# PRESSURE DROP DURING FORCED CONVECTION BOILING OF BINARY REFRIGERANT MIXTURES

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Abstract—An experimental investigation was carried out in an electrically heated horizontal tube to measure pressure drop for various flow rates and heat fluxes during forced convection boiling of pure refrigerant 12 and four compositions of refrigerants 13 and 12 mixtures. The Martinelli–Nelson correlation, using the properties of the flowing refrigerant mixture, could not predict satisfactorily the pressure drop data. Total, as well as frictional pressure drops were found to be function of concentration. Two separate models each for total, as well as frictional pressure drop were developed for predicting the corresponding pressure drop. In each case, the maximum per cent deviation between predicted and measured pressure drop was within  $\pm 30\%$ .

### INTRODUCTION

Mixtures of pure refrigerants when used in convectional vapour compression refrigeration systems result in non-isothermal boiling as well as condensation processes. This in turn reduces thermodynamic irreversibility involved in the phase change processes equipment. In addition, mixed refrigerants possess numerous other advantages over pure refrigerants, namely, improvement in miscibility of refrigerant and oil, better control and increase in refrigerating capacity and a wider cooling range Arora (1967), Arora (1970), Haselden (1952–53), Haselden & Klimek (1957–58), McHarness & Chapman (1962) and Tchaikoveski & Kuznetsov (1963). But inspite of these advantages, mixed refrigerants have not yet been put to commercial use. The major difficulty is that accurate design of heat transfer equipment is not possible because of the non-availability of reliable experimentally measured data for thermodynamic and transport properties of the binary refrigerant, mixtures and also the design parameters, namely, the heat transfer and pressure drop characteristics.

Measured pressure drop data, during forced convection phase change in a horizontal duct, is available for commonly used pure refrigerants and many calculation models have been suggested for its determination. Altmann *et al.* (1960), Hatch & Jacobs (1962), Johnson & Chaddock (1964), Pierre (1964a, b). However, experimentally measured pressure drop data are scarce for binary mixtures of pure refrigerants. The present experimental investigation reports a correlation for pressure drop during forced convection boiling of mixtures of refrigerants 12 and 13.

### EXPERIMENTAL APPARATUS AND DATA COLLECTION

A line diagram of the experimental set up is shown in figure 1. The test evaporator consisted of two identical horizontal stainless steel tubes of effective length 2.35 m each and having inside and outside diameters as 9.52 and 12.50 mm respectively. These tubes were connected by a smooth copper U-bend. The refrigerant flowed through these tubes in series. They were heated directly by passing a stabilized low voltage high intensity current through them.

The refrigerant circulation system employed a twin cylinder reciprocating compressor. An oil separator was installed in the discharge line to make circulating refrigerant effectively oil free. An evaporative type condenser was used to ensure complete condensation. A rotameter installed in the liquid line measured the flow rate of the circulating refrigerant mixture. A pre-heater was located in between the expansion valve and the test section inlet so as to give any desired quality of the working medium at the inlet to the test section. A back pressure regulating valve was used to maintain constant pressure at the test section outlet for various flow rates and heat fluxes. An afterheater ensured dry vapour reached the compressor inlet.





Pressure tappings were provided at the inlet and the outlet of the two test sections and they were connected to a common distributor with four shut-off valves, one for each location of pressure measurement. The pressures were measured by a precalibrated pressure gauge.

After starting the refrigerating plant, a pre-calculated heat flux was applied to the test sections. Then adjustments were made to the expansion valve and the back pressure regulating valve till a steady state condition was achieved for a constant pressure at the test section outlet for any particular flow rate and the chosen heat flux.

Measurements of flow rates, power input to the test section and preheater, pressures and temperatures were recorded. Since flow boiling shows random fluctuations, three to four readings were taken for each run to get good representative mean steady state values. Although large fluctuations were observed in temperatures, these were insignificant for pressure measurements. In all 116 test runs were conducted using different combinations of the following variables—

Heat flux	:	5000-17,000 W/m <sup>2</sup>
Flow rate	:	60-120 kg/hr (234-454 kg/m <sup>2</sup> s)
Concentration of	:	0-20% by mass at the interval
R-13 in R-12		of 5%
Temperature at	:	$-9 \text{ to } +5^{\circ}\text{C}$
test section outles		

The measured pressure drops for all test runs, viz. at different mass velocity, heat flux, the inlet and the outlet vapour quality of each test section, are given in Table A1 of Appendix A. The data are listed separately for each composition of refrigerant charge. Slight variation in vapour quality is noticeable between the outlet of the first test section and inlet of the second tube. This occurs due to drop of pressure in the tube bend and not because of any heat addition.

#### PRESSURE DROP ESTIMATION

Total pressure drop in a duct  $\Delta p_{\text{total}}$  consists of frictional  $\Delta p_f$ , accelerational  $\Delta p_a$  and gravitational  $\Delta p_g$  components given by [1]

$$\Delta p_{\text{total}} = \Delta p_f + \Delta p_a + \Delta p_g \tag{1}$$

where  $\Delta p_{\text{total}}$  is the total two-phase pressure drop, Pa  $\Delta p_f$  is the frictional two-phase pressure drop, Pa  $\Delta p_a$  is the acceleration pressure drop, Pa and  $\Delta p_g$  is the gravitational pressure drop, Pa.

Equation [2] gives the total pressure drop in a horizontal pipe, since the pressure drop due to gravity effect is zero

$$\Delta p_{\text{total}} = \Delta p_f + \Delta p_a \tag{2}$$

The irreversible frictional pressure drop component,  $\Delta p_f$ , is generally the most important contribution to the total pressure drop. In a two-phase flow, it is usually estimated using a physical model incorporating the experimentally measured data. However, the acceleration pressure drop component  $\Delta p_a$  is generally small as compared to the frictional pressure drop component  $\Delta p_f$  and it is a reversible pressure drop. The Martinelli-Nelson correlation (1948) has been used widely to predict the pressure drop during convective boiling in a horizontal pipe. Wallis (1969) has used this development to derive [3].

$$\Delta p_{MN} = \frac{2f_{f0}G^2L}{D\rho_L} \left[ \frac{1}{x} \int_0^x \phi_{f0}^2 \, \mathrm{d}x \right] + \frac{G^2}{\rho_L} \left[ \frac{x^2}{\alpha} \left( \frac{\rho_L}{\rho_G} \right) + \frac{(1-x)^2}{(1-\alpha)} - 1 \right]$$
[3]

where  $\Delta p_{MN}$  is the Martinelli-Nelson total two-phase pressure drop, Pa,  $f_{f0}$  is the frictional coefficient considering total two-phase flow as liquid flow, G is the mass velocity, kg/m<sup>2</sup>s, L is the length, m, D is the diameter, m,  $\rho_L$  is the density of liquid, kg/m<sup>3</sup>, x is the vapour quality,  $\phi_{f0}^2$  is the two-phase frictional multiplier,  $\alpha$  is the void fraction and  $\rho_G$  is the density of vapour, kg/m<sup>3</sup>.

Equation [3] in general, requires a stepwise integration as it demands the local values of the two-phase frictional multiplier  $\phi_{f0}^2$  and the void fraction  $\alpha$ . Steps employed to determine  $\phi_{f0}^2$  and  $\alpha$  for convective phase change have been described in detail by Collier (1972) and Wallis (1969) and are as follows—

$$\left[\frac{1}{\phi_L^2}\right]^{1/n} + \left[\frac{1}{\phi_G^2}\right]^{1/n} = 1 \text{ with } n = 4 \text{ for turbulent flow}$$

where  $\phi_L^2$  is the two-phase frictional multiplier based on pressure gradient for liquid alone flow and  $\phi_G^2$  is the two-phase frictional multiplier based on pressure gradient for gas alone flow

$$X^{2} = \frac{\phi_{G}^{2}}{\phi_{L}^{2}}$$
 [5]

where

X = Lockhart-Martinelli parameter

$$= \left(\frac{\rho_G}{\rho_L}\right)^{0.5} \left(\frac{\mu_L}{\mu_G}\right)^{0.1} \left(\frac{1-x}{x}\right)^{0.9}$$

 $\mu_L$  is the viscosity of liquid, kg/ms and  $\mu_G$  is the viscosity of vapour, kg/ms.

On simplifying, [4] and [5] give

$$\phi_L = \left(1 + \frac{1}{x^{0.3}}\right)^2.$$
 [6]

Frictional pressure drop, considering total flow as liquid, is given in [7]

$$\Delta p_{f,MN} = \left[\frac{2f_{f0}G^2L}{D\rho_L}\right]\phi_{f0}^2$$
[7]

where  $\Delta p_{f,MN}$  is the Martinelli-Nelson frictional two-phase pressure drop, Pa.

The Blasius relation for smooth pipe turbulent flow is given in [8] and [9]. Further, equation [10] expresses the relation between  $\phi_L$  given in [6] and  $\phi_{f0}$  required in [3], Wallis (1969) and Collier (1972),

$$f_{f0} = 0.079 \, (Re)^{-0.25} \tag{8}$$

where

$$Re = \frac{DG}{\bar{\mu}_L}$$
[9]

$$\phi_{f0}^2 = \phi_L^2 (1-x)^{1.75}.$$
 [10]

The Martinelli value of void fraction  $\alpha$  at low pressures has been expressed by Wallis (1969) as,

$$\alpha = (1 + X^{0.8})^{-0.378}.$$
 [11]

The first term on the right hand side of equation [3] involves integration of  $\phi_{10}^2$  with respect to vapour quality x. This has been done numerically by dividing each tube length into 55 subsections of 4 cm each. The values of x, X and the thermodynamic and transport properties were considered constant over this short length. However, it may be observed here that in case of binary refrigerant mixtures, the liquid and vapour compositions change continuously as the boiling proceeds non-isothermally. Therefore, the properties of the liquid and vapour phases change quite significantly along the test length.

Thermodynamic properties, namely, liquid enthalpy, vapour enthalpy and vapour density of the mixtures of refrigerants 13 and 12 have been determined using equations from Agarwal (1975). However, the thermodynamic and transport properties of pure refrigerants 13 and 12 have been taken from ASHRAE (1972) and ASHRAE (1973). Based on Kandlikar *et al.* (1975), transport properties of the refrigerant mixtures have been determined using [12]-[18].

$$\rho_{L.m} = \frac{\rho_{L.1}\rho_{L.2}}{W_{L.1}\rho_{L.1} + W_{L.2}\rho_{L.2}}$$
[12]

where  $W_L$  is mass concentration in liquid phase, and subscripts *m*, 1 and 2 represent mixture and components 1 and 2 respectively.

$$C_{P_{L,m}} = W_{L,1}C_{P_{L,1}} + W_{L,2}C_{P_{L,2}}$$
[13]

$$\mu_{L,m} = (\mu_{L,1})^{W_{L,1}} (\mu_{L,2})^{W_{L,2}}$$
[14]

$$\mu_{G,m} = \frac{\mu_{G,1}}{1 + \left(\frac{W_{G,2}}{W_{G,1}}\right)\beta_{12}} + \frac{\mu_{G,2}}{1 + \left(\frac{W_{G,1}}{W_{G,2}}\right)\beta_{21}}.$$
[15]

Here, the subscript G stands for gaseous phase. Further,

$$\beta_{12} = \frac{\left[1 + \left(\frac{\mu_{G,1}}{\mu_{G,2}}\right)^{0.5} \left(\frac{M_2}{M_1}\right)^{0.25}\right]^2}{2\sqrt{2}\left(1 + \frac{M_1}{M_2}\right)^{0.5}}$$
[16]

$$\beta_{21} = \beta_{12} \left( \frac{\mu_{G2}}{\mu_{G,1}} \right) \left( \frac{M_1}{M_2} \right)$$
[17]

$$k_{L,m} = k_{L,1} W_{L,1} + k_{L,2} W_{L,2} + 0.72 |k_{L,2} - k_{L,1}| W_{L,1} W_{L,2}$$
[18]

where M is the molecular weight and  $c_p$  is the specific heat at constant pressure, J/kg K.

### EXPERIMENTAL PRESSURE DROP

Figure 2 shows the variation of the experimentally measured total pressure drop for refrigerant 12 plotted against those calculated using the method of Martinelli-Nelson. It is apparent from this graph that the Martinelli-Nelson correlation mostly overpredicts the pressure drop for refrigerant 12. A best fitting straight line on this graph has a slope of 1.185. Consequently the Martinelli-Nelson correlation did not predict satisfactorily the measured pressure drop data for pure R-12. Such observations also have been reported by several workers namely, Hatch & Jacob (1962), Johnson & Chaddock (1964), Pierre (1964a, b).

Further, figures 3-6 show a similar comparison for four mixtures of refrigerants 12 and 13. From the study of these graphs, it is apparent that the Martinelli-Nelson correlation underpredicts the two-phase pressure drop for mixtures. However, the deviation becomes larger as



Figure 2. Comparison of  $\Delta p_{MN}$  vs  $\Delta p_{TP}$  (Pure R-12).



Figure 3. Comparison of  $\Delta p_{MN}$  vs  $\Delta p_{TP}$  (5% R-13, 95% R-12).



Figure 4. Comparison of  $\Delta p_{MN}$  vs  $\Delta p_{PP}$  (10% R-13, 90% R-12).



Figure 5. Comparison of  $\Delta p_{MN}$  vs  $\Delta p_{TP}$  (15% R-13, 85% R-12).



Figure 6. Comparison of  $\Delta p_{MN}$  vs  $\Delta p_{TP}$  (20% R-13, 80% R-12).

the concentration of refrigerant 13 increases, indicating also that the experimentally measured pressure drop is a function of mixture composition.

### DEVELOPMENT OF CORRELATIONS

An attempt was made to develop a correlation for pressure drop during boiling of binary mixtures of pure refrigerants 13 and 12. It was found that the ratio of the measured pressure drop to that calculated by the Martinelli-Nelson correlation tended to be the same for a given composition. Consequently, it was concluded that a relation of the type given in [19] exists

$$\frac{\Delta p_{TP}}{\Delta p_{MN}} = f(C)$$
<sup>[19]</sup>

where  $\Delta p_{TP}$  is the measured two-phase total pressure drop, Pa and C is the concentration of R-13 in the binary mixture.

It may be noted that using [19] the ratio would be a constant for each composition. An attempt was made later to develop an expression for this ratio in terms of mixture composition. An examination of the measured pressure drop data in view of the relation proposed in [19], led to the following two simple expressions.

$$\frac{\Delta p_{TP}}{\Delta p_{MN}} = 0.87(1+C)^{2.66}$$
 [20]

and

$$\frac{\Delta p_{TP}}{\Delta p_{MN}} = 0.89(1-C)^{-2.12}.$$
[21]



Figure 7. Comparison of predicted and measured pressure drops [20].

Figure 7 shows the variation of pressure drop predicted, by employing [20], versus experimentally measured pressure drop. From the study of this graph, it is apparent that almost the entire data have  $\pm 30\%$  deviation. Similarly, the variation of pressure drop calculated with the use of [21] versus measured pressure drop is shown in figure 8. In this case too, the deviation is of the order of  $\pm 30\%$ .

The percentage mean and standard deviations of total pressure drops calculated by using [20] and [21] from experimentally measured values were also calculated. Whereas the mean deviation was nearly zero for both these equations, the standard deviations were 23.1 and 23.2% respectively. This statistical analysis and figures 7 and 8 indicate that the two proposed correlations for total pressure drop are having the same degree of success. It may, however, be observed that the variables used, viz. 1 + C or 1 - C yield satisfactory correlation for pressure drop data with pure R-12 but the relation cannot possibly be extrapolated to pure R-13.

### FRICTIONAL PRESSURE DROP CORRELATION

In the total pressure drop correlations described above the frictional as well as acceleration pressure drops calculated by the method of Martinelli-Nelson are multiplied by a corrective



Figure 8. Comparison of predicted and measured pressure drops [21].

term which is a function of mixture composition. Since the acceleration pressure drop component is the difference due to the change of momentum, the use of the correction term could not be justified in the case of the acceleration pressure drop. However, as the acceleration pressure drop component is usually quite small as compared to the frictional pressure drop, the effect of including the acceleration pressure drop term in the above development would be insignificant. It was, therefore, decided to study the variation of the actual frictional drop component for the binary mixtures. The experimental values of the frictional pressure drop were calculated by subtracting the calculated acceleration pressure drop component  $\Delta p_a$ from the measured total pressure drop for the given test conditions using [3]. It was then possible to develop the two correlations for  $\Delta p_f$  as given in equations [22] and [23].

$$\Delta p_f = 0.86 \,\Delta p_{f,MN} (1+C)^{2.86}$$
[22]

and

$$\Delta p_f = 0.88 \,\Delta p_{f,MN} (1 - C)^{-2.28}.$$
[23]



Figure 9. Comparison of predicted and measured pressure drops [22].

Comparing [22] and [23] with [7], it is observed that the two-phase friction multiplier,  $\phi_{f_0}^2$ , for the Martinelli-Nelson correlation has been modified for the pure refrigerant as well as binary mixtures. The total pressure drop can then be calculated by substituting the value of  $\Delta p_f$  from [22] and [23] into [3].

The variation of predicted pressure drop using equation [22] for  $\Delta p_f$  and the experimentally measured pressure drop is shown in figure 9. The dispersion of the entire data including that of refrigerant 12 is within  $\pm 30\%$ . Similarly figure 10 shows the variation of predicted pressure drop using [23] and measured pressure drop. Here in this case also, the percentage deviation for almost entire data is within  $\pm 30\%$ . The percentage mean deviation of the total pressure drops calculated on the basis of [22] and [23] with respect to those measured experimentally, was found to be nearly zero. The standard deviations were 23.1 and 23.2% respectively. The foregoing discussion indicates that these two correlations, developed on the basis of two-phase frictional pressure drop, also have the same degree of success as those based on total pressure drop.



Figure, 10. Comparison of predicted and measured pressure drops [22].

### CONCLUSIONS

From the study of predicted and experimentally measured pressure drop data, the following conclusions are drawn.

(1) The Martinelli-Nelson correlation mostly overpredicts the pressure drop data for pure R-12 and tends to underpredict the same for refrigerant mixtures of R-13 and R-12, the deviation increasing with increased fraction of R-13. Hence, the correlation does not predict satisfactorily the measured pressure drop data. Further, it was found that the pressure drop was a function of mixture composition also.

(2) Two correlations for total pressure drop as given below were found to produce an agreement with experimental measurements to within  $\pm 30\%$ 

$$\frac{\Delta p_{TP}}{\Delta p_{MN}} = 0.87(1+C)^{2.66}$$
$$\frac{\Delta p_{TP}}{\Delta p_{MN}} = 0.89(1-C)^{-2.12}.$$

(3) Two correlations have been developed by considering a modifying factor for binary refrigerant mixtures for the two-phase frictional pressure drop multiplier. The resulting correlations are given below—

$$\Delta p_f = 0.86 \,\Delta p_{f,MN} (1+C)^{2.86}$$
$$\Delta p_f = 0.88 \,\Delta p_{f,MN} (1-C)^{-2.28}.$$

The two correlations for frictional pressure drop have agreed with the pressure drop measurements to within  $\pm 30\%$ .

(4) All the four proposed correlations are nearly equally successful for the experimental pressure drop data of pure R-12 as well as that of the binary mixtures.

(5) The drawback of these correlations is that they do not allow extrapolation of the pressure drops to high concentrations of R-13, say above about 25%.

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## APPENDIX

Table A1. Pressure drop data

Velocity         Flug         Inlet         Outlet         Pressure Drop         Inlet         Outlet         Pressure Aupour         Inlet           234         5000         0.12         0.26         C.0210         0.57         0.420         0.0233         0.1233           333         5000         0.16         0.26         0.0210         0.17         0.16         0.261         0.1233           334         13000         0.16         0.26         0.1261         0.665         0.19         0.64         0.1741           334         13000         0.17         0.24         0.0315         0.25         0.32         0.0412         0.1623           33	Mass	Heat	T	Tube 1			Tube 2			
kg/m*         k/m*         Vapour         Darop         Darop         Darop         Vapour         Darop           1         2         3         4         5         6         1         1         8           234         5000         0.12         0.26         0.021         0.27         0.46         0.67         0.61         0.632           234         5000         0.37         0.51         0.620         0.37         0.61         0.632           234         5000         0.37         0.51         0.621         0.53         0.65         0.623           234         17000         0.09         0.51         0.6241         0.51         0.97         0.1235           333         5000         0.15         0.143         0.631         0.49         0.49         0.59         0.1235           334         5000         0.15         0.130         0.657         0.77         0.140         0.141         0.53         0.42         0.1623           335         13000         0.13         0.41         0.141         0.141         0.141         0.141         0.141         0.142         0.142         0.1623         0.44         0.142	Velocity	Flux	Inlet	Outlet	Pressure	Inlet	Outlet	Pressure		
I         2         3         4         5         6         7         88           PURE R-12           234         5000         0.12         0.26         0.021         0.54         0.67         0.0623           734         5000         0.12         0.35         0.0421         0.54         0.67         0.0623           734         9000         0.12         0.047         0.0210         0.55         0.0423           234         15000         0.12         0.47         0.0210         0.50         0.87         0.1833           234         17000         0.03         0.0341         0.51         0.92         0.1235           333         5000         0.16         0.26         0.0210         0.47         0.43         0.59         0.1029           334         5000         0.13         0.43         0.667         0.122         0.46         0.77         0.44         0.123           334         13000         0.13         0.44         0.0716         0.44         0.0720         0.124         1.434         0.1629           334         13000         0.123         0.44         0.11156         0.452         0.642	kg/m <sup>r</sup> S	W/m²	Vapour	Vapour	Drop	Vapour	Vapour	Drop		
PURE R-12           234         5000         0.12         0.26         0.216         0.324         0.67         0.64c         0.6412           734         9000         0.37         0.61         0.6420         0.63         0.87         0.6823           734         9000         0.37         0.61         0.6420         0.63         0.87         0.6823           734         9000         0.50         0.402         0.611         0.92         0.1233           736         9000         0.50         0.40         0.6420         0.41         0.50         0.0226           7333         5000         0.53         0.43         0.6420         0.441         0.533         0.429         0.1223           7334         9000         0.15         0.31         0.6921         0.33         0.469         0.1233           7334         9000         0.13         0.37         0.6526         0.53         0.44         0.1732           7334         13000         0.13         0.37         0.6526         0.529         0.441         0.1629           7345         5000         0.12         0.44         0.1767         0.444         0.1647	1	2	Juditev 3	4	5	6	7	8		
PURE R-12           234         5000         0.12         0.26         C.0216         0.57         0.46         0.0611           734         5000         0.12         0.35         C.0420         0.57         0.611         0.0623           734         9000         0.12         0.35         C.0420         0.55         0.87         0.1235           734         9000         0.17         0.47         0.0210         0.55         0.875         0.0233           734         17000         0.09         0.51         0.0341         0.50         0.460         0.0220           7333         5000         0.16         0.26         0.0210         0.77         0.36         0.0223           7333         9000         0.15         0.31         0.37         0.44         0.59         0.1023           7333         9000         0.15         0.156         0.57         0.74         0.1441           7333         13000         0.37         0.45         0.156         0.55         0.32         0.441           734         5000         0.52         0.40         0.156         0.55         0.52         0.4041           734										
234 5000 0.12 0.26 0.021 0.27 0.40 0.67 0.0423 234 5000 0.37 0.52 0.041 0.54 0.67 0.0423 234 17000 0.37 0.61 0.042 0.53 0.49 0.1233 234 17000 0.16 0.26 0.0210 0.50 0.49 0.1233 234 17000 0.16 0.26 0.0210 0.57 0.36 0.0226 333 5000 0.36 0.40 0.0420 0.41 0.50 0.0623 333 5000 0.36 0.40 0.0421 0.57 0.36 0.0226 333 5000 0.16 0.26 0.0210 0.77 0.36 0.0226 333 5000 0.38 0.43 0.0631 0.49 0.59 0.1029 333 9000 0.15 0.31 0.0641 0.33 0.49 0.1233 333 5000 0.13 0.37 0.0526 0.39 0.64 0.1441 333 13000 0.13 0.37 0.0526 0.39 0.64 0.77 0.1441 333 13000 0.12 0.44 0.0736 0.46 0.77 0.1441 333 13000 0.59 0.65 0.1156 0.25 0.42 0.041 0.135 454 5000 0.17 0.24 0.0315 0.25 0.42 0.0126 454 5000 0.56 0.34 0.1156 0.55 0.42 0.1024 454 5000 0.57 0.50 0.1156 0.51 0.43 0.1647 454 5000 0.57 0.50 0.1156 0.41 0.136 454 9000 0.50 0.44 0.1747 0.45 0.99 0.410 0.123 454 13000 0.50 0.44 0.1747 0.45 0.99 0.1235 454 13000 0.50 0.44 0.1747 0.45 0.99 0.1235 454 13000 0.50 0.44 0.1747 0.45 0.99 0.2235 454 13000 0.50 0.44 0.1747 0.46 0.55 0.42 0.1029 95% R-12, 5% R-13 MIXTURE 734 5000 0.17 0.23 0.021 0.29 0.40 0.063 0.1235 454 13000 0.50 0.44 0.335 0.39 0.651 0.43 0.1235 454 13000 0.50 0.44 0.335 0.49 0.550 0.61 0.1029 95% R-12, 5% R-13 MIXTURE 734 5000 0.16 0.29 0.54 0.1397 0.56 0.61 0.1029 339 5000 0.33 0.40 0.0946 0.43 0.44 0.353 0.259 95% R-12, 5% R-13 MIXTURE 734 5000 0.18 0.49 0.027 0.55 0.30 0.1235 449 500 0.33 0.44 0.0355 0.130 0.44 0.353 339 9000 0.41 0.57 0.136 0.49 0.57 0.40 0.2059 95% R-12, 5% R-13 MIXTURE 279 5000 0.33 0.44 0.0241 0.25 0.30 0.44 0.248 0.1338 339 9000 0.34 0.52 0.136 0.43 0.44 0.247 0.45 0.44 0.2639 339 13000 0.38 0.52 0.136 0.420 0.24 0.25 0.44 0.2679 339 9000 0.38 0.52 0.33 0.442 0.257 0.44 0.2577 339 13000 0.31 0.44 0.357 0.45 0.072 0.44 454 5000 0.32 0.33 0.44 0.577 0.58 0.6143 0.577 0.58 0.6141 0.577 0.58 0.1132 279 5000 0.23 0.34 0.055 0.1787 0.57 0	PURE R-12	2								
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	234	5000	0.12	0.26	C.0210	0.27	0.4C	0.0412		
734 9000 0.12 0.35 C.C420 0.37 C.61 0.0823 734 13000 0.12 0.47 0.0210 0.55 0.87 C.1833 734 13000 0.12 0.47 0.0210 0.55 0.87 0.1833 733 5000 0.50 0.40 0.0210 0.77 0.36 0.0223 7333 5000 0.53 0.43 0.0630 0.49 0.59 0.1029 7333 9000 0.15 0.31 0.0641 0.57 0.74 0.1441 7333 13000 0.13 0.37 0.0526 0.39 0.64 0.1235 7333 9000 0.15 0.31 0.77 0.056 0.39 0.64 0.1441 7333 13000 0.12 0.44 0.0735 0.46 0.77 0.1441 7454 5000 0.17 0.24 0.0315 0.75 0.74 0.1441 7454 5000 0.17 0.24 0.0156 0.45 0.42 0.1041 7454 5000 0.17 0.24 0.0156 0.41 0.43 0.46 0.77 7.01441 7454 5000 0.17 0.24 0.0156 0.41 0.43 0.1647 7454 9000 0.50 0.44 0.1356 0.55 0.42 0.1029 7454 5000 0.17 0.52 0.40 0.1156 0.41 0.43 0.1647 7454 9000 0.50 0.44 0.136 0.55 0.42 0.1029 7454 9000 0.50 0.44 0.136 0.55 0.42 0.1029 7454 9000 0.50 0.44 0.136 0.55 0.42 0.1029 7454 9000 0.50 0.44 0.136 0.55 0.42 0.1024 7454 9000 0.50 0.44 0.136 0.55 0.42 0.1023 7454 13000 0.17 0.50 0.136 0.52 0.65 0.1235 7454 13000 0.17 0.54 0.021 0.29 0.41 0.1029 755 5.00 0.17 0.54 0.1019 0.55 0.053 0.1235 7454 13000 0.17 0.54 0.1019 0.55 0.053 0.1235 7454 13000 0.17 0.54 0.1019 0.55 0.050 0.1235 7454 17000 0.14 0.35 0.044 0.25 0.65 0.1235 755 1000 0.17 0.54 0.1019 0.45 0.1019 735 5.000 0.17 0.54 0.1019 0.55 0.051 0.1029 735 5.000 0.17 0.54 0.1019 0.55 0.10 0.1029 735 5.000 0.18 0.44 0.0241 0.25 0.051 0.1029 735 5.000 0.18 0.45 0.0015 0.53 0.45 0.1235 7454 5000 0.18 0.52 0.0621 0.25 0.64 0.1338 739 5000 0.18 0.52 0.1051 0.53 0.44 0.1338 739 5000 0.18 0.52 0.0420 0.54 0.45 0.1235 734 15000 0.18 0.52 0.0621 0.55 0.54 0.66 0.123 735 13000 0.18 0.52 0.0621 0.55 0.54 0.663 0.125 739 5000 0.53 0.44 0.0241 0.55 0.54 0.663 0.125 739 5000 0.53 0.44 0.02641 0.55 0.57 0.66 0.123 744 7 9000 0.18 0.52 0.0641 0.57 0.54 0.663 0.125 757 5000 0.52 0.53 0.440 0.57 0.54 0.55 757 5000 0.52 0.52 0.0241 0.55 0.57 0.56 0.126 757 5000 0.52 0.52 0.0241 0.57 0.56 0.126 757 5000 0.52 0.52 0.0241 0.55 0.57	234	5000	0.39	0.52	0.0841	0.54	0.67	0.0823		
334         3000         0.12         0.144         0.153         0.164         0.144         1.144 <th1.144< th="">         1.144         1.14</th1.144<>	234	9000	0.12	0.35	0.0420	0.37	0.61	0.0823		
234       17000       0.12       0.0341       0.12       0.1235         333       5000       0.16       0.26       0.0210       0.27       0.36       0.0226         333       5000       0.30       0.44       0.06420       0.44       0.50       0.0623         333       5000       0.30       0.44       0.050       0.49       0.59       0.1023         333       9000       0.15       0.31       0.077       0.0526       0.39       0.66       0.91       0.0720         334       13000       0.39       0.65       0.1256       0.44       0.77       0.14441         334       13000       0.17       0.24       0.0315       0.25       0.40       0.1720         454       5000       0.76       0.44       0.0176       0.44       0.1647         454       5000       0.57       0.55       0.52       0.40       0.1353         454       13000       0.14       0.137       0.56       0.425       0.425       0.425         454       13000       0.14       0.35       0.57       0.57       0.1235       1.235         454       15000       0.17	234	13000	0.37	0.01	0.0420	0.03	0.07	0.1075		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	234	17000	0.09	0.51	0.0341	0.51	0.92	0.1235		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	338	5000	0.16	0.26	0.0210	0.27	0.36	0.0206		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	338	5000	0.30	0.40	0.0420	0.41	0.50	0.0823		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	338	5000	0.38	0.43	0.0630	0.49	0.59	0.1029		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	338	9000	0.15	0.31	0.0841	0.33	0.49	0.1235		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	330	13000	0.13	0.37	0.0526	0.39	0.64	0.1441		
338 17000 0.12 0.44 0.0736 0.46 0.77 0.1441 454 5000 0.17 0.24 0.0315 0.25 0.32 0.0412 454 5000 0.56 0.34 0.1156 0.35 0.42 0.1029 454 9000 0.50 0.44 0.1767 0.45 0.58 0.1029 454 9000 0.57 0.50 0.1366 0.52 0.65 0.1353 454 9000 0.14 0.35 0.0946 0.35 0.53 0.1235 454 13000 0.14 0.35 0.0946 0.35 0.53 0.1235 454 13000 0.14 0.36 0.1472 0.40 0.63 0.1235 454 13000 0.14 0.36 0.1472 0.40 0.63 0.1235 454 17000 0.12 0.78 0.0315 0.59 0.59 0.2064 454 17000 0.12 0.78 0.0315 0.59 0.59 0.2064 454 15000 0.12 0.77 0.54 0.1397 0.56 0.59 0.2064 454 15000 0.12 0.79 0.54 0.1397 0.56 0.80 0.2059 95'/ R-12, 5'/. R-13 MIXTURE 734 5000 0.17 0.73 0.0315 0.59 0.59 0.0623 735 9000 0.17 0.73 0.0315 0.59 0.59 0.0623 735 9000 0.16 0.23 0.0420 0.74 0.31 0.1029 341 5000 0.16 0.23 0.0420 0.74 0.31 0.1029 341 5000 0.16 0.23 0.0420 0.74 0.31 0.1029 341 5000 0.18 0.29 0.051 0.46 0.133 339 5000 0.37 0.45 0.1051 0.46 0.54 0.1544 339 9000 0.18 0.32 0.0631 0.33 0.47 0.1029 341 5000 0.18 0.32 0.0631 0.33 0.44 0.253 339 15000 0.38 0.52 0.1156 0.54 0.68 0.1853 339 15000 0.18 0.52 0.156 0.54 0.68 0.1853 339 15000 0.18 0.52 0.156 0.54 0.68 0.1853 346 17000 0.18 0.49 0.0261 0.36 0.44 0.2659 447 9000 0.18 0.59 0.0315 0.41 0.63 0.77 0.1853 449 50 0 0 0.19 0.24 0.0841 0.25 0.30 0.44 0.2659 454 5000 0.32 0.56 0.1665 0.52 0.56 0.2470 451 15000 0.18 0.54 0.1651 0.56 0.52 0.2367 451 15000 0.18 0.54 0.1651 0.52 0.56 0.2470 451 9000 0.20 0.44 0.0270 0.44 0.2659 229 5000 0.23 0.53 0.44 0.0671 0.57 0.68 0.1132 279 9000 0.23 0.54 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup> 90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.23 0.54 0.0631 0.57 0.68 0.1132 320 5000 0.42 0.54 0.661 0.57 0.68 0.1132 327 5000 0.42 0.54 0.661 0.57 0.56 0.1257 325 17000 0.42 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup>	338	13000	0.39	0.65	0.1261	0.66	0.91	0.0720		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	338	17000	0.12	0.44	0.0736	0.46	0.77	0.1441		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	454	5000	0.17	0.24	0.0315	0.25	0.32	0.0412		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	454	5000	0.26	0.34	0.1156	0.35	0.42	0.1029		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	474 454	9000	0.15	0.23	0.0526	0.41	0.40	0.1029		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	454	9000	0.30	0.44	0.1787	0.45	0.58	0.1353		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	454	9000	0.37	0.50	0.1366	0.52	0.65	0.1853		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	454	13000	0.14	0.35	0.0946	0.35	0.53	0.1235		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	454	17000	0.14	C. 38	0.1472	0.40	0.63	0.1235		
95% R-12, 5% R-13 MIXTURE 734 5000 0.17 0.23 0.021 0.29 0.40 0.0618 735 5000 0.17 0.37 0.0315 0.39 0.59 0.0423 735 9000 0.41 0.62 0.0736 0.64 0.85 0.1235 735 13000 0.18 0.49 0.042 0.24 0.31 0.1029 341 5000 0.33 0.40 0.0946 0.41 0.43 0.1338 339 5000 0.37 0.45 0.1051 0.33 0.47 0.1029 339 9000 0.18 0.32 0.0631 0.33 0.47 0.1029 339 9000 0.38 0.52 0.1156 0.54 0.68 0.1853 339 13000 0.18 0.39 0.0135 0.41 0.63 0.1853 340 17000 0.18 0.46 0.0841 0.48 0.76 0.1853 344 5000 0.39 0.61 0.1261 0.63 0.85 0.1853 344 17000 0.18 0.46 0.0841 0.48 0.76 0.1853 449 5000 0.32 0.38 0.151 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.41 0.48 0.76 0.1853 449 5000 0.32 0.38 0.1051 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 449 5000 0.32 0.36 0.1366 0.38 0.44 0.25 0.30 0.1441 454 5000 0.32 0.38 0.1051 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 449 5000 0.32 0.38 0.1051 0.39 0.45 0.2470 451 9000* 0.32 0.50 0.1635 0.52 0.64 0.2676 451 10000 0.18 0.34 0.1051 0.36 0.52 0.2470 451 10000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.31 0.49 0.1787 0.57 0.66 0.1132 279 5000 0.22 0.54 0.0631 0.57 0.66 0.1132 279 5000 0.23 0.33 0.0420 0.43 0.653 0.2773 451 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup> 90% R-12, 10% R-13 MIXTURE 229 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 230 5000 0.42 0.50 0.1051 0.39 0.45 0.2573 451 17000 0.31 0.40 0.0210 0.41 0.57 0.66 0.1132 279 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 13000 0.72 0.73 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup> 90% R-12, 10% R-13 MIXTURE	454	17000	0.29	0.54	0.1892	0.56	0.80	0.2059		
95'/, R-12, 5'/, R-13 MIXTURE 734 5000 0.17 0.23 0.021 0.29 0.40 0.0618 735 5000 0.17 0.37 0.0315 0.50 0.61 0.1029 735 9000 0.14 0.62 0.0736 0.64 0.85 0.1235 735 13000 0.18 0.49 0.042 0.52 0.84 0.1029 341 5000 0.33 0.40 0.0946 0.41 0.48 0.1338 339 5000 0.37 0.45 0.1051 0.46 0.54 0.1544 339 9000 0.18 0.32 0.0631 0.33 0.47 0.1029 339 5000 0.38 0.52 0.1156 0.54 0.68 0.1853 340 17000 0.18 0.46 0.0841 0.48 0.76 0.1853 344 5000 0.39 0.61 0.250 0.0841 0.48 0.76 0.1853 344 5000 0.39 0.61 0.251 0.46 0.54 0.68 0.1853 346 17000 0.18 0.46 0.0841 0.48 0.76 0.1853 346 17000 0.18 0.46 0.0841 0.48 0.76 0.1853 449 5000 0.30 0.36 0.1366 0.38 0.44 0.255 0.30 0.1441 454 5000 0.30 0.36 0.1365 0.38 0.44 0.2059 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 449 5000 0.32 0.38 0.52 0.1651 0.39 0.45 0.2773 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 449 5000 0.32 0.38 0.1051 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 449 5000 0.32 0.50 0.1635 0.52 0.64 0.2676 451 9000* 0.32 0.50 0.1635 0.52 0.64 0.2676 451 9000* 0.32 0.50 0.1635 0.52 0.64 0.2676 451 17000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.31 0.49 0.1787 0.57 0.78 0.2779 451 17000 0.31 0.49 0.1787 0.57 0.66 0.1132 229 9000 0.45 0.56 0.031 0.30 0.37 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup> 90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 5000 0.42 0.50 0.1051 0.57 0.48 0.1132 229 9000 0.44 0.6210 0.41 0.57 0.66 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 5000 0.42 0.50 0.1051 0.57 0.58 0.1132 229 9000 0.44 0.57 0.66 0.1132 229 9000 0.44 0.691 0.57 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup>										
734 5000 0.17 0.23 0.021 0.29 0.40 0.0618 735 5000 0.17 0.37 0.0315 0.39 0.0423 736 9000 0.11 0.62 0.073 0.0315 0.39 0.0423 734 9000 0.18 0.49 0.042 0.52 0.84 0.1029 341 5000 0.16 0.23 0.0420 0.24 0.31 0.1029 341 5000 0.33 0.40 0.0946 0.41 0.48 0.1338 339 5000 0.37 0.45 0.1051 0.46 0.54 0.1544 339 9000 0.18 0.32 0.0631 0.33 0.47 0.1029 349 9000 0.18 0.39 0.0315 0.41 0.63 0.1750 339 13000 0.18 0.39 0.0315 0.41 0.63 0.1750 339 13000 0.18 0.46 0.0841 0.25 0.30 0.1653 340 17000 0.18 0.46 0.0841 0.48 0.76 0.1853 449 5000 0.19 0.24 0.0841 0.25 0.30 0.1441 454 5000 0.32 0.36 0.1366 0.38 0.44 0.2059 454 5000 0.33 0.44 0.1577 0.45 0.56 0.2470 451 9000 0.18 0.32 0.0946 0.30 0.41 0.1853 454 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 454 9000 0.32 0.50 0.1635 0.52 0.64 0.2679 451 13000 0.18 0.34 0.1571 0.57 0.45 0.56 0.2470 451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.20 0.41 0.1787 0.51 0.69 0.2779 451 17000 0.20 0.41 0.1787 0.57 0.68 0.1132 229 5000 0.43 0.55 0.1787 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 730 13000 0.73 0.54 0.0631 0.57 0.68 0.1132 229 9000 0.43 0.55 0.1787 0.57 0.57 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup> 90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.23 0.54 0.0631 0.57 0.68 0.1132 230 5000 0.42 0.56 0.0341 0.57 0.68 0.1132 230 5000 0.42 0.50 0.1631 0.30 0.37 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.24 0.55 0.1051 0.51 0.59 0.175 0.154 320 9000 0.44 0.50 0.1651 0.51 0.59 0.175 0.154 320 9000 0.4	95"/ R-12	2. 5%	R-13 MIX7	URE						
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	23/	5000	0.17	0.24	0.021	0.20	0.40	6 618		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	235	5000	0.37	0.49	0.0315	0.50	0.61	0.1029		
234 9000 0.41 0.62 C.0736 0.64 0.85 0.1235 235 13000 0.18 0.49 0.042 0.52 0.84 0.1029 339 5000 0.33 0.40 0.0946 0.41 0.48 0.1338 339 5000 0.37 0.45 0.1051 0.46 0.54 0.1544 339 9000 0.18 0.32 0.0631 0.33 0.47 0.1029 339 9000 0.38 0.52 0.1156 0.54 0.68 0.1853 330 13000 0.18 0.39 0.0315 0.41 0.63 0.1750 339 13000 0.18 0.46 0.0841 0.48 0.76 0.1853 340 17000 0.18 0.46 0.0841 0.48 0.76 0.1853 449 5000 0.32 0.36 0.1366 0.38 0.44 0.2059 454 5000 0.32 0.38 0.1051 0.39 0.41 0.1853 454 9000 0.33 0.44 0.1577 0.45 0.56 0.2470 451 9000 <sup>6</sup> 0.32 0.50 0.1685 0.52 0.2470 451 13000 0.18 0.34 0.1051 0.36 0.52 0.2367 451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 350 5000 0.23 0.54 0.0631 0.57 0.64 0.125 90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.23 0.54 0.0631 0.57 0.68 0.1132 229 9000 0.23 0.54 0.0631 0.57 0.68 0.1132 229 9000 0.23 0.54 0.0631 0.57 0.78 0.2779 3 Heat flux in tube 1 = 17000 W/m <sup>2</sup>	235	9000	0.17	0.37	0.0315	0.39	0.59	0.0023		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	234	9000	0.41	0.62	0.0736	0.64	0.85	0.1235		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	233 341	5000	0.10	0.49	0.042	0.24	0.31	0.1029		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	339	5000	0.33	0.40	0.0946	0.41	0.48	0.1338		
339 9000 0.18 0.32 0.0631 0.33 0.47 0.1029 339 9000 0.38 0.52 0.1156 0.54 0.68 0.1853 338 13000 0.18 0.39 0.61 0.1261 0.63 0.85 0.1853 340 17000 0.18 0.46 0.0841 0.48 0.76 0.1853 449 5000 0.30 0.36 0.1366 0.38 0.44 0.2059 454 5000 0.32 0.38 0.1051 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 454 5000 0.32 0.38 0.1051 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 454 9000 0.33 0.44 0.1577 0.45 0.56 0.2470 451 9000 0.18 0.34 0.1051 0.36 0.52 0.64 0.2676 454 13000 0.18 0.34 0.1051 0.36 0.52 0.2470 451 13000 0.18 0.34 0.1051 0.36 0.52 0.2470 451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.31 0.49 0.1787 0.57 0.78 0.2779 451 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup> 90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.45 0.56 0.0841 0.70 0.91 0.1235 230 5000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 5000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 5000 0.48 0.69 0.0841 0.57 0.68 0.1132 279 9000 0.23 0.54 0.0631 0.57 0.64 0.1029 229 9000 0.23 0.54 0.0631 0.57 0.64 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.24 0.50 0.1051 0.51 0.59 0.1544 324 9000 0.44 0.50 0.1647 0.51 0.59 0.1544 324 9000 0.45 0.667 0.1156 0.69 0.91 0.1353 325 17000 0.45 0.67 0.1156 0.69 0.91 0.1353 325 17000 0.45 0.67	339	5000	0.37	0.45	0.1051	0.46	0.54	0.1544		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	339	9000	0.18	0.52	0.0051	0.33	0.47	0.1853		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	338	13000	0.18	0.39	0.0315	0.41	0.63	0.1750		
340 17000 0.18 0.46 0.0841 0.48 0.76 0.1853 449 5000 0.19 0.24 0.0841 0.25 0.30 0.1441 454 5000 0.30 0.36 0.1366 0.38 0.44 0.2059 454 5000 0.32 0.38 0.1051 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 454 9000 0.33 0.44 0.1577 0.45 0.56 0.2470 451 9000 0.32 0.50 0.1685 0.52 0.64 0.2676 454 13000 0.18 0.34 0.1051 0.36 0.52 0.2367 451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 451 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 451 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup> 90'. R-12, 10'. R-13 MIXTURE 229 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 730 13000 0.73 0.54 0.0631 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 730 13000 0.72 0.79 0.631 0.30 0.37 0.1132 323 5000 0.42 0.50 0.1051 0.51 0.59 0.1754 325 1000 0.42 0.50 0.1051 0.51 0.59 0.1754 326 0.022 0.29 0.0631 0.30 0.37 0.1132 327 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 730 13000 0.72 0.79 0.631 0.30 0.37 0.1132 323 5000 0.42 0.50 0.1051 0.51 0.59 0.1754 324 9000 0.44 0.0216 0.41 0.50 0.1544 377 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 325 1000 0.22 0.29 0.0631 0.30 0.37 0.1132 326 9000 0.45 0.56 0.1051 0.51 0.59 0.1750 327 9000 0.45 0.56 0.1051 0.51 0.59 0.1750 329 9000 0.45 0.50 0.1051 0.51 0.59 0.1750 320 9000 0.45 0.50 0.1051 0.51 0.59 0.1750 321 13000 0.22 0.29 0.0631 0.30 0.37 0.1132 324 9000 0.45 0.56 0.1051 0.51 0.59 0.1750 325 10000 0.24 0.50 0.1051 0.51 0.59 0.1750 321 13000 0.24 0.50 0.1051 0.51 0.59 0.1750 321 13000 0.45 0.667 0.1156 0.68 0.99 0.91 0.1353 325 10000 0.24 0.50 0.1051 0.51 0.59 0.1750 321 13000 0.45 0.67 0.1156 0.69 0.91 0.1353 325 10000 0.24 0.50 0.1051 0.51 0.55 0.1564 325 10000 0.24 0.50 0.1051 0.55 0.83 0.14647 325 10000 0.24 0.50 0.1051 0.55 0.83 0.14647 325 10000 0.45 0.67 0.1156 0.59 0.91 0.1353 325 10000 0.45 0.67 0.	339	13000	0.39	0.61	0.1261	0.63	0.85	0.1853		
449 5000 0.19 0.24 0.0841 0.25 0.30 0.1441 454 5000 0.30 0.36 0.1366 0.38 0.44 0.2059 454 5000 0.32 0.38 0.1051 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 454 9000 0.33 0.44 0.1577 0.45 0.56 0.2470 451 9000 0.32 0.50 0.1685 0.52 0.64 0.2676 454 13000 0.18 0.34 0.1051 0.36 0.52 0.2367 451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.20 0.41 0.1261 0.43 0.63 0.2573 458 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 W/m <sup>2</sup> 90'. R-12, 10'. R-13 MIXTURE 229 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 5000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 13000 0.73 0.54 0.0631 0.57 0.48 0.1132 330 5000 0.27 0.54 0.0631 0.57 0.48 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.42 0.50 0.1051 0.51 0.59 0.1754 323 13000 0.21 0.40 0.0214 0.41 0.50 0.1544 377 5000 0.42 0.50 0.1051 0.51 0.59 0.1754 324 9000 0.45 0.56 0.1051 0.51 0.59 0.1754 325 1000 0.22 0.29 0.0631 0.30 0.37 0.1132 326 5000 0.42 0.50 0.1051 0.51 0.59 0.1754 327 9000 0.44 0.0214 0.41 0.50 0.1544 377 5000 0.42 0.50 0.1051 0.51 0.59 0.1754 329 9000 0.445 0.66 0.1051 0.51 0.59 0.1754 320 9000 0.440 0.0214 0.41 0.50 0.1544 377 5000 0.42 0.50 0.1051 0.51 0.59 0.1754 320 9000 0.45 0.66 0.1051 0.51 0.59 0.1754 321 13000 0.22 0.29 0.0631 0.30 0.37 0.1132 323 5000 0.42 0.50 0.1051 0.51 0.59 0.1754 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 377 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 371 13000 0.23 0.46 0.0631 0.48 0.70 0.91 0.1353 325 10000 0.24 0.50 0.1051 0.51 0.59 0.1750 321 13000 0.45 0.67 0.1156 0.68 0.91 0.1647 325 10000 0.24 0.50 0.1051 0.51 0.59 0.1750 321 13000 0.45 0.67 0.1156 0.68 0.91 0.1353 325 10000 0.24 0.50 0.1051 0.51 0.55 0.1644 325 10000 0.24 0.50 0.1051 0.55 0.83 0.1447 325 10000 0.45 0.67 0.1156 0.48 0.70 0.1647 325 10000 0.45 0.67 0.1156 0.59 0.91 0.1353 325 10000 0.45 0.67 0.1156 0.59 0.91 0.1353 325 10000 0.45 0.67 0.1156 0.55 0.83 0.1447 325 10000 0.45 0.67 0.1156 0.59 0.91 0.1353 325 10000 0.45 0.67 0.115	<b>34</b> 0	17000	0.18	0.46	0.0841	0.48	0.76	0.1853		
454 5000 0.30 0.36 0.1366 0.38 0.44 0.2059 454 5000 0.32 0.38 0.1051 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 454 9000 0.33 0.44 0.1577 0.45 0.56 0.2470 451 9000 0.32 0.50 0.1685 0.52 0.64 0.2676 454 13000 0.18 0.34 0.1051 0.36 0.52 0.2367 451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.20 0.41 0.1261 0.43 0.63 0.2573 453 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 $W/m^2$ 90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.23 0.33 0.0420 0.34 0.45 0.0720 230 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 13000 0.23 0.54 0.0631 0.57 0.48 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 323 5000 0.44 0.0210 0.41 0.57 0.51 0.59 0.1750 324 0.50 0.123 0.54 0.0631 0.57 0.48 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 323 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 324 0.050 0.45 0.66 0.1051 0.51 0.59 0.1750 325 0.000 0.45 0.60 0.1051 0.51 0.59 0.1750 326 9000 0.44 0.0210 0.41 0.50 0.1544 327 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 329 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 325 13000 0.22 0.29 0.0631 0.30 0.37 0.1132 326 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 327 5000 0.45 0.60 0.1472 0.61 0.75 0.1544 325 13000 0.22 0.29 0.0631 0.30 0.37 0.1132 326 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 327 5000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 325 13000 0.45 0.60 0.1472 0.61 0.75 0.1544 326 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 327 5000 0.45 0.60 0.1472 0.61 0.75 0.1544 325 13000 0.45 0.67 0.1156 0.68 0.91 0.1353 325 10000 0.24 0.52 0.67 0.1156 0.59 0.1051	449	5000	0.19	0.24	0.0841	0.25	0.30	0.1441		
454 5000 0.32 0.38 0.1051 0.39 0.45 0.2573 447 9000 0.18 0.29 0.0946 0.30 0.41 0.1853 454 9000 0.33 0.44 0.1577 0.45 0.56 0.2470 451 9000 0.32 0.50 0.1685 0.52 0.64 0.2676 454 13000 0.18 0.34 0.1051 0.36 0.52 0.2367 451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.20 0.41 0.1261 0.43 0.63 0.2573 458 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = $17000 \text{ W/m}^2$ 90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 5000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 13000 0.23 0.54 0.0631 0.57 0.48 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 323 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 324 0.0210 0.41 0.57 0.68 0.1132 325 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 323 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 324 0.000 0.44 0.00210 0.41 0.50 0.1544 327 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 324 9000 0.44 0.60 0.1051 0.51 0.59 0.1750 325 1.000 0.45 0.66 0.1472 0.61 0.75 0.1544 327 5000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 325 13000 0.22 0.29 0.0631 0.30 0.37 0.1132 326 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 327 5000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 325 13000 0.22 0.29 0.0631 0.38 0.70 0.1647 325 13000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 325 13000 0.45 0.67 0.1156 0.69 0.91 0.1353 325 1000 0.45 0.67 0.1156 0.48 0.70 0.1647 325 13000 0.45 0.67 0.1156 0.59 0.1750 326 1000 0.24 0.52 0.29 0.136 0.48 0.70 0.1647 325 13000 0.45 0.67 0.1156 0.59 0.91 0.1353 325 13000 0.45 0.67 0.1156 0.5	454	5000	0.30	0.36	0.1366	0.38	0.44	0.2059		
447 9000 0.16 0.29 0.0946 0.90 0.41 0.1077 454 9000 0.33 0.44 0.1577 0.45 0.56 0.2470 451 9000 0.32 0.50 0.1685 0.52 0.64 0.2676 454 13000 0.18 0.34 0.1051 0.36 0.52 0.2367 451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.20 0.41 0.1261 0.43 0.63 0.2573 453 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = $17000 \text{ W/m}^2$ 90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 5000 0.23 0.54 0.0631 0.57 0.48 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 323 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 320 9000 0.44 0.0210 0.41 0.55 0.1544 327 5000 0.45 0.60 0.1051 0.51 0.59 0.1750 320 9000 0.44 0.00210 0.41 0.55 0.1544 327 5000 0.45 0.60 0.1051 0.51 0.59 0.1750 320 9000 0.44 0.00210 0.41 0.55 0.1544 327 5000 0.45 0.60 0.1051 0.51 0.59 0.1750 329 9000 0.45 0.60 0.1472 0.61 0.75 0.1564 324 9000 0.45 0.67 0.1156 0.69 0.91 0.1353 325 13000 0.22 0.29 0.0631 0.30 0.37 0.1132 326 9000 0.45 0.60 0.1472 0.61 0.75 0.1564 327 5000 0.45 0.60 0.1472 0.61 0.75 0.1564 325 13000 0.22 0.29 0.0631 0.38 0.70 0.1647 325 13000 0.24 0.55 0.1051 0.59 0.1750 326 9000 0.45 0.60 0.1472 0.61 0.75 0.1564 325 0.1564 0.663 0.048 0.70 0.1667 0.1156 0.69 0.91 0.1353 325 1000 0.45 0.67 0.1156 0.59 0.1051	454	5000	0.32	0.38	0.1051	0.39	0.45	0.2573		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	447 454	9000	0.10	0.44	0.1577	0.45	0.56	0.2470		
454 13000 0.18 0.34 0.1051 0.36 0.52 0.2367 451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.20 0.41 0.1261 0.43 0.63 0.2573 453 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = $17000 \text{ W/m}^2$ 90% R-12, 10% R-13 MIXTURE 229 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 230 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 13000 0.23 0.54 0.0631 0.57 0.38 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.22 0.29 0.0631 0.51 0.59 0.1750 322 9000 0.44 0.0210 0.41 0.59 0.1544 327 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 320 9000 0.44 0.06210 0.41 0.59 0.1544 327 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 320 9000 0.44 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 325 13000 0.22 0.29 0.4631 0.48 0.70 0.91 0.1353 325 17000 0.42 0.50 0.1156 0.58 0.91 0.1353 325 17000 0.42 0.50 0.1156 0.48 0.70 0.91 0.1353 325 17000 0.44 0.67 0.1156 0.59 0.91 0.1353 325 17000 0.45 0.67 0.1156 0.55 0.83 0.1441	451	9000*	0.32	0.50	0.1685	0.52	0.64	0.2676		
451 13000 0.31 0.49 0.1787 0.51 0.69 0.2779 451 17000 0.20 0.41 0.1261 0.43 0.63 0.2573 453 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 <b>*</b> Heat flux in tube 1 = 17000 W/m <sup>2</sup> 90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 13000 0.23 0.54 0.0631 0.57 0.68 0.1132 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 13000 0.22 0.29 0.0631 0.57 0.38 0.1132 330 5000 0.22 0.29 0.0631 0.57 0.38 0.1132 330 5000 0.22 0.29 0.0631 0.57 0.38 0.1132 332 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 322 9000 0.44 0.0210 0.41 0.59 0.1750 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1750 371 13000 0.23 0.54 0.0631 0.48 0.70 0.91 0.1353 325 13000 0.45 0.67 0.1156 0.69 0.91 0.1353 326 9000 0.45 0.67 0.1156 0.48 0.70 0.91 0.1353 327 13000 0.45 0.67 0.1156 0.59 0.91	454	13000	0.18	0.34	0.1051	0.36	0.52	0.2367		
453 17000 0.20 0.41 0.1201 0.42 0.52 453 17000 0.34 0.55 0.1787 0.57 0.78 0.2779 * Heat flux in tube 1 = 17000 $W/m^2$ 90% R-12, 10% R-13 MIXTURE 229 5000 0.23 0.33 0.0420 0.34 0.45 0.0720 230 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.23 0.44 0.0420 0.45 0.66 0.1029 229 9000 0.23 0.44 0.0420 0.45 0.66 0.1029 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 13000 0.22 0.29 0.0631 0.57 0.38 0.1132 330 5000 0.22 0.29 0.0631 0.57 0.38 0.1132 330 5000 0.22 0.29 0.0631 0.57 0.38 0.1132 323 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 320 9000 0.44 0.00210 0.41 0.59 0.1750 320 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1750 371 13000 0.23 0.46 0.0631 0.48 0.70 0.1647 325 13000 0.45 0.67 0.1156 0.69 0.91 0.1353 326 9.000 0.45 0.67 0.1156 0.55 0.83 0.1447	451	13000	0.31	0.49	0.1787	0.51	0.63	0.2179		
* Heat flux in tube 1 = $17000 \text{ W/m}^2$ 90% R-12, 10% R-13 MIXTURE 229 5000 0.23 0.33 0.0420 0.34 0.45 0.0720 230 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.23 0.44 0.0420 0.45 0.66 0.1029 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 13000 0.23 0.54 0.0631 0.57 0.38 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 323 5000 0.42 0.50 0.1051 0.51 0.59 0.1750 320 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1544 324 9000 0.45 0.60 0.1472 0.61 0.75 0.1750 371 13000 0.23 0.46 0.0631 0.48 0.70 0.1647 325 13000 0.45 0.67 0.1156 0.69 0.91 0.1353 325 13000 0.44 0.52 0.1156 0.55 0.83 0.1441	458	17000	0.20	0.55	0.1787	0.57	0.78	0.2779		
90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.23 0.33 0.0420 0.34 0.45 0.072 $\dot{\nu}$ 230 5000 0.45 0.56 0.0341 0.57 0.68 0.1132 229 9000 0.23 0.44 0.042 $\dot{\nu}$ 0.45 0.66 0.1029 229 9000 0.23 0.44 0.042 $\dot{\nu}$ 0.45 0.66 0.1029 229 9000 0.48 0.69 0.0841 0.70 0.91 0.1235 230 1300C 0.23 0.54 0.0631 0.57 0.88 0.1132 330 5000 0.22 0.29 0.0631 0.30 0.37 0.1132 323 5000 0.31 0.40 0.021 $\dot{\nu}$ 0.41 0.50 0.1544 327 5000 0.42 0.50 0.1051 0.51 0.59 0.175 $\dot{\nu}$ 320 9000 0.24 0.38 0.0341 0.39 0.53 0.1544 327 5000 0.45 0.60 0.1472 0.61 0.75 0.175 $\dot{\nu}$ 371 13000 0.23 0.46 0.0631 0.48 0.70 0.1647 323 13000 0.45 0.67 0.1156 0.69 0.91 0.1353 325 17000 0.24 0.52 0.1156 0.55 0.83 0.1441	» Heat	flux in	n tube l	= 17000	$W/m^2$					
90'/. R-12, 10'/. R-13 MIXTURE 229 5000 0.23 0.33 $0.0420$ 0.34 0.45 $0.0720$ 230 5000 0.45 0.56 $0.0341$ 0.57 0.68 $0.1132$ 229 9000 0.23 0.44 $0.0420$ 0.45 0.66 $0.1029$ 229 9000 0.48 0.69 $0.0841$ 0.70 0.91 $0.1235$ 230 13000 0.23 0.54 $0.0631$ 0.57 0.88 $0.1132$ 330 5000 0.22 0.29 $0.0631$ 0.57 0.88 $0.1132$ 323 5000 0.31 0.40 $0.0210$ 0.41 0.50 $0.1544$ 327 5000 0.42 0.50 $0.1051$ 0.51 0.59 $0.1750$ 329 9000 0.24 0.38 $0.0411$ 0.39 $0.53$ $0.1544$ 327 5000 0.42 0.50 $0.1051$ 0.51 $0.59$ $0.1750$ 329 9000 0.24 $0.6011$ 0.48 $0.70$ $0.1544$ 321 13000 0.23 0.46 $0.0631$ 0.48 $0.70$ $0.1647$ 325 1000 0.45 0.67 $0.1156$ 0.69 $0.91$ $0.1353$ 325 17000 0.24 $0.52$ $0.1156$ 0.55 $0.83$ $0.1447$	- Hode Fran Fill Amor F - Fland - Lin									
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	90"/ P=12. 10"/ R=13 MIXTIPF									
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	220	5000	0.23	0.33	0.0420	0.34	0.45	0.0720		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	230	5000	0.45	0.56	0.0341	0.57	0.68	0.1132		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	229	9000	0.23	0.44	0.0420	0.45	0.66	0.1029		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	229	9000	0.48	0.09	0.0841	0.70	0.91	0.1235		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	330	5000	0.22	0.29	0.0631	0.30	0.37	0.1132		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	323	5000	0.31	0.40	0.0210	0.41	0.50	0.1544		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	327	5000	0.42	0.50	0.1051	0.51	0.59	0.1750		
321         13000         0.23         0.46         0.0631         0.48         0.70         0.1647           323         13000         0.45         0.67         0.1156         0.69         0.91         0.1353           325         17000         0.24         0.52         0.1156         0.55         0.83         0.1441	324	9000	0.45	0.60	0.1472	0.61	0.75	0.1750		
373 13000 0.45 0.67 0.1156 0.69 0.91 0.1353 325 17000 0.24 0.52 0.1156 0.55 0.83 0.1441	321	13000	0.23	0.46	0.0631	0.48	0.70	0.1647		
	323	13000	0.45	0.67	0.1156	0.69	0.91	0.1353		

Mage	11	-								
Mass Velocity	Heat Flux	Inlet	ube 1 LOutlet	Pressure	Tut Inlet	Outlet	Pressure			
kg/m <sup>2</sup> S	w/m <sup>2</sup>	Vapour	Vapour	Drop	Vapour	Vapour	Drop			
		Quality	Quality	Bar	Quality	<u>Cuality</u>	Bar			
90% R-12, 10% R-13 MIXTURE										
435	5000	0.24	0.29	0.0841	0.20	0.34	C.1647			
434	5000	0.38	0.44	0.1787	0.45	0.44	0.2264			
430	9000	0.24	0.34	0.1761	0.35	0.46	0.2161			
428	9000	0.34	0.50	0.1392	0.51	0.63	0.2470			
410	13000	0.20	0.39	0.1997	0.59	0.75	C. 20/0			
413	13000	0.41	0.59	0.1997	0.60	0.78	0.2882			
443	17000	0.22	0.42	0.1261	0.44	0.65	0.2676			
410	17000	0.41	0.64	0.1997	0.00	0.88	0.2470			
🛪 Heat	flux i	n tube	1 = 1700	Jw/m²						
85% 1	R-12, 1	5% R-13	MIXTURE							
231	5000	0.22	0.32	0.0631	0.33	0.43	0.0720			
231	9000	0.42	0.55	0.0051	0.74	0.00	0.1235			
231	9000	0.46	0.67	0.0841	0.69	0.90	0.1029			
231	13000	0.23	0.53	0.0631	0.56	0.86	0.1338			
331	5000	0.23	0.30	0.0736	0.31	0.38	0.1235			
336	5000	0.34	0.42	0.1051	0.43	0.52	0.1441			
336	9000	0.22	0.40	0.0631	0.49	0.50	0.1730			
335	9000	0.44	0.58	0.1051	0.60	0.75	0.1956			
335	13000	0.22	0.43	0.0841	0.45	0.66	0.1647			
333	17000	0.41	0.04	0.0841	0.00	0.89	0.2059			
451	500.0	0.21	0.27	0.2312	0.27	0.33	0.1647			
439	5000	0.32	0.39	0.1892	0.40	0.46	0.1853			
444	5000	0.38	0.45	0.1682	0.46	0.52	0.2059			
455	9000	0.25	0.34	0.0841	0.35	0.40	0.2070			
457	9000*	0.33	0.53	0.1682	0.55	0.67	0.2676			
454	13000	0.28	0.38	0.2102	0.39	0.54	0.1853			
404	17000	0.37	0.53	0.2102	0.54	0.70	0.2059			
456	17000	0.35	0.57	0.1682	0.59	0.80	0.2470			
* Heat	flux ir	tube 1	= 17000	) w/m <sup>2</sup>						
80% R-	12, 20	/. R-13	MIXTURE							
223	5000	0.29	0.39	0.0526	0.40	0.50	0.1029			
224	5000 9000	0.20	0.01	0.0736	0.62	0.73	0.1441			
224	9000	0.53	0.74	0.0946	0.76	0.97	0.1441			
225	13000	0.28	0.59	0.0631	0.62	0.93	0.1544			
309	5000	0.28	0.36	0.0841	0.36	0.44	0.1441			
306 307	5000	6.44	0.52	0.0736	0.53	0.61	0.1853			
310	9000	0.29	0.43	0.1156	0.45	0.59	0.2059			
309	9000	0.52	c.67	0.1787	0.69	0.84	0.7161			
321	13000	0.28	0.50	0.1051	01	0.73	0.1956			
314	17000	0.29	0.70	0.1261	0.11	0.99	0.1647			
404	5000	0.29	0.34	0.1261	0.35	0.40	0.1647			
394	5000	0.39	0.46	0.1682	0.46	0.53	0.2161			
388	9000	0.45	0.52	0.1/87	0.52	0.39	0.2367			
415	9000_	0.46	0.56	0.1787	0.57	0.68	0.2779			
409	9000	0.41	0.61	0.1997	0.63	0.75	c.31 <u>9</u> 1			
408 395	13000	0.23	0.45	0.1472	0.47	0.64	C.2573			
422	17000	0.29	0.49	0.1682	0.51	0.72	0.2676			
436	17000	0.43	0.64	0.2102	0.66	0.87	0.2470			
* Heat	flux in	tube 1	= 17000	w/m <sup>2</sup>						

Table A1. (Contd)