.2	17.9	54257.	72.65	73.53	0.85	14.70	9415.	9447.	0.3	399.
R-600A-018E	92.35	65.7	64.2	0.2499	90.06	67.82	7.6	6.1	18890.	73.14	75.61	2.49	17.98	9184.	9429.	2.7	318.
R-600A-019E	96.09	69.6	67.9	0.2522	93.68	68.10	5.2	4.2	13122.	73.80	77.28	3.49	20.55	9146.	9053.	-1.0	277.
R-600A-020E	101.68	75.7	73.8	0.2503	98.71	67.14	3.0	2.4	7684.	73.80	79.60	5.79	24.98	8904.	8668.	-2.6	222.
R-600A-021E	94.47	67.8	66.3	0.2923	92.85	79.04	22.2	17.9	55851.	74.82	75.80	0.96	19.16	10653.	10665.	0.1	346.
R-600A-022E	98.56	72.2	70.5	0.2845	96.11	76.58	7.6	6.1	19372.	74.96	77.70	2.76	22.23	10228.	10464.	2.3	287.
R-600A-023E	102.25	76.2	74.4	0.2873	99.83	76.95	5.2	4.2	13434.	75.44	79.33	3.90	24.87	10190.	10114.	-0.7	255.
R-600A-024E	108.43	83.2	81.4	0.2885	105.54	76.66	3.0	2.4	7864.	75.30	81.75	6.44	29.90	10006.	9644.	-3.6	208.
R-600A-025E	105.42	79.9	77.9	0.3713	103.83	98.90	22.2	17.9	57196.	76.56	77.77	1.19	28.26	13001.	13135.	1.0	287.
R-600A-026E	110.12	85.7	83.4	0.3646	107.82	96.55	7.6	6.1	19838.	76.50	79.89	3.41	31.93	12552.	12913.	2.9	245.
R-600A-027E	114.13	90.7	88.2	0.3676	111.81	96.79	5.2	4.2	13742.	76.74	81.61	4.87	34.96	12460.	12636.	1.4	222.
R-600A-028E	122.70	100.7	99.4	0.3721	119.94	96.82	3.0	2.4	8115.	76.99	85.12	8.13	41.65	12199.	12160.	-0.3	183.
R-600A-029E	101.41	75.2	73.5	0.3394	99.89	90.89	22.2	17.9	56882.	76.18	77.28	1.08	24.67	12060.	11939.	-1.0	305.
R-600A-030E	104.25	78.2	76.6	0.3230	102.12	86.23	7.6	6.1	19615.	75.77	78.83	3.08	26.95	11367.	11677.	2.7	263.
R-600A-031E	107.70	82.6	80.5	0.3232	105.45	85.88	5.2	4.2	13580.	76.08	80.39	4.32	29.46	11229.	11214.	-0.1	237.
R-600A-032E	114.25	90.7	88.4	0.3218	111.47	84.78	3.0	2.4	7965.	75.99	83.11	7.12	34.69	10911.	10657.	-2.3	196.
R-600A-033E	86.86	60.2	59.0	0.2327	85.38	63.53	22.5	18.1	56259.	74.44	75.23	0.76	12.03	8706.	8542.	-1.9	451.
R-600A-034E	90.74	63.9	62.7	0.2275	88.84	61.85	7.6	6.1	19210.	74.54	76.80	2.28	15.07	8405.	8656.	3.0	347.
R-600A-035E	93.41	66.7	65.3	0.2270	91.27	61.50	5.2	4.2	13248.	74.68	77.89	3.22	17.13	8308.	8343.	0.4	302.
R-600A-036E	99.05	72.2	71.0	0.2272	96.65	61.11	3.0	2.4	7754.	74.76	80.08	5.31	21.63	8153.	7950.	-2.5	235.

Table C-45. Experimental data for R-600a condensing on tube F

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\bar{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{Q_c}{Q} \times 100$	U_o , Btu hr·ft ² ·°F
R-600A-001F	100.01	73.0	72.0	0.0604	95.90	16.27	23.0	16.8	73423.	97.30	97.52	0.16	2.60	2166.	1864.	-13.9	802.
R-600A-002F	100.97	74.0	73.0	0.0611	97.04	16.42	7.6	5.5	24249.	97.07	97.66	0.56	3.61	2181.	2116.	-3.0	582.
R-600A-003F	101.70	74.7	73.8	0.0611	97.67	16.40	5.2	3.8	16623.	97.11	97.96	0.85	4.16	2175.	2190.	0.7	504.
R-600A-004F	103.00	76.2	75.2	0.0602	98.64	16.15	3.0	2.2	9613.	97.06	98.45	1.39	5.25	2135.	2071.	-3.0	392.
R-600A-005F	99.09	71.7	71.0	0.0989	96.93	26.61	23.0	16.8	70392.	93.31	93.65	0.28	5.61	3549.	3253.	-8.3	609.
R-600A-006F	100.60	73.7	72.6	0.0987	98.21	26.50	7.6	5.5	23254.	92.98	93.93	0.93	7.14	3523.	3509.	-0.4	475.
R-600A-007F	101.58	74.7	73.7	0.0992	98.99	26.59	5.2	3.8	15900.	92.71	94.09	1.38	8.17	3527.	3561.	1.0	416.
R-600A-008F	103.46	76.7	75.7	0.0985	100.60	26.36	3.0	2.2	9177.	92.31	94.57	2.26	10.02	3481.	3375.	-3.0	335.
R-600A-013F	97.92	70.7	69.8	0.1333	96.35	35.87	23.0	16.8	65859.	87.48	87.93	0.41	10.22	4798.	4708.	-1.9	452.
R-600A-014F	99.67	72.7	71.6	0.1306	97.78	35.07	7.6	5.5	21802.	87.24	88.48	1.25	11.81	4673.	4716.	0.9	381.
R-600A-015F	100.70	73.7	72.7	0.1292	98.64	34.66	5.2	3.8	14913.	86.94	88.73	1.79	12.87	4606.	4639.	0.7	345.
R-600A-016F	103.22	76.7	75.5	0.1279	100.62	34.22	3.0	2.2	8623.	86.53	89.53	3.00	15.19	4521.	4483.	-0.9	287.
R-600A-017F	95.36	68.2	67.2	0.1537	94.23	41.48	23.0	16.8	61691.	81.86	82.39	0.49	13.24	5580.	5634.	1.0	406.
R-600A-018F	97.03	69.7	68.9	0.1479	95.28	39.86	7.6	5.5	20363.	81.33	82.75	1.41	14.99	5343.	5350.	0.1	343.
R-600A-019F	98.31	71.2	70.2	0.1469	96.31	39.53	5.2	3.8	13953.	81.14	83.17	2.01	16.15	5282.	5219.	-1.2	315.
R-600A-020F	101.14	74.2	73.2	0.1448	98.71	38.84	3.0	2.2	8080.	80.80	84.12	3.30	18.68	5158.	4946.	-4.1	266.
R-600A-021F	98.82	71.7	70.7	0.1902	96.98	51.15	23.0	16.8	59990.	79.54	80.18	0.60	18.96	6827.	6884.	0.8	347.
R-600A-022F	102.12	75.2	74.3	0.1898	99.91	50.83	7.6	5.5	20000.	79.68	81.48	1.78	21.55	6734.	6768.	0.5	301.
R-600A-023F	104.12	77.3	76.5	0.1904	101.74	50.87	5.2	3.8	13737.	79.59	82.19	2.58	23.23	6708.	6703.	-0.1	278.
R-600A-024F	107.87	81.7	80.7	0.1890	104.77	50.27	3.0	2.2	7986.	79.36	83.66	4.29	26.36	6571.	6420.	-2.3	240.
R-600A-025F	95.95	68.7	67.8	0.2260	94.46	60.96	23.0	16.8	53380.	70.33	71.08	0.72	25.24	8190.	8297.	1.3	313.
R-600A-026F	99.77	72.7	71.7	0.2203	97.76	59.16	7.6	5.5	17939.	70.92	73.02	2.09	27.80	7879.	7948.	0.9	273.
R-600A-027F	102.85	75.7	75.1	0.2249	100.80	60.16	5.2	3.8	12374.	71.18	74.23	3.05	30.14	7957.	7904.	-0.7	254.
R-600A-028F	103.24	76.2	75.5	0.2311	101.22	61.78	5.2	3.8	12381.	71.22	74.29	3.07	30.49	8163.	7969.	-2.4	256.

Table C-46. Experimental data for R-600a condensing on tube F3

Run No.	T_v , °F	P, psia	P_{sat} , psia	F_c , gpm	T_c , °F	$\dot{m}_c$, lb _m /hr	F_w , gpm	v , ft/sec	Re	$T_{w,in}$, °F	$T_{w,out}$, °F	ΔT_w , °F	$\overline{\Delta T}$, °F	Q_c , Btu/hr	Q_w , Btu/hr	$\frac{Q_c}{Q_w} \times 100$	U_o , $\frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}$
R-600A-001F3	100.13	73.2	72.1	0.0569	96.95	15.84	23.0	16.8	73870.	97.85	98.08	0.17	2.17	2108.	1921.	-8.8	937.
R-600A-002F3	100.64	73.7	72.7	0.0585	97.32	15.72	7.6	5.5	24287.	97.21	97.81	0.58	3.14	2089.	2196.	5.1	642.
R-600A-003F3	101.14	74.2	73.2	0.0589	97.74	15.82	5.2	3.8	16602.	97.00	97.85	0.84	3.71	2100.	2182.	3.9	545.
R-600A-004F3	102.46	75.7	74.6	0.0595	98.81	15.97	3.0	2.2	9581.	96.74	98.16	1.41	5.02	2114.	2111.	-0.1	406.
R-600A-005F3	99.51	72.2	71.5	0.0864	97.38	23.21	23.0	16.8	72220.	95.61	95.93	0.26	3.74	3094.	2955.	-4.5	797.
R-600A-006F3	100.66	73.7	72.7	0.0878	98.40	23.57	7.6	5.5	23782.	95.03	95.89	0.84	5.20	3133.	3164.	1.0	560.
R-600A-007F3	101.60	74.7	73.7	0.0878	99.17	23.55	5.2	3.8	16284.	94.91	96.15	1.24	6.07	3123.	3201.	2.5	496.
R-600A-008F3	103.52	76.7	75.8	0.0880	100.76	23.54	3.0	2.2	9409.	94.62	96.71	2.08	7.86	3109.	3108.	-0.0	381.
R-600A-009F3	98.70	71.2	70.6	0.1180	96.95	31.73	23.0	16.8	70057.	92.85	93.27	0.36	5.64	4237.	4181.	-1.3	724.
R-600A-010F3	99.87	73.1	71.9	0.1170	97.92	31.41	7.6	5.5	23007.	91.95	93.08	1.10	7.35	4183.	4183.	0.0	546.
R-600A-011F3	100.95	74.1	73.0	0.1151	98.69	30.88	5.2	3.8	15750.	91.75	93.38	1.62	8.39	4101.	4185.	2.0	471.
R-600A-012F3	103.46	76.7	75.7	0.1159	100.70	31.01	3.0	2.2	9100.	91.32	94.06	2.73	10.77	4096.	4075.	-0.5	366.
R-600A-013F3	95.89	68.7	67.7	0.1457	94.48	39.32	23.0	16.8	66386.	88.13	88.64	0.47	7.51	5283.	5361.	1.5	678.
R-600A-014F3	98.45	71.2	70.4	0.1451	96.61	39.04	7.6	5.5	22039.	88.08	89.48	1.40	9.66	5215.	5311.	1.8	520.
R-600A-015F3	100.13	73.2	72.1	0.1459	98.15	39.18	5.2	3.8	15111.	87.95	89.98	2.03	11.17	5214.	5265.	1.0	450.
R-600A-016F3	103.52	76.7	75.8	0.1470	100.97	39.30	3.0	2.2	8761.	87.70	91.06	3.36	14.14	5190.	5016.	-3.3	354.
R-600A-017F3	96.73	65.6	68.6	0.1744	95.21	47.01	23.0	16.8	65522.	86.97	87.57	0.55	9.46	6304.	6346.	0.7	642.
R-600A-018F3	100.15	73.2	72.2	0.1754	98.34	47.08	7.6	5.5	21832.	87.15	88.81	1.66	12.17	6265.	6287.	0.4	496.
R-600A-019F3	102.14	75.2	74.3	0.1752	100.05	46.91	5.2	3.8	14988.	87.06	89.47	2.41	13.88	6214.	6239.	0.4	431.
R-600A-020F3	106.26	79.7	78.9	0.1758	104.01	46.82	3.0	2.2	8685.	86.65	90.64	3.99	17.61	6143.	5960.	-3.0	336.
R-600A-021F3	95.76	68.6	67.6	0.2084	94.67	56.21	23.0	16.8	62643.	83.03	83.73	0.66	12.39	7554.	7550.	-0.1	586.
R-600A-022F3	99.15	72.2	71.1	0.2082	97.65	55.93	7.6	5.5	20744.	82.56	84.55	1.99	15.60	7459.	7549.	1.2	461.
R-600A-023F3	101.53	74.7	73.6	0.2096	99.87	56.14	5.2	3.8	14243.	82.41	85.27	2.86	17.69	7447.	7422.	-0.3	406.
R-600A-024F3	106.49	80.2	79.1	0.2100	104.21	55.91	3.0	2.2	8279.	82.08	86.85	4.76	22.02	7332.	7127.	-2.8	321.
R-600A-025F3	94.86	67.7	66.7	0.2347	93.58	63.40	23.0	16.8	60131.	79.65	80.44	0.75	14.81	8538.	8663.	1.5	555.
R-600A-026F3	99.79	72.7	71.8	0.2364	98.19	63.45	7.6	5.5	20229.	80.39	82.60	2.20	18.29	8450.	8326.	-1.5	445.
R-600A-027F3	103.00	76.2	75.2	0.2364	101.28	63.18	5.2	3.8	13969.	80.66	83.84	3.17	20.75	8352.	8223.	-1.5	388.
R-600A-028F3	108.45	82.2	81.4	0.2372	106.02	62.97	3.0	2.2	8139.	80.43	85.69	5.25	25.39	8219.	7853.	-4.5	312.
R-600A-029F3	90.94	63.7	62.9	0.2686	90.25	72.88	23.0	16.8	54294.	71.52	72.44	0.88	18.96	9900.	10136.	2.4	503.
R-600A-030F3	96.24	68.8	68.1	0.2664	94.98	71.82	7.6	5.5	18294.	72.30	74.86	2.54	22.66	9642.	9641.	-0.0	410.
R-600A-031F3	100.26	73.2	72.3	0.2708	98.97	72.62	5.2	3.8	12661.	72.61	76.31	3.69	25.80	9662.	9583.	-0.8	361.
R-600A-032F3	107.13	80.7	79.9	0.2710	105.17	72.05	3.0	2.2	7429.	72.71	78.82	6.10	31.36	9434.	9123.	-3.3	290.

APPENDIX D

SI CONVERSION FACTORS

An attempt has been made to present all key tables and figures in dual units (ACU and SI). The following conversion factors may be used to convert from ACU to SI units:

<u>To convert from</u>	<u>To</u>	<u>Multiply by</u>
Btu/hr	W	0.2929
Btu/hr·ft ²	W/m ²	3.152
Btu/hr·ft·°F	W/m·K	1.730
Btu/hr·ft ² ·°F	W/m ² ·K	5.675
Btu/lb _m	J/kg	2.324 X 10 ³
Btu/lb _m ·°F	J/kg·K	4.184 X10 ³
ft	m	0.3048
ft ²	m ²	0.0929
ft/hr ²	m/s ²	2.35 X 10 ⁻⁸
ft/sec	m/s	0.3048
gpm	m ³ /s	6.309 X 10 ⁻⁵
in.	cm	2.54
lb _f /ft	N/m	14.59
lb _m /ft ³	kg/m ³	16.02
lb _m /hr·ft	Pa·s	4.134 X 10 ⁻⁴
lb _m /hr·ft ²	Pa·s/m	1.356 X 10 ⁻³
psia	Pa	6.895 X 10 ³
Δ(°F)	Δ(K) or Δ(°C)	0.5556

Temperature conversion: $T(K) = 5/9 \times [T(^{\circ}F) - 32] + 273.15$
 $T(^{\circ}C) = 5/9 \times [T(^{\circ}F) - 32]$

INTERNAL DISTRIBUTION

1. S. E. Beall	40. F. R. Mynatt
2. R. H. Chapman	41. H. Postma
3. F. C. Chen	42. R. C. Robertson
4-8. S. K. Combs	43. David J. Rose, Consultant
9. W. B. Cottrell	44. M. W. Rosenthal
10. F. A. Creswick	45. M. R. Sheldon
11. N. Domingo	46. V. Kerry Smith, Consultant
12. D. M. Eissenberg	47. I. Spiewak
13. Harold Falkenberry, Consultant	48. D. G. Thomas
14. W. Fulkerson	49. H. E. Trammell
15. R. F. Hibbs	50. D. B. Trauger
16-20. H. W. Hoffman	51. Macauley Whiting, Consultant
21. R. N. Lyon	52. G. D. Whitman
22. R. E. MacPherson	53. ORNL Patent Office
23-27. G. S. Mailen	54-56. Central Research Library
28. R. E. Males, Consultant	57. Document Reference Section
29-33. J. W. Michel	58-59. Laboratory Records
34. S. L. Milora	60. Laboratory Records - RC
35-39. R. W. Murphy	

EXTERNAL DISTRIBUTION

61. R. L. Aamondt, Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, NM 87544
62. A. L. Austin, L-504, Geothermal Program, Lawrence Livermore Laboratory, University of California, P. O. Box 808, Livermore, CA 94550
63. J. R. Blevins, Oak Ridge Operations, DOE, P. O. Box E, Oak Ridge, TN 37830
64. G. E. Brandvold, Sandia Laboratories, P. O. Box 5800, Albuquerque, N. M. 87115
65. R. B. Coryell, Geothermal Program, National Science Foundation, Washington, DC 20550
66. T. C. Hinrichs, Magma Power Company, 5143 Sunset Blvd., Los Angeles, CA 92112
67. Ivonne J. Ingvarsson, Aerojet Nuclear Company, 550 Second Street, Idaho Falls, ID 83401
68. Gerald Johnson, Bechtel Corporation, P. O. Box 3956, San Francisco, CA 94119
69. G. A. Kolstad, Office of Energy Research, DOE, Washington, DC 20545
70. J. T. Kuwada, Rogers Engineering Company, Inc., 111 Pine Street, Sixth Floor, San Francisco, CA 94111
71. Alan D. K. Laird, Mechanical Engineering Department, University of California, Lawrence Berkeley Laboratory, Berkeley, CA 94720
72. G. W. Leonard, ATDD(P&E) HPDD, Department of the Navy, China Lake, CA 93555

73. A. Lundberg, L-505, University of California, Lawrence Livermore Laboratory, P. O. Box 808, Livermore, CA 94550
74. Dr. Paul Marto, Naval Postgraduate School, Monterey, CA 93940
75. Dr. R. B. Mesler, Department of Chemical & Petroleum Engineering, University of Kansas, 102 Nuclear Reactor Bldg., Lawrence, KS 66045
76. Kenneth Mirk, Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720
77. W. C. Moore, York Division, Borg Warner Corp., York, PA 17403
78. Kevin P. Murphy, Specialty Chemicals Division, Allied Chemical Corporation, P. O. Box 1069, Buffalo, NY 14240
79. James Nugent, Geothermal Energy, San Diego Gas & Electric Company, P. O. Box 1831, San Diego, CA 92112
80. J. J. Perona, Chemical & Metallurgical Engineering Department, University of Tennessee, Knoxville, TN 37916
81. D. R. Pitts, 876 Forest Drive, Route 12, Cookeville, TN 38501
82. Kenneth E. Starling, College of Engineering, School of Chemical Engineering & Materials Science, University of Oklahoma, Norman, OK 73069
83. J. W. Tester, Los Alamos Scientific Laboratory, P. O. Box 163, Los Alamos, NM 87544
84. Ronald A. Walter, Battelle - Pacific Northwest Laboratory, P. O. Box 999, Richland, WA 99352
85. Director, Research & Technical Support Division, Oak Ridge Operations Office, DOE, P. O. Box E, Oak Ridge, TN 37830
- 86-616. Given distribution as shown in TID-4500-R66, Geothermal Energy-Basic (Distribution Category UC-66d: GE: Utilization Technology)