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THERMODYNAMIC PROPERTIES OF REFRIGERANT MIXTURES

L.R. GRZYLL, J.J. SILVESTRI

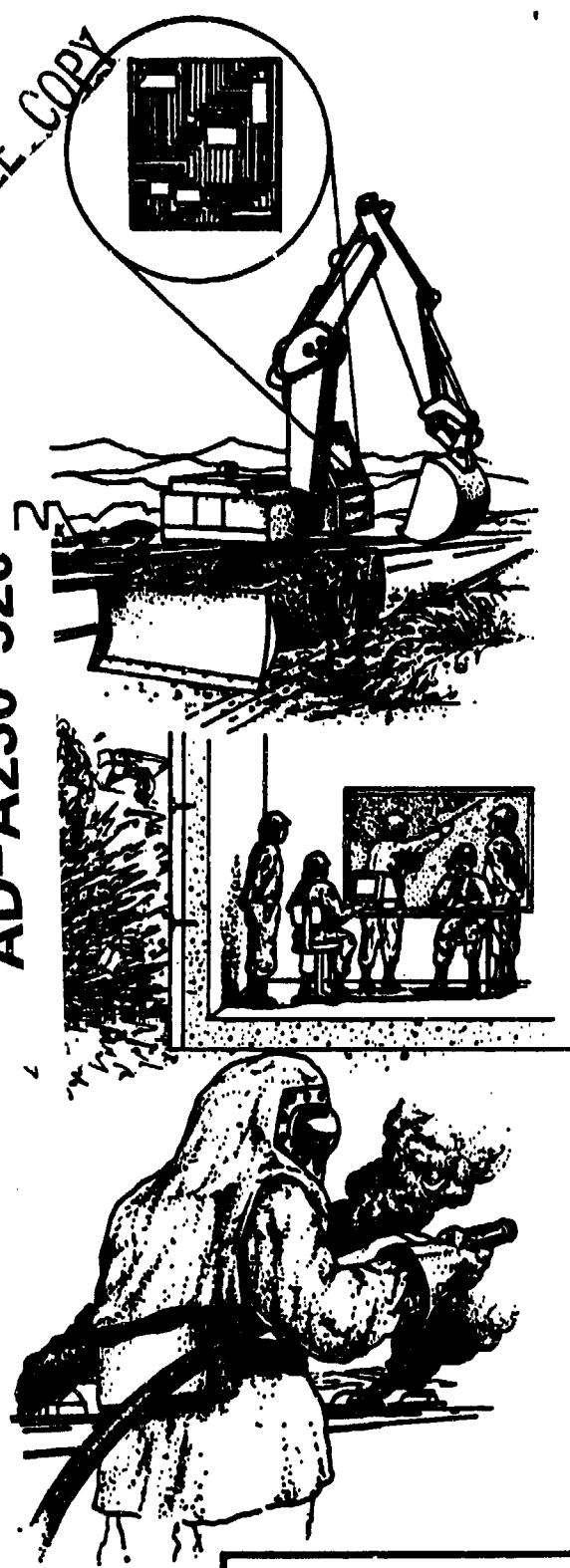
MAINSTREAM ENGINEERING CORPORATION
200 YELLOW PLACE
ROCKLEDGE FL 32955

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Air Force Engineering & Services Center
ENGINEERING & SERVICES LABORATORY
Tyndall Air Force Base, Florida 32403



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13. ABSTRACT (Maximum 200 words) The objective of this project was to analyze the impact of refrigerant mixtures on refrigeration system capacity and components. A heat pump computer simulator was developed to predict the change in system capacity of two baseline air-conditioning systems as a function of refrigerant mixture concentration. Refrigerant mixtures made of refrigerants normally stocked on Air Force bases were considered. ←				
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EXECUTIVE SUMMARY

The objective of this Phase I SBIR research effort, conducted between 21 June 1989 and 21 December 1989, was to analyze the impact of various refrigerant mixtures on refrigeration system capacity and components. This information would be essential if an attack on an Air Force base results in loss of refrigerant in the air-conditioning system and in base stockpiles, forcing replacement with a refrigerant alternative.

Technical literature was searched to find the necessary data on refrigerants normally stocked at Air Force bases. This data was obtained for refrigerants R-11, R-12, R-13B1, R-22, R-502, and R-290. A heat pump computer simulator was then developed to model the various refrigerant mixtures in two baseline refrigeration systems, a 50-kW R-22 system and a 430-kW R-11 system. The simulator used an equation of state to predict the thermodynamic properties of the refrigerant mixtures. Mainstream modeled the expansion device two ways; with a thermostatic expansion valve (TXV), like the baseline system, and with a generic expansion device, which is an idealized model. The TXV approach was the most indicative of actual system performance since this is the type of device used in the baseline systems. Using the TXV approach, adverse affects on system components (such as liquid slugging in the compressor and water chiller freezing) could be predicted. These affects could not be predicted using the generic expansion device.

The modeling results for the 50-kW R-22 system showed that the R-22/R-502 is the most desirable mixture candidate for that system, resulting in a slight decrease in system capacity. The mixture R-22/R-13B1 also resulted in a decrease in system capacity, but the potential for freezing in the system water chiller exists above 20 wt% R-13B1. The mixture R-22/R-12 also resulted in a decrease in system capacity, but liquid slugging in the compressor (resulting in compressor failure) is a problem above 60 wt% R-12. The mixture R-22/R-290 is not suitable because the power requirement in the compressor increased over the baseline system, causing compressor failure. The mixture R-22/R-11 is not suitable because liquid slugging in the compressor will occur, causing compressor failure. The modeling results for the 430-kW R-11 system showed that the mixture R-11/R-12 is not a desirable candidate for that system. The compressor power requirement for this mixture increased significantly over the baseline system, causing compressor failure. The mixture R-11/R-22 is also not desirable because of the increase in the compressor power requirement.

Further research should validate the Phase I performance results using a heat pump test stand apparatus. This would allow for studying the effects of mixtures on system hardware, as well. Additional work should also identify suitable mixtures for the R-11 system and investigate system hardware improvements to fully utilize the advantages of refrigerant mixtures.

PREFACE

This report was prepared by the Thermal Systems Division of Mainstream Engineering Corporation, 200 Yellow Place, Rockledge, FL 32955, under contract F08635-89-C-0354, for the Air Force Engineering and Services Center, Engineering and Services Laboratory, Tyndall Air Force Base, Florida. Captain Isaac J. Schantz was the Government technical program manager.

This report summarizes work done between 21 June 1989 and 21 December 1989.

Mainstream Engineering Corporation gratefully acknowledges Dr. Mark O. McLinden of the National Institute of Standards and Technology, Boulder, Colorado, for supplying the Fortran source code for the CSD equation of state and accompanying property routines.

This report has been reviewed by the Public Affairs Office and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

Isaac J. Schantz
ISAAC J. SCHANTZ, Capt, USAF
Research Mechanical Engineer

William S. Strickland
WILLIAM S. STRICKLAND
Chief, Engineering Research
Division

Allen D. Nease
ALLEN D. NEASE
Chief, Air Base Energy
Systems Branch

Richard M. Hanes
RICHARD M. HANES, Col, USAF
Director, Engineering
and Services Laboratory

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TABLE OF CONTENTS

Section	Title	Page
I	INTRODUCTION	1
A.	OBJECTIVE.	1
	1. Task I: Search The Literature.	1
	2. Task II: Determine The Impact Of Refrigerant Mixtures On Refrigeration System Components	1
	3. Task III: Model Azeotropic Refrigerant Mixtures In Various Refrigeration Systems .	1
	4. Task IV: Model Nonazeotropic Refrigerant Mixtures In Various Refrigeration Systems .	1
	5. Task V: Recommend Future Work.	1
B.	BACKGROUND	2
C.	SCOPE/APPROACH	2
	1. The Status of Refrigerant Mixtures	2
	2. Refrigerants To Be Studied	5
	3. Air-Conditioning System Operating Parameters	6
II	MODELING TECHNIQUE	7
A.	THERMODYNAMIC PROPERTY PREDICTION	7
B.	COMPRESSOR MODEL	7
C.	EXPANSION DEVICE	8
	1. The Generic Approach	9
	2. The TXV Approach	10
	3. The Impact of Two Approaches on Modeling Results	11
III	RESULTS AND DISCUSSION	14
A.	TASK I: SEARCH THE LITERATURE	14
B.	TASK II: DETERMINE THE IMPACT OF REFRIGERANT MIXTURES ON REFRIGERATION SYSTEM COMPONENTS . .	17
C.	TASK III: MODEL AZEOTROPIC REFRIGERANT MIXTURES IN VARIOUS REFRIGERATION SYSTEMS . . .	18
	1. Small System: R-22 Base Refrigerant	18
	2. Large System: R-11 Base Refrigerant	21
D.	TASK IV: MODEL NONAZEOTROPIC REFRIGERANT MIXTURES IN VARIOUS REFRIGERATION SYSTEMS . . .	26
	1. Small System: R-22 Base Refrigerant	26
	2. Large System: R-11 Base Refrigerant	26
E.	TASK V: RECOMMEND FUTURE WORK	35

TABLE OF CONTENTS (CONCLUDED)

Section	Title	Page
IV	CONCLUSIONS	36
V	REFERENCES	38
APPENDIX		
A	TABLES OF THERMODYNAMIC PROPERTY DATA FOR REFRIGERANT MIXTURES	39
B	TELEPHONE CONVERSATIONS	121
C	HEAT PUMP SIMULATOR SOURCE CODE	123
D	MODELING RESULTS - CONSTANT POWER COMPRESSOR OPERATION	133

LIST OF FIGURES

Figure	Title	Page
1	HYPOTHETICAL ISOTHERMAL PURE REFRIGERANT CYCLE . . .	4
2	HYPOTHETICAL NONAZEOTROPIC REFRIGERANT MIXTURE CYCLE	4
3	PLOT OF COP _c VERSUS CONCENTRATION FOR AZEOTROPIC AZEOTROPIC MIXTURE R-22/R-502.	12
4	PLOT OF COP _c VERSUS CONCENTRATION FOR NONAZEOTROPIC NONAZEOTROPIC MIXTURE R-22/R-13B1	12
5	PLOT OF SYSTEM CAPACITY VERSUS CONCENTRATION FOR AZEOTROPIC MIXTURE R-22/R-502.	13
6	PLOT OF SYSTEM CAPACITY VERSUS CONCENTRATION FOR NONAZEOTROPIC MIXTURE R-22/R-13B1	13

LIST OF TABLES

Table	Title	Page
1	REFRIGERANTS CONSIDERED UNDER THIS CONTRACT.	5
2	BASELINE AIR-CONDITIONING SYSTEMS USED FOR THIS PROJECT	6
3	RESULTS OF LITERATURE SEARCH	15
4	SENSITIVITY ANALYSIS ON BINARY INTERACTION COEFFICIENT.	16
5	MODELING RESULTS FOR R-22/R-12 MIXTURE	19
6	MODELING RESULTS FOR R-22/R-115 (R-502) MIXTURE. . .	22
7	MODELING RESULTS FOR R-22/R-290 MIXTURE	24
8	MODELING RESULTS FOR R-22/R-11 MIXTURE	27
9	MODELING RESULTS FOR R-22/R-13B1 MIXTURE	29
10	MODELING RESULTS FOR R-11/R-12 MIXTURE	31
11	MODELING RESULTS FOR R-11/R-22 MIXTURE	33
A.1	SATURATED VAPOR-LIQUID PROPERTIES FOR R-11/R-12 MIXTURE	41
A.2	SUPERHEATED VAPOR PROPERTIES FOR R-11/R-12 MIXTURE .	47
A.3	SATURATED VAPOR-LIQUID PROPERTIES FOR R-11/R-22 MIXTURE	55
A.4	SUPERHEATED VAPOR PROPERTIES FOR R-11/R-22 MIXTURE .	60
A.5	SATURATED VAPOR-LIQUID PROPERTIES FOR R-22/R-115 MIXTURE.	68
A.6	SUPERHEATED VAPOR PROPERTIES FOR R-22/R-115 MIXTURE.	73
A.7	SATURATED VAPOR-LIQUID PROPERTIES FOR R-22/R-13B1 MIXTURE	81
A.8	SUPERHEATED VAPOR PROPERTIES FOR R-22/R-13B1 MIXTURE	86
A.9	SATURATED VAPOR-LIQUID PROPERTIES FOR R-22/R-290 MIXTURE.	94
A.10	SUPERHEATED VAPOR PROPERTIES FOR R-22/R-290 MIXTURE.	100

LIST OF TABLES (CONCLUDED)

Table	Title	Page
A.11	SATURATED VAPOR-LIQUID PROPERTIES FOR R-22/R-12 MIXTURE	108
A.12	SUPERHEATED VAPOR PROPERTIES FOR R-22/R-12 MIXTURE .	113
D.1	MODELING RESULTS FOR R-22/R-12 MIXTURE (CONSTANT POWER COMPRESSOR OPERATION)	135
D.2	MODELING RESULTS FOR R-22/R-115 (R-502) MIXTURE (CONSTANT POWER COMPRESSOR OPERATION)	137
D.3	MODELING RESULTS FOR R-22/R-290 MIXTURE (CONSTANT POWER COMPRESSOR OPERATION)	138
D.4	MODELING RESULTS FOR R-22/R-11 MIXTURE (CONSTANT POWER COMPRESSOR OPERATION)	140
D.5	MODELING RESULTS FOR R-22/R-13B1 MIXTURE (CONSTANT POWER COMPRESSOR OPERATION)	142
D.6	MODELING RESULTS FOR R-11/R-12 MIXTURE (CONSTANT POWER COMPRESSOR OPERATION)	144
D.7	MODELING RESULTS FOR R-11/R-22 MIXTURE (CONSTANT POWER COMPRESSOR OPERATION)	146

SECTION I

INTRODUCTION

A. OBJECTIVE

This final report addresses topic AF89-064, Thermodynamics of Advanced Refrigerants, from 1989 SBIR Solicitation 89.1. The objective was to analyze the impact of various refrigerant mixtures on refrigeration system capacity and components. This objective was accomplished by a succession of tasks, identified below.

1. Task I: Search The Literature

Recent literature was reviewed to identify various azeotropic refrigerant mixtures and to locate needed experimental data on both azeotropic and nonazeotropic refrigerant mixtures (binary interaction coefficient for each binary pair). The goal was to identify the needed data on as many mixtures as possible.

2. Task II: Determine The Impact Of Refrigerant Mixtures On Refrigeration System Components

Literature was surveyed to determine the various material compatibility characteristics of pure refrigerants and refrigerant mixtures. The goal of this task was to identify any pure refrigerants and refrigerant mixtures that will have an adverse effect on refrigeration system components.

3. Task III: Model Azeotropic Refrigerant Mixtures In Various Refrigeration Systems

The various azeotropic refrigerant mixtures identified in Tasks I and II were modeled in a refrigeration system using an equation of state. The predicted performance of the refrigerant mixture in the system was compared to the baseline pure refrigerant. The goal was to identify suitable azeotropic refrigerant mixtures.

4. Task IV: Model Nonazeotropic Refrigerant Mixtures In Various Refrigeration Systems

The various nonazeotropic refrigerant mixtures identified were modeled in a refrigeration system using an equation of state. The predicted performance of the refrigerant mixture in the system was compared to the baseline pure refrigerant. The goal was to identify suitable nonazeotropic refrigerant alternatives.

5. Task V: Recommend Future Work

This goal of this task was to identify and recommend specific tasks to be undertaken in Phase II of this research.

B. BACKGROUND

Proper operation of the air-conditioning systems at Air Force bases is essential in the event of a military attack on an Air Force base. Such an attack could result in a loss of refrigerant in the air-conditioning system, resulting in system failure. The normal procedure would be to repair the damage and recharge the air-conditioner with the system (baseline) refrigerant. However, the baseline refrigerant may not always be available during such an attack. The only refrigerant available for recharging the system may be different from the baseline refrigerant. Thus, it is essential to know the impact of using mixed refrigerants on air-conditioning system capacity. Having this knowledge would allow for selection of the proper refrigerant alternative, if the original refrigerant is unavailable.

Mainstream Engineering Corporation analyzed various refrigerant mixtures in two different air-conditioning systems, using an equation of state to predict the thermodynamic properties. This study determined the change in capacity (evaporator heat load) as a function of mixture type and mixture concentration. The impact of these refrigerant mixtures on air-conditioning system components was also addressed.

C. SCOPE/APPROACH

1. The Status Of Refrigerant Mixtures

Over the last several years the use of refrigerant mixtures as working fluids in refrigeration has been receiving much attention. Both azeotropic and nonazeotropic refrigerant mixtures have been investigated to meet the ever-increasing refrigeration system requirements because of their inherent advantages.

Azeotropic mixtures are those mixtures whose total pressure curve exhibits a maximum or minimum when plotted as a function of mixture composition (at constant temperature). It is this extreme point in the total pressure curve that defines the azeotropic composition of the mixture. As long as the composition remains at this point the fluid behaves thermodynamically like a pure fluid. Azeotropic refrigerant mixtures are used in systems in which certain properties of standard refrigerants need to be modified, or when boiling point properties different from those of the standard refrigerants are required. For example, R-500 is an azeotropic mixture of R-12 and R-152a. This mixture has a 20% capacity increase over R-22 (different boiling point property) and suppresses the flammability of R-152a (modification of standard refrigerant property)(1).

Nonazeotropic mixtures are those mixtures whose total pressure curve does not pass through an extreme value when plotted as a function of mixture composition (at constant temperature). Nonazeotropic refrigerant mixtures differ from pure refrigerants and azeotropic refrigerant mixtures in two important ways(2):

1. A constant pressure liquid-vapor phase change will occur over a temperature range, as opposed to pure and azeotropic systems, which have an isothermal constant pressure liquid-vapor phase change.
2. The equilibrium composition of the vapor and liquid phases are different, as opposed to pure and azeotropic systems, which have equal vapor and liquid compositions at equilibrium.

Both of the above-mentioned characteristics of nonazeotropic refrigerant mixtures can be used to improve the refrigeration system(1, 2). Utilization of the non-isothermal phase-change can result in improvement of the coefficient of performance of the cycle. Utilization of the composition difference at equilibrium can result in a capacity shift of the refrigeration system.

To improve the coefficient of performance of a refrigerant cycle, one would want to minimize the normal heat transfer penalties. One way to do this is to minimize the temperature difference between the entering temperature of the outside fluids at the heat source and heat sink (which for the real world are rarely isothermal). For isothermal phase-change fluids (i.e., pure refrigerants), the actual condensing and evaporating temperatures are dictated by the maximum heat sink temperature and the minimum heat source temperature. This can result in much higher thermodynamic lifts than if the average sink and source temperatures are used(3). The temperature profiles for a hypothetical isothermal refrigeration cycle are shown in Figure 1.

If a non-isothermal phase change fluid (i.e., a nonazeotropic refrigerant mixture) is used in the cycle, the temperature profiles of the refrigerant mixture can more closely resemble the heat sink and source temperature profiles. This will result in higher average evaporator temperatures and lower average condenser temperatures. This will lower the thermodynamic lift of the cycle and raise the potential coefficient of performance(3). A counterflow heat exchanger at the heat source and heat sink is required for this type of cycle. The temperature profiles for a hypothetical nonazeotropic refrigerant cycle are shown in Figure 2.

The utilization of the concentration difference between the equilibrium vapor and liquid phases of nonazeotropic refrigerant mixtures can result in the ability of the refrigeration system to change its capacity as the heat rejection temperature changes. This can be accomplished by adding a refrigerant component to, or taking a refrigerant component away from, the circulating refrigerant mixture. Extraction of the refrigerant with the highest boiling point may be needed to increase the system capacity if heat rejection temperatures are low. This can be done by collecting non-vaporized liquid in an accumulator, located in the compressor suction line. This collected liquid has the highest

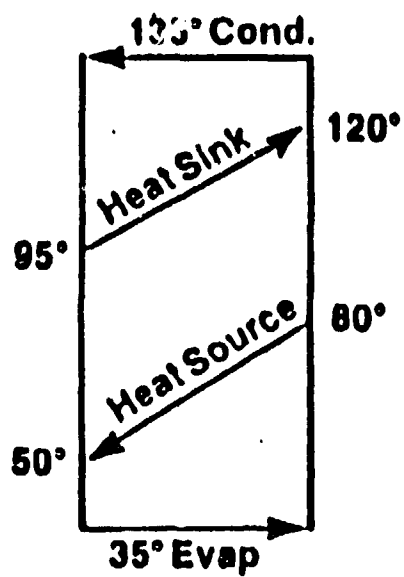


FIGURE 1. HYPOTHETICAL ISOTHERMAL PURE REFRIGERANT CYCLE(2)

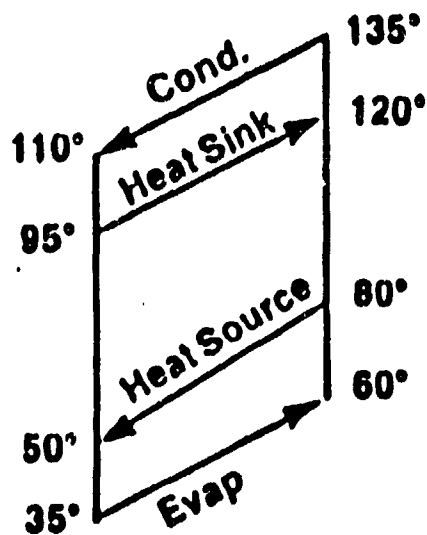


FIGURE 2. HYPOTHETICAL NONAZEOTROPIC REFRIGERANT MIXTURE CYCLE(2)

concentration of the highest-boiling refrigerant of any stream in the cycle. As the heat rejection temperature increases, the accumulator liquid will vaporize, re-entering the system. Similarly, the lowest-boiling refrigerant may need to be removed if the heat rejection temperature increases. This refrigerant component is removed as un-condensed vapor at the condenser outlet. It is at this location that the concentration of lowest-boiling refrigerant is the highest(1).

2. Refrigerants To Be Studied

Tyndall AFB personnel supplied Mainstream with a list of refrigerants to be considered under this contract. These refrigerants, their chemical name, and chemical formula are given in Table 1. The original list supplied by Tyndall AFB contained R-502, which is an azeotropic mixture of R-22 and R-115. Therefore, R-115 is listed in the table, rather than R-502.

TABLE 1. REFRIGERANTS CONSIDERED UNDER THIS CONTRACT

REFRIGERANT NAME	CHEMICAL NAME	CHEMICAL FORMULA
R-11	trichlorofluoromethane	CCl_3F
R-12	dichlorodifluoromethane	CCl_2F_2
R-13B1 (Halon 1301)	bromotrifluoromethane	CBrF_3
R-22	chlorodifluoromethane	CHClF_2
R-114B2 (Halon 2402)	dibromotetrafluoroethane	$\text{CBrF}_2\text{CBrF}_2$
R-115	chloropentafluoroethane	CClF_2CF_3
R-50	methane	CH_4
R-290	propane	$\text{CH}_3\text{CH}_2\text{CH}_3$
R-728	nitrogen	N_2
R-732	oxygen	O_2
Halon 1211	bromochlorodifluoromethane	CBrClF_2

3. Air-Conditioning System Operating Parameters

Personnel at Tyndall AFB have identified two baseline air-conditioning systems for a study on the impact of using mixed refrigerants in air-conditioning systems. This information was supplied to Mainstream via facsimile on 6 September 1989. Preliminary calculations by Mainstream engineers determined that the energy balance for the R-11 baseline system supplied in the fax of September 6, 1989 was slightly incorrect. According to the ASHRAE tables(4), if 100 kW is supplied to the compressor, the evaporator heat load is 430 kW instead of the 500 kW listed on the fax (for the given operating temperatures). Therefore the coefficient of performance for cooling (COP_c) and evaporator heat load for the R-11 base system is lower than specified in the fax. The various parameters of these systems are given in Table 2.

TABLE 2. BASELINE AIR-CONDITIONING SYSTEMS USED FOR THIS PROJECT

PARAMETER	SMALL (50 kW SYSTEM)	LARGE (430 kW) SYSTEM
Refrigerant	R-22	R-11
Mass Flow Rate	0.303 kg/s	3.087 kg/s
Evaporator Type	Shell-and-tube Water Chiller (Both Systems)	
Evaporator Inlet	2°C	2°C
Evaporator Outlet	7°C	7°C
Compressor Type	Reciprocating	Centrifugal
Compressor Eff.	75 %	80 %
Compressor Outlet	82°C	61°C
Condenser Load	62.5 kW	530 kW
Condensing Temp	50°C	50°C
Condenser Outlet	35°C	35°C
Expansion Device	Superheat-Controlled TXV (Both Systems)	

SECTION II

MODELING TECHNIQUE

Mainstream developed a heat pump computer simulator to predict the change in cooling capacity as a function of refrigerant concentration. The simulator was designed to hold many of the system parameters equal to those of the baseline system. For example, the condenser saturation temperature was taken as 50°C and its outlet was assumed to be 35°C. The condenser pressure was taken as the bubble pressure of the mixture at 50°C. Similarly, the evaporator outlet temperature was held at 7°C by the expansion device, which controls the evaporator pressure. The compressor isentropic efficiency was also held to the baseline value. The heat pump computer simulator source code developed by Mainstream (FORTRAN-77) is included in Appendix C.

A. THERMODYNAMIC PROPERTY PREDICTION

Mainstream selected the Carnahan-Starling-Desantis (CSD) equation of state to predict the thermodynamic properties of refrigerant mixtures. This equation of state and associated thermodynamic property routines were developed by the National Bureau of Standards for predicting the thermodynamic properties of refrigerants and refrigerant mixtures(5). The CSD equation of state accurately models both the vapor and liquid phases. Mainstream has implemented these subroutines for use in the heat pump computer simulator.

B. COMPRESSOR MODEL

The compressor of the heat pump simulator was modeled as a positive displacement machine that supplies a constant volumetric flow rate of refrigerant. Most compressors have an AC power supply and their speed is a function of the frequency of the power source (for example, a compressor operating from a 60 Hz power source rotates at about 1725 rpm). As a result, a positive displacement compressor will operate at constant volumetric flow rate. The power supplied to the compressor will vary to accommodate the flow.

The volumetric flow rate and mass flow rate through the small-system compressor and large-system compressor were calculated based upon the baseline system operating parameters. The baseline refrigerant mass flow rate multiplied by the specific volume of the baseline refrigerant entering the compressor yielded the volumetric flow rate of the compressor, which was held constant. When the refrigerant concentration was different than the baseline system, the refrigerant mass flow rate changed because the specific volume of the refrigerant mixture was different than the baseline refrigerant (most likely). Thus, a new mass flow rate was calculated whenever the refrigerant concentration changed.

As the refrigerant concentration in the system changed, the new refrigerant mass flow rate was calculated by dividing the compressor volumetric flow rate by the specific volume of the vapor entering the compressor. The power required by the compressor was then calculated by multiplying the mass flow rate of the refrigerant and the enthalpy change of the refrigerant through the compressor (the specific enthalpy and entropy of the refrigerant at the compressor inlet were known and the specific enthalpy of the refrigerant at the compressor outlet was calculated based on the evaporator outlet entropy, condenser pressure, and the isentropic efficiency of the baseline compressor). Thus, both the refrigerant mass flow rate and the enthalpy difference through the compressor changed when refrigerant concentration changed.

The change in refrigerant mass flow rate and enthalpy difference through the compressor affect the compressor power requirement, as well. If a more-dense refrigerant is added to the system the mass flow rate of refrigerant will increase, which could result in an increase in the compressor power requirement over the baseline system. If the enthalpy difference through the compressor increases as a refrigerant is added, the compressor power requirement may also increase. This additional power requirement will cause motor failure or will cause the thermal overload control of the unit to shut the compressor off. Conversely, if a less-dense refrigerant is in the system the mass flow rate of refrigerant will decrease, which could result in a decrease in the compressor power requirement over the baseline system. The compressor power could also decrease if the enthalpy difference through the compressor decreased as a result of adding a secondary refrigerant. This decrease in the compressor power requirement may result in a decrease in system capacity.

Mainstream also modeled the compressor as a constant power machine rather than a constant volumetric flow rate machine. Constant power operation of a positive displacement machine can be achieved by supplying the compressor with power from a DC motor (rather than AC) or by varying the speed of the compressor to change its power requirement. These modeling results are contained in Appendix D.

C. EXPANSION DEVICE

Mainstream modeled the expansion device in the heat pump cycle two ways, one using a generic expansion device and the other using a superheat-controlled thermostatic expansion valve (TXV). Mainstream took this approach because the TXV could play an important role in the cycle performance when the cycle working fluid is changed. These expansion devices control the evaporator pressure. Using a generic expansion device, it was assumed that the device maintains a constant evaporator outlet superheat of 5°C by setting the evaporator pressure to the dew pressure of the mixture at 2°C (evaporator saturation temperature). This allowed Mainstream to model the heat pump to the specifications of the baseline system, maintaining the same temperature lift.

An actual TXV operates differently, however. The TXV bulb is always charged with the same working fluid as the baseline cycle. The saturation properties of the working fluid in the bulb determine the evaporator pressure and thus control the evaporator outlet superheat and evaporator saturation temperature. Thus, if the working fluid in the cycle changes, the saturation properties of the working fluid in the cycle and in the bulb would be independent of one another. The TXV sets the same evaporator pressure as the baseline system, but this pressure would have a different saturation temperature for the cycle fluid mixture because it would be different from the TXV fluid. Because of this, the calculated evaporator outlet superheat will be different from that of the baseline system. This could significantly affect system capacity and performance; it could even result in a system that cannot operate at the baseline conditions (i.e., if the evaporator outlet is a saturated vapor/liquid mixture or a subcooled liquid).

1. The Generic Approach

In the generic approach, the change in cooling capacity was predicted as a function of refrigerant concentration (mol fraction of parent refrigerant) while holding many of the system parameters equal to those of the baseline system. The evaporator outlet temperature was held at 7°C while maintaining a constant evaporator outlet superheat of 5°C (evaporator saturation temperature held to 2°C). Thus, for the generic case, the system high- and low-side pressures must be allowed to vary to maintain the specified system temperatures as refrigerant concentration changes.

For example, consider the extreme cases of a baseline system of pure R-11, then R-12 is slowly added to the system, and finally the system consists of pure R-12. For the case of pure R-11, the low-side pressure will be the saturation pressure of R-11 at 2°C (43.6 kPa). As R-12 is added to the system, the low-side pressure is forced to increase in order to maintain the required superheat. When the system is completely recharged with R-12, the low-side pressure has magically risen to 318.0 kPa. Classically, this is the manner in which the performance of heat pump systems using non-azeotropic blends is predicted.

Unfortunately, the simplistic generic approach does not predict the performance truly indicative of a system with a real, as opposed to generic, metering device. The primary controller in the heat pump system is a TXV. The TXV is a hermetically sealed device that meters the refrigerant to the evaporator using a thermal sensing element to monitor the superheat. For typical systems, the valve is set (via spring preload) to provide a constant superheat at the evaporator outlet (typically around 5°C). The most commonly used TXV is the liquid charge bulb TXV in which the valve sensing element contains the same fluid as the system working fluid. These valves are extremely reliable and predictable when the system fluid is the same as the sensor fluid. However, when a different fluid is added to the system without changing the

TXV, the system may respond in an unfavorable manner. The second modeling technique, the TXV approach, was implemented to determine exactly what the system response would be as a secondary fluid was added to the system without replacing the metering device.

2. The TXV Approach

The TXV model varies from the generic model in one very pronounced fashion. The TXV model places absolutely no restrictions on the evaporator outlet superheat, whereas the generic model always restricts the superheat to 5°C. In the TXV model, the evaporator outlet temperature is assumed to be at 7°C for all cases. The metering device is a TXV charged with the same fluid as the baseline system. For example, a system originally charged with R-22 has a TXV charged with R-22 at all times, even when the R-22 in the system has been completely replaced with another fluid. This will cause the superheat to vary as a function of concentration, because the TXV's saturation properties and the system's saturation properties are no longer the same.

To better illustrate the change in superheat, consider the following discussion. Assume that a baseline system is originally charged with R-12 and contains a liquid charge bulb TXV that is preloaded to provide 5°C of superheat. Also assume that the evaporator outlet temperature is held at 7°C. For such a system, the low-side pressure is the saturation pressure of the TXV bulb fluid, R-12, at 7°C (384.5 kPa) minus the spring preload. This difference comes to approximately 325.0 kPa. Now assume that the TXV parameters and the evaporator outlet temperature remain the same, but the R-12 in the system has been replaced with R-11. This system will have the same low-side pressure as the original system (because the TXV and outlet temperature are the same). Thus, at equilibrium, the low side of this system contains R-11 at approximately 325.0 kPa. From an R-11 saturation table, the saturation temperature at 325.0 kPa equals 61.0°C. However, the evaporator outlet temperature is held at 7°C. Therefore, the evaporator outlet is 54°C subcooled. This will cause almost immediate failure of the compressor due to massive liquid slugging, and the system obviously will not function.

A similar phenomena holds for fluid mixtures. In general, fluid mixtures do not exhibit one distinct boiling point, rather they exhibit a gliding boiling range. At a fixed pressure and concentration, the heating of a saturated liquid will result in the onset of boiling. The first temperature at which bubbles start to form is referred to as the bubble point. As heat is added, the fluid continues boiling and the temperature also keeps increasing. When the last bit of liquid has boiled off, the fluid has reached the dew point. These bubble and dew points may differ anywhere from 0.0°C (for the rare azeotropic mixture) to over 100°C for some fluid mixtures. With this in mind, consider again the above system, but instead of recharging the system completely with R-11, add 50 wt percent R-11 to the system. Thermodynamic properties of 50-50 mixtures of R-11 with R-12 reveal the dew temperature of the

mixture to be approximately 42.0°C. For such a refrigeration system, a 50-50 mixture of R-11 and R-12 results in an evaporator outlet temperature 35.0°C below the dew temperature, making compressor slugging again a major concern.

Another concern is excessive superheat at the evaporator outlet. This phenomena will occur if the dew temperature of the refrigerant mixture is below 0°C. For example, if the desired evaporator outlet temperature is 7°C and steady-state operation of the TXV requires more than 7°C of superheat, the mixture dew point must be below 0°C. This will cause the water in the chiller to freeze, forming an insulating layer on the evaporator that limits heat transfer and cooling capability. As a result, evaporation is limited, which may again cause slugging of the compressor. If antifreeze is used in the water chiller, a lower mixture dew temperature can be tolerated.

3. Impact Of Two Approaches On Modeling Results

The above examples illustrate the importance of the TXV modeling approach. None of the information about varying superheat and liquid slugging is available from the generic model. This generic model only predicts the change in performance of the system if all other conditions are magically adjusted to allow the system to operate at a constant superheat. In reality, though, this is not practical. The TXV approach is the only modeling technique available that will yield results truly indicative of the system performance and behavior.

The approach used to model the expansion device also has an impact on the predicted performance of the system. Figure 3 shows a plot of COP_c versus mixture concentration for the azeotropic mixture R-22/R-502, while Figure 4 shows a plot of COP_c versus mixture concentration for the nonazeotropic mixture R-22/R-13B1. As Figure 3 shows, there is a dramatic difference in the COP_c between the two approaches. The COP_c of the cycle is more dependent on the mixture concentration for the TXV approach than for the generic approach. This difference is due to the fact that the thermodynamic lift of the cycle is unchanged with the generic approach while the thermodynamic lift of the cycle changes with the TXV approach. The generic approach maintains a constant superheat no matter what the refrigerant concentration, maintaining the same thermodynamic lift in the cycle. The TXV approach changes the thermodynamic lift because the evaporation saturation temperature changes as the refrigerant concentration changes. This change in evaporator saturation temperature has a dramatic affect on COP_c, which varies inversely with thermodynamic lift. Figures 5 and 6 show how system capacity varies with the modeling technique and mixture concentration for the R-22/R-502 and R-22/R-13B1 systems. Figures 5 and 6 show that the TXV approach and the generic approach give varying results, illustrating the significance of using the most appropriate modeling technique. These results were taken from Tables 7 and 9 of Section III, Results and Discussion.

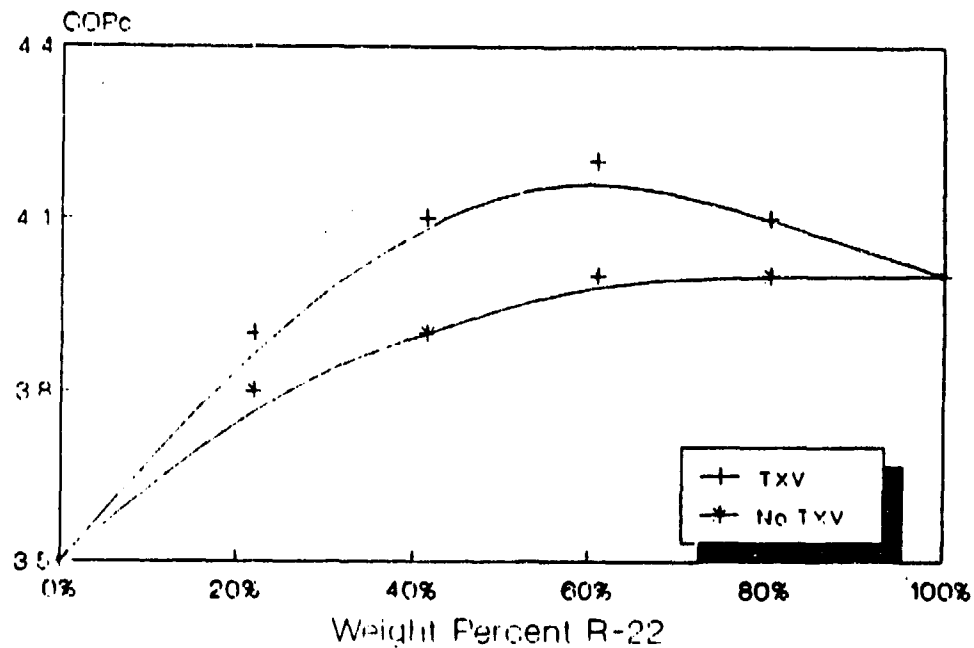


FIGURE 3. PLOT OF COP_c VERSUS CONCENTRATION FOR AZEOTROPIC MIXTURE R-22/R-502.

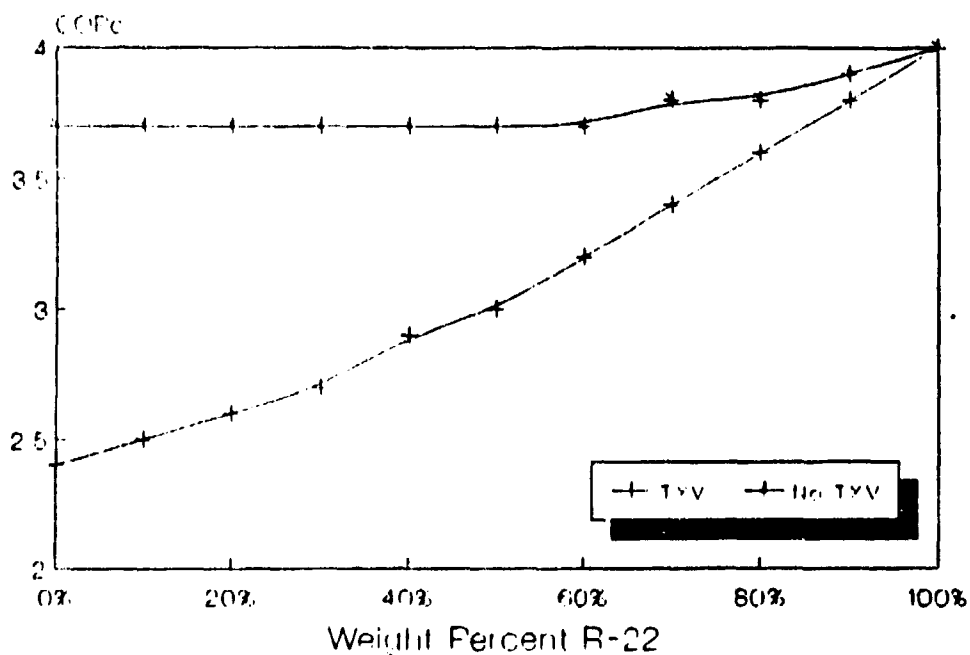


FIGURE 4. PLOT OF COP_c VERSUS CONCENTRATION FOR NONAZEOTROPIC MIXTURE R-22/R-13B1.

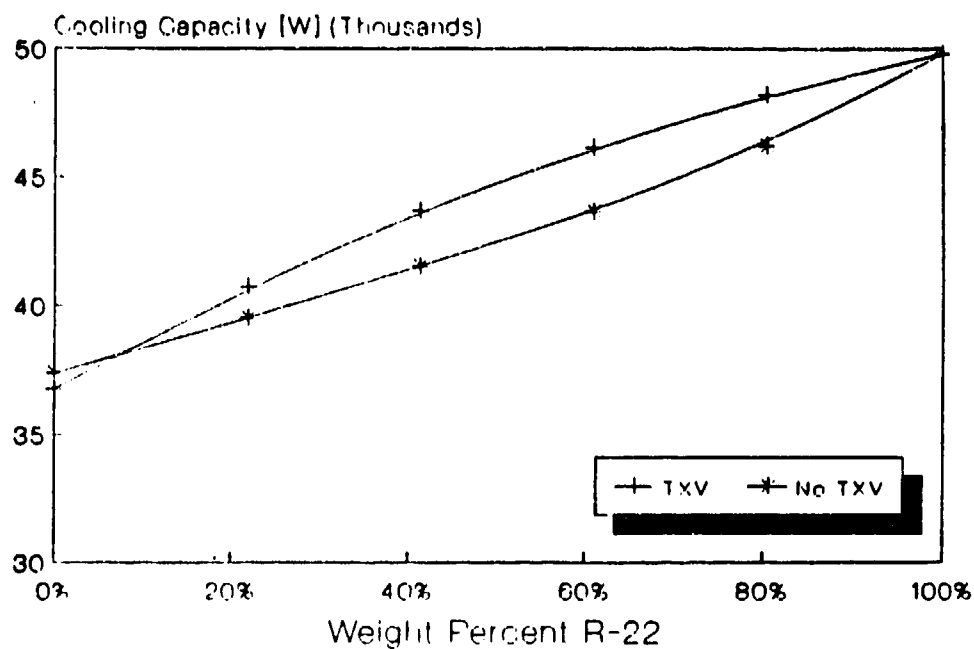


FIGURE 5. PLOT OF SYSTEM CAPACITY VERSUS CONCENTRATION FOR AZEOTROPIC MIXTURE R-22/R-502.

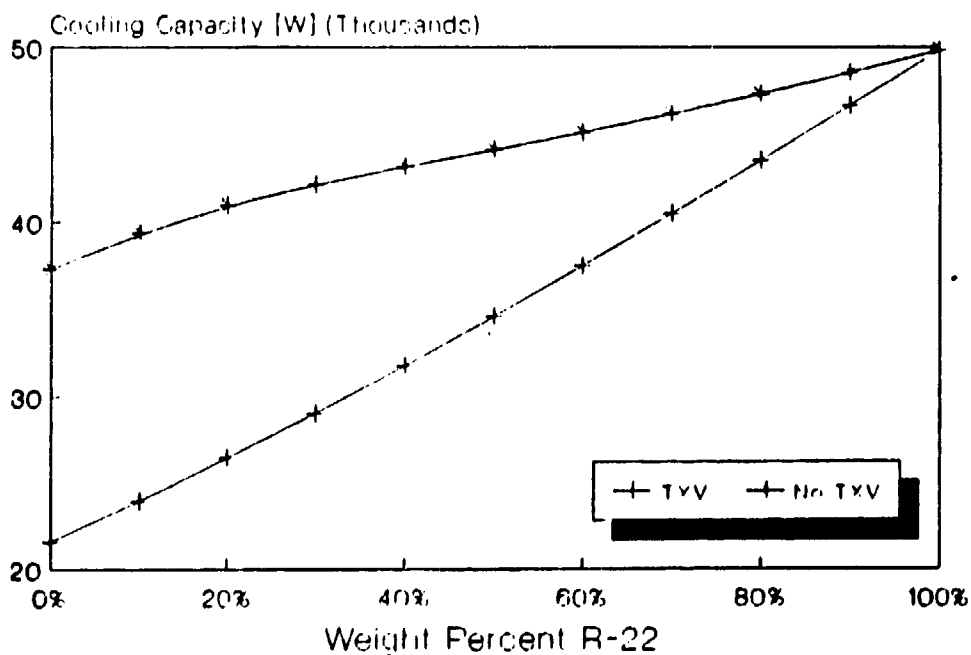


FIGURE 6. PLOT OF SYSTEM CAPACITY VERSUS CONCENTRATION FOR NONAZEOTROPIC MIXTURE R-22/R-13B1.

SECTION III

RESULTS AND DISCUSSION

This section will present the results obtained in each of the tasks performed under this contract. A discussion of the impact of the results is also included in this section.

A. TASK I: SEARCH THE LITERATURE

The refrigerants to be considered under this contract are listed in Table 1. Two things should be noted from this table. First, R-502 is an azeotropic mixture of R-22 and R-115; therefore R-115 is listed in the table rather than R-502. Second, some of the Halon compounds also have ASHRAE refrigerant designations, namely, Halon 1301 is R-13B1 and Halon 2402 is R-114B2.

Mainstream contacted Dr. Mark McLinden of the National Bureau of Standards in an effort to determine the best source for experimental vapor-liquid equilibrium data for refrigerant mixtures (see Appendix B). Dr. McLinden suggested searching *Chemical Abstracts*, using the actual chemical name as the search topic. Dr. McLinden stated that any experimental data published would be referenced in *Chemical Abstracts*. Dr. McLinden's research areas include the evaluation of working fluids in refrigeration systems.

Mainstream conducted a literature search for refrigerant mixture data by searching *Chemical Abstracts* for trichlorofluoromethane (R-11) and chlorodifluoromethane (R-22). The dates searched were from the first volume of *Chemical Abstracts* (1907) to the current volume (1989). A summary of the results of this literature search is given in Table 3. As Table 3 shows, there is a lot of mixture data available concerning R-22, but very little data concerning R-11.

During a telephone conversation with Halon manufacturers (see Appendix B), it was stated that Halon 2402 is a Japanese product no longer in production and the thermodynamic data for this product is difficult to obtain. Although Mainstream obtained data on the mixture R-114B2/R-22, we were unable to find any of the pure component data on R-114B2 that is required by the equation of state. Therefore, we were unable to model pure R-114B2 or any mixture containing R-114B2.

TABLE 3. RESULTS OF LITERATURE SEARCH

	R-11	R-22
R-11	----	Binary Coef. Known
R-12	Binary Coef. Known	Binary Coef. Known
R-13B1	No Data Available	Binary Coef. Known
R-22	Binary Coef. Known	----
R-114B2	No Data Available	Data Source Obtained* Requires Translation
R-115	No Data Available	Binary Coef. Known
R-50	No Data Available	Data Source Obtained (Outside EOS Range)
R-290	No Data Available	Binary Coef. Known
R-728	No Data Available	Data Source Obtained (Outside EOS Range)
R-732	No Data Available	No Data Available
H-1211	No Data Available	No Data Available

* See comments in text concerning R-114B2

The binary interaction coefficient for the pairs R-11/R-12, R-11/R-22, R-12/R-22, and R-22/R-13B1 were found in the literature concerning the CSD equation of state(5). Mainstream has determined the binary interaction coefficient for the remaining refrigerant pairs for which the data could be obtained. The value of this coefficient was determined by minimizing the error between experimental and predicted bubble pressures. For the pair R-22/R-115, literature data(6) yielded a value of -0.277 for the binary interaction coefficient. For the pair R-22/R-290, experimental data(7) yielded a value of 0.072 for the binary interaction coefficient. Experimental data for the pairs R-22/R-50(8) and R-22/R-728(9) were at temperatures and pressures that were above the critical point of either methane (R-50) or nitrogen (R-728). Because of this, the CSD equation of state was unable to predict the two-phase data for these super-critical conditions. Thus, Mainstream was unable to determine a binary interaction coefficient for R-22/R-50 and R-22/R-728.

For those refrigerant pairs where no data is available, it is possible to assume a binary interaction coefficient for a binary pair (0.0 for the CSD equation of state). Mainstream performed a sensitivity analysis on the pair R-11/R-12 that showed that the predicted capacity of the system is a strong function of the value of the binary interaction coefficient.

Table 4 shows the results of this sensitivity analysis for the R-11 base system with the R-11/R-12 mixture. Evaporator heat loads were determined for the R-11 base system (TXV modeling approach) with R-12 as the secondary refrigerant. The binary interaction coefficient was varied from its correct value of 0.005 to -0.05 and 0.05. As the table shows, the evaporator heat load is a strong function of the value of the binary interaction coefficient, even if the coefficient is only slightly adjusted. The data in Table 1 show maximum errors as high as 12.8 percent. Thus, Mainstream determined it was not feasible to assume a value of 0.0 for any pair that experimental data could not be obtained.

TABLE 4. SENSITIVITY ANALYSIS ON BINARY INTERACTION COEFFICIENT
EVAPORATOR HEAT LOAD (W)

	$f_{12} = 0.005$	$f_{12} = -0.05$	$f_{12} = 0.05$
100.0 wt% R-11	429,779.	429,779.	429,779.
90.0 wt% R-11	332,596.	364,292.	305,705.
80.0 wt% R-11	280,220.	315,177.	253,942.
70.0 wt% R-11	245,480.	276,799.	222,791.
60.0 wt% R-11	219,778.	245,882.	200,867.
50.0 wt% R-11	199,450.	220,143.	184,067.
40.0 wt% R-11	182,639.	198,372.	170,521.
30.0 wt% R-11	168,290.	179,548.	159,250.
20.0 wt% R-11	155,748.	162,970.	149,684.
10.0 wt% R-11	144,570.	148,094.	141,496.
0.0 wt% R-11	134,471.	134,471.	134,471.

Base Refrigerant: R-11 Secondary Refrigerant: R-12
TXV Modeling Approach
Actual value of binary interaction coefficient: 0.005

**B. TASK II: DETERMINE THE IMPACT OF REFRIGERANT MIXTURES
ON REFRIGERANT SYSTEM COMPONENTS**

Some general trends have been identified concerning refrigeration system lubricants, refrigerant chemistry, and the interaction of system lubricants with the refrigerants. This information was obtained through the 1980 ASHRAE Systems Handbook(10).

Refrigeration system lubricants fall into four general categories: paraffins, napthenes, aromatics, and non-hydrocarbons. Paraffins (noncyclic, saturated hydrocarbons) and napthenes (cyclic, saturated hydrocarbons) offer good stability but have poor solubility in polar refrigerants and are poor boundary lubricants. Straight-chained paraffins are typically not used in refrigeration systems due to their high pour point, which causes wax precipitation in the system. Aromatics (cyclic hydrocarbons with alternating double bonds) are more reactive but have good solubility in refrigerants and offer good boundary lubrication. Non-hydrocarbons (molecules with elements other than carbon and hydrogen) are the most reactive but also have good solubility and lubrication characteristics. Synthetic oils, such as the alkylbenzenes, have been found to be completely satisfactory as refrigeration system lubricants.

Several trends have also been identified in terms of refrigerant/oil reactivity. Reactions between the oil and refrigerant are undesirable because the reaction products can cause a reduction in system capacity or system failure. Hydrocarbon refrigerants generally pose no stability problems in the presence of lubricants. For the chlorofluorocarbons, substituting fluorine for chlorine decreases reactivity, substituting hydrogen for chlorine decreases reactivity, and substituting fluorine for hydrogen decreases reactivity.

Mainstream contacted Pete Narreau of the Carlyle Compressor Division of Carrier Corporation (see Appendix B) in an effort to get some information concerning compressor lubricants, and what happens when a leak occurs. Mr. Narreau stated that only a small amount of oil (1-3 percent) is actually circulated in the refrigeration cycle; the majority of the oil is in the compressor crankcase and oil separator. Therefore, a leak in the system will not result in a critical loss of oil unless the leak is in the crankcase of the compressor, in an oil trap, or in an oil separator. Thus, the decision to replace oil is totally dependent upon the location of the leak, the severity of the leak, and how long the system was run after the leak occurred. If the leak results in compressor failure, the oil must be checked and the compressor tested. A large leak in the system may also allow moisture to collect in the oil, which may force replacement of the oil.

Mainstream also addressed the issue of refrigerant mixture flammability, and feels that the mixture R-22/R-290 may possess some degree of flammability due to the presence of R-290 (propane). None of the other refrigerants possess any flammability properties due to their high halogen content(11). The Halon compounds are also well-known for their use in fire extinguishing applications(12).

C. TASK III: MODEL AZEOTROPIC REFRIGERANT MIXTURES IN VARIOUS REFRIGERATION SYSTEMS

Mainstream has identified three binary azeotropic mixtures out of all the possible binary pairs to be considered. These azeotropic binaries are R-12/R-22 (R-501), R-22/R-115 (R-502), and R-22/R-290.

1. Small System: R-22 Base Refrigerant

Tables 5-7 show the results of modeling the pairs R-22/R-12, R-22/R-115, and R-22/R-290. Tables of the thermodynamic properties of these refrigerants are given in Appendix A. Table 5 shows the affect of refrigerant concentration on the R-22/R-12 system parameters.

For the TXV approach, Table 5 shows that the refrigerant mass flow rate increased with increasing R-12 concentration since R-12 is the more-dense fluid. This increase in mass flow rate resulted in lower compressor work, however, because the enthalpy difference through the compressor decreased (the condenser pressure decreased). System capacity decreased with increasing R-12 concentration as a result of the decrease in compressor work. The table shows that the evaporator superheat also decreased with increasing R-12 concentration. This resulted in an increase in system COPc since the thermodynamic lift of the cycle decreased. At about 60 wt% R-12, however, the outlet superheat became negative (the dew temperature rose above 7°C) causing liquid slugging in the compressor. Thus, the system should not be operated if the R-12 concentration exceeds 60 wt%.

For the generic approach, Table 5 shows that the low-side pressure decreased with increasing R-12 concentration (R-12 is less-volatile than R-22). The generic approach maintained constant thermodynamic lift (constant evaporator superheat) so the COPc of the cycle changed little as concentration changed. The refrigerant mass flow rate through the compressor decreased because the specific volume of the refrigerant entering the compressor increased (the low-side pressure dropped). This decrease in mass flow rate resulted in a decrease in compressor work, lowering system capacity. The potential for liquid slugging in the compressor was not seen using the generic approach.

TABLE 5. MODELING RESULTS FOR R-22/R-12 MIXTURE

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Compressor Work (W)	12500.	12500.
		Q Evap (W)	49823.	49823.
		% Capacity Change	----	----
90.0	92.6	High Pres (kPa)	1924.1	1924.1
		Low Pres. (kPa)	527.1	529.1
		Superheat (C)	5.1	5.0
		Flow Rate (kg/s)	0.2972	0.2985
		COPc	4.0	4.0
		Compressor Work (W)	12051.	12058.
		Q Evap (W)	47804.	47996.
		% Capacity Change	- 4.05	- 3.67
80.0	84.8	High Pres (kPa)	1903.8	1903.8
		Low Pres. (kPa)	527.1	526.2
		Superheat (C)	4.9	5.0
		Flow Rate (kg/s)	0.2979	0.2974
		COPc	4.0	4.0
		Compressor Work (W)	11550.	11547.
		Q Evap (W)	45934.	45852.
		% Capacity Change	- 7.81	- 7.97
70.0	76.5	High Pres (kPa)	1872.4	1872.4
		Low Pres. (kPa)	527.1	516.9
		Superheat (C)	4.4	5.0
		Flow Rate (kg/s)	0.2988	0.2923
		COPc	4.0	3.9
		Compressor Work (W)	11002.	10971.
		Q Evap (W)	44218.	43305.
		% Capacity Change	- 11.3	- 13.1
60.0	67.7	High Pres (kPa)	1829.4	1829.4
		Low Pres. (kPa)	527.1	500.3
		Superheat (C)	3.3	5.0
		Flow Rate (kg/s)	0.2999	0.2827
		COPc	4.1	3.9
		Compressor Work (W)	10407.	10332.
		Q Evap (W)	42659.	40349.
		% Capacity Change	- 14.4	- 19.0
50.0	58.3	High Pres (kPa)	1773.6	1773.6
		Low Pres. (kPa)	527.1	477.2
		Superheat (C)	1.8	5.0
		Flow Rate (kg/s)	0.3011	0.2690
		COPc	4.2	3.9

TABLE 5. MODELING RESULTS FOR R-22/R-12 MIXTURE (continued)

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
50.0 (continued)	58.3	Compressor Work (W)	9764.	9633.
		Q Evap (W)	41262.	37097.
		% Capacity Change	- 17.3	- 25.5
40.0	48.2	High Pres (kPa)	1703.2	1703.2
		Low Pres. (kPa)	527.1	449.2
		Superheat (C)	- 0.1*	5.0
		Flow Rate (kg/s)	----	0.2524
		COPc	----	3.8
		Compressor Work (W)	----	8880.
		Q Evap (W)	----	33738.
		% Capacity Change	----	- 32.3
30.0	37.5	High Pres (kPa)	1615.7	1615.7
		Low Pres. (kPa)	527.1	418.7
		Superheat (C)	- 2.4*	5.0
		Flow Rate (kg/s)	----	0.2344
		COPc	----	3.8
		Q Evap (W)	----	30455
		Compressor Work (W)	----	8081.
		% Capacity Change	----	- 38.9
20.0	25.9	High Pres (kPa)	1507.6	1507.6
		Low Pres. (kPa)	527.1	387.5
		Superheat (C)	- 5.0*	5.0
		Flow Rate (kg/s)	----	0.2160
		COPc	----	3.8
		Compressor Work (W)	----	7239.
		Q Evap (W)	----	27377.
		% Capacity Change	----	- 45.1
10.0	13.4	High Pres (kPa)	1373.8	1373.8
		Low Pres. (kPa)	527.1	356.8
		Superheat (C)	- 7.7*	5.0
		Flow Rate (kg/s)	----	0.1981
		COPc	----	3.9
		Compressor Work (W)	----	6352.
		Q Evap (W)	----	24571.
		% Capacity Change	----	- 50.7
0.0	0.0	High Pres (kPa)	1207.9	1207.9
		Low Pres. (kPa)	527.1	327.4
		Superheat (C)	- 10.6*	5.0
		Flow Rate (kg/s)	----	0.1812
		COPc	----	4.1
		Compressor Work (W)	----	5409.
		Q Evap (W)	----	22060.
		% Capacity Change	----	- 55.7

* Compressor will fail due to slugging

Table 6 shows the modeling results for the pair R-22/R-115 (R-502). Since the Air Force stocks R-502 (an azeotropic mixture of R-22 and R-115), not R-115, Table 6 gives the results based on R-502 concentration. For example, a concentration of 80 wt% R-22 from Table 6 means 20 wt% R-502. However, the actual mixture concentrations are 89.8 wt% R-22 and 10.2 wt% R-115.

For the TXV approach the refrigerant mass flow rate increased with increasing R-502 concentration since R-502 is more dense than R-22. The compressor work, however, did not increase, which means the enthalpy difference through the compressor decreased. The decrease in compressor work with increasing R-502 concentration lowered system capacity. Table 6 shows the generic approach yielded similar results to the TXV approach. The generic approach, however, yielded lower mass flow rates with increasing R-502 concentration (except at 100% R-502). This is because the generic approach allowed the low-side pressure to decrease, increasing the specific volume of the fluid. For both the TXV and generic approach, the COP_c of the system remained fairly constant until 100% R-502 was in the system, where it dropped to 3.5. Thus, Table 6 shows that R-502 is a suitable replacement for the R-22 system over the entire concentration range, resulting in a slight decrease in system capacity.

Table 7 presents the results from modeling the mixture R-22/R-290. As Table 7 shows, addition of R-290 to the R-22 system results in an increase in compressor work for both the TXV approach and the generic approach. For the TXV system, the increase in compressor work was due to an increase in the enthalpy difference through the compressor (the mass flow rate remained fairly constant). For the generic approach, the increase in compressor work was due to an increase in refrigerant mass flow rate. The mass flow rate increased because the low-side pressure increased, causing a decrease in the specific volume of refrigerant. The increase in compressor work will result in motor failure or will cause the thermal overload control of the unit to shut the compressor off. Thus, R-290 is not a suitable replacement in the R-22 system it will cause a power overload in the compressor.

It is interesting to note the equation of state predicts the presence of an azeotrope for all the azeotropic pairs. This can be seen by noticing that each of the azeotropic pairs has either a minimum or maximum in pressure at a concentration between the pure component concentrations (in other words, at a concentration greater than 0% and less than 100%). For each of the nonazeotropic pairs, however, the equation of state predicts the maximum and minimum pressures to be at the pure component concentrations (in other words, at 0% or at 100%). This is typical pressure behavior for azeotropic and nonazeotropic mixtures.

2. Large System: R-11 Base Refrigerant

There are no azeotropic mixtures of R-11 with the fluids to be considered under this contract.

TABLE 6. MODELING RESULTS FOR R-22/R-115 (R-502) MIXTURE

MASS % R-22	MASS% R-502	PARAMETER	TXV	NO TXV
100.0	0.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Compressor Work (W)	12500.	12500.
		Q Evap (W)	49823.	49823.
80.4	19.6	High Pres (kPa)	1904.1	1904.1
		Low Pres. (kPa)	527.1	506.8
		Superheat (C)	3.8	5.0
		Flow Rate (kg/s)	0.2977	0.2848
		COPc	4.1	4.0
		Compressor Work (W)	11716.	11643.
		Q Evap (W)	48198.	46221.
		% Capacity Change	- 3.26	- 7.23
61.0	39.0	High Pres (kPa)	1902.3	1902.3
		Low Pres. (kPa)	527.1	500.3
		Superheat (C)	3.4	5.0
		Flow Rate (kg/s)	0.2987	0.2817
		COPc	4.2	4.0
		Compressor Work (W)	11084.	10989.
		Q Evap (W)	46161.	43667.
		% Capacity Change	- 7.35	- 12.4
41.4	58.6	High Pres (kPa)	1946.5	1946.5
		Low Pres. (kPa)	527.1	502.4
		Superheat (C)	3.5	5.0
		Flow Rate (kg/s)	0.2996	0.2838
		COPc	4.1	3.9
		Compressor Work (W)	10663.	10572.
		Q Evap (W)	43679.	41500.
		% Capacity Change	- 12.3	- 16.7
21.9	78.1	High Pres (kPa)	2056.5	2056.5
		Low Pres. (kPa)	527.1	512.5
		Superheat (C)	4.2	5.0
		Flow Rate (kg/s)	0.3004	0.2910
		COPc	3.9	3.8
		Compressor Work (W)	10479.	10419.
		Q Evap (W)	40714.	39512.
		% Capacity Change	- 18.3	- 20.7

TABLE 6. MODELING RESULTS FOR R-22/R-115 MIXTURE (Concluded).

MASS % R-22	MASS% R-502	PARAMETER	TXV	NO TXV
0.0	100.0	High Pres (kPa)	2282.0	2282.0
		Low Pres. (kPa)	527.1	535.4
		Superheat (C)	5.5	5.0
		Flow Rate (kg/s)	0.3010	0.3064
		COPc	3.5	3.5
		Compressor Work (W)	10525.	10566.
		Q Evap (W)	36760.	37379.
		% Capacity Change	- 26.2	- 25.0

TABLE 7. MODELING RESULTS FOR R-22/R-290 MIXTURE

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Compressor Work (W)	12500.	12500.
		Q Evap (W)	49823.	49823.
90.0	82.1	High Pres (kPa)	2094.2	2094.2
		Low Pres. (kPa)	527.1	583.5
		Superheat (C)	8.2**	5.0
		Flow Rate (kg/s)	0.2966	0.3327
		COPc	3.5	3.9
		Compressor Work (W)	14476.†	14732.†
		Q Evap (W)	-----	-----
		% Capacity Change	-----	-----
80.0	67.1	High Pres (kPa)	2141.9	2141.9
		Low Pres. (kPa)	527.1	621.0
		Superheat (C)	10.3**	5.0
		Flow Rate (kg/s)	0.2970	0.3579
		COPc	3.4	3.9
		Compressor Work (W)	15901.†	16347.†
		Q Evap (W)	-----	-----
		% Capacity Change	-----	-----
70.0	54.3	High Pres (kPa)	2138.2	2138.2
		Low Pres. (kPa)	527.1	631.6
		Superheat (C)	10.9**	5.0
		Flow Rate (kg/s)	0.2975	0.3659
		COPc	3.3	3.9
		Compressor Work (W)	17054.†	17568.†
		Q Evap (W)	-----	-----
		% Capacity Change	-----	-----
60.0	43.3	High Pres (kPa)	2106.2	2106.2
		Low Pres. (kPa)	527.1	620.7
		Superheat (C)	10.4**	5.0
		Flow Rate (kg/s)	0.2982	0.3596
		COPc	3.3	3.9
		Compressor Work (W)	18022.†	18505.†
		Q Evap (W)	-----	-----
		% Capacity Change	-----	-----
50.0	33.8	High Pres (kPa)	2056.8	2056.8
		Low Pres. (kPa)	527.1	600.0
		Superheat (C)	9.3**	5.0
		Flow Rate (kg/s)	0.2990	0.3468
		COPc	3.4	3.8
		Compressor Work (W)	18842.†	19234.†

TABLE 7. MODELING RESULTS FOR R-22/R-290 MIXTURE (Concluded).

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
50.0 (continued)	33.8	Q Evap (W)	----	----
		% Capacity Change	----	----
40.0	25.4	High Pres (kPa)	1996.3	1996.3
		Low Pres. (kPa)	527.1	576.9
		Superheat (C)	8.0**	5.0
		Flow Rate (kg/s)	0.2998	0.3325
		COPc	3.5	3.8
		Compressor Work (W)	19530.†	19804.†
		Q Evap (W)	----	----
		% Capacity Change	----	----
30.0	17.9	High Pres (kPa)	1928.4	1928.4
		Low Pres. (kPa)	527.1	554.9
		Superheat (C)	6.7	5.0
		Flow Rate (kg/s)	0.3006	0.3188
		COPc	3.6	3.8
		Compressor Work (W)	20095.†	20246.†
		Q Evap (W)	----	----
		% Capacity Change	----	----
20.0	11.3	High Pres (kPa)	1855.6	1855.6
		Low Pres. (kPa)	527.1	534.9
		Superheat (C)	5.5	5.0
		Flow Rate (kg/s)	0.3013	0.3065
		COPc	3.8	3.9
		Compressor Work (W)	20540.†	20580.†
		Q Evap (W)	----	----
		% Capacity Change	----	----
10.0	5.4	High Pres (kPa)	1779.6	1779.6
		Low Pres. (kPa)	527.1	517.1
		Superheat (C)	4.4	5.0
		Flow Rate (kg/s)	0.3021	0.2956
		COPc	4.0	3.9
		Compressor Work (W)	20865.†	20817.†
		Q Evap (W)	----	----
		% Capacity Change	----	----
0.0	0.0	High Pres (kPa)	1701.6	1701.6
		Low Pres. (kPa)	527.1	501.4
		Superheat (C)	3.3	5.0
		Flow Rate (kg/s)	0.3029	0.2860
		COPc	4.2	4.0
		Compressor Work (W)	21070.†	20964.†
		Q Evap (W)	----	----
		% Capacity Change	----	----

** Potential freezing in water chiller
† Compressor will fail due to power overload

D. TASK IV: MODEL NONAZEOTROPIC REFRIGERANT MIXTURES IN VARIOUS REFRIGERATION SYSTEMS

All the remaining refrigerant pairs from Table 1 are nonazeotropic refrigerant mixtures over their concentration range.

1. Small System: R-22 Base Refrigerant

Two nonazeotropic refrigerant pairs have been modeled, the pairs R-22/R-11 and R-22/R13B1. Tables 8 and 9 show the modeling results for these pairs.

As Table 8 shows, R-11 is a poor candidate for mixing in an R-22 system controlled by an R-22 TXV. The significant difference in volatility of these two fluids results in a mixture dew temperature well above 7°C over the entire concentration range, resulting in compressor slugging due to liquid leaving the evaporator. Even when modeled using the generic approach, the addition of R-11 to the R-22 system results in a significant decrease in system capacity due to a significant decrease in refrigerant mass flow rate (the low-side pressure dropped increasing the specific volume of the refrigerant entering the compressor). The COP_c also drops significantly with increasing R-11 concentration using the generic approach.

Table 9 shows the results of adding R-13B1 to the R-22 system. Using the TXV approach, the addition of R-13B1 to the system results in excess evaporator superheat because R-13B1 is more volatile than R-22. This higher volatility causes the evaporator saturation temperature to drop if the evaporator outlet temperature is maintained at 7°C. If the R-13B1 concentration is above 20 wt%, the potential for freezing the water in the water chiller exists because the evaporator saturation temperature dropped below 0°C. Table 9 shows that system capacity and compressor work decreased with increasing R-13B1 concentration using both the generic and TXV approach. COP_c also was found to decrease with increasing R-13B1 concentration for both the generic and TXV approach.

2. Large System: R-11 Base Refrigerant

Two nonazeotropic refrigerant pairs have been modeled, the pairs R-11/R12 and R-11/R-22. Tables 10 and 11 show the modeling results for these pairs.

As Tables 10 and 11 show, mixing either R-12 or R-22 in an R-11 system results in a dramatic increase in the compressor power requirement of the system. This same result is seen when modeling with either the TXV or generic approach. This additional power requirement will cause motor failure or will cause the thermal overload control of the unit to shut the compressor off. Thus neither R-12 or R-22 are suitable replacement refrigerants for the R-11 system due to the compressor power overload.

TABLE 8. MODELING RESULTS FOR R-22/R-11 MIXTURE

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Compressor Work (W)	12500.	12500.
		Q Evap (W)	49823.	49823.
		% Capacity Change	---	---
90.0	93.5	High Pres (kPa)	1812.2	1812.2
		Low Pres. (kPa)	527.1	369.2
		Superheat (C)	- 5.8*	5.0
		Flow Rate (kg/s)	----	0.1979
		COPc	----	3.2
		Compressor Work (W)	----	10454.
		Q Evap (W)	----	33178.
		% Capacity Change	----	- 33.4
80.0	86.4	High Pres (kPa)	1690.3	1690.3
		Low Pres. (kPa)	527.1	243.8
		Superheat (C)	- 16.4*	5.0
		Flow Rate (kg/s)	----	0.1300
		COPc	----	2.6
		Compressor Work (W)	----	8297.
		Q Evap (W)	----	21699.
		% Capacity Change	----	- 56.5
70.0	78.8	High Pres (kPa)	1565.5	1565.5
		Low Pres. (kPa)	527.1	175.4
		Superheat (C)	- 25.5*	5.0
		Flow Rate (kg/s)	----	0.0924
		COPc	----	2.3
		Compressor Work (W)	----	6566.
		Q Evap (W)	----	15302.
		% Capacity Change	----	- 69.3
60.0	70.4	High Pres (kPa)	1435.2	1435.2
		Low Pres. (kPa)	527.1	133.5
		Superheat (C)	- 33.6*	5.0
		Flow Rate (kg/s)	----	0.0698
		COPc	----	2.2
		Compressor Work (W)	----	5238.
		Q Evap (W)	----	11476.
		% Capacity Change	----	- 77.0
50.0	61.4	High Pres (kPa)	1295.8	1295.8
		Low Pres. (kPa)	527.1	105.6
		Superheat (C)	- 40.9*	5.0
		Flow Rate (kg/s)	----	0.0550
		COPc	----	2.1

TABLE 8. MODELING RESULTS FOR R-22/R-11 MIXTURE (concluded).

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
50.0 (continued)	61.4	Compressor Work (W)	----	4201.
		Q Evap (W)	----	8981.
		% Capacity Change	----	- 82.0
40.0	51.4	High Pres (kPa)	1142.6	1142.6
		Low Pres. (kPa)	527.1	85.9
		Superheat (C)	- 47.8*	5.0
		Flow Rate (kg/s)	----	0.0446
		COPc	----	2.2
		Compressor Work (W)	----	3366.
		Q Evap (W)	----	7244.
		% Capacity Change	----	- 85.5
30.0	40.5	High Pres (kPa)	969.4	969.4
		Low Pres. (kPa)	527.1	71.2
		Superheat (C)	- 54.4*	5.0
		Flow Rate (kg/s)	----	0.0369
		COPc	----	2.2
		Compressor Work (W)	----	2672.
		Q Evap (W)	----	5973.
		% Capacity Change	----	- 88.0
20.0	28.4	High Pres (kPa)	768.0	768.0
		Low Pres. (kPa)	527.1	59.8
		Superheat (C)	- 60.8*	5.0
		Flow Rate (kg/s)	----	0.0309
		COPc	----	2.4
		Compressor Work (W)	----	2069.
		Q Evap (W)	----	5008.
		% Capacity Change	----	- 90.0
10.0	15.0	High Pres (kPa)	527.6	527.6
		Low Pres. (kPa)	527.1	50.8
		Superheat (C)	- 67.2*	5.0
		Flow Rate (kg/s)	----	0.0262
		COPc	----	2.8
		Compressor Work (W)	----	1506.
		Q Evap (W)	----	4254.
		% Capacity Change	----	- 91.5
0.0	0.0	High Pres (kPa)	243.3	243.3
		Low Pres. (kPa)	527.1	43.5
		Superheat (C)	- 73.6*	5.0
		Flow Rate (kg/s)	----	0.0224
		COPc	----	4.3
		Compressor Work (W)	----	849.
		Q Evap (W)	----	3649.
		% Capacity Change	----	- 92.7

* Compressor will fail due to slugging

TABLE 9. MODELING RESULTS FOR R-22/R-13B1 MIXTURE

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Compressor Work (W)	12500.	12500.
		Q Evap (W)	49823.	49823.
		% Capacity Change	---	---
90.0	93.9	High Pres (kPa)	2018.4	2018.4
		Low Pres. (kPa)	527.1	547.0
		Superheat (C)	6.2	5.0
		Flow Rate (kg/s)	0.2963	0.3089
		COPc	3.8	3.9
		Compressor Work (W)	12376.	12454.
		Q Evap (W)	46646.	48524.
		% Capacity Change	- 6.38	- 2.61
80.0	87.3	High Pres (kPa)	2104.0	2104.0
		Low Pres. (kPa)	527.1	569.9
		Superheat (C)	7.4**	5.0
		Flow Rate (kg/s)	0.2961	0.3234
		COPc	3.6	3.8
		Compressor Work (W)	12199.	12373.
		Q Evap (W)	43526.	47302.
		% Capacity Change	- 12.6	- 5.06
70.0	80.1	High Pres (kPa)	2190.0	2190.0
		Low Pres. (kPa)	527.1	596.4
		Superheat (C)	8.9**	5.0
		Flow Rate (kg/s)	0.2959	0.3402
		COPc	3.4	3.8
		Compressor Work (W)	11973.	12258.
		Q Evap (W)	40470.	46162.
		% Capacity Change	- 18.8	- 7.35
60.0	72.1	High Pres (kPa)	2276.4	2276.4
		Low Pres. (kPa)	527.1	627.2
		Superheat (C)	10.5**	5.0
		Flow Rate (kg/s)	0.2957	0.3601
		COPc	3.2	3.7
		Compressor Work (W)	11701.	12107.
		Q Evap (W)	37484.	45105.
		% Capacity Change	- 24.8	- 9.47
50.0	63.3	High Pres (kPa)	2363.3	2363.3
		Low Pres. (kPa)	527.1	662.8
		Superheat (C)	12.2**	5.0
		Flow Rate (kg/s)	0.2955	0.3835
		COPc	3.0	3.7

TABLE 9. MODELING RESULTS FOR R-22/R-13B1 MIXTURE (Concluded).

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
50.0 (continued)	63.3	Compressor Work (W)	11382.	11920.
		Q Evap (W)	34575.	44118.
		% Capacity Change	- 30.6	- 11.5
40.0	53.4	High Pres (kPa)	2450.3	2450.3
		Low Pres. (kPa)	527.1	703.4
		Superheat (C)	14.2**	5.0
		Flow Rate (kg/s)	0.2954	0.4107
		COPc	2.9	3.7
		Compressor Work (W)	11020.	11689.
		Q Evap (W)	31753.	43163.
		% Capacity Change	- 36.3	- 13.4
30.0	42.5	High Pres (kPa)	2536.7	2536.7
		Low Pres. (kPa)	527.1	748.6
		Superheat (C)	16.3**	5.0
		Flow Rate (kg/s)	0.2952	0.4416
		COPc	2.7	3.7
		Compressor Work (W)	10615.	11407.
		Q Evap (W)	29029.	42157.
		% Capacity Change	- 41.7	- 15.4
20.0	30.1	High Pres (kPa)	2621.2	2621.2
		Low Pres. (kPa)	527.1	796.3
		Superheat (C)	18.4**	5.0
		Flow Rate (kg/s)	0.2951	0.4752
		COPc	2.6	3.7
		Compressor Work (W)	10166.	11064.
		Q Evap (W)	26417.	40959.
		% Capacity Change	- 47.0	- 17.8
10.0	16.1	High Pres (kPa)	2700.8	2700.8
		Low Pres. (kPa)	527.1	842.6
		Superheat (C)	20.5**	5.0
		Flow Rate (kg/s)	0.2951	0.5089
		COPc	2.5	3.7
		Compressor Work (W)	9668.	10644.
		Q Evap (W)	23934.	39390.
		% Capacity Change	- 52.0	- 20.9
0.0	0.0	High Pres (kPa)	2769.9	2769.9
		Low Pres. (kPa)	527.1	882.2
		Superheat (C)	22.2**	5.0
		Flow Rate (kg/s)	0.2952	0.5388
		COPc	2.4	3.7
		Compressor Work (W)	9117.	10131.
		Q Evap (W)	21599.	37300.
		% Capacity Change	- 56.7	- 25.1

** Potential freezing in water chiller

TABLE 10. MODELING RESULTS FOR R-11/R-12 MIXTURE

MASS % R-11	MOL % R-11	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	243.3	243.3
		Low Pres. (kPa)	43.5	43.5
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	2.6426	2.6426
		COPc	4.3	4.3
		Compressor Work (W)	100000.	100000.
		Q Evap (W)	429779.	429779.
90.0	88.8	High Pres (kPa)	340.7	340.7
		Low Pres. (kPa)	43.5	48.3
		Superheat (C)	7.5**	5.0
		Flow Rate (kg/s)	2.6399	2.9393
		COPc	3.3	3.5
		Compressor Work (W)	126047. #	132080. #
		Q Evap (W)	----	----
90.0	77.9	% Capacity Change	----	----
		High Pres (kPa)	443.3	443.3
		Low Pres. (kPa)	43.5	54.2
		Superheat (C)	10.1**	5.0
		Flow Rate (kg/s)	2.6373	3.2998
		COPc	2.8	3.1
		Compressor Work (W)	145906. #	162426. #
70.0	67.3	Q Evap (W)	----	----
		% Capacity Change	----	----
		High Pres (kPa)	542.5	542.5
		Low Pres. (kPa)	43.5	61.4
		Superheat (C)	13.0**	5.0
		Flow Rate (kg/s)	2.6350	3.7467
		COPc	2.5	2.9
60.0	56.9	Compressor Work (W)	162401. #	193863. #
		Q Evap (W)	----	----
		% Capacity Change	----	----
		High Pres (kPa)	639.2	639.2
		Low Pres. (kPa)	43.5	70.6
		Superheat (C)	16.1**	5.0
		Flow Rate (kg/s)	2.6327	4.3150
50.0	46.8	COPc	2.2	2.8
		Compressor Work (W)	176827. #	228323. #
		Q Evap (W)	----	----
		% Capacity Change	----	----
		High Pres (kPa)	734.0	734.0
		Low Pres. (kPa)	43.5	82.6
		Superheat (C)	19.6**	5.0
50.0	46.8	Flow Rate (kg/s)	2.6306	5.0611
		COPc	2.0	2.7
		Compressor Work (W)	189693. #	267700. #

TABLE 10. MODELING RESULTS FOR R-11/R-12 MIXTURE (Concluded).

MASS % R-11	MOL % R-11	PARAMETER	TXV	NO TXV
50.0 (continued)	46.8	Q Evap (W)	----	----
		% Capacity Change	----	----
40.0	37.0	High Pres (kPa)	827.6	827.6
		Low Pres. (kPa)	43.5	98.9
		Superheat (C)	23.6**	5.0
		Flow Rate (kg/s)	2.6286	6.0817
		COPc	1.8	2.7
		Compressor Work (W)	202032.‡	314307.‡
		Q Evap (W)	----	----
		% Capacity Change	----	----
30.0	27.4	High Pres (kPa)	920.9	920.9
		Low Pres. (kPa)	43.5	122.2
		Superheat (C)	28.3**	5.0
		Flow Rate (kg/s)	2.6268	7.5564
		COPc	1.7	2.8
		Compressor Work (W)	213532.‡	371269.‡
		Q Evap (W)	----	----
		% Capacity Change	----	----
20.0	18.0	High Pres (kPa)	1014.7	1014.7
		Low Pres. (kPa)	43.5	157.9
		Superheat (C)	34.0**	5.0
		Flow Rate (kg/s)	2.6250	9.8514
		COPc	1.6	2.9
		Compressor Work (W)	224602.‡	442819.‡
		Q Evap (W)	----	----
		% Capacity Change	----	----
10.0	8.9	High Pres (kPa)	1109.9	1109.9
		Low Pres. (kPa)	43.5	217.9
		Superheat (C)	41.9**	5.0
		Flow Rate (kg/s)	2.6233	13.7975
		COPc	1.4	3.3
		Compressor Work (W)	235420.‡	533235.‡
		Q Evap (W)	----	----
		% Capacity Change	----	----
0.0	0.0	High Pres (kPa)	1207.9	1207.9
		Low Pres. (kPa)	43.5	327.4
		Superheat (C)	54.8**	5.0
		Flow Rate (kg/s)	2.6218	21.3358
		COPc	1.3	4.1
		Compressor Work (W)	246096.‡	637029.‡
		Q Evap (W)	----	----
		% Capacity Change	----	----

** Potential freezing in water chiller

‡ Compressor will fail due to power overload

TABLE 11. MODELING RESULTS FOR R-11/R-22 MIXTURE

MASS % R-11	MOL % R-11	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	234.3	234.3
		Low Pres. (kPa)	43.5	43.5
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	2.6426	2.6426
		COPc	4.3	4.3
		Compressor Work (W)	100000.	100000.
		Q Evap (W)	429779.	429779.
90.0	85.0	High Pres (kPa)	527.6	527.6
		Low Pres. (kPa)	43.5	50.8
		Superheat (C)	8.6**	5.0
		Flow Rate (kg/s)	2.6370	3.0907
		COPc	2.6	2.8
		Compressor Work (W)	163446. #	177361. #
		Q Evap (W)	-----	-----
80.0	71.6	% Capacity Change	-----	-----
		High Pres (kPa)	768.0	768.0
		Low Pres. (kPa)	43.5	59.8
		Superheat (C)	12.4**	5.0
		Flow Rate (kg/s)	2.6324	3.6430
		COPc	2.1	2.4
		Compressor Work (W)	203488. #	243075. #
70.0	59.5	Q Evap (W)	-----	-----
		% Capacity Change	-----	-----
		High Pres (kPa)	969.4	969.4
		Low Pres. (kPa)	43.5	71.2
		Superheat (C)	16.2**	5.0
		Flow Rate (kg/s)	2.6286	4.3402
		COPc	1.8	2.2
60.0	48.6	Compressor Work (W)	236271. #	314609. #
		Q Evap (W)	-----	-----
		% Capacity Change	-----	-----
		High Pres (kPa)	1142.6	1142.6
		Low Pres. (kPa)	43.5	85.9
		Superheat (C)	20.2**	5.0
		Flow Rate (kg/s)	2.6254	5.2473
50.0	38.6	COPc	1.6	2.2
		Compressor Work (W)	265815. #	396359. #
		Q Evap (W)	-----	-----
		% Capacity Change	-----	-----
		High Pres (kPa)	1295.8	1295.8
		Low Pres. (kPa)	43.5	105.6
		Superheat (C)	24.6**	5.0
		Flow Rate (kg/s)	2.6277	6.4737
		COPc	1.5	2.1
		Compressor Work (W)	293739. #	494684. #

TABLE 11. MODELING RESULTS FOR R-11/R-22 MIXTURE (Concluded)

MASS % R-11	MOL % R-11	PARAMETER	TXV	NO TXV
50.0 (continued)	48.6	Q Evap (W) & Capacity Change	---- ----	---- ----
40.0	29.6	High Pres (kPa) Low Pres. (kPa) Superheat (C) Flow Rate (kg/s) COPc Compressor Work (W) Q Evap (W) & Capacity Change	1435.2 43.5 29.4** 2.6204 1.4 320896.† ---- ----	1435.2 133.5 5.0 8.2186 2.2 616873.† ---- ----
30.0	21.2	High Pres (kPa) Low Pres. (kPa) Superheat (C) Flow Rate (kg/s) COPc Compressor Work (W) Q Evap (W) & Capacity Change	1565.5 43.5 34.9** 2.6184 1.3 347733.† ---- ----	1565.5 175.4 5.0 10.8776 2.3 773217.† ---- ----
20.0	13.6	High Pres (kPa) Low Pres. (kPa) Superheat (C) Flow Rate (kg/s) COPc Compressor Work (W) Q Evap (W) & Capacity Change	1690.3 43.5 41.7** 2.6167 1.2 374574.† ---- ----	1690.3 243.8 5.0 15.3145 2.6 977049.† ---- ----
10.0	6.5	High Pres (kPa) Low Pres. (kPa) Superheat (C) Flow Rate (kg/s) COPc Compressor Work (W) Q Evap (W) & Capacity Change	1812.2 43.5 51.1** 2.6152 1.1 401626.† ---- ----	1812.2 362.9 5.0 23.3096 3.2 1231072.† ---- ----
0.0	0.0	High Pres (kPa) Low Pres. (kPa) Superheat (C) Flow Rate (kg/s) COPc Compressor Work (W) Q Evap (W) & Capacity Change	1933.3 43.5 64.4** 2.6140 1.1 429036.† ---- ----	1933.3 527.1 5.0 34.9224 4.0 1472058.† ---- ----

** Potential freezing in water chiller
† Compressor will fail due to power overload

TASK V: RECOMMEND FUTURE WORK

Based on the results obtained to date on this contract, Mainstream has identified several preliminary tasks to be done in Phase II of this effort.

1. Set up a heat pump test stand apparatus to determine actual performance using the selected refrigerant mixtures in the base system. The objective of this task will be to verify the Phase I modeling and to perform some long-term system testing. This task would investigate how temperatures and heat transfer rates are affected when a refrigerant is substituted in a TXV-controlled system. These tests would also verify any potential compressor slugging, power overload, or water chiller problems.
2. Verify vapor-liquid equilibrium data of refrigerant mixtures. The goal of this task will be to verify the thermodynamic properties generated by the CSD equation of state. This will be accomplished by experimentally generating dew and bubble points.
3. Periodically check system hardware (valves, seals, lines, etc.) for any adverse affects caused by refrigerant/lubricant. This will ensure that the refrigerant mixture and lubricant do not adversely affect system components.
4. Perform lubrication tests and consult with refrigeration experts to determine which lubricant is best for a particular mixture. This may be an easy problem because many refrigerant lubricants are used for more than one refrigerant. Mainstream plans to consult with refrigerant manufacturers for recommendations.
5. Perform experiments to identify suitable replacement refrigerants for the R-11 baseline system. Suitable candidates would be refrigerants with volatilities similar to R-11. Halon-1211 and R-114B2 are the most likely candidates, with volatilities approaching R-11.
6. Study development of system hardware suitable for use with refrigerant mixtures. Components such as compressors and expansion devices should be studied to see what modifications or changes can be made with these components to fully utilize the advantages of refrigerant mixtures.

SECTION IV

CONCLUSIONS

1. The effect of the expansion device plays an important role in the changing system performance when substituting refrigerants in an air-conditioning system. If the refrigerant is changed in a system equipped with a TXV, significant changes in evaporator conditions and system performance result. This is because the pressure/temperature saturation properties of the fluid in the TXV are used to control the evaporator pressure. If the fluid in the cycle changes, the pressure/temperature relationship of the cycle fluid changes. Thus, the evaporator saturation temperature corresponding to the TXV pressure has changed. This type of behavior is not seen when modeling the system using a generic expansion device, which allows the pressure to change to match the desired evaporator saturation temperature.
2. Refrigerant R-502 was found to be the best substitute for the R-22 baseline system. The R-22/R-502 mixture gives a slight decrease in system capacity over the entire concentration range. No adverse affects to the compressor or water chiller were found for the R-22/R-502 mixture.
3. Refrigerant R-13B1 is a suitable substitute for the R-22 baseline system but its use results in a decrease in system capacity. The potential for freezing in the water chiller exists for this mixture at R-13B1 concentrations above 20 wt%. This problem could be overcome by utilizing a material that lowers the freezing point of the water in the chiller.
4. Refrigerant R-12 is a suitable substitute for the R-22 baseline system if the R-12 concentration can be maintained below 60 wt%. System capacity decreases with increasing R-12 concentration until a concentration of 60 wt% is reached. An R-12 concentration of 60 wt% or above will result in failure of the compressor due to liquid slugging.
5. Refrigerant R-290 is not a suitable substitute for the R-22 system. Its use results in an increase in the compressor power for the system over the entire concentration range. This additional power requirement will cause motor failure or will cause the thermal overload control of the unit to shut the compressor off.
6. Refrigerant R-11 is not a suitable substitute for the R-22 baseline system. Its use will result in compressor failure due to liquid slugging over the entire R-22/R-11 concentration range.
7. Refrigerants R-12 and R-22 are not suitable substitutes for the R-11 baseline system. Use of either of these refrigerants results in an increase in the compressor power of the system. This additional power requirement will cause motor failure or will cause the unit's thermal overload control to shut the compressor off.

8. Replacement of the system lubricant should not be necessary unless a system leak occurs in the compressor crankcase or oil separator. However, if a system leak results in compressor failure, the compressor and oil should be checked thoroughly and tested.

9. None of the refrigerant mixtures considered should possess flammability with the exception of R-22/R-290, which may be flammable in high R-290 concentrations. Mainstream was unable to find any literature to clarify this point.

SECTION V

REFERENCES

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APPENDIX A

TABLES OF THERMODYNAMIC PROPERTY DATA FOR REFRIGERANT MIXTURES

A. INTRODUCTION

The data contained in Appendix A was generated through the use of FORTRAN subroutines and functions implementing the CSD equation of state. These routines were supplied to Mainstream by Dr. Mark McLinden of the National Bureau of Standards. The routines were intended to supply property information to a user's application program, such as the heat pump simulator developed by Mainstream. Included in these routines were two subroutines to generate the tabular data contained in Appendix A.

B. NOMENCLATURE

The following nomenclature is used in the Tables of Appendix A.

xl = liquid mol fraction of component A
xv = vapor mol fraction of component A
p = pressure
vl = liquid specific volume
vv = vapor specific volume
hl = liquid enthalpy
hv = vapor enthalpy
sl = liquid entropy
sv = vapor entropy
cvl = liquid isochoric heat capacity
cvv = vapor isochoric heat capacity
cpl = liquid isobaric heat capacity
cpv = vapor isobaric heat capacity
cv = vapor isochoric heat capacity
cp = vapor isobaric heat capacity
vsnd = sonic speed

TABLE A.1 - SATURATED VAPOR-LIQUID PROPERTIES FOR R-11/R-12 MIXTURE

DEW/BUBBLE LINES AT T = 273.1 K

COMPONENT A: R12 COMPONENT B: R11

MIXING COEFFICIENT, F = .0030

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	40.21	.08959	55.453	4609.1	30641.8	18.221	113.527	106.893	66.773	117.936	75.670
.1000	.4678	69.03	.08908	32.082	4620.9	27150.7	20.843	109.662	106.359	64.164	117.393	73.324
.2000	.6572	96.91	.08860	22.692	4626.0	25708.0	22.218	104.295	105.801	63.142	116.867	72.576
.3000	.7609	124.00	.08816	17.610	4624.5	24896.4	23.052	100.245	105.218	62.609	116.361	72.321
.4000	.8273	150.47	.08776	14.412	4616.2	24360.5	23.483	97.061	104.608	62.289	115.880	72.286
.5000	.8740	176.49	.08741	12.201	4601.2	23968.7	23.565	94.436	103.970	62.080	115.430	72.368
.6000	.9094	202.27	.08711	10.572	4579.4	23660.8	23.314	92.182	103.300	61.936	115.020	72.525
.7000	.9376	228.04	.08687	9.310	4550.8	23405.0	22.716	90.175	102.598	61.853	114.658	72.737
.8000	.9612	254.08	.08670	8.295	4515.6	23182.6	21.720	88.322	101.859	61.759	114.359	72.992
.9000	.9816	280.69	.08661	7.451	4474.0	22981.7	20.192	86.543	101.081	61.705	114.139	73.290
1.0000	1.0000	308.25	.08662	6.731	4426.4	22793.8	17.427	84.670	100.259	61.665	114.023	73.632

DEW/BUBBLE LINES AT T = 283.1 K

COMPONENT A: R12 COMPONENT B: R11

MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	60.63	.09093	37.859	5796.4	31346.5	22.484	112.719	108.024	68.059	119.308	77.200
.1000	.4381	98.87	.09045	23.030	5803.3	28037.4	25.085	109.437	107.479	65.656	118.783	75.126
.2000	.6297	136.04	.09001	16.598	5803.7	26555.0	26.440	104.328	106.909	64.649	118.279	74.465
.3000	.7384	172.32	.08961	12.993	5797.6	25687.5	27.254	100.327	106.311	64.112	117.802	74.286
.4000	.8094	207.91	.08926	10.677	5785.0	25100.0	27.667	97.114	105.684	63.787	117.356	74.332
.5000	.8602	243.04	.08897	9.056	5766.0	24662.3	27.732	94.426	105.025	63.578	116.951	74.508
.6000	.8990	277.96	.08874	7.849	5740.5	24313.1	27.465	92.091	104.332	63.437	116.596	74.771
.7000	.9302	312.99	.08859	6.909	5708.8	24019.2	26.853	89.992	103.602	63.341	116.306	75.101
.8000	.9565	348.49	.08851	6.148	5671.1	23760.7	25.845	88.037	102.830	63.275	116.100	75.490
.9000	.9793	384.86	.08855	5.513	5627.9	23524.7	24.308	86.143	102.014	63.232	116.002	75.940
1.0000	1.0000	422.63	.08870	4.970	5579.6	23301.7	21.538	84.127	101.146	63.207	116.048	76.455

**TABLE A.1 - SATURATED VAPOR-LIQUID PROPERTIES
FOR R-11/R-12 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 293.1 K

COMPONENT A: R12 COMPONENT B: R11

MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	88.54	.09234	26.614	6997.8	32047.9	26.644	112.096	109.080	69.312	120.684	78.768
.1000	.4105	138.05	.09190	16.911	7000.0	28907.4	29.226	109.308	108.524	67.107	120.182	76.969
.2000	.6029	186.41	.09150	12.401	6995.9	27393.9	30.562	104.455	107.940	66.128	119.707	76.422
.3000	.7159	233.82	.09115	9.788	6985.7	26473.7	31.358	100.512	107.326	65.595	119.264	76.344
.4000	.7913	280.52	.09086	8.075	6969.2	25834.5	31.754	97.277	106.679	65.274	118.863	76.502
.5000	.8460	326.81	.09063	6.860	6946.6	25349.3	31.804	94.528	105.998	65.071	118.514	76.803
.6000	.8882	373.01	.09048	5.946	6918.1	24956.0	31.522	92.111	105.279	64.939	118.232	77.207
.7000	.9224	419.52	.09043	5.229	6884.0	24620.5	30.898	89.916	104.518	64.855	118.036	77.698
.8000	.9514	466.80	.09048	4.646	6844.8	24321.8	29.882	87.852	103.710	64.805	117.953	78.271
.9000	.9769	515.41	.09066	4.158	6801.1	24045.9	28.339	85.833	102.849	64.780	118.021	78.933
1.0000	1.0000	566.06	.09100	3.737	6753.8	23782.3	25.568	83.656	101.928	64.776	118.293	79.698

DEW/BUBBLE LINES AT T = 303.1 K

COMPONENT A: R12 COMPONENT B: R11

MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	125.67	.09382	19.192	8213.3	32743.1	30.710	111.626	110.060	70.535	122.074	80.394
.1000	.3848	188.41	.09342	12.666	8211.2	29758.4	33.273	109.258	109.491	68.521	121.600	78.875
.2000	.5770	249.96	.09307	9.439	8203.1	28221.1	34.591	104.653	108.892	67.582	121.159	78.471
.3000	.6935	310.59	.09278	7.508	8189.0	27251.4	35.371	100.776	108.260	67.064	120.761	78.525
.4000	.7729	370.58	.09255	6.217	8169.0	26560.9	35.751	97.524	107.593	66.755	120.417	78.826
.5000	.8312	430.29	.09241	5.288	8143.5	26026.5	35.787	94.717	106.888	66.565	120.141	79.291
.6000	.8768	490.13	.09236	4.584	8112.8	25586.4	35.494	92.218	106.140	66.450	119.954	79.883
.7000	.9142	550.59	.09242	4.026	8077.2	25205.7	34.860	89.922	105.343	66.385	119.883	80.592
.8000	.9460	612.30	.09262	3.570	8037.6	24862.4	33.838	87.741	104.493	66.358	119.967	81.419
.9000	.9742	676.00	.09298	3.186	7995.0	24541.2	32.294	85.585	103.581	66.360	120.264	82.381
1.0000	1.0000	742.64	.09355	2.854	7950.8	24230.5	29.528	83.230	102.598	66.387	120.858	83.510

**TABLE A.1 - SATURATED VAPOR-LIQUID PROPERTIES
FOR R-11/R-12 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 313.1 K

COMPONENT A: R12 COMPONENT B: R11

MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	173.93	.09540	14.152	9443.3	33429.0	34.687	111.282	110.961	71.732	123.488	82.100
.1000	.3610	251.91	.09504	9.655	9437.1	30587.9	37.232	109.269	110.378	69.903	123.049	80.870
.2000	.5518	328.77	.09474	7.302	9425.3	29033.3	38.533	104.903	109.763	69.015	122.653	80.640
.3000	.6712	404.82	.09451	5.850	9407.8	28017.4	39.298	101.098	109.113	68.522	122.312	80.861
.4000	.7542	480.42	.09437	4.861	9385.0	27275.8	39.664	97.835	108.423	68.234	122.041	81.348
.5000	.8161	555.98	.09432	4.140	9357.3	26690.8	39.688	94.973	107.690	68.066	121.860	82.026
.6000	.8650	632.03	.09439	3.587	9325.1	26201.3	39.385	92.390	106.909	67.975	121.799	82.867
.7000	.9054	709.21	.09460	3.146	9289.2	25771.5	38.746	89.989	106.074	67.939	121.896	83.869
.8000	.9402	788.31	.09498	2.783	9250.7	25378.6	37.721	87.684	105.175	67.945	122.211	85.048
.9000	.9713	870.33	.09557	2.475	9211.2	25006.1	36.181	85.377	104.204	67.985	122.832	86.440
1.0000	1.0000	956.56	.09643	2.207	9173.0	24640.5	33.429	82.822	103.146	68.056	123.896	88.106

DEW/BUBBLE LINES AT T = 323.1 K

COMPONENT A: R12 COMPONENT B: R11

MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	235.36	.09707	10.641	10687.9	34102.2	38.581	111.037	111.781	72.908	124.941	83.914
.1000	.3389	330.63	.09676	7.473	10678.1	31393.8	41.109	109.323	111.184	71.259	124.546	82.986
.2000	.5275	424.98	.09653	5.730	10663.0	29827.2	42.395	105.188	110.551	70.433	124.208	82.964
.3000	.6491	518.76	.09638	4.622	10642.7	28768.1	43.145	101.458	109.880	69.976	123.941	83.396
.4000	.7352	612.39	.09633	3.853	10617.8	27976.1	43.500	98.189	109.165	69.718	123.765	84.120
.5000	.8005	706.41	.09640	3.284	10588.7	27339.2	43.513	95.274	108.402	69.581	123.711	85.075
.6000	.8527	801.45	.09660	2.843	10556.1	26797.3	43.204	92.608	107.584	69.525	123.818	86.245
.7000	.8962	898.33	.09699	2.489	10521.4	26314.5	42.562	90.098	106.704	69.528	124.147	87.646
.8000	.9340	998.09	.09759	2.195	10486.0	25866.5	41.541	87.659	105.749	69.579	124.786	89.318
.9000	.9681	1102.07	.09847	1.944	10452.3	25435.5	40.012	85.187	104.708	69.671	125.876	91.333
1.0000	1.0000	1212.06	.09972	1.725	10423.9	25005.8	37.282	82.406	103.559	69.804	127.650	93.815

**TABLE A.1 - SATURATED VAPOR-LIQUID PROPERTIES
FOR R-11/R-12 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 333.1 K

COMPONENT A: R12 COMPONENT B: R11

MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	312.12	.09886	8.138	11947.7	34759.6	42.397	110.870	112.518	74.068	126.453	85.870
.1000	.3183	426.76	.09862	5.864	11934.6	32173.6	44.910	109.413	111.905	72.595	126.116	85.262
.2000	.5040	540.81	.09845	4.552	11916.7	30599.5	46.181	105.493	111.253	71.841	125.852	85.491
.3000	.6272	654.68	.09839	3.695	11894.3	29500.3	46.919	101.842	110.559	71.431	125.681	86.184
.4000	.7161	768.88	.09845	3.089	11868.0	28658.5	47.263	98.571	109.816	71.214	125.633	87.209
.5000	.7845	884.06	.09866	2.635	11838.5	27968.3	47.269	95.606	109.019	71.119	125.748	88.524
.6000	.8398	1001.04	.09904	2.279	11807.1	27371.3	46.957	92.855	108.159	71.109	126.086	90.134
.7000	.8865	1120.86	.09964	1.990	11775.3	26830.9	46.316	90.232	107.227	71.164	126.737	92.083
.8000	.9274	1244.86	.10052	1.749	11745.5	26321.9	45.304	87.649	106.207	71.275	127.842	94.455
.9000	.9647	1374.86	.10178	1.541	11721.3	25824.0	43.796	84.994	105.081	71.438	129.634	97.398
1.0000	1.0000	1513.36	.10353	1.358	11708.3	25318.3	41.103	81.955	103.821	71.656	132.525	101.165

DEW/BUBBLE LINES AT T = 343.1 K

COMPONENT A: R12 COMPONENT B: R11

MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	406.49	.10079	6.317	13223.1	35397.8	46.141	110.762	113.169	75.218	128.051	88.009
.1000	.2991	542.57	.10061	4.656	13207.3	32924.7	48.640	109.519	112.539	73.917	127.790	87.750
.2000	.4813	678.53	.10054	3.656	13187.2	31347.0	49.898	105.804	111.866	73.246	127.623	88.279
.3000	.6054	814.87	.10059	2.985	13163.5	30210.4	50.625	102.233	111.145	72.894	127.580	89.298
.4000	.6968	952.23	.10078	2.502	13136.8	29319.4	50.961	98.966	110.371	72.729	127.702	90.708
.5000	.7681	1091.39	.10115	2.135	13108.3	28574.8	50.963	95.953	109.536	72.689	128.048	92.494
.6000	.8264	1233.39	.10174	1.844	13079.6	27919.5	50.651	93.116	108.628	72.738	128.707	94.696
.7000	.8761	1379.56	.10261	1.606	13053.2	27316.8	50.018	90.374	107.634	72.861	129.820	97.408
.8000	.9202	1531.68	.10385	1.405	13032.5	26739.6	49.024	87.636	106.536	73.050	131.615	100.801
.9000	.9609	1692.21	.10560	1.231	13022.9	26164.7	47.548	84.778	105.307	73.308	134.498	105.170
1.0000	1.0000	1864.69	.10806	1.075	13033.5	25567.8	44.912	81.439	103.907	73.645	139.249	111.064

**TABLE A.1 - SATURATED VAPOR-LIQUID PROPERTIES
FOR R-11/R-12 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 353.1 K
COMPONENT A: R12 COMPONENT B: R11
MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	520.85	.10287	4.967	14514.9	36013.2	49.818	110.694	113.731	76.364	129.772	90.388
.1000	.2812	680.39	.10278	3.735	14497.0	33644.5	52.304	109.631	113.081	75.233	129.610	90.513
.2000	.4593	840.45	.10281	2.964	14475.5	32066.1	53.551	106.108	112.384	74.655	129.574	91.404
.3000	.5839	1001.65	.10299	2.433	14451.3	30894.7	54.270	102.619	111.635	74.373	129.703	92.833
.4000	.6772	1164.76	.10334	2.044	14425.4	29955.1	54.601	99.358	110.825	74.274	130.057	94.739
.5000	.7511	1330.77	.10391	1.744	14399.6	29154.8	54.602	96.299	109.945	74.301	130.724	97.148
.6000	.8123	1500.97	.10476	1.504	14376.0	28438.1	54.295	93.376	108.981	74.425	131.842	100.160
.7000	.8651	1677.08	.10598	1.305	14358.1	27767.6	53.677	90.510	107.916	74.635	133.633	103.961
.8000	.9124	1861.44	.10770	1.136	14351.2	27113.9	52.711	87.603	106.723	74.928	136.491	108.886
.9000	.9566	2057.43	.11011	.987	14363.7	26449.1	51.286	84.514	105.365	75.313	141.158	115.552
1.0000	1.0000	2270.17	.11358	.853	14410.5	25740.4	48.738	80.820	103.779	75.817	149.245	125.226

DEW/BUBBLE LINES AT T = 363.1 K
COMPONENT A: R12 COMPONENT B: R11
MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	657.63	.10514	3.950	15824.2	36602.1	53.434	110.650	114.199	77.514	131.665	93.079
.1000	.2644	842.58	.10515	3.023	15804.7	34329.9	55.908	109.738	113.527	76.553	131.637	93.639
.2000	.4381	1028.89	.10531	2.422	15782.7	32753.4	57.147	106.395	112.804	76.077	131.776	94.972
.3000	.5625	1217.29	.10564	1.998	15759.3	31549.4	57.859	102.987	112.022	75.877	132.141	96.919
.4000	.6575	1408.73	.10619	1.682	15735.9	30561.8	58.188	99.735	111.171	75.857	132.819	99.473
.5000	.7337	1604.44	.10701	1.434	15714.8	29704.1	58.194	96.632	110.240	75.968	133.945	102.723
.6000	.7975	1806.05	.10820	1.234	15699.3	28922.4	57.899	93.621	109.210	76.187	135.735	106.868
.7000	.8532	2015.77	.10987	1.066	15694.3	28177.8	57.306	90.622	108.057	76.507	138.564	112.269
.8000	.9038	2236.71	.11221	.922	15708.0	27437.2	56.385	87.529	106.746	76.935	143.137	119.596
.9000	.9519	2473.54	.11557	.794	15753.9	26665.6	55.036	84.174	105.220	77.495	150.934	130.209
1.0000	1.0000	2733.85	.12058	.675	15858.0	25814.3	52.628	80.044	103.378	78.241	165.699	147.353

**TABLE A.1 - SATURATED VAPOR-LIQUID PROPERTIES
FOR R-11/R-12 MIXTURE (Concluded)**

DEW/BUBBLE LINES AT T = 373.1 K
COMPONENT A: R12 COMPONENT B: R11
MIXING COEFFICIENT, F = .0050

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	819.35	.10763	3.171	17152.1	37160.5	56.995	110.615	114.568	78.676	133.801	96.179
.1000	.2486	1031.57	.10777	2.466	17132.1	34977.5	59.459	109.827	113.872	77.885	133.955	97.244
.2000	.4175	1246.16	.10807	1.993	17110.8	33404.8	60.691	106.652	113.118	77.523	134.336	99.126
.3000	.5413	1464.01	.10859	1.651	17089.6	32170.1	61.401	103.324	112.298	77.418	135.032	101.742
.4000	.6374	1686.28	.10939	1.392	17070.6	31134.7	61.733	100.083	111.400	77.492	136.173	105.157
.5000	.7156	1914.49	.11053	1.186	17057.1	30218.0	61.748	96.937	110.408	77.705	137.971	109.568
.6000	.7819	2150.69	.11215	1.018	17053.8	29366.9	61.476	93.835	109.297	78.041	140.785	115.349
.7000	.8405	2397.71	.11442	.875	17068.0	28540.3	60.921	90.694	108.037	78.503	145.277	123.202
.8000	.8943	2659.68	.11765	.750	17112.5	27699.5	60.068	87.392	106.574	79.111	152.807	134.532
.9000	.9464	2943.10	.12243	.637	17210.3	26796.6	58.840	83.720	104.820	79.915	166.664	152.604
1.0000	1.0000	3259.57	.13003	.531	17411.5	25751.2	56.668	79.018	102.595	81.037	197.385	187.299

TABLE A.2 - SUPERHEATED VAPOR PROPERTIES OF R-11/R-12 MIXTURE

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .200 MASS FRACTION R11

= .180 MOLE FRACTION R11

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	247.24	1502.008	12.9	.0833	.7976	.8885	348.6
SAT VAP	263.79	5.842	192.6	.7945	.4923	.5689	138.2
	280.00	5.472	201.9	.8289	.5093	.5845	142.8
	300.00	5.079	213.8	.8699	.5290	.6028	148.1
	320.00	4.741	226.0	.9093	.5473	.6200	153.2
	340.00	4.448	238.6	.9474	.5641	.6360	158.0
	360.00	4.189	251.5	.9842	.5795	.6507	162.7
	380.00	3.961	264.6	1.0197	.5935	.6640	167.2
	400.00	3.756	278.0	1.0541	.6061	.6761	171.6
	420.00	3.573	291.7	1.0873	.6172	.6868	175.9
	440.00	3.406	305.5	1.1195	.6269	.6962	180.0

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .400 MASS FRACTION R11

= .370 MOLE FRACTION R11

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	252.57	1513.180	17.6	.1127	.7932	.8799	358.8
SAT VAP	275.28	5.735	205.1	.8268	.5006	.5751	139.2
	280.00	5.628	207.9	.8366	.5053	.5794	140.5
	300.00	5.221	219.6	.8772	.5244	.5970	145.8
	320.00	4.872	231.7	.9162	.5420	.6135	150.9
	340.00	4.568	244.2	.9537	.5583	.6288	155.7
	360.00	4.302	256.9	.9902	.5730	.6428	160.4
	380.00	4.066	269.9	1.0253	.5864	.6556	164.9
	400.00	3.855	283.1	1.0593	.5983	.6670	169.2
	420.00	3.666	296.5	1.0921	.6088	.6771	173.5
	440.00	3.495	310.2	1.1238	.6179	.6858	177.6

**TABLE A.2 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .600 MASS FRACTION R11

= .569 MOLE FRACTION R11

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	260.11	1518.588	23.9	.1377	.7899	.8737	366.1
SAT VAP	283.71	5.712	215.9	.8409	.5048	.5776	139.1
	300.00	5.373	225.4	.8735	.5198	.5913	143.4
	320.00	5.010	237.4	.9122	.5368	.6071	148.5
	340.00	4.696	249.7	.9494	.5524	.6217	153.3
	360.00	4.421	262.3	.9853	.5666	.6351	158.0
	380.00	4.177	275.1	1.0200	.5793	.6471	162.5
	400.00	3.960	288.2	1.0535	.5906	.6579	166.8
	420.00	3.765	301.4	1.0858	.6005	.6673	171.0
	440.00	3.589	314.8	1.1170	.6090	.6754	175.1

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .800 MASS FRACTION R11

= .779 MOLE FRACTION R11

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	272.39	1512.775	33.9	.1653	.7896	.8723	367.0
SAT VAP	290.59	5.733	225.8	.8400	.5069	.5781	138.5
	300.00	5.534	231.2	.8585	.5151	.5856	141.0
	320.00	5.158	243.1	.8968	.5315	.6007	146.1
	340.00	4.833	255.3	.9336	.5465	.6146	150.9
	360.00	4.547	267.7	.9691	.5601	.6273	155.5
	380.00	4.296	280.3	1.0034	.5722	.6387	160.0
	400.00	4.071	293.2	1.0364	.5829	.6488	164.3
	420.00	3.870	306.3	1.0683	.5922	.6576	168.5
	440.00	3.688	319.5	1.0990	.6000	.6651	172.6

**TABLE A.2 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12
 MIXING COEFFICIENT = .005
 COMPOSITION = .200 MASS FRACTION R11
 = .180 MOLE FRACTION R11

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	287.09	1387.575	49.4	.2195	.8317	.9428	284.6
SAT VAP	301.80	21.746	210.4	.7700	.5360	.6362	140.3
	320.00	20.134	222.1	.8075	.5524	.6463	146.3
	340.00	18.661	235.1	.8470	.5690	.6579	152.4
	360.00	17.418	248.4	.8850	.5842	.6693	158.0
	380.00	16.351	261.9	.9215	.5980	.6801	163.3
	400.00	15.421	275.6	.9566	.6103	.6901	168.3
	420.00	14.602	289.5	.9905	.6213	.6992	173.0
	440.00	13.874	303.5	1.0232	.6309	.7071	177.6

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12
 MIXING COEFFICIENT = .005
 COMPOSITION = .400 MASS FRACTION R11
 = .370 MOLE FRACTION R11

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	294.32	1400.591	55.5	.2507	.8280	.9320	293.6
SAT VAP	315.29	21.282	224.4	.8065	.5431	.6398	141.5
	320.00	20.866	227.4	.8160	.5471	.6422	143.0
	340.00	19.298	240.3	.8552	.5631	.6525	149.3
	360.00	17.985	253.5	.8928	.5776	.6629	155.0
	380.00	16.862	266.9	.9289	.5908	.6728	160.4
	400.00	15.888	280.4	.9637	.6026	.6820	165.4
	420.00	15.033	294.1	.9971	.6129	.6902	170.2
	440.00	14.274	308.0	1.0294	.6219	.6975	174.8

**TABLE A.2 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .600 MASS FRACTION R11

= .569 MOLE FRACTION R11

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP ----- (KJ/KG K)	VSND (M/S)
SAT LIQ	304.19	1405.599	63.6	.2779	.8249	.9249	299.3
SAT VAP	325.80	21.156	236.4	.8248	.5464	.6411	141.5
	340.00	19.998	245.5	.8523	.5571	.6475	146.0
	360.00	18.602	258.6	.8896	.5711	.6567	151.9
	380.00	17.416	271.8	.9253	.5837	.6657	157.3
	400.00	16.392	285.2	.9597	.5948	.6740	162.5
	420.00	15.496	298.8	.9928	.6046	.6814	167.3
	440.00	14.703	312.5	1.0246	.6129	.6879	171.9

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .800 MASS FRACTION R11

= .779 MOLE FRACTION R11

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP ----- (KJ/KG K)	VSND (M/S)
SAT LIQ	318.89	1397.289	75.8	.3063	.8232	.9233	298.8
SAT VAP	334.67	21.219	247.3	.8279	.5475	.6408	140.8
	340.00	20.771	250.7	.8381	.5512	.6429	142.5
	360.00	19.279	263.6	.8750	.5646	.6509	148.6
	380.00	18.020	276.7	.9104	.5765	.6588	154.2
	400.00	16.938	290.0	.9444	.5871	.6662	159.4
	420.00	15.996	303.4	.9771	.5962	.6728	164.3
	440.00	15.164	316.9	1.0085	.6039	.6784	169.0

**TABLE A.2 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .200 MASS FRACTION R11

= .180 MOLE FRACTION R11

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	307.57	1321.961	69.1	.2850	.8446	.9767	253.3
SAT VAP	321.13	37.614	218.4	.7622	.5590	.6839	138.9
	340.00	34.479	231.3	.8013	.5742	.6865	146.2
	360.00	31.809	245.1	.8407	.5891	.6921	153.0
	380.00	29.605	259.0	.8783	.6026	.6989	159.1
	400.00	27.743	273.0	.9144	.6148	.7059	164.8
	420.00	26.139	287.2	.9490	.6256	.7127	170.1
	440.00	24.739	301.5	.9823	.6350	.7189	175.1

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .400 MASS FRACTION R11

= .370 MOLE FRACTION R11

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	315.87	1336.342	76.0	.3171	.8414	.9634	261.7
SAT VAP	335.52	36.740	233.0	.8005	.5650	.6848	140.3
	340.00	35.990	236.1	.8096	.5684	.6851	142.1
	360.00	33.076	249.8	.8488	.5826	.6884	149.2
	380.00	30.700	263.6	.8861	.5955	.6935	155.6
	400.00	28.710	277.6	.9219	.6071	.6993	161.4
	420.00	27.008	291.6	.9561	.6172	.7050	166.9
	440.00	25.529	305.8	.9890	.6260	.7102	172.0

**TABLE A.2 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12
MIXING COEFFICIENT = .005
COMPOSITION = .600 MASS FRACTION R11
 = .569 MOLE FRACTION R11

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY -----	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	326.93	1341.220	85.0	.3432	.8381	.9552	266.7
SAT VAP	347.08	36.495	245.7	.8207	.5675	.6849	140.3
	360.00	34.504	254.5	.8457	.5761	.6856	145.1
	380.00	31.919	268.3	.8829	.5884	.6888	151.8
	400.00	29.776	282.1	.9183	.5993	.6931	157.9
	420.00	27.958	296.0	.9522	.6088	.6976	163.5
	440.00	26.388	310.0	.9848	.6170	.7018	168.7

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12
MIXING COEFFICIENT = .005
COMPOSITION = .800 MASS FRACTION R11
 = .779 MOLE FRACTION R11

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY -----	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	342.67	1331.530	98.1	.3732	.8352	.9535	265.7
SAT VAP	357.01	36.618	257.1	.8255	.5678	.6844	139.5
	360.00	36.135	259.1	.8312	.5697	.6842	140.7
	380.00	33.289	272.8	.8682	.5813	.6850	147.7
	400.00	30.962	286.5	.9034	.5916	.6875	154.0
	420.00	29.006	300.3	.9370	.6005	.6907	159.8
	440.00	27.329	314.1	.9692	.6080	.6937	165.2

**TABLE A.2 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .200 MASS FRACTION R11

= .180 MOLE FRACTION R11

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	322.36	1270.304	83.8	.3309	.8517	1.0069	231.1
SAT VAP	334.99	53.918	223.4	.7574	.5763	.7290	136.9
	340.00	52.479	227.0	.7681	.5801	.7261	139.2
	360.00	47.661	241.5	.8095	.5945	.7209	147.5
	380.00	43.890	255.9	.8484	.6076	.7212	154.8
	400.00	40.818	270.3	.8855	.6195	.7240	161.2
	420.00	38.242	284.9	.9209	.6300	.7278	167.1
	440.00	36.038	299.5	.9549	.6392	.7317	172.6

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .400 MASS FRACTION R11

= .370 MOLE FRACTION R11

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	331.47	1285.929	91.2	.3636	.8488	.9908	239.2
SAT VAP	349.97	52.574	238.5	.7967	.5814	.7267	138.4
	360.00	50.021	245.8	.8172	.5881	.7224	142.8
	380.00	45.824	260.2	.8561	.6006	.7192	150.3
	400.00	42.460	274.6	.8930	.6118	.7197	157.3
	420.00	39.674	289.0	.9282	.6217	.7217	163.4
	440.00	37.311	303.5	.9618	.6302	.7243	169.0

**TABLE A.2 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-12 MIXTURE (Concluded).**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .600 MASS FRACTION R11

= .569 MOLE FRACTION R11

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	343.39	1290.747	101.0	.3921	.8454	.9813	243.6
SAT VAP	362.27	52.199	251.6	.8181	.5832	.7257	138.4
	380.00	48.049	264.4	.8526	.5935	.7190	145.7
	400.00	44.319	278.7	.8894	.6041	.7165	153.0
	420.00	41.275	293.1	.9244	.6133	.7165	159.4
	440.00	38.720	307.4	.9577	.6212	.7175	165.3

SUPERHEATED VAPOR PROPERTIES FOR R11 /R12

MIXING COEFFICIENT = .005

COMPOSITION = .800 MASS FRACTION R11

= .779 MOLE FRACTION R11

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	359.78	1279.943	114.7	.4197	.8414	.9799	242.4
SAT VAP	373.00	52.409	263.3	.8240	.5828	.7253	137.5
	380.00	50.658	268.4	.8375	.5866	.7213	140.5
	400.00	46.449	282.8	.8743	.5964	.7148	148.3
	420.00	43.082	297.0	.9091	.6050	.7122	155.1
	440.00	40.293	311.3	.9422	.6123	.7114	161.2

TABLE A.3 - SATURATED VAPOR-LIQUID PROPERTIES OF R-11/R-22 MIXTURE

DEW/BUBBLE LINES AT T = 273.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	40.12	.08958	55.564	4603.2	30638.3	18.200	113.531	106.887	66.766	117.929	75.662
.1000	.6465	105.54	.08772	20.907	4698.5	25144.3	20.841	103.733	104.152	53.528	115.692	62.846
.2000	.7898	163.62	.08584	13.339	4766.5	23867.1	22.204	97.224	101.443	50.656	113.530	60.414
.3000	.8540	215.27	.08391	10.037	4804.5	23259.1	22.990	93.255	98.766	49.406	111.455	59.587
.4000	.8915	261.46	.08193	8.187	4809.2	22882.0	23.330	90.473	96.131	48.701	109.478	59.283
.5000	.9169	303.28	.07989	6.998	4776.6	22610.8	23.267	88.341	93.551	48.238	107.612	59.202
.6000	.9362	341.92	.07775	6.157	4701.7	22394.6	22.805	86.588	91.040	47.897	105.865	59.228
.7000	.9524	378.72	.07549	5.517	4578.1	22207.1	21.915	85.047	88.621	47.617	104.245	59.312
.8000	.9674	415.25	.07306	4.993	4397.9	22030.5	20.526	83.591	86.324	47.363	102.746	59.430
.9000	.9827	453.42	.07041	4.537	4150.9	21849.6	18.474	82.090	84.189	47.105	101.348	59.573
1.0000	1.0000	495.71	.06746	4.114	3823.7	21647.2	15.021	80.285	82.274	46.812	100.002	59.732

DEW/BUBBLE LINES AT T = 283.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	60.51	.09092	37.929	5790.4	31342.9	22.463	112.722	108.019	68.053	119.301	77.192
.1000	.6115	145.60	.08911	15.579	5864.5	26000.4	25.021	103.706	105.284	55.480	117.122	65.133
.2000	.7642	222.09	.08728	10.083	5911.9	24594.5	26.305	97.189	102.572	52.420	115.030	62.628
.3000	.8349	290.95	.08542	7.603	5930.1	23898.4	27.014	93.091	99.890	51.052	113.037	61.806
.4000	.8769	353.30	.08351	6.190	5915.8	23456.3	27.282	90.166	97.245	50.274	111.158	61.560
.5000	.9057	410.42	.08153	5.272	5865.2	23132.9	27.150	87.893	94.650	49.761	109.410	61.568
.6000	.9277	463.75	.07947	4.618	5773.4	22871.9	26.625	86.002	92.122	49.385	107.805	61.705
.7000	.9463	514.95	.07728	4.118	5634.2	22643.4	25.676	84.325	89.680	49.078	106.353	61.916
.8000	.9634	565.98	.07492	3.710	5439.6	22427.8	24.232	82.732	87.357	48.803	105.052	62.180
.9000	.9807	619.26	.07233	3.356	5179.2	22208.0	22.129	81.089	85.194	48.527	103.875	62.491
1.0000	1.0000	677.94	.06942	3.031	4839.0	21965.0	18.627	79.122	83.253	48.219	102.756	62.851

**TABLE A.3 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-11/R-22 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 293.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG	MOL K)		
.0000	.0000	88.38	.09233	26.659	6991.7	32044.4	26.624	112.099	109.075	69.306	120.677	78.760
.1000	.5773	196.58	.09058	11.829	7045.3	26858.4	29.104	103.784	106.343	57.414	118.569	67.486
.2000	.7379	295.00	.08881	7.766	7073.0	25330.3	30.313	97.282	103.629	54.205	116.559	64.965
.3000	.8149	384.67	.08702	5.870	7072.2	24543.3	30.951	93.066	100.941	52.731	114.666	64.191
.4000	.8614	466.84	.08519	4.770	7039.9	24031.4	31.150	89.998	98.285	51.886	112.908	64.045
.5000	.8937	542.96	.08330	4.048	6972.5	23650.2	30.956	87.577	95.675	51.330	111.307	64.190
.6000	.9186	614.76	.08133	3.530	6865.3	23338.3	30.373	85.540	93.124	50.923	109.884	64.494
.7000	.9396	684.26	.07924	3.132	6712.1	23062.7	29.371	83.715	90.656	50.596	108.655	64.900
.8000	.9590	753.88	.07698	2.807	6505.1	22801.3	27.880	81.971	88.300	50.305	107.621	65.389
.9000	.9785	826.63	.07447	2.526	6233.4	22535.1	25.736	80.168	86.101	50.017	106.756	65.965
1.0000	1.0000	906.42	.07162	2.271	5882.6	22243.5	22.194	78.014	84.124	49.700	105.972	66.642

DEW/BUBBLE LINES AT T = 303.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG	MOL K)		
.0000	.0000	125.46	.09382	19.223	8207.2	32739.7	30.690	111.628	110.055	70.529	122.067	80.386
.1000	.5441	260.32	.09213	9.130	8241.2	27713.6	33.096	103.944	107.326	59.325	120.041	69.919
.2000	.7112	384.38	.09043	6.079	8249.9	26071.1	34.234	97.481	104.611	56.007	118.131	67.447
.3000	.7941	498.71	.08872	4.607	8231.2	25191.5	34.805	93.155	101.916	54.445	116.359	66.770
.4000	.8450	604.67	.08698	3.738	8182.2	24605.3	34.943	89.945	99.249	53.544	114.751	66.779
.5000	.8808	703.93	.08520	3.160	8099.4	24160.8	34.691	87.373	96.620	52.952	113.338	67.127
.6000	.9086	798.50	.08335	2.742	7978.5	23791.6	34.056	85.180	94.044	52.524	112.151	67.676
.7000	.9323	890.81	.08139	2.420	7813.5	23461.8	33.010	83.196	91.541	52.183	111.219	68.373
.8000	.9541	983.84	.07926	2.157	7596.5	23146.8	31.481	81.284	89.144	51.884	110.557	69.207
.9000	.9760	1081.27	.07688	1.929	7316.5	22825.4	29.304	79.299	86.897	51.594	110.142	70.197
1.0000	1.0000	1187.87	.07412	1.724	6958.2	22475.0	25.733	76.927	84.871	51.278	109.866	71.386

**TABLE A.3 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-11/R-22 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 313.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)		(KJ/KG MOL K)					
.0000	.0000	173.66	.09539	14.173	9437.1	33425.6	34.667	111.283	110.957	71.726	123.481	82.092
.1000	.5121	338.76	.09377	7.151	9452.3	28561.5	37.004	104.168	108.231	61.214	121.553	72.452
.2000	.6842	492.28	.09216	4.828	9443.1	26813.6	38.075	97.763	105.515	57.830	119.763	70.100
.3000	.7725	635.32	.09055	3.669	9407.7	25840.7	38.584	93.338	102.813	56.199	118.139	69.581
.4000	.8277	769.35	.08892	2.972	9343.4	25176.1	38.664	89.988	100.132	55.254	116.719	69.815
.5000	.8670	896.26	.08727	2.503	9247.0	24662.7	38.362	87.262	97.481	54.638	115.546	70.452
.6000	.8979	1018.39	.08557	2.161	9114.4	24229.7	37.683	84.906	94.874	54.198	114.670	71.356
.7000	.9242	1138.66	.08377	1.896	8940.2	23837.9	36.601	82.748	92.329	53.855	114.146	72.484
.8000	.9486	1260.67	.08182	1.678	8716.5	23460.1	35.044	80.648	89.879	53.561	114.013	73.846
.9000	.9732	1388.95	.07962	1.491	8432.2	23072.7	32.847	78.455	87.569	53.281	114.270	75.494
1.0000	1.0000	1529.27	.07703	1.323	8071.0	22650.7	29.261	75.827	85.474	52.982	114.800	77.527

DEW/BUBBLE LINES AT T = 323.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)		(KJ/KG MOL K)					
.0000	.0000	235.01	.09706	10.655	10681.7	34098.9	38.561	111.038	111.777	72.902	124.933	83.905
.1000	.4812	433.93	.09553	5.672	10679.1	29398.0	40.832	104.438	109.056	63.081	123.124	75.113
.2000	.6570	620.77	.09401	3.882	10653.2	27554.4	41.842	98.110	106.338	59.673	121.479	72.959
.3000	.7501	796.70	.09251	2.958	10602.4	26488.3	42.294	93.599	103.628	57.997	120.039	72.673
.4000	.8095	963.30	.09103	2.393	10524.3	25742.0	42.322	90.113	100.931	57.024	118.856	73.220
.5000	.8522	1122.70	.08954	2.007	10416.4	25154.1	41.976	87.229	98.253	56.398	117.995	74.262
.6000	.8861	1277.63	.08802	1.724	10274.9	24650.1	41.261	84.699	95.607	55.960	117.538	75.676
.7000	.9153	1431.60	.08644	1.503	10094.8	24187.6	40.152	82.353	93.010	55.630	117.581	77.444
.8000	.9425	1589.00	.08474	1.320	9868.9	23736.3	38.581	80.045	90.491	55.358	118.225	79.622
.9000	.9700	1755.38	.08281	1.163	9585.9	23269.7	36.381	77.610	88.097	55.108	119.532	82.341
1.0000	1.0000	1937.77	.08046	1.023	9228.6	22759.2	32.799	74.677	85.906	54.848	121.412	85.819

**TABLE A.3 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-11/R-22 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 333.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	311.69	.09885	8.148	11941.4	34756.4	42.378	110.871	112.515	74.062	126.445	85.859
.1000	.4516	547.92	.09741	4.550	11922.0	30219.1	44.587	104.739	109.798	64.928	124.778	77.939
.2000	.6296	771.94	.09601	3.155	11880.8	28289.9	45.540	98.505	107.078	61.540	123.312	76.068
.3000	.7269	984.97	.09465	2.412	11816.1	27131.7	45.940	93.920	104.357	59.843	122.102	76.106
.4000	.7902	1188.77	.09332	1.948	11726.4	26300.7	45.923	90.302	101.640	58.862	121.223	77.083
.5000	.8364	1385.75	.09203	1.627	11609.3	25633.0	45.539	87.259	98.929	58.243	120.775	78.686
.6000	.8733	1579.13	.09076	1.390	11462.2	25050.7	44.797	84.548	96.235	57.827	120.891	80.829
.7000	.9054	1773.11	.08947	1.202	11280.7	24507.8	43.675	81.998	93.571	57.530	121.751	83.556
.8000	.9356	1973.11	.08811	1.048	11058.5	23970.2	42.106	79.454	90.963	57.304	123.579	87.026
.9000	.9663	2186.07	.08657	.914	10785.2	23407.2	39.925	76.738	88.455	57.113	126.609	91.548
1.0000	1.0000	2420.63	.08464	.794	10442.4	22785.3	36.377	73.432	86.126	56.928	130.922	97.663

DEW/BUBBLE LINES AT T = 343.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	405.97	.10078	6.324	13216.7	35394.6	46.122	110.762	113.166	75.212	128.043	87.998
.1000	.4232	682.86	.09945	3.687	13181.9	31020.6	48.274	105.056	110.453	66.759	126.549	80.977
.2000	.6020	947.81	.09818	2.589	13126.7	29016.4	49.174	98.932	107.729	63.433	125.305	79.487
.3000	.7030	1202.15	.09698	1.985	13050.0	27768.2	49.528	94.288	104.996	61.744	124.388	79.961
.4000	.7699	1447.83	.09585	1.601	12950.9	26850.1	49.472	90.544	102.252	60.777	123.906	81.518
.5000	.8193	1687.61	.09481	1.332	12827.8	26097.5	49.059	87.340	99.502	60.187	124.014	83.899
.6000	.8593	1925.33	.09384	1.130	12679.2	25429.0	48.302	84.440	96.747	59.816	124.938	87.095
.7000	.8944	2166.11	.09294	.970	12502.2	24794.5	47.182	81.668	93.998	59.580	127.012	91.282
.8000	.9276	2416.74	.09208	.836	12292.4	24155.1	45.637	78.858	91.271	59.434	130.732	96.857
.9000	.9619	2686.08	.09114	.720	12041.3	23473.1	43.508	75.806	88.603	59.348	136.795	104.601
1.0000	1.0000	2985.21	.08992	.616	11731.2	22706.6	40.043	72.032	86.070	59.297	145.976	115.992

**TABLE A.3 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-11/R-22 MIXTURE (Concluded).**

DEW/BUBBLE LINES AT T = 355.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	520.22	.10286	4.973	14508.4	36010.1	49.800	110.694	113.728	76.358	129.763	90.376
.1000	.3959	840.92	.10166	3.012	14459.6	31798.8	51.899	105.377	111.017	68.581	128.484	84.291
.2000	.5745	1150.40	.10055	2.142	14392.1	29730.2	52.752	99.379	108.288	65.358	127.520	83.294
.3000	.6784	1450.09	.09955	1.647	14305.6	28394.8	53.065	94.698	105.537	63.707	126.981	84.347
.4000	.7484	1742.24	.09867	1.326	14199.8	27387.8	52.978	90.826	102.762	62.780	127.027	86.686
.5000	.8009	2030.06	.09793	1.099	14074.7	26545.1	52.546	87.461	99.960	62.246	127.905	90.149
.6000	.8438	2318.14	.09737	.926	13930.0	25782.0	51.788	84.363	97.130	61.950	130.001	94.884
.7000	.8818	2612.81	.09701	.787	13765.7	25043.2	50.690	81.349	94.269	61.813	133.959	101.352
.8000	.9184	2922.75	.09686	.671	13581.0	24282.2	49.201	78.234	91.382	61.798	140.894	110.535
.9000	.9565	3259.70	.09690	.568	13372.6	23449.6	47.178	74.773	88.485	61.886	152.833	124.537
1.0000	1.0000	3638.86	.09698	.475	13129.0	22484.9	43.883	70.379	85.629	62.077	173.469	148.238

DEW/BUBBLE LINES AT T = 363.1 K

COMPONENT A: R22 COMPONENT B: R11

MIXING COEFFICIENT, F = .0370

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	656.89	.10513	3.954	15817.6	36599.2	53.416	110.650	114.196	77.508	131.655	93.065
.1000	.3698	1024.31	.10408	2.480	15756.2	32549.4	55.468	105.690	111.486	70.399	130.646	87.966
.2000	.5468	1381.62	.10316	1.784	15678.5	30427.1	56.278	99.829	108.747	67.320	130.042	87.598
.3000	.6529	1730.48	.10240	1.377	15584.7	29007.9	56.558	95.107	105.974	65.740	130.002	89.414
.4000	.7258	2073.46	.10182	1.107	15475.9	27910.9	56.449	91.136	103.159	64.884	130.771	92.808
.5000	.7811	2414.34	.10149	.912	15353.5	26973.2	56.011	87.610	100.293	64.437	132.744	97.796
.6000	.8267	2758.66	.10148	.763	15220.1	26106.3	55.268	84.305	97.365	64.255	136.611	104.831
.7000	.8676	3114.31	.10187	.642	15080.2	25247.9	54.221	81.027	94.356	64.271	143.650	115.010
.8000	.9073	3492.57	.10282	.538	14940.6	24339.1	52.839	77.556	91.245	64.462	156.521	130.826
.9000	.9496	3909.66	.10456	.446	14812.0	23307.1	51.014	73.574	87.998	64.849	181.629	158.747
1.0000	1.0000	4388.87	.10741	.360	14710.8	22041.6	48.085	68.275	84.574	65.514	238.363	220.622

TABLE A.4 - SUPERHEATED VAPOR PROPERTIES OF R-11/R-22 MIXTURE

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .200 MASS FRACTION R11

= .136 MOLE FRACTION R11

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	234.48	1428.699	4.9	.0478	.8595	1.0078	411.4
SAT VAP	254.42	4.538	238.7	1.0257	.5017	.6009	160.2
	260.00	4.433	242.1	1.0388	.5088	.6074	162.0
	280.00	4.094	254.5	1.0847	.5333	.6302	168.1
	300.00	3.806	267.3	1.1289	.5568	.6525	174.0
	320.00	3.557	280.6	1.1717	.5794	.6740	179.7
	340.00	3.339	294.3	1.2132	.6011	.6948	185.1
	360.00	3.148	308.4	1.2535	.6218	.7148	190.3
	380.00	2.977	322.8	1.2927	.6415	.7339	195.3
	400.00	2.825	337.7	1.3308	.6602	.7522	200.2
	420.00	2.688	352.9	1.3679	.6780	.7695	205.0
	440.00	2.563	368.5	1.4041	.6948	.7860	209.6

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .400 MASS FRACTION R11

= .296 MOLE FRACTION R11

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	237.40	1451.590	9.5	.0768	.8288	.9615	409.2
SAT VAP	268.21	4.678	240.1	1.0062	.5098	.6010	156.6
	280.00	4.466	247.3	1.0323	.5232	.6135	160.1
	300.00	4.148	259.8	1.0753	.5452	.6341	165.8
	320.00	3.875	272.7	1.1169	.5661	.6539	171.3
	340.00	3.637	285.9	1.1571	.5860	.6728	176.6
	360.00	3.427	299.6	1.1951	.6047	.6908	181.6
	380.00	3.241	313.6	1.2339	.6224	.7079	186.6
	400.00	3.074	327.9	1.2706	.6389	.7240	191.3
	420.00	2.924	342.5	1.3063	.6545	.7390	195.9
	440.00	2.789	357.4	1.3410	.6689	.7531	200.4

**TABLE A.4 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-22 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .600 MASS FRACTION R11

= .486 MOLE FRACTION R11

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	241.85	1482.076	13.4	.0948	.8032	.9184	408.3
SAT VAP	278.70	4.939	239.3	.9648	.5119	.5956	151.3
	280.00	4.913	240.1	.9676	.5132	.5969	151.6
	300.00	4.561	252.2	1.0094	.5336	.6158	157.2
	320.00	4.257	264.7	1.0498	.5528	.6338	162.6
	340.00	3.993	277.6	1.0887	.5708	.6509	167.7
	360.00	3.762	290.8	1.1264	.5876	.6669	172.6
	380.00	3.556	304.3	1.1628	.6033	.6819	177.4
	400.00	3.372	318.0	1.1982	.6177	.6958	182.0
	420.00	3.207	332.1	1.2324	.6309	.7086	186.5
	440.00	3.058	346.4	1.2657	.6429	.7202	190.8

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .800 MASS FRACTION R11

= .716 MOLE FRACTION R11

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	251.78	1512.317	19.9	.1136	.7856	.8830	402.9
SAT VAP	287.87	5.302	237.5	.9055	.5108	.5874	144.9
	300.00	5.068	244.7	.9300	.5220	.5977	148.2
	320.00	4.726	256.8	.9691	.5395	.6140	153.4
	340.00	4.430	269.2	1.0068	.5557	.6291	158.3
	360.00	4.170	281.9	1.0431	.5706	.6432	163.1
	380.00	3.941	294.9	1.0783	.5842	.6561	167.7
	400.00	3.736	308.2	1.1122	.5964	.6677	172.2
	420.00	3.552	321.6	1.1450	.6074	.6782	176.5
	440.00	3.386	335.3	1.1768	.6170	.6874	180.7

**TABLE A.4 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-22 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .200 MASS FRACTION R11

= .136 MOLE FRACTION R11

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	270.23	1317.700	42.4	.1953	.9062	1.0835	340.4
SAT VAP	288.29	16.887	254.9	.9682	.5482	.6727	163.4
	300.00	16.057	262.9	.9952	.5618	.6820	167.6
	320.00	14.839	276.7	1.0397	.5843	.6987	174.4
	340.00	13.814	290.8	1.0826	.6059	.7158	180.8
	360.00	12.937	305.3	1.1240	.6265	.7329	186.7
	380.00	12.175	320.1	1.1641	.6461	.7498	192.4
	400.00	11.506	335.3	1.2029	.6648	.7662	197.7
	420.00	10.912	350.8	1.2407	.6825	.7820	202.9
	440.00	10.381	366.6	1.2774	.6993	.7972	207.9

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .400 MASS FRACTION R11

= .296 MOLE FRACTION R11

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	274.69	1341.732	46.7	.2213	.8737	1.0294	339.4
SAT VAP	304.89	17.315	258.3	.9616	.5553	.6692	160.1
	320.00	16.295	268.5	.9942	.5709	.6801	165.2
	340.00	15.141	282.3	1.0359	.5906	.6949	171.6
	360.00	14.159	296.3	1.0761	.6093	.7098	177.5
	380.00	13.310	310.7	1.1148	.6268	.7244	183.1
	400.00	12.567	325.3	1.1524	.6434	.7385	188.4
	420.00	11.909	340.2	1.1887	.6588	.7520	193.5
	440.00	11.323	355.4	1.2240	.6731	.7647	198.3

**TABLE A.4 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-22 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .600 MASS FRACTION R11

= .486 MOLE FRACTION R11

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY -----	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	281.57	1372.968	51.2	.2385	.8465	.9793	338.9
SAT VAP	318.37	18.226	259.2	.9329	.5561	.6614	154.7
	320.00	18.107	260.2	.9363	.5576	.6624	155.3
	340.00	16.778	273.6	.9768	.5754	.6748	161.7
	360.00	15.657	287.2	1.0157	.5921	.6873	167.6
	380.00	14.694	301.1	1.0532	.6076	.6995	173.2
	400.00	13.856	315.2	1.0894	.6220	.7112	178.4
	420.00	13.118	329.6	1.1244	.6351	.7222	183.4
	440.00	12.462	344.1	1.1582	.6470	.7324	188.2

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .800 MASS FRACTION R11

= .716 MOLE FRACTION R11

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY -----	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	295.91	1400.324	60.2	.2602	.8270	.9391	332.0
SAT VAP	330.60	19.365	258.7	.8856	.5530	.6513	147.9
	340.00	18.861	264.8	.9039	.5603	.6558	150.9
	360.00	17.546	278.0	.9417	.5750	.6656	156.9
	380.00	16.429	291.4	.9779	.5885	.6753	162.5
	400.00	15.463	305.0	1.0128	.6006	.6845	167.8
	420.00	14.618	318.8	1.0464	.6114	.6929	172.7
	440.00	13.869	332.7	1.0788	.6210	.7005	177.5

**TABLE A.4 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-22 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .200 MASS FRACTION R11

= .136 MOLE FRACTION R11

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	288.38	1255.561	62.5	.2666	.9257	1.1318	306.1
SAT VAP	305.26	29.128	261.8	.9462	.5732	.7240	162.8
	320.00	27.220	272.5	.9804	.5895	.7298	168.8
	340.00	25.077	287.2	1.0250	.6109	.7408	176.3
	360.00	23.306	302.1	1.0677	.6314	.7537	183.0
	380.00	21.808	317.3	1.1088	.6509	.7674	189.3
	400.00	20.519	332.8	1.1485	.6695	.7814	195.2
	420.00	19.393	348.6	1.1870	.6871	.7953	200.8
	440.00	18.399	364.6	1.2243	.7038	.8090	206.1

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .400 MASS FRACTION R11

= .296 MOLE FRACTION R11

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	293.77	1280.419	66.8	.2912	.8926	1.0714	305.7
SAT VAP	323.09	29.780	266.2	.9451	.5792	.7160	159.7
	340.00	27.702	278.4	.9818	.5956	.7225	166.2
	360.00	25.664	292.9	1.0233	.6141	.7323	173.1
	380.00	23.957	307.7	1.0632	.6315	.7433	179.5
	400.00	22.500	322.6	1.1016	.6479	.7547	185.4
	420.00	21.235	337.8	1.1387	.6632	.7660	190.9
	440.00	20.124	353.3	1.1746	.6775	.7770	196.2

**TABLE A.4 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-22 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .600 MASS FRACTION R11

= .486 MOLE FRACTION R11

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	302.10	1312.050	71.7	.3081	.8648	1.0157	305.2
SAT VAP	338.13	31.311	268.0	.9219	.5789	.7061	154.3
	340.00	31.058	269.3	.9258	.5805	.7065	155.0
	360.00	28.635	283.5	.9663	.5969	.7126	162.2
	380.00	26.638	297.8	1.0050	.6123	.7204	168.7
	400.00	24.951	312.3	1.0422	.6264	.7288	174.7
	420.00	23.500	326.9	1.0780	.6394	.7374	180.4
	440.00	22.234	341.8	1.1125	.6512	.7456	185.6

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .800 MASS FRACTION R11

= .716 MOLE FRACTION R11

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	318.84	1337.323	82.2	.3310	.8439	.9718	297.5
SAT VAP	352.07	33.657	268.2	.8798	.5744	.6949	147.1
	360.00	32.541	273.7	.8953	.5799	.6957	150.0
	380.00	30.106	287.7	.9330	.5931	.6994	156.9
	400.00	28.087	301.7	.9690	.6050	.7044	163.1
	420.00	26.372	315.9	1.0035	.6157	.7098	168.8
	440.00	24.891	330.1	1.0366	.6251	.7151	174.2

**TABLE A.4 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-22 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .200 MASS FRACTION R11

= .136 MOLE FRACTION R11

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	301.39	1207.426	77.5	.3166	.9375	1.1744	282.0
SAT VAP	317.33	41.611	265.9	.9317	.5924	.7719	161.4
	320.00	41.032	267.9	.9381	.5953	.7712	162.7
	340.00	37.298	283.3	.9849	.6163	.7715	171.5
	360.00	34.346	298.8	1.0291	.6366	.7778	179.2
	380.00	31.928	314.5	1.0714	.6559	.7871	186.2
	400.00	29.893	330.3	1.1121	.6743	.7980	192.6
	420.00	28.148	346.4	1.1513	.6918	.8095	198.6
	440.00	26.629	362.7	1.1892	.7084	.8213	204.2

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22

MIXING COEFFICIENT = .037

COMPOSITION = .400 MASS FRACTION R11

= .296 MOLE FRACTION R11

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	307.54	1233.040	81.8	.3404	.9042	1.1076	282.0
SAT VAP	335.92	42.442	271.0	.9342	.5973	.7588	158.5
	340.00	41.613	274.1	.9433	.6011	.7582	160.3
	360.00	38.098	289.3	.9867	.6193	.7595	168.5
	380.00	35.271	304.5	1.0279	.6364	.7650	175.7
	400.00	32.924	319.9	1.0673	.6526	.7726	182.3
	420.00	30.931	335.4	1.1052	.6678	.7812	188.3
	440.00	29.209	351.1	1.1417	.6819	.7901	194.0

**TABLE A.4 - SUPERHEATED VAPOR PROPERTIES
OF R-11/R-22 MIXTURE (Concluded).**

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22
 MIXING COEFFICIENT = .037
 COMPOSITION = .600 MASS FRACTION R11
 = .486 MOLE FRACTION R11

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	317.01	1264.958	87.1	.3571	.8761	1.0464	281.5
SAT VAP	352.10	44.592	273.5	.9147	.5959	.7465	153.1
	360.00	42.990	279.4	.9313	.6022	.7451	156.4
	380.00	39.550	294.3	.9716	.6172	.7455	164.1
	400.00	36.752	309.2	1.0099	.6311	.7491	170.9
	420.00	34.411	324.2	1.0465	.6439	.7543	177.2
	440.00	32.410	339.4	1.0818	.6555	.7600	182.9

SUPERHEATED VAPOR PROPERTIES FOR R11 /R22
 MIXING COEFFICIENT = .037
 COMPOSITION = .800 MASS FRACTION R11
 = .716 MOLE FRACTION R11

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	335.50	1288.347	98.6	.3806	.8539	.9991	273.2
SAT VAP	367.34	48.012	274.3	.8761	.5902	.7349	145.5
	380.00	45.317	283.6	.9009	.5982	.7309	150.7
	400.00	41.801	298.2	.9383	.6098	.7289	158.1
	420.00	38.931	312.8	.9739	.6202	.7296	164.7
	440.00	36.520	327.4	1.0079	.6293	.7315	170.7

TABLE A.5 - SATURATED VAPOR-LIQUID PROPERTIES OF R-22/R-115 MIXTURE

DEW/BUBBLE LINES AT T = 263.1 K

COMPONENT A: R115 COMPONENT B: R22

MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	353.26	.06570	5.696	2833.6	21296.5	11.363	81.538	81.200	45.461	97.571	57.102
.1000	.0799	334.17	.06901	6.029	1944.1	20963.4	12.074	83.767	87.468	49.178	104.659	60.837
.2000	.2425	335.46	.07297	5.969	1368.0	20232.0	12.270	84.766	93.076	56.797	111.569	68.892
.3000	.4533	371.74	.07761	5.309	1067.1	19238.5	12.570	83.272	98.059	66.736	118.426	79.797
.4000	.6438	446.98	.08306	4.318	1010.5	18271.2	13.056	79.633	102.444	75.820	125.407	90.464
.5000	.7797	556.68	.08950	3.362	1174.8	17472.7	13.746	75.176	106.245	82.459	132.782	99.497
.6000	.8662	691.27	.09730	2.602	1544.2	16822.3	14.650	70.819	109.464	86.887	141.000	107.455
.7000	.9197	839.46	.10704	2.041	2113.2	16256.7	15.788	66.864	112.076	89.859	150.901	115.575
.8000	.9540	991.63	.11986	1.631	2892.9	15724.8	17.206	63.286	114.021	92.004	164.336	125.312
.9000	.9782	1144.35	.13827	1.319	3931.1	15179.0	19.013	59.862	115.148	93.768	186.567	139.069
1.0000	1.0000	1311.10	.16993	1.047	5397.6	14507.9	21.220	55.847	115.016	95.630	242.687	165.489

DEW/BUBBLE LINES AT T = 273.1 K

COMPONENT A: R115 COMPONENT B: R22

MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	495.71	.06746	4.114	3823.7	21647.2	15.021	80.285	82.274	46.812	100.002	59.732
.1000	.0844	472.28	.07091	4.321	3007.0	21327.5	16.003	82.639	88.830	50.824	107.512	63.827
.2000	.2440	476.78	.07508	4.245	2502.2	20661.2	16.461	83.751	94.670	58.477	114.904	72.148
.3000	.4436	525.72	.08004	3.781	2272.1	19771.5	17.020	82.595	99.832	68.139	122.339	83.207
.4000	.6246	622.76	.08592	3.106	2287.7	18879.8	17.765	79.434	104.342	77.045	130.058	94.389
.5000	.7577	762.00	.09300	2.446	2528.0	18093.4	18.723	75.340	108.212	83.812	138.452	104.660
.6000	.8460	932.15	.10173	1.905	2981.2	17398.3	19.920	71.111	111.433	88.585	148.213	114.819
.7000	.9031	1120.31	.11295	1.492	3649.2	16742.9	21.401	67.050	113.961	92.010	160.745	126.700
.8000	.9414	1316.01	.12837	1.177	4559.4	16074.9	23.272	63.132	115.687	94.688	179.555	143.499
.9000	.9701	1517.48	.15235	.925	5807.0	15316.4	25.807	59.030	116.331	97.143	217.078	173.909
1.0000	1.0000	1754.18	.20400	.674	7819.6	14151.2	29.941	53.125	114.791	100.408	389.417	283.741

**TABLE A.5 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-115 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 283.1 K
COMPONENT A: R115 COMPONENT B: R22
MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	677.94	.06942	3.031	4839.0	21965.0	18.627	79.122	83.253	48.219	102.756	62.851
.1000	.0886	650.30	.07303	3.159	4099.5	21660.5	19.886	81.599	90.077	52.528	110.724	67.357
.2000	.2447	659.71	.07746	3.080	3670.6	21052.2	20.612	82.802	96.124	60.208	118.673	76.056
.3000	.4336	724.17	.08279	2.744	3517.1	20248.1	21.438	81.916	101.436	69.621	126.819	87.500
.4000	.6052	846.59	.08922	2.271	3611.9	19414.9	22.455	79.147	106.038	78.367	135.506	99.566
.5000	.7346	1019.50	.09710	1.804	3937.4	18629.4	23.703	75.356	109.934	85.261	145.327	111.707
.6000	.8236	1229.82	.10705	1.410	4487.6	17877.8	25.225	71.223	113.100	90.396	157.412	125.337
.7000	.8833	1463.15	.12032	1.098	5276.1	17111.1	27.107	67.013	115.458	94.339	174.311	143.920
.8000	.9249	1708.37	.13966	.851	6359.1	16259.2	29.553	62.642	116.818	97.699	203.503	176.243
.9000	.9575	1966.31	.17384	.636	7937.5	15151.3	33.203	57.473	116.608	101.236	282.548	263.321

CRITICAL POINT OF PURE OR PSEUDO-PURE MATERIAL EXCEEDED IN BUBLT

PSEUDO-PURE COMPONENT CRITICAL POINT EXCEEDED

DEW/BUBBLE LINES AT T = 293.1 K
COMPONENT A: R115 COMPONENT B: R22
MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	906.42	.07162	2.271	5882.6	22243.5	22.194	78.014	84.124	49.700	105.972	66.642
.1000	.0925	875.05	.07542	2.349	5224.7	21954.3	23.733	80.607	91.191	54.309	114.455	71.647
.2000	.2448	891.53	.08017	2.272	4877.3	21395.5	24.737	81.873	97.417	62.019	123.085	80.908
.3000	.4234	974.61	.08597	2.023	4806.8	20657.9	25.842	81.191	102.845	71.215	132.162	93.102
.4000	.5855	1126.03	.09309	1.683	4989.4	19863.8	27.149	78.728	107.495	79.829	142.207	106.671
.5000	.7103	1336.44	.10201	1.343	5412.2	19063.4	28.713	75.174	111.361	86.861	154.179	121.828
.6000	.7985	1590.81	.11365	1.050	6078.2	18236.9	30.608	71.084	114.393	92.387	170.087	141.432
.7000	.8594	1873.00	.12992	.810	7020.7	17324.3	32.984	66.648	116.455	96.936	195.107	173.437
.8000	.9023	2170.43	.15586	.609	8353.6	16203.0	36.239	61.617	117.190	101.207	248.470	247.433

MIXTURE PRESSURE ITERATION IN BUBLT DID NOT CONVERGE

VOLUME ITERATION FOR INCIPIENT PHASE DID NOT CONVERGE

.9000	.9346	2393.16	.23188	.244	11058.9	11441.9	43.727	44.104	113.638	114.616	850.437	618.626
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CRITICAL POINT OF PURE OR PSEUDO-PURE MATERIAL EXCEEDED IN BUBLT

PSEUDO-PURE COMPONENT CRITICAL POINT EXCEEDED

**TABLE A.5 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-115 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 303.1 K
COMPONENT A: R115 COMPONENT B: R22
MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1187.87	.07012	1.724	6958.2	22475.0	25.733	76.927	84.871	51.278	109.866	71.386
.1000	.0959	1153.75	.07017	1.769	6386.9	22199.8	27.560	79.621	92.151	56.193	118.967	77.033
.2000	.2442	1179.85	.08331	1.699	6127.2	21679.5	28.851	80.919	98.521	63.942	128.489	87.171
.3000	.4126	1284.86	.08971	1.509	6148.2	20988.1	30.250	80.374	104.021	72.961	138.883	100.718
.4000	.5651	1468.75	.09774	1.258	6429.9	20210.8	31.871	78.129	108.664	81.482	150.993	116.897
.5000	.6842	1719.83	.10809	1.006	6967.1	19373.4	33.793	74.728	112.423	88.682	166.522	137.321
.6000	.7701	2020.58	.12218	.784	7777.8	18441.5	36.139	70.596	115.203	94.650	189.487	168.460
.7000	.8296	2351.67	.14333	.593	8933.2	17321.5	39.180	65.787	116.756	99.937	232.401	232.410

MIXTURE PRESSURE ITERATION IN BUBLT DID NOT CONVERGE

VOLUME ITERATION FOR INCIPIENT PHASE DID NOT CONVERGE

.8000	.8716	2579.67	.19031	.367	10941.8	15016.7	44.678	54.074	115.323	107.485	439.173	714.774
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CRITICAL POINT OF PURE OR PSEUDO-PURE MATERIAL EXCEEDED IN BUBLT

PSEUDO-PURE COMPONENT CRITICAL POINT EXCEEDED

DEW/BUBBLE LINES AT T = 313.1 K
COMPONENT A: R115 COMPONENT B: R22
MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1529.27	.07703	1.323	8071.0	22650.7	29.261	75.827	85.474	52.982	114.800	77.527
.1000	.0988	1493.89	.08137	1.346	7592.1	22385.7	31.384	78.603	92.930	58.216	124.703	84.068
.2000	.2427	1532.58	.08703	1.282	7428.0	21890.6	32.976	79.893	99.399	66.023	135.501	95.633
.3000	.4012	1662.91	.09423	1.134	7551.2	21222.5	34.691	79.414	104.915	74.916	147.932	111.619
.4000	.5438	1882.30	.10351	.945	7948.4	20434.6	36.664	77.287	109.474	83.398	163.518	132.572
.5000	.6559	2175.93	.11596	.754	8626.5	19527.1	39.013	73.929	113.012	90.816	185.696	163.265
.6000	.7369	2522.09	.13397	.581	9632.6	18436.0	41.950	69.607	115.347	97.317	224.106	220.829

MIXTURE PRESSURE ITERATION IN BUBLT DID NOT CONVERGE

VOLUME ITERATION FOR INCIPIENT PHASE DID NOT CONVERGE

.7000	.7927	2825.97	.16709	.249	11225.3	13956.6	46.377	54.125	115.531	112.049	340.558	901.242
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CRITICAL POINT OF PURE OR PSEUDO-PURE MATERIAL EXCEEDED IN BUBLT

PSEUDO-PURE COMPONENT CRITICAL POINT EXCEEDED

**TABLE A.5 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-115 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 323.1 K

COMPONENT A: R115 COMPONENT B: R22

MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1937.77	.08046	1.023	9228.6	22759.2	32.799	74.677	85.906	54.848	121.412	85.819
.1000	.1013	1903.19	.08521	1.032	8849.2	22498.0	35.229	77.506	93.491	60.423	132.473	93.721
.2000	.2403	1957.79	.09155	.973	8791.1	22011.2	37.141	78.741	100.002	68.320	145.298	107.752
.3000	.3888	2116.69	.09987	.856	9032.3	21338.6	39.208	78.244	105.456	77.153	161.261	128.341
.4000	.5209	2373.71	.11100	.710	9570.4	20503.2	41.597	76.115	109.817	85.673	183.539	158.949
.5000	.6242	2709.09	.12681	.561	10436.7	19470.9	44.500	72.630	112.945	93.407	220.624	213.478
.6000	.6960	3091.70	.15230	.421	11749.4	18104.3	48.347	67.794	114.437	100.638	304.440	352.237

CRITICAL POINT OF PURE OR PSEUDO-PURE MATERIAL EXCEEDED IN BUBLT

PSEUDO-PURE COMPONENT CRITICAL POINT EXCEEDED

DEW/BUBBLE LINES AT T = 333.1 K

COMPONENT A: R115 COMPONENT B: R22

MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	2420.63	.08464	.794	10442.4	22785.3	36.377	73.432	86.126	56.928	130.922	97.663
.1000	.1032	2389.58	.08995	.793	10172.0	22517.4	39.130	76.274	93.780	62.879	143.893	107.864
.2000	.2368	2463.57	.09727	.740	10235.2	22016.4	41.397	77.391	100.251	70.919	160.399	126.557
.3000	.3750	2653.84	.10726	.645	10619.7	21302.0	43.876	76.767	105.526	79.782	183.506	156.824
.4000	.4955	2948.62	.12143	.529	11345.3	20360.8	46.803	74.458	109.497	88.466	221.588	210.875
.5000	.5866	3318.58	.14373	.408	12505.9	19088.9	50.554	70.509	111.822	96.724	304.868	341.914

CRITICAL POINT OF PURE OR PSEUDO-PURE MATERIAL EXCEEDED IN BUBLT

PSEUDO-PURE COMPONENT CRITICAL POINT EXCEEDED

**TABLE A.5 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-115 MIXTURE (Concluded).**

DEW/BUBBLE LINES AT T = 343.1 K

COMPONENT A: R115 COMPONENT B: R22

MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	2985.21	.08992	.616	11731.2	22706.6	40.043	72.032	86.070	59.297	145.976	115.992
.1000	.1044	2960.92	.09605	.608	11583.9	22415.2	43.149	74.831	93.710	65.680	162.681	130.658
.2000	.2320	3057.86	.10491	.560	11794.2	21866.0	45.830	75.733	100.017	73.949	187.243	159.602
.3000	.3591	3281.01	.11775	.480	12370.6	21049.2	48.846	74.810	104.908	82.993	228.755	215.078
.4000	.4655	3608.75	.13799	.383	13394.8	19879.7	52.610	71.960	108.070	92.102	321.524	352.280

CRITICAL POINT OF PURE OR PSEUDO-PURE MATERIAL EXCEEDED IN BUBLT

PSEUDO-PURE COMPONENT CRITICAL POINT EXCEEDED

DEW/BUBBLE LINES AT T = 353.1 K

COMPONENT A: R115 COMPONENT B: R22

MIXING COEFFICIENT, F = -.2560

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	3638.86	.09698	.475	13129.0	22484.9	43.883	70.379	85.629	62.077	173.469	148.238
.1000	.1049	3625.08	.10447	.462	13130.6	22140.5	47.400	73.042	93.121	68.996	199.519	173.747
.2000	.2255	3748.01	.11613	.417	13541.6	21480.6	50.630	73.555	99.036	77.663	248.136	232.759
.3000	.3392	4002.01	.13518	.345	14438.6	20421.2	54.523	71.930	103.058	87.226	367.433	395.372

CRITICAL POINT OF PURE OR PSEUDO-PURE MATERIAL EXCEEDED IN BUBLT

PSEUDO-PURE COMPONENT CRITICAL POINT EXCEEDED

TABLE A.6 - SUPERHEATED VAPOR PROPERTIES OF R-22/R-115 MIXTURE

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .200 MASS FRACTION R22

= .309 MOLE FRACTION R22

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP ----- (KJ/KG K)	VSND (M/S)
SAT LIQ	208.24	1542.994	-39.2	-.1119	.7285	.8921	329.4
SAT VAP	226.97	7.366	118.0	.6074	.5298	.6035	121.8
	240.00	6.918	126.0	.6116	.5480	.6201	125.7
	260.00	6.335	138.6	.6922	.5747	.6450	131.4
	280.00	5.847	151.8	.7409	.6000	.6688	136.7
	300.00	5.433	165.4	.7878	.6240	.6916	141.8
	320.00	5.076	179.4	.8331	.6465	.7133	146.6
	340.00	4.765	193.9	.8770	.6677	.7337	151.2
	360.00	4.491	208.8	.9195	.6875	.7528	155.6
	380.00	4.248	224.0	.9607	.7059	.7707	159.9
	400.00	4.031	239.6	1.0006	.7229	.7872	164.0
	420.00	3.836	255.5	1.0394	.7385	.8025	168.0
	440.00	3.659	271.7	1.0771	.7528	.8164	171.9

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .400 MASS FRACTION R22

= .544 MOLE FRACTION R22

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP ----- (KJ/KG K)	VSND (M/S)
SAT LIQ	222.54	1528.772	-32.7	-.0570	.8092	.9648	355.4
SAT VAP	231.95	6.330	148.7	.7350	.5225	.6051	132.6
	240.00	6.093	153.6	.7558	.5336	.6152	135.2
	260.00	5.580	166.1	.8060	.5604	.6399	141.2
	280.00	5.151	179.2	.8543	.5859	.6639	146.8
	300.00	4.786	192.7	.9009	.6101	.6869	152.1
	320.00	4.472	206.6	.9460	.6331	.7089	157.2
	340.00	4.198	221.0	.9896	.6549	.7298	162.1
	360.00	3.957	235.8	1.0319	.6754	.7496	166.8
	380.00	3.742	251.0	1.0729	.6946	.7682	171.4
	400.00	3.551	266.5	1.1127	.7126	.7858	175.8
	420.00	3.379	282.4	1.1515	.7293	.8021	180.1
	440.00	3.223	298.6	1.1891	.7448	.8172	184.2

TABLE A.6 - SUPERHEATED VAPOR PROPS. OF R-22/R-115 MIXTURE (Continued)

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .600 MASS FRACTION R22

= .728 MOLE FRACTION R22

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	232.56	1490.107	-21.8	-.0117	.8638	1.0185	372.4
SAT VAP	233.88	5.594	177.5	.8419	.5109	.6022	142.5
	240.00	5.436	181.2	.8576	.5193	.6098	144.5
	260.00	4.980	193.7	.9074	.5461	.6345	150.8
	280.00	4.599	206.6	.9553	.5717	.6585	156.7
	300.00	4.274	220.0	1.0015	.5963	.6818	162.3
	320.00	3.994	233.9	1.0462	.6197	.7042	167.6
	340.00	3.749	248.2	1.0896	.6420	.7256	172.8
	360.00	3.534	262.9	1.1316	.6632	.7461	177.7
	380.00	3.343	278.0	1.1725	.6833	.7656	182.5
	400.00	3.172	293.5	1.2122	.7023	.7841	187.1
	420.00	3.018	309.4	1.2509	.7201	.8015	191.6
	440.00	2.879	325.6	1.2886	.7368	.8179	196.0

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .800 MASS FRACTION R22

= .877 MOLE FRACTION R22

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	233.98	1455.852	-12.7	.0016	.8870	1.0430	395.5
SAT VAP	234.14	5.038	205.4	.9334	.4968	.5968	151.8
	240.00	4.902	209.0	.9482	.5049	.6041	153.7
	260.00	4.494	221.3	.9976	.5317	.6287	160.2
	280.00	4.151	234.1	1.0450	.5575	.6529	166.4
	300.00	3.859	247.4	1.0909	.5824	.6765	172.2
	320.00	3.607	261.2	1.1353	.6062	.6993	177.8
	340.00	3.387	275.4	1.1784	.6291	.7213	183.1
	360.00	3.193	290.0	1.2202	.6510	.7425	188.3
	380.00	3.020	305.1	1.2609	.6719	.7629	193.3
	400.00	2.866	320.5	1.3005	.6919	.7823	198.1
	420.00	2.727	336.3	1.3391	.7108	.8008	202.8
	440.00	2.601	352.5	1.3768	.7288	.8185	207.4

TABLE A.6 - SUPERHEATED VAPOR PROPS. OF R-22/R-115 MIXTURE (Continued)

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .200 MASS FRACTION R22

= .309 MOLE FRACTION R22

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	241.09	1383.427	-7.9	.0261	.7993	1.0110	263.4
SAT VAP	258.42	27.927	133.0	.5889	.5776	.6831	122.1
	260.00	27.679	134.1	.5931	.5797	.6842	122.7
	280.00	24.956	147.9	.6443	.6054	.6996	130.1
	300.00	22.814	162.1	.6932	.6296	.7169	136.7
	320.00	21.067	176.6	.7400	.6523	.7346	142.6
	340.00	19.606	191.4	.7851	.6737	.7521	148.1
	360.00	18.361	206.6	.8285	.6936	.7689	153.2
	380.00	17.283	222.2	.8705	.7120	.7849	157.9
	400.00	16.339	238.0	.9112	.7291	.7999	162.5
	420.00	15.503	254.2	.9505	.7447	.8139	166.8
	440.00	14.756	270.6	.9887	.7589	.8266	170.9

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .400 MASS FRACTION R22

= .544 MOLE FRACTION R22

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	256.31	1388.773	1.8	.0860	.8785	1.0753	286.7
SAT VAP	265.05	23.781	164.4	.7069	.5722	.6865	133.9
	280.00	22.044	174.8	.7449	.5913	.6977	139.6
	300.00	20.150	188.9	.7936	.6157	.7145	146.5
	320.00	18.605	203.4	.8403	.6389	.7321	152.8
	340.00	17.312	218.2	.8852	.6607	.7497	158.6
	360.00	16.209	233.3	.9285	.6813	.7669	164.0
	380.00	15.254	248.9	.9705	.7006	.7836	169.1
	400.00	14.418	264.7	1.0111	.7186	.7994	173.9
	420.00	13.677	280.8	1.0504	.7353	.8143	178.5
	440.00	13.015	297.2	1.0886	.7508	.8282	183.0

TABLE A.6 - SUPERHEATED VAPOR PROPS. OF R-22/R-115 MIXTURE (Continued)

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .600 MASS FRACTION R22

= .728 MOLE FRACTION R22

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	266.23	1364.332	14.2	.1319	.9268	1.1206	303.4
SAT VAP	267.76	20.883	193.5	.8027	.5615	.6843	144.5
	280.00	19.656	201.9	.8335	.5771	.6936	149.3
	300.00	17.985	216.0	.8819	.6018	.7104	156.5
	320.00	16.617	230.4	.9284	.6253	.7282	163.0
	340.00	15.468	245.1	.9730	.6477	.7462	169.0
	360.00	14.487	260.2	1.0162	.6689	.7640	174.7
	380.00	13.635	275.7	1.0580	.6890	.7814	180.0
	400.00	12.888	291.5	1.0985	.7079	.7981	185.1
	420.00	12.226	307.6	1.1378	.7257	.8140	190.0
	440.00	11.634	324.0	1.1760	.7424	.8291	194.6

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .800 MASS FRACTION R22

= .877 MOLE FRACTION R22

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	268.36	1338.259	24.8	.1500	.9446	1.1365	324.1
SAT VAP	268.39	18.707	221.4	.8824	.5479	.6789	154.5
	280.00	17.687	229.3	.9114	.5628	.6879	159.1
	300.00	16.207	243.2	.9594	.5877	.7051	166.4
	320.00	14.989	257.5	1.0055	.6116	.7234	173.1
	340.00	13.962	272.2	1.0499	.6344	.7419	179.3
	360.00	13.082	287.2	1.0928	.6563	.7604	185.2
	380.00	12.318	302.6	1.1344	.6772	.7786	190.7
	400.00	11.645	318.3	1.1748	.6971	.7963	196.0
	420.00	11.048	334.4	1.2141	.7161	.8133	201.1
	440.00	10.514	350.9	1.2523	.7340	.8297	205.9

TABLE A.6 - SUPERHEATED VAPOR PROPS. OF R-22/R-115 MIXTURE (Continued)

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .200 MASS FRACTION R22

= .309 MOLE FRACTION R22

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	257.71	1290.843	9.5	.0950	.8295	1.0914	231.3
SAT VAP	273.89	49.107	138.9	.5811	.6037	.7468	119.7
	280.00	47.204	143.5	.5976	.6114	.7458	122.7
	300.00	42.176	158.4	.6492	.6357	.7501	131.2
	320.00	38.376	173.5	.6979	.6585	.7604	138.5
	340.00	35.354	188.9	.7444	.6799	.7731	144.9
	360.00	32.869	204.5	.7889	.6998	.7866	150.7
	380.00	30.776	220.3	.8318	.7183	.8001	156.0
	400.00	28.980	236.5	.8732	.7353	.8132	160.9
	420.00	27.416	252.9	.9132	.7509	.8256	165.5
	440.00	26.038	269.5	.9518	.7650	.8371	169.9

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .400 MASS FRACTION R22

= .544 MOLE FRACTION R22

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	273.25	1308.636	20.6	.1562	.9074	1.1468	253.6
SAT VAP	281.51	41.497	170.9	.6960	.5994	.7496	132.1
	300.00	37.395	184.7	.7437	.6219	.7518	140.4
	320.00	34.001	199.9	.7925	.6451	.7608	148.1
	340.00	31.305	215.2	.8390	.6669	.7729	155.0
	360.00	29.089	230.8	.8835	.6875	.7864	161.1
	380.00	27.223	246.7	.9264	.7067	.8002	166.8
	400.00	25.622	262.8	.9678	.7247	.8138	172.1
	420.00	24.228	279.2	1.0078	.7414	.8270	177.0
	440.00	22.999	295.9	1.0466	.7567	.8395	181.7

TABLE A.6 - SUPERHEATED VAPOR PROPS. OF R-22/R-115 MIXTURE (Continued)

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .600 MASS FRACTION R22

= .728 MOLE FRACTION R22

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	283.10	1292.743	33.7	.2019	.9529	1.1861	270.0
SAT VAP	284.72	36.252	200.1	.7876	.5892	.7466	143.2
	300.00	33.363	211.5	.8267	.6078	.7490	150.1
	320.00	30.373	226.6	.8753	.6313	.7580	158.1
	340.00	27.985	241.9	.9216	.6536	.7703	165.2
	360.00	26.015	257.4	.9660	.6748	.7842	171.6
	380.00	24.352	273.2	1.0088	.6948	.7986	177.5
	400.00	22.921	289.4	1.0501	.7137	.8130	183.0
	420.00	21.674	305.8	1.0901	.7315	.8272	188.3
	440.00	20.574	322.4	1.1289	.7481	.8408	193.2

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .800 MASS FRACTION R22

= .877 MOLE FRACTION R22

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	285.60	1271.902	44.9	.2218	.9684	1.1964	289.7
SAT VAP	285.61	32.342	228.0	.8628	.5758	.7401	153.6
	300.00	29.988	238.6	.8992	.5935	.7433	160.1
	320.00	27.358	253.6	.9475	.6172	.7530	168.2
	340.00	25.241	268.8	.9935	.6400	.7660	175.4
	360.00	23.486	284.3	1.0377	.6618	.7806	182.0
	380.00	21.997	300.0	1.0803	.6827	.7958	188.1
	400.00	20.713	316.1	1.1215	.7025	.8112	193.9
	420.00	19.590	332.5	1.1615	.7214	.8265	199.3
	440.00	18.598	349.1	1.2003	.7392	.8413	204.4

TABLE A.6 - SUPERHEATED VAPOR PROPS. OF R-22/R-115 MIXTURE (Continued)

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .200 MASS FRACTION R22

= .309 MOLE FRACTION R22

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP ----- (KJ/KG K)	VSND (M/S)
SAT LIQ	269.61	1216.836	22.8	.1446	.8476	1.1675	208.5
SAT VAP	284.72	71.560	142.1	.5746	.6243	.8142	116.9
	300.00	64.208	154.4	.6166	.6425	.7964	125.3
	320.00	57.295	170.3	.6678	.6651	.7925	134.2
	340.00	52.141	186.2	.7160	.6864	.7974	141.7
	360.00	48.079	202.2	.7618	.7063	.8061	148.2
	380.00	44.757	218.4	.8057	.7247	.8164	154.1
	400.00	41.969	234.9	.8478	.7417	.8271	159.4
	420.00	39.583	251.5	.8884	.7572	.8376	164.3
	440.00	37.508	268.4	.9276	.7712	.8477	168.8

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .400 MASS FRACTION R22

= .544 MOLE FRACTION R22

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP ----- (KJ/KG K)	VSND (M/S)
SAT LIQ	285.32	1245.297	34.7	.2060	.9248	1.2119	230.2
SAT VAP	293.16	60.002	174.5	.6879	.6209	.8139	129.7
	300.00	57.265	180.1	.7066	.6289	.8058	133.5
	320.00	50.987	196.1	.7582	.6517	.7975	143.1
	340.00	46.333	212.1	.8066	.6734	.8005	151.1
	360.00	42.675	228.1	.8526	.6939	.8082	158.2
	380.00	39.689	244.4	.8966	.7131	.8182	164.4
	400.00	37.185	260.9	.9388	.7309	.8291	170.2
	420.00	35.044	277.6	.9795	.7475	.8402	175.5
	440.00	33.183	294.5	1.0189	.7628	.8511	180.4

TABLE A.6 - SUPERHEATED VAPOR PROPS. OF R-22/R-115 MIXTURE (Concluded).

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .600 MASS FRACTION R22

= .728 MOLE FRACTION R22

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	295.11	1236.512	48.2	.2514	.9685	1.2451	246.5
SAT VAP	296.78	52.157	203.9	.7771	.6109	.8084	141.2
	300.00	51.075	206.5	.7858	.6147	.8050	143.0
	320.00	45.564	222.5	.8374	.6378	.7963	152.8
	340.00	41.448	238.5	.8857	.6599	.7991	161.1
	360.00	38.197	254.5	.9316	.6809	.8070	168.4
	380.00	35.534	270.8	.9755	.7009	.8174	175.0
	400.00	33.295	287.2	1.0178	.7197	.8290	181.0
	420.00	31.376	303.9	1.0585	.7373	.8409	186.5
	440.00	29.706	320.9	1.0979	.7538	.8529	191.7

SUPERHEATED VAPOR PROPERTIES FOR R22 /R115

MIXING COEFFICIENT = -.256

COMPOSITION = .800 MASS FRACTION R22

= .877 MOLE FRACTION R22

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	297.88	1220.137	59.9	.2724	.9827	1.2499	265.6
SAT VAP	297.88	46.350	231.8	.8496	.5975	.7994	151.9
	300.00	45.746	233.5	.8552	.6000	.7976	153.1
	320.00	40.970	249.4	.9064	.6234	.7909	162.9
	340.00	37.353	265.2	.9544	.6457	.7947	171.3
	360.00	34.471	281.2	1.0001	.6676	.8035	178.7
	380.00	32.076	297.4	1.0438	.6883	.8147	185.5
	400.00	30.091	313.8	1.0854	.7080	.8273	191.7
	420.00	28.366	330.5	1.1264	.7267	.8403	197.5
	440.00	26.861	347.4	1.1660	.7445	.8535	202.9

**TABLE A.7 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-13B1 MIXTURE**

DEW/BUBBLE LINES AT T = 253.1 K

COMPONENT A: R13B1 COMPONENT B: R22

MIXING COEFFICIENT, F = .0250

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	244.47	.06409	8.079	1866.6	20919.0	7.644	82.920	80.040	44.150	95.373	54.834
.1000	.2090	282.43	.06596	6.926	2064.2	20217.8	10.822	84.260	80.996	46.684	96.233	57.813
.2000	.3521	313.33	.06784	6.191	2216.4	19727.3	12.656	83.320	81.998	48.436	97.182	59.958
.3000	.4613	339.18	.06971	5.679	2326.0	19347.9	13.856	82.069	83.043	49.781	98.209	61.655
.4000	.5517	361.36	.07158	5.297	2395.7	19031.6	14.565	80.740	84.132	50.898	99.303	63.093
.5000	.6313	380.81	.07343	4.997	2427.5	18751.8	14.841	79.365	85.265	51.887	100.453	64.379
.6000	.7053	398.16	.07525	4.755	2423.5	18492.4	14.703	77.920	86.440	52.806	101.648	65.578
.7000	.7769	413.79	.07703	4.553	2385.8	18242.6	14.141	76.353	87.658	53.696	102.878	66.734
.8000	.8486	427.90	.07877	4.383	2315.9	17994.6	13.104	74.582	88.919	54.586	104.134	67.878
.9000	.9224	440.55	.08045	4.239	2215.5	17741.9	11.460	72.450	90.222	55.499	105.406	69.035
1.0000	1.0000	451.70	.08207	4.118	2085.9	17479.3	8.505	69.324	91.568	56.457	106.685	70.226

DEW/BUBBLE LINES AT T = 263.1 K

COMPONENT A: R13B1 COMPONENT B: R22

MIXING COEFFICIENT, F = .0250

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	353.26	.06570	5.696	2833.6	21296.5	11.363	81.538	81.200	45.461	97.571	57.102
.1000	.1949	401.52	.06765	4.955	3040.1	20647.5	14.573	83.012	82.130	47.885	98.485	60.105
.2000	.3343	441.36	.06962	4.464	3202.2	20172.2	16.441	82.273	83.106	49.638	99.495	62.381
.3000	.4436	475.03	.07158	4.111	3322.5	19793.6	17.680	81.156	84.128	51.023	100.588	64.245
.4000	.5357	504.14	.07354	3.844	3403.4	19471.7	18.430	79.912	85.194	52.197	101.751	65.862
.5000	.6179	529.75	.07548	3.633	3447.1	19183.9	18.749	78.588	86.305	53.248	102.971	67.328
.6000	.6946	552.58	.07739	3.460	3455.4	18915.6	18.656	77.170	87.461	54.231	104.237	68.706
.7000	.7691	573.09	.07926	3.316	3430.2	18657.1	18.139	75.615	88.662	55.185	105.537	70.037
.8000	.8436	591.50	.08109	3.195	3373.1	18401.1	17.150	73.843	89.908	56.137	106.857	71.353
.9000	.9200	607.87	.08285	3.093	3285.6	18141.9	15.553	71.699	91.199	57.111	108.187	72.674
1.0000	1.0000	622.15	.08454	3.007	3169.0	17874.4	12.647	68.540	92.535	58.127	109.516	74.022

**TABLE A.7 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-13B1 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 273.1 K

COMPONENT A: R13B1 COMPONENT B: R22

MIXING COEFFICIENT, F = .0250

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	495.71	.06746	4.114	3823.7	21647.2	15.021	80.285	82.274	46.812	100.002	59.732
.1000	.1826	555.66	.06951	3.622	4039.8	21040.9	18.262	81.855	83.174	49.147	100.995	62.819
.2000	.3182	605.80	.07158	3.284	4212.3	20578.4	20.166	81.288	84.122	50.903	102.092	65.274
.3000	.4274	648.61	.07366	3.036	4343.9	20199.7	21.442	80.292	85.115	52.330	103.279	67.352
.4000	.5209	685.83	.07573	2.844	4436.7	19672.1	22.233	79.127	86.154	53.561	104.542	69.197
.5000	.6052	718.69	.07778	2.691	4492.8	19575.9	22.596	77.851	87.240	54.675	105.866	70.896
.6000	.6845	747.99	.07980	2.565	4514.0	19298.5	22.547	76.461	88.373	55.725	107.237	72.506
.7000	.7616	774.22	.08178	2.460	4501.9	19030.9	22.076	74.917	89.552	56.746	108.640	74.066
.8000	.8388	797.64	.08371	2.371	4458.2	18766.7	21.134	73.144	90.779	57.764	110.058	75.606
.9000	.9177	818.32	.08557	2.297	4384.1	18500.6	19.585	70.988	92.054	58.803	111.476	77.144
1.0000	1.0000	836.16	.08735	2.235	4280.9	18228.2	16.726	67.796	93.376	59.880	112.881	78.698

DEW/BUBBLE LINES AT T = 283.1 K

COMPONENT A: R13B1 COMPONENT B: R22

MIXING COEFFICIENT, F = .0250

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	677.94	.06942	3.031	4839.0	21965.0	18.627	79.122	83.253	48.219	102.756	62.851
.1000	.1717	750.94	.07159	2.696	5065.4	21393.3	21.901	80.756	84.119	50.482	103.865	66.100
.2000	.3036	812.74	.07378	2.457	5249.2	20940.8	23.840	80.334	85.033	52.247	105.091	68.804
.3000	.4123	865.98	.07599	2.278	5392.8	20560.9	25.156	79.447	85.993	53.717	106.419	71.169
.4000	.5070	912.54	.07820	2.138	5498.4	20226.6	25.988	78.354	87.001	55.008	107.833	73.319
.5000	.5933	953.77	.08039	2.024	5567.8	19921.4	26.394	77.123	88.057	56.190	109.316	75.331
.6000	.6749	990.52	.08255	1.930	5602.7	19634.1	26.391	75.757	89.160	57.311	110.849	77.257
.7000	.7545	1023.34	.08467	1.852	5604.7	19356.8	25.967	74.223	90.313	58.403	112.412	79.133
.8000	.8342	1052.49	.08673	1.786	5575.1	19083.6	25.072	72.448	91.515	59.493	113.985	80.982
.9000	.9155	1078.03	.08871	1.730	5515.0	18810.1	23.570	70.280	92.769	60.601	115.547	82.821
1.0000	1.0000	1099.82	.09060	1.684	5425.8	18532.2	20.758	67.054	94.073	61.745	117.077	84.661

**TABLE A.7 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-13B1 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 293.1 K

COMPONENT A: R13B1 COMPONENT B: R22

MIXING COEFFICIENT, F = .0250

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	906.42	.07162	2.271	5882.6	22243.5	22.194	78.014	84.124	49.700	105.972	66.642
.1000	.1619	993.76	.07393	2.036	6120.1	21698.9	25.501	79.687	84.951	51.908	107.256	70.163
.2000	.2903	1068.53	.07628	1.864	6316.2	21253.3	27.477	79.386	85.826	53.689	108.679	73.222
.3000	.3984	1133.48	.07865	1.732	6473.0	20870.4	28.833	78.592	86.748	55.208	110.225	75.989
.4000	.4940	1190.60	.08103	1.627	6592.5	20528.3	29.709	77.563	87.717	56.564	111.876	78.568
.5000	.5819	1241.31	.08340	1.541	6676.5	20212.8	30.161	76.372	88.736	57.819	113.612	81.025
.6000	.6657	1286.51	.08574	1.470	6726.4	19914.3	30.205	75.027	89.804	59.016	115.408	83.407
.7000	.7477	1326.77	.08803	1.410	6743.6	19626.0	29.829	73.500	90.923	60.187	117.237	85.741
.8000	.8297	1362.35	.09026	1.359	6729.2	19342.8	28.983	71.720	92.095	61.355	119.070	88.046
.9000	.9134	1393.26	.09240	1.317	6684.2	19060.7	27.529	69.536	93.321	62.539	120.876	90.330
1.0000	1.0000	1419.36	.09444	1.282	6609.7	18776.7	24.765	66.276	94.602	63.756	122.624	92.595

DEW/BUBBLE LINES AT T = 303.1 K

COMPONENT A: R13B1 COMPONENT B: R22

MIXING COEFFICIENT, F = .0250

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1187.87	.07412	1.724	6958.2	22475.0	25.733	76.927	84.871	51.278	109.866	71.386
.1000	.1532	1290.77	.07662	1.556	7208.2	21950.7	29.076	78.616	85.654	53.450	111.424	75.339
.2000	.2781	1379.75	.07917	1.429	7418.0	21508.5	31.092	78.413	86.482	55.255	113.161	78.926
.3000	.3854	1457.65	.08174	1.330	7589.6	21120.2	32.492	77.698	87.358	56.830	115.061	82.285
.4000	.4816	1526.51	.08434	1.250	7724.8	20768.1	33.415	76.723	88.281	58.258	117.103	85.501
.5000	.5712	1587.78	.08694	1.184	7825.2	20440.3	33.915	75.564	89.254	59.594	119.264	88.632
.6000	.6569	1642.41	.08951	1.129	7891.9	20128.7	34.010	74.234	90.277	60.878	121.511	91.714
.7000	.7411	1690.93	.09204	1.082	7926.1	19827.4	33.686	72.708	91.354	62.138	123.807	94.767
.8000	.8255	1733.59	.09450	1.043	7928.7	19532.3	32.891	70.918	92.487	63.394	126.106	97.796
.9000	.9114	1770.36	.09686	1.010	7900.4	19240.1	31.489	68.714	93.677	64.664	128.360	100.796
1.0000	1.0000	1801.02	.09909	.982	7841.9	18948.4	28.775	65.418	94.927	65.962	130.517	103.748

**TABLE A.7 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-13B1 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 313.1 K

COMPONENT A: R13B1 COMPONENT B: R22

MIXING COEFFICIENT, F = .0250

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1529.27	.07703	1.323	8071.0	22650.7	29.261	75.827	85.474	52.982	114.800	77.527
.1000	.1453	1648.80	.07976	1.200	8335.4	22139.9	32.644	77.510	86.203	55.136	116.808	82.170
.2000	.2668	1753.15	.08256	1.105	8561.2	21696.9	34.705	77.382	86.977	56.978	119.069	86.577
.3000	.3732	1845.15	.08541	1.029	8750.0	21300.0	36.153	76.730	87.795	58.619	121.573	90.861
.4000	.4699	1926.88	.08831	.967	8903.6	20934.7	37.128	75.797	88.661	60.131	124.301	95.096
.5000	.5608	1999.76	.09122	.915	9023.2	20591.5	37.685	74.660	89.576	61.562	127.228	99.330
.6000	.6484	2064.73	.09412	.871	9109.7	20263.4	37.837	73.336	90.542	62.946	130.311	103.591
.7000	.7348	2122.29	.09698	.834	9163.9	19946.0	37.571	71.801	91.563	64.309	133.497	107.882
.8000	.8214	2172.62	.09976	.803	9186.3	19635.7	36.835	69.993	92.643	65.669	136.715	112.190
.9000	.9094	2215.63	.10243	.776	9177.4	19330.4	35.490	67.761	93.785	67.040	139.878	116.476
1.0000	1.0000	2251.04	.10495	.755	9137.5	19028.6	32.830	64.421	94.992	68.434	142.890	120.682

DEW/BUBBLE LINES AT T = 323.1 K

COMPONENT A: R13B1 COMPONENT B: R22

MIXING COEFFICIENT, F = .0250

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1937.77	.08046	1.023	9228.6	22759.2	32.799	74.677	85.906	54.848	121.412	85.819
.1000	.1381	2074.85	.08351	.931	9510.5	22254.7	36.228	76.333	86.569	57.006	124.201	91.604
.2000	.2563	2195.59	.08666	.858	9755.6	21805.6	38.342	76.257	87.274	58.901	127.399	97.372
.3000	.3616	2302.75	.08990	.799	9965.7	21395.0	39.848	75.648	88.020	60.626	131.019	103.230
.4000	.4587	2398.37	.09321	.750	10142.0	21011.7	40.887	74.738	88.810	62.239	135.060	109.258
.5000	.5508	2483.82	.09657	.708	10285.6	20647.8	41.510	73.608	89.648	63.784	139.510	115.511
.6000	.6401	2559.99	.09995	.673	10397.0	20297.8	41.733	72.274	90.537	65.291	144.329	122.014
.7000	.7285	2627.28	.10330	.643	10476.7	19958.3	41.539	70.716	91.481	66.781	149.446	128.761
.8000	.8173	2685.79	.10658	.617	10524.4	19627.2	40.875	68.873	92.486	68.270	154.746	135.699
.9000	.9075	2735.33	.10974	.595	10540.1	19303.3	39.601	66.598	93.557	69.768	160.067	142.728
1.0000	1.0000	2775.53	.11272	.577	10523.4	18986.2	37.008	63.200	94.701	71.282	165.201	149.688

**TABLE A.7 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-13B1 MIXTURE (Concluded).**

DEW/BUBBLE LINES AT T = 333.1 K
COMPONENT A: R13B1 COMPONENT B: R22
MIXING COEFFICIENT, F = .0250

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	2420.63	.08464	.794	10442.4	22785.3	36.377	73.432	86.126	56.928	130.922	97.663
.1000	.1315	2576.00	.08813	.724	10746.7	22278.4	39.865	75.037	86.705	59.117	135.188	105.480
.2000	.2464	2713.97	.09178	.667	11017.1	21815.5	42.046	74.982	87.318	61.090	140.235	113.740
.3000	.3505	2837.19	.09559	.620	11255.2	21383.6	43.627	74.390	87.967	62.923	146.164	122.619
.4000	.4477	2947.60	.09954	.580	11462.3	20973.6	44.749	73.479	88.654	64.669	153.077	132.287
.5000	.5408	3046.48	.10361	.546	11639.0	20579.3	45.463	72.328	89.381	66.363	161.073	142.901
.6000	.6318	3134.58	.10777	.516	11785.8	20196.7	45.783	70.954	90.154	68.033	170.220	154.594
.7000	.7222	3212.20	.11197	.491	11902.1	19823.5	45.691	69.341	90.980	69.696	180.522	167.444
.8000	.8132	3279.29	.11613	.469	11987.3	19458.9	45.132	67.428	91.866	71.362	191.875	181.422
.9000	.9056	3335.51	.12019	.450	12039.9	19103.6	43.961	65.074	92.821	73.038	204.002	196.343
1.0000	1.0000	3380.40	.12404	.435	12058.3	18759.2	41.467	61.584	93.855	74.723	216.408	211.791

TABLE A.8 - SUPERHEATED VAPOR PROPERTIES OF R-22/R-13B1 MIXTURE

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .200 MASS FRACTION R13B1

= .127 MOLE FRACTION R13B1

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	226.89	1507.767	-3.8	.0124	.8258	.9676	396.0
SAT VAP	229.96	5.101	207.0	.9334	.4520	.5517	152.1
	240.00	4.868	212.6	.9572	.4649	.5634	155.5
	260.00	4.465	224.1	1.0032	.4899	.5864	161.9
	280.00	4.127	236.0	1.0475	.5140	.6091	167.9
	300.00	3.838	248.4	1.0903	.5373	.6312	173.7
	320.00	3.588	261.3	1.1317	.5597	.6527	179.3
	340.00	3.370	274.5	1.1719	.5812	.6734	184.6
	360.00	3.177	288.2	1.2110	.6019	.6935	189.7
	380.00	3.006	302.2	1.2490	.6217	.7128	194.7
	400.00	2.852	316.7	1.2860	.6407	.7313	199.5
	420.00	2.714	331.5	1.3221	.6588	.7491	204.3
	440.00	2.589	346.6	1.3574	.6761	.7660	208.8

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .400 MASS FRACTION R13B1

= .279 MOLE FRACTION R13B1

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	223.09	1606.992	-5.3	.0165	.7610	.8855	371.0
SAT VAP	227.34	5.686	181.8	.8465	.4241	.5151	143.6
	240.00	5.358	188.4	.8748	.4392	.5287	147.7
	260.00	4.914	199.2	.9179	.4624	.5501	153.8
	280.00	4.542	210.4	.9595	.4847	.5710	159.6
	300.00	4.224	222.0	.9996	.5061	.5914	165.2
	320.00	3.949	234.0	1.0384	.5266	.6110	170.5
	340.00	3.709	246.5	1.0760	.5462	.6300	175.6
	360.00	3.497	259.2	1.1125	.5650	.6482	180.5
	380.00	3.308	272.4	1.1480	.5829	.6656	185.2
	400.00	3.139	285.9	1.1826	.5999	.6822	189.9
	420.00	2.987	299.7	1.2163	.6161	.6980	194.4
	440.00	2.850	313.8	1.2491	.6314	.7130	198.7

**TABLE A.8 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-13B1 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .600 MASS FRACTION R13B1

= .466 MOLE FRACTION R13B1

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	220.11	1716.617	-6.7	.0119	.6993	.8075	343.4
SAT VAP	223.85	6.430	156.4	.7469	.3958	.4780	134.6
	240.00	5.957	164.2	.7808	.4136	.4941	139.6
	260.00	5.464	174.3	.8211	.4349	.5138	145.4
	280.00	5.050	184.8	.8599	.4553	.5330	150.9
	300.00	4.696	195.6	.8973	.4749	.5515	156.2
	320.00	4.391	206.8	.9334	.4935	.5694	161.2
	340.00	4.124	218.4	.9685	.5112	.5865	166.1
	360.00	3.888	230.3	1.0025	.5281	.6029	170.7
	380.00	3.679	242.5	1.0355	.5441	.6184	175.3
	400.00	3.491	255.0	1.0676	.5592	.6331	179.7
	420.00	3.322	267.8	1.0988	.5734	.6470	183.9
	440.00	3.169	280.9	1.1292	.5867	.6601	188.1

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .800 MASS FRACTION R13B1

= .699 MOLE FRACTION R13B1

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	217.56	1842.163	-8.7	-.0057	.6403	.7327	314.3
SAT VAP	219.39	7.406	130.8	.6333	.3670	.4407	124.9
	220.00	7.383	131.0	.6346	.3677	.4412	125.1
	240.00	6.708	140.0	.6738	.3880	.4596	131.0
	260.00	6.153	149.4	.7113	.4075	.4776	136.5
	280.00	5.686	159.1	.7473	.4260	.4950	141.7
	300.00	5.288	169.2	.7820	.4437	.5118	146.7
	320.00	4.944	179.6	.8156	.4604	.5278	151.4
	340.00	4.644	190.3	.8480	.4763	.5431	156.0
	360.00	4.378	201.3	.8795	.4912	.5576	160.4
	380.00	4.142	212.6	.9100	.5052	.5712	164.7
	400.00	3.931	224.2	.9396	.5184	.5841	168.9
	420.00	3.741	236.0	.9684	.5306	.5960	172.9
	440.00	3.569	248.0	.9964	.5420	.6071	176.9

**TABLE A.8 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-13B1 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .200 MASS FRACTION R13B1

= .127 MOLE FRACTION R13B1

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	262.16	1387.835	31.7	.1568	.8718	1.0438	325.3
SAT VAP	264.30	18.863	221.6	.8778	.5001	.6288	155.3
	280.00	17.500	231.6	.9144	.5189	.6404	161.3
	300.00	16.064	244.6	.9591	.5420	.6569	168.4
	320.00	14.875	257.9	1.0021	.5644	.6743	174.9
	340.00	13.869	271.6	1.0435	.5859	.6919	181.0
	360.00	13.003	285.6	1.0836	.6065	.7096	186.8
	380.00	12.249	299.9	1.1224	.6263	.7269	192.3
	400.00	11.584	314.6	1.1601	.6452	.7438	197.5
	420.00	10.993	329.7	1.1968	.6632	.7602	202.5
	440.00	10.464	345.0	1.2325	.6804	.7760	207.4

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .400 MASS FRACTION R13B1

= .279 MOLE FRACTION R13B1

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	258.33	1478.597	27.2	.1506	.8027	.9547	304.0
SAT VAP	261.34	21.056	195.4	.7977	.4687	.5869	146.4
	280.00	19.245	206.4	.8386	.4893	.5996	153.4
	300.00	17.669	218.6	.8805	.5106	.6148	160.1
	320.00	16.363	231.0	.9207	.5310	.6307	166.4
	340.00	15.257	243.8	.9594	.5506	.6468	172.2
	360.00	14.306	256.9	.9968	.5693	.6628	177.7
	380.00	13.478	270.3	1.0331	.5872	.6784	182.9
	400.00	12.747	284.0	1.0682	.6041	.6936	187.9
	420.00	12.097	298.0	1.1024	.6202	.7082	192.7
	440.00	11.515	312.3	1.1357	.6354	.7221	197.3

**TABLE A.8 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-13B1 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .600 MASS FRACTION R13B1

= .466 MOLE FRACTION R13B1

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	255.04	1579.078	22.6	.1346	.7364	.8699	280.7
SAT VAP	257.64	23.848	168.9	.7053	.4370	.5451	137.0
	260.00	23.556	170.2	.7102	.4395	.5464	137.9
	280.00	21.383	181.2	.7512	.4598	.5589	145.0
	300.00	19.634	192.5	.7902	.4792	.5728	151.4
	320.00	18.184	204.1	.8276	.4977	.5872	157.3
	340.00	16.958	216.0	.8637	.5154	.6018	162.9
	360.00	15.902	228.2	.8985	.5321	.6161	168.1
	380.00	14.982	240.7	.9322	.5480	.6300	173.1
	400.00	14.171	253.4	.9648	.5631	.6434	177.8
	420.00	13.449	266.4	.9965	.5772	.6561	182.4
	440.00	12.803	279.6	1.0273	.5904	.6682	186.8

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .800 MASS FRACTION R13B1

= .699 MOLE FRACTION R13B1

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	252.12	1694.129	17.6	.1057	.6728	.7887	256.2
SAT VAP	253.34	27.473	142.4	.5997	.4055	.5038	126.9
	260.00	26.515	145.7	.6128	.4118	.5070	129.4
	280.00	24.069	156.0	.6507	.4302	.5183	136.1
	300.00	22.100	166.5	.6869	.4478	.5309	142.2
	320.00	20.469	177.2	.7216	.4644	.5437	147.8
	340.00	19.089	188.2	.7550	.4801	.5568	153.0
	360.00	17.902	199.5	.7872	.4950	.5695	158.0
	380.00	16.867	211.0	.8183	.5090	.5816	162.7
	400.00	15.954	222.8	.8484	.5220	.5932	167.2
	420.00	15.143	234.7	.8776	.5342	.6042	171.5
	440.00	14.416	246.9	.9060	.5454	.6144	175.6

**TABLE A.8 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-13B1 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .200 MASS FRACTION R13B1

= .127 MOLE FRACTION R13B1

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	279.90	1320.563	50.7	.2260	.8907	1.0934	291.4
SAT VAP	281.65	32.516	227.8	.8565	.5263	.6854	154.6
	300.00	29.593	240.4	.8999	.5473	.6902	162.6
	320.00	27.073	254.3	.9447	.5694	.7005	170.3
	340.00	25.024	268.5	.9876	.5908	.7133	177.3
	360.00	23.314	282.9	1.0287	.6113	.7275	183.8
	380.00	21.856	297.6	1.0685	.6309	.7423	189.8
	400.00	20.593	312.5	1.1069	.6497	.7572	195.4
	420.00	19.486	327.8	1.1442	.6677	.7719	200.8
	440.00	18.506	343.4	1.1804	.6848	.7864	205.9

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .400 MASS FRACTION R13B1

= .279 MOLE FRACTION R13B1

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	276.11	1406.162	44.6	.2150	.8199	1.0001	271.8
SAT VAP	278.57	36.341	201.1	.7791	.4930	.6401	145.6
	280.00	36.050	202.0	.7824	.4945	.6401	146.3
	300.00	32.521	214.8	.8267	.5155	.6449	154.7
	320.00	29.760	227.8	.8686	.5358	.6544	162.0
	340.00	27.515	241.0	.9086	.5552	.6662	168.7
	360.00	25.639	254.5	.9471	.5738	.6791	174.8
	380.00	24.040	268.2	.9841	.5915	.6923	180.6
	400.00	22.654	282.2	1.0200	.6084	.7057	185.9
	420.00	21.439	296.4	1.0547	.6244	.7188	191.1
	440.00	20.362	310.9	1.0885	.6395	.7315	195.9

**TABLE A.8 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-13B1 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .600 MASS FRACTION R13B1

= .466 MOLE FRACTION R13B1

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	272.72	1500.822	38.4	.1937	.7515	.9113	250.4
SAT VAP	274.84	41.216	174.2	.6896	.4596	.5953	136.1
	280.00	40.015	177.2	.7007	.4647	.5953	138.3
	300.00	36.111	189.2	.7419	.4838	.5999	146.3
	320.00	33.053	201.3	.7809	.5022	.6086	153.3
	340.00	30.566	213.5	.8181	.5197	.6192	159.6
	360.00	28.487	226.0	.8538	.5363	.6307	165.4
	380.00	26.713	238.8	.8882	.5521	.6425	170.9
	400.00	25.177	251.7	.9215	.5670	.6542	176.0
	420.00	23.829	264.9	.9537	.5811	.6657	180.8
	440.00	22.634	278.4	.9849	.5942	.6767	185.5

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .800 MASS FRACTION R13B1

= .699 MOLE FRACTION R13B1

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	269.67	1609.071	31.8	.1594	.6859	.8262	227.8
SAT VAP	270.65	47.538	147.3	.5872	.4266	.5513	125.9
	280.00	45.009	152.5	.6059	.4349	.5510	129.8
	300.00	40.622	163.5	.6440	.4522	.5552	137.3
	320.00	37.188	174.7	.6801	.4686	.5630	144.0
	340.00	34.393	186.0	.7145	.4842	.5725	149.9
	360.00	32.058	197.6	.7475	.4989	.5826	155.5
	380.00	30.066	209.3	.7793	.5128	.5928	160.6
	400.00	28.340	221.3	.8099	.5257	.6030	165.4
	420.00	26.825	233.5	.8396	.5378	.6127	170.0
	440.00	25.482	245.8	.8683	.5489	.6220	174.4

**TABLE A.8 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-13B1 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .200 MASS FRACTION R13B1

= .127 MOLE FRACTION R13B1

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	292.55	1268.273	64.8	.2745	.9020	1.1381	267.7
SAT VAP	294.05	46.487	231.4	.8424	.5465	.7397	153.1
	300.00	44.869	235.8	.8571	.5530	.7360	156.2
	320.00	40.397	250.5	.9045	.5748	.7332	165.4
	340.00	36.949	265.2	.9491	.5959	.7385	173.5
	360.00	34.170	280.0	.9915	.6162	.7477	180.7
	380.00	31.861	295.1	1.0322	.6357	.7590	187.2
	400.00	29.900	310.4	1.0715	.6544	.7714	193.3
	420.00	28.206	326.0	1.1094	.6723	.7843	199.0
	440.00	26.722	341.8	1.1462	.6893	.7972	204.4

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .400 MASS FRACTION R13B1

= .279 MOLE FRACTION R13B1

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	288.80	1349.644	57.5	.2600	.8301	1.0412	249.1
SAT VAP	290.91	52.016	204.4	.7668	.5118	.6913	144.1
	300.00	49.246	210.7	.7880	.5210	.6860	148.6
	320.00	44.368	224.4	.8321	.5409	.6839	157.4
	340.00	40.600	238.1	.8737	.5600	.6889	165.0
	360.00	37.559	251.9	.9133	.5784	.6973	171.9
	380.00	35.031	266.0	.9513	.5960	.7075	178.2
	400.00	32.882	280.2	.9879	.6127	.7185	184.0
	420.00	31.025	294.7	1.0232	.6286	.7299	189.4
	440.00	29.397	309.4	1.0574	.6436	.7413	194.5

**TABLE A.8 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-13B1 MIXTURE (Concluded).**

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .600 MASS FRACTION R13B1

= .466 MOLE FRACTION R13B1

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	285.38	1439.427	50.2	.2350	.7604	.9492	229.0
SAT VAP	287.17	59.075	177.3	.6792	.4771	.6440	134.4
	300.00	54.618	185.5	.7072	.4890	.6365	140.6
	320.00	49.237	198.2	.7481	.5070	.6349	148.9
	340.00	45.073	210.9	.7867	.5242	.6395	156.2
	360.00	41.711	223.8	.8235	.5407	.6471	162.7
	380.00	38.913	236.8	.8587	.5563	.6561	168.6
	400.00	36.533	250.1	.8926	.5711	.6658	174.1
	420.00	34.476	263.5	.9254	.5850	.6757	179.3
	440.00	32.672	277.1	.9570	.5980	.6855	184.1

SUPERHEATED VAPOR PROPERTIES FOR R13B1 /R22

MIXING COEFFICIENT = .025

COMPOSITION = .800 MASS FRACTION R13B1

= .699 MOLE FRACTION R13B1

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	282.26	1541.899	42.3	.1971	.6935	.8611	207.8
SAT VAP	283.07	68.237	150.2	.5788	.4430	.5980	124.1
	300.00	61.389	160.3	.6132	.4570	.5877	132.0
	320.00	55.359	172.0	.6511	.4731	.5865	139.9
	340.00	50.692	183.8	.6867	.4885	.5905	146.7
	360.00	46.920	195.6	.7207	.5030	.5972	152.9
	380.00	43.782	207.6	.7531	.5167	.6050	158.5
	400.00	41.112	219.8	.7844	.5295	.6133	163.7
	420.00	38.802	232.2	.8145	.5414	.6216	168.5
	440.00	36.778	244.7	.8436	.5525	.6298	173.1

**TABLE A.9 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-290 MIXTURE**

DEW/BUBBLE LINES AT T = 263.1 K
COMPONENT A: R22 COMPONENT B: R290
MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	344.54	.08142	5.764	3035.9	20065.4	12.166	76.892	92.286	57.708	105.476	69.920
.1000	.1705	380.15	.08083	5.195	3347.9	20225.9	15.484	80.566	90.495	55.675	104.646	68.175
.2000	.2889	404.70	.08005	4.861	3598.8	20337.0	17.436	81.728	88.823	54.262	103.850	66.969
.3000	.3783	420.80	.07905	4.663	3784.5	20424.5	18.716	82.293	87.283	53.190	103.070	66.027
.4000	.4511	430.33	.07781	4.555	3900.4	20501.4	19.447	82.634	85.887	52.311	102.289	65.208
.5000	.5150	434.55	.07634	4.511	3941.5	20575.4	19.670	82.887	84.648	51.533	101.498	64.428
.6000	.5761	434.01	.07462	4.523	3902.7	20653.5	19.384	83.109	83.577	50.780	100.690	63.615
.7000	.6408	428.41	.07267	4.594	3778.5	20743.8	18.565	83.322	82.687	49.976	99.872	62.684
.8000	.7181	416.19	.07051	4.749	3563.1	20859.4	17.148	83.509	81.987	49.008	99.060	61.503
.9000	.8246	393.65	.06818	5.056	3250.4	21025.4	14.986	83.499	81.488	47.667	98.282	59.826
1.0000	1.0000	353.26	.06570	5.696	2853.6	21296.5	11.363	81.538	81.200	45.461	97.571	57.102

DEW/BUBBLE LINES AT T = 273.1 K
COMPONENT A: R22 COMPONENT B: R290
MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	473.35	.08345	4.246	4109.5	20533.1	16.131	76.268	94.314	60.173	108.643	73.786
.1000	.1656	520.04	.08295	3.838	4413.1	20657.2	19.415	79.787	92.400	58.033	107.849	72.043
.2000	.2839	553.06	.08224	3.591	4655.9	20745.6	21.335	80.910	90.608	56.501	107.082	70.807
.3000	.3754	575.34	.08129	3.441	4833.6	20818.4	22.583	81.448	88.952	55.312	106.315	69.810
.4000	.4511	589.06	.08008	3.356	4941.4	20885.9	23.284	81.762	87.448	54.318	105.523	68.911
.5000	.5184	595.65	.07859	3.319	4974.2	20954.5	23.475	81.983	86.107	53.425	104.685	68.025
.6000	.5829	595.76	.07683	3.323	4926.8	21029.9	23.159	82.165	84.943	52.558	103.794	67.076
.7000	.6507	589.02	.07480	3.372	4793.9	21119.2	22.308	82.326	83.968	51.635	102.854	65.978
.8000	.7300	573.64	.07254	3.481	4569.8	21234.1	20.861	82.435	83.192	50.545	101.884	64.594
.9000	.8355	545.35	.07008	3.692	4248.5	21395.6	18.670	82.303	82.624	49.086	100.919	62.681
1.0000	1.0000	495.71	.06746	4.114	3823.7	21647.2	15.021	80.285	82.274	46.812	100.002	59.732

**TABLE A.9 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-290 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 283.1 K

COMPONENT A: R22 COMPONENT B: R290

MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	635.04	.08569	3.185	5215.6	20581.0	20.059	75.748	96.250	62.680	112.069	78.140
.1000	.1608	695.01	.08531	2.886	5511.1	21066.6	23.310	79.105	94.209	60.448	111.361	76.460
.2000	.2789	738.43	.08469	2.700	5746.1	21129.0	25.199	80.179	92.293	58.806	110.671	75.243
.3000	.3721	768.54	.08381	2.584	5915.8	21183.8	26.417	80.682	90.520	57.502	109.961	74.227
.4000	.4506	787.74	.08262	2.515	6015.3	21239.1	27.087	80.962	88.904	56.392	109.190	73.269
.5000	.5211	797.64	.08113	2.484	6039.4	21299.9	27.247	81.145	87.461	55.382	108.327	72.282
.6000	.5888	798.93	.07932	2.484	5982.7	21370.7	26.898	81.283	86.204	54.396	107.355	71.188
.7000	.6595	791.20	.07720	2.518	5839.9	21457.9	26.014	81.388	85.144	53.351	106.278	69.899
.8000	.7406	772.39	.07482	2.596	5605.5	21571.4	24.533	81.421	84.294	52.137	105.120	68.276
.9000	.8451	737.74	.07220	2.745	5273.9	21729.0	22.308	81.180	83.661	50.560	103.926	66.080
1.0000	1.0000	677.94	.06942	3.031	4839.1	21965.0	18.627	79.122	83.253	48.219	102.756	62.851

DEW/BUBBLE LINES AT T = 293.1 K

COMPONENT A: R22 COMPONENT B: R290

MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	834.29	.08819	2.426	6356.3	21403.8	23.958	75.298	98.085	65.246	115.868	83.162
.1000	.1560	909.91	.08795	2.202	6644.4	21448.2	27.179	78.486	95.911	62.939	115.321	81.633
.2000	.2737	965.92	.08746	2.059	6872.1	21481.0	29.040	79.501	93.868	61.196	114.784	80.511
.3000	.3686	1005.75	.08666	1.967	7034.3	21514.4	30.229	79.961	91.973	59.782	114.197	79.533
.4000	.4496	1031.99	.08552	1.912	7125.7	21554.2	30.870	80.199	90.243	58.557	113.499	78.553
.5000	.5230	1046.36	.08402	1.885	7140.8	21604.5	30.999	80.338	88.695	57.428	112.640	77.478
.6000	.5939	1049.56	.08215	1.883	7074.1	21669.0	30.617	80.428	87.344	56.318	111.590	76.228
.7000	.6672	1041.13	.07993	1.907	6920.2	21752.8	29.696	80.476	86.202	55.147	110.350	74.712
.8000	.7500	1018.74	.07740	1.964	6673.8	21864.5	28.176	80.434	85.279	53.805	108.955	72.793
.9000	.8534	977.19	.07460	2.071	6329.8	22019.1	25.912	80.096	84.584	52.110	107.468	70.242
1.0000	1.0000	906.42	.07162	2.271	5882.6	22243.5	22.194	78.014	84.124	49.700	105.972	66.642

**TABLE A.9 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-290 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 303.1 K

COMPONENT A: R22 COMPONENT B: R290

MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1075.85	.09102	1.871	7534.5	21795.3	27.838	74.888	99.805	67.890	120.223	89.118
.1000	.1514	1169.68	.09097	1.700	7816.4	21795.4	31.033	77.900	97.494	65.527	119.952	87.874
.2000	.2684	1240.69	.09064	1.588	8037.9	21794.7	32.868	78.844	95.317	63.696	119.686	86.968
.3000	.3646	1292.42	.08996	1.515	8193.6	21802.4	34.034	79.251	93.294	62.178	119.332	86.127
.4000	.4480	1327.55	.08888	1.469	8277.6	21823.2	34.648	79.439	91.446	60.839	118.794	85.193
.5000	.5243	1347.80	.08738	1.446	8283.7	21860.1	34.746	79.529	89.790	59.590	117.988	84.058
.6000	.5981	1353.86	.08545	1.443	8206.2	21916.1	34.329	79.566	88.344	58.354	116.863	82.637
.7000	.6740	1345.18	.08310	1.460	8039.8	21995.5	33.369	79.555	87.121	57.051	115.416	80.839
.8000	.7583	1319.19	.08038	1.502	7779.4	22105.5	31.805	79.442	86.130	55.577	113.700	78.530
.9000	.8607	1270.31	.07736	1.581	7420.5	22258.4	29.496	79.019	85.379	53.760	111.810	75.500
1.0000	1.0000	1187.87	.07412	1.724	6958.2	22475.0	25.733	76.927	84.871	51.278	109.866	71.386

DEW/BUBBLE LINES AT T = 313.1 K

COMPONENT A: R22 COMPONENT B: R290

MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1364.57	.09428	1.457	8754.1	22148.2	31.710	74.489	101.397	70.636	125.429	96.424
.1000	.1466	1479.29	.09447	1.325	9031.8	22100.2	34.884	77.314	98.939	68.239	125.630	95.682
.2000	.2628	1567.93	.09435	1.236	9249.2	22061.2	36.702	78.175	96.619	66.336	125.836	95.202
.3000	.3601	1634.03	.09383	1.176	9400.2	22038.4	37.848	78.517	94.461	64.724	125.907	94.679
.4000	.4458	1680.19	.09285	1.138	9477.8	22035.8	38.439	78.647	92.487	63.276	125.682	93.917
.5000	.5249	1708.06	.09137	1.118	9475.4	22055.9	38.510	78.680	90.720	61.906	125.016	92.782
.6000	.6015	1718.22	.08935	1.114	9386.7	22101.2	38.057	78.661	89.179	60.539	123.818	91.171
.7000	.6800	1709.94	.08684	1.126	9206.1	22175.3	37.054	78.590	87.876	59.100	122.080	88.992
.8000	.7657	1680.48	.08388	1.159	8929.2	22284.1	35.441	78.411	86.821	57.487	119.889	86.126
.9000	.8672	1623.94	.08058	1.218	8552.0	22437.4	33.078	77.914	86.021	55.543	117.399	82.401
1.0000	1.0000	1529.27	.07703	1.323	8071.0	22650.7	29.261	75.827	85.474	52.982	114.800	77.527

**TABLE A.9 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-290 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 323.1 K

COMPONENT A: R22 COMPONENT B: R290

MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1705.26	.09811	1.143	10020.9	22453.8	35.589	74.069	102.838	73.516	132.004	105.772
.1000	.1418	1843.68	.09862	1.039	10297.6	22352.7	38.753	76.694	100.220	71.111	133.020	105.915
.2000	.2568	1952.81	.09879	.967	10514.2	22269.4	40.561	77.455	97.745	69.157	134.075	106.250
.3000	.3550	2036.02	.09851	.917	10663.4	22210.0	41.697	77.720	95.440	67.465	134.936	106.396
.4000	.4428	2095.72	.09768	.885	10737.1	22178.4	42.274	77.779	93.332	65.917	135.325	106.072
.5000	.5246	2133.28	.09623	.867	10727.3	22177.4	42.320	77.747	91.448	64.427	134.974	105.069
.6000	.6042	2149.06	.09412	.863	10626.9	22209.5	41.831	77.667	89.808	62.925	133.705	103.241
.7000	.6851	2142.08	.09139	.873	10430.2	22277.9	40.781	77.537	88.429	61.341	131.502	100.490
.8000	.7723	2109.45	.08812	.898	10133.3	22386.8	39.110	77.298	87.319	59.580	128.525	96.742
.9000	.8730	2045.09	.08443	.944	9733.4	22543.6	36.683	76.743	86.479	57.500	125.054	91.905
1.0000	1.0000	1937.77	.08046	1.023	9228.6	22759.2	32.799	74.677	85.906	54.848	121.412	85.819

DEW/BUBBLE LINES AT T = 333.1 K

COMPONENT A: R22 COMPONENT B: R290

MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	2102.72	.10270	.900	11343.5	22700.3	39.499	73.593	104.098	76.569	140.919	118.403
.1000	.1368	2267.69	.10367	.817	11624.5	22539.3	42.666	75.997	101.302	74.193	143.430	120.179
.2000	.2504	2400.33	.10428	.758	11845.9	22403.3	44.482	76.638	98.653	72.217	146.109	122.138
.3000	.3493	2503.71	.10436	.716	11998.8	22298.7	45.622	76.806	96.182	70.469	148.558	123.735
.4000	.4390	2579.82	.10377	.689	12072.9	22230.6	46.196	76.779	93.924	68.833	150.243	124.474
.5000	.5235	2629.57	.10239	.673	12058.1	22202.9	46.225	76.670	91.912	67.227	150.607	123.939
.6000	.6060	2652.85	.10017	.669	11945.9	22219.0	45.702	76.524	90.172	65.586	149.265	121.848
.7000	.6896	2648.36	.09714	.677	11730.1	22281.7	44.597	76.337	88.722	63.845	146.181	118.094
.8000	.7782	2613.06	.09341	.697	11407.8	22393.9	42.855	76.049	87.568	61.921	141.704	112.729
.9000	.8782	2540.86	.08918	.733	10978.5	22559.7	40.346	75.456	86.706	59.688	136.416	105.882
1.0000	1.0000	2420.63	.08464	.794	10442.4	22785.3	36.377	73.432	86.126	56.928	130.922	97.663

**TABLE A.9 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-290 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 343.1 K
COMPONENT A: R22 COMPONENT B: R290
MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	2561.64	.10840	.710	12735.5	22870.8	43.472	73.013	105.129	79.856	154.212	136.817
.1000	.1315	2755.97	.11008	.642	13030.2	22639.1	46.669	75.165	102.125	77.557	159.763	141.907
.2000	.2432	2915.26	.11137	.592	13266.7	22437.8	48.519	75.654	99.269	75.607	165.966	147.474
.3000	.3424	3042.15	.11206	.557	13433.5	22274.8	49.693	75.693	96.601	73.840	172.099	152.608
.4000	.4340	3137.98	.11190	.533	13516.7	22158.0	50.288	75.553	94.165	72.143	176.993	156.222
.5000	.5214	3202.90	.11069	.519	13502.3	22094.9	50.316	75.350	92.008	70.432	179.249	157.206
.6000	.6070	3236.02	.10832	.515	13378.5	22091.4	49.759	75.131	90.164	68.645	177.813	154.770
.7000	.6933	3235.56	.10481	.521	13138.4	22150.7	48.586	74.896	88.654	66.727	172.605	148.773
.8000	.7836	3198.32	.10038	.538	12781.4	22273.1	46.750	74.579	87.479	64.612	164.603	139.740
.9000	.8829	3118.44	.09532	.568	12310.8	22458.4	44.129	73.979	86.625	62.196	155.288	128.542
1.0000	1.0000	2985.21	.08992	.616	11731.2	22706.6	40.043	72.032	86.070	59.297	145.976	115.992

DEW/BUBBLE LINES AT T = 353.1 K
COMPONENT A: R22 COMPONENT B: R290
MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	3086.56	.11586	.557	14221.5	22937.9	47.572	72.257	105.851	83.468	176.933	166.955
.1000	.1257	3312.79	.11870	.501	14548.0	22616.4	50.846	74.102	102.584	81.329	189.897	180.076
.2000	.2349	3501.83	.12123	.458	14821.1	22326.0	52.788	74.376	99.457	79.489	205.714	195.615
.3000	.3340	3655.78	.12311	.427	15024.9	22078.5	54.057	74.223	96.523	77.781	223.211	212.003
.4000	.4273	3775.17	.12389	.405	15138.4	21888.6	54.730	73.913	93.849	76.083	239.251	226.175
.5000	.5176	3858.92	.12312	.392	15137.8	21773.1	54.793	73.576	91.505	74.296	248.744	233.690
.6000	.6068	3904.88	.12052	.388	15003.3	21745.3	54.206	73.277	89.552	72.353	247.102	230.729
.7000	.6963	3910.38	.11613	.394	14726.8	21809.9	52.935	73.018	88.012	70.214	234.069	216.955
.8000	.7885	3872.16	.11037	.409	14313.3	21961.6	50.946	72.725	86.873	67.843	214.130	195.837
.9000	.8873	3784.92	.10381	.436	13776.2	22189.9	48.148	72.183	86.094	65.177	192.767	171.885
1.0000	1.0000	3638.86	.09698	.475	13129.0	22484.9	43.883	70.379	85.629	62.077	173.469	148.238

**TABLE A.9 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-290 MIXTURE (Concluded).**

DEW/BUBBLE LINES AT T = 363.1 K

COMPONENT A: R22 COMPONENT B: R290

MIXING COEFFICIENT, F = .0720

XL	XV	P	VL	WV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				----- (KJ/KG MOL K) -----			
.0000	.0000	3681.73	.12642	.431	15852.4	22847.6	51.924	71.190	106.101	87.583	225.614	227.515
.1000	.1190	3941.72	.13164	.383	16254.6	22392.0	55.392	72.598	102.443	85.769	264.604	268.530
.2000	.2244	4163.00	.13708	.344	16624.3	21951.0	57.585	72.493	98.875	84.246	323.974	329.342
.3000	.3223	4347.43	.14229	.313	16942.6	21539.5	59.155	71.943	95.460	82.841	412.617	417.303
.4000	.4167	4494.77	.14631	.290	17171.2	21188.6	60.134	71.240	92.314	81.382	530.350	530.807
.5000	.5105	4602.25	.14755	.277	17247.4	20953.7	60.402	70.605	89.612	79.671	633.568	628.106
.6000	.6046	4665.30	.14447	.274	17105.1	20893.8	59.792	70.211	87.538	77.544	630.727	624.811
.7000	.6987	4679.32	.13721	.281	16731.9	21020.0	58.260	70.079	86.127	74.989	519.297	515.798
.8000	.7934	4641.37	.12755	.299	16174.7	21283.9	55.887	70.028	85.257	72.116	393.049	388.983
.9000	.8917	4547.26	.11729	.324	15489.7	21635.3	52.696	69.760	84.773	68.981	299.813	290.004
1.0000	1.0000	4388.87	.10741	.360	14710.8	22041.6	48.085	68.275	84.574	65.514	238.363	220.622

TABLE A.10 - SUPERHEATED VAPOR PROPERTIES OF R-22/R-290 MIXTURE

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .200 MASS FRACTION R22

= .113 MOLE FRACTION R22

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	227.80	655.918	-2.8	.0313	1.6966	1.9354	523.0
SAT VAP	229.11	2.666	379.5	1.7041	.9929	1.1888	207.8
	240.00	2.532	392.7	1.7604	1.0417	1.2346	212.7
	260.00	2.321	418.3	1.8625	1.1293	1.3180	221.3
	280.00	2.143	445.4	1.9632	1.2145	1.3999	229.5
	300.00	1.992	474.2	2.0625	1.2973	1.4800	237.4
	320.00	1.862	504.6	2.1605	1.3775	1.5582	244.9
	340.00	1.748	536.6	2.2573	1.4553	1.6344	252.1
	360.00	1.648	570.0	2.3528	1.5307	1.7083	259.1
	380.00	1.559	604.9	2.4471	1.6035	1.7800	265.9
	400.00	1.479	641.2	2.5402	1.6739	1.8494	272.5
	420.00	1.407	678.8	2.6321	1.7418	1.9165	279.0
	440.00	1.342	717.8	2.7227	1.8072	1.9813	285.2

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .400 MASS FRACTION R22

= .254 MOLE FRACTION R22

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	226.05	752.842	1.1	.0616	1.4743	1.6999	495.0
SAT VAP	227.21	3.015	340.3	1.5586	.8564	1.0307	196.0
	240.00	2.838	353.8	1.6163	.9038	1.0751	201.4
	260.00	2.601	376.0	1.7051	.9763	1.1438	209.6
	280.00	2.403	399.5	1.7923	1.0467	1.2114	217.3
	300.00	2.234	424.4	1.8782	1.1150	1.2775	224.7
	320.00	2.088	450.6	1.9627	1.1813	1.3421	231.8
	340.00	1.960	478.1	2.0459	1.2455	1.4048	238.7
	360.00	1.848	506.8	2.1280	1.3077	1.4658	245.3
	380.00	1.748	536.7	2.2088	1.3678	1.5249	251.7
	400.00	1.659	567.8	2.2885	1.4258	1.5821	257.9
	420.00	1.578	600.0	2.3670	1.4817	1.6373	264.0
	440.00	1.505	633.3	2.4444	1.5356	1.6906	269.9

**TABLE A.10 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-290 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .600 MASS FRACTION R22

= .433 MOLE FRACTION R22

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	225.30	886.196	4.1	.0744	1.2633	1.4730	466.3
SAT VAP	225.42	3.458	301.7	1.3954	.7232	.8759	183.6
	240.00	3.227	314.8	1.4515	.7660	.9157	189.5
	260.00	2.959	333.7	1.5270	.8233	.9699	197.1
	280.00	2.734	353.6	1.6008	.8789	1.0231	204.4
	300.00	2.542	374.6	1.6732	.9328	1.0752	211.3
	320.00	2.376	396.6	1.7442	.9851	1.1260	218.0
	340.00	2.231	419.6	1.8139	1.0357	1.1754	224.4
	360.00	2.104	443.6	1.8825	1.0847	1.2233	230.6
	380.00	1.990	468.5	1.9499	1.1320	1.2698	236.6
	400.00	1.888	494.4	2.0162	1.1777	1.3148	242.5
	420.00	1.797	521.1	2.0814	1.2216	1.3582	248.2
	440.00	1.714	548.7	2.1455	1.2640	1.4000	253.7

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .800 MASS FRACTION R22

= .671 MOLE FRACTION R22

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	225.64	1086.298	3.4	.0592	1.0654	1.2542	440.8
SAT VAP	226.78	3.984	266.0	1.2208	.5997	.7304	171.7
	240.00	3.744	275.8	1.2629	.6282	.7567	176.7
	260.00	3.433	291.3	1.3251	.6703	.7961	183.8
	280.00	3.173	307.6	1.3855	.7111	.8350	190.6
	300.00	2.950	324.7	1.4444	.7506	.8730	197.1
	320.00	2.758	342.5	1.5019	.7889	.9100	203.3
	340.00	2.590	361.1	1.5582	.8260	.9461	209.3
	360.00	2.442	380.4	1.6133	.8617	.9810	215.1
	380.00	2.310	400.3	1.6672	.8963	1.0148	220.7
	400.00	2.192	421.0	1.7201	.9296	1.0475	226.1
	420.00	2.086	442.2	1.7720	.9616	1.0791	231.4
	440.00	1.990	464.1	1.8229	.9924	1.1094	236.6

**TABLE A.10 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-290 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .200 MASS FRACTION R22

= .113 MOLE FRACTION R22

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	264.37	603.618	71.9	.3331	1.8513	2.1462	425.5
SAT VAP	265.66	9.850	415.0	1.6272	1.1650	1.4256	210.3
	280.00	9.176	435.7	1.7033	1.2255	1.4707	218.1
	300.00	8.401	465.8	1.8070	1.3079	1.5375	228.1
	320.00	7.764	497.2	1.9084	1.3879	1.6061	237.3
	340.00	7.228	530.1	2.0079	1.4655	1.6751	245.9
	360.00	6.770	564.2	2.1055	1.5406	1.7435	253.9
	380.00	6.372	599.8	2.2016	1.6132	1.8107	261.6
	400.00	6.022	636.7	2.2962	1.6834	1.8765	268.8
	420.00	5.712	674.8	2.3893	1.7511	1.9406	275.8
	440.00	5.435	714.3	2.4810	1.8163	2.0028	282.5

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .400 MASS FRACTION R22

= .254 MOLE FRACTION R22

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	262.03	691.583	65.6	.3241	1.6005	1.8796	403.4
SAT VAP	263.28	11.139	370.3	1.4845	.9977	1.2287	198.5
	280.00	10.258	391.2	1.5615	1.0561	1.2717	207.1
	300.00	9.398	417.2	1.6511	1.1242	1.3266	216.5
	320.00	8.691	444.3	1.7385	1.1902	1.3831	225.1
	340.00	8.095	472.5	1.8240	1.2542	1.4398	233.1
	360.00	7.584	501.9	1.9079	1.3162	1.4960	240.6
	380.00	7.140	532.3	1.9903	1.3761	1.5513	247.8
	400.00	6.750	563.9	2.0712	1.4340	1.6054	254.6
	420.00	6.403	596.5	2.1508	1.4898	1.6581	261.2
	440.00	6.093	630.2	2.2292	1.5435	1.7092	267.5

**TABLE A.10 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-290 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .600 MASS FRACTION R22

= .433 MOLE FRACTION R22

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	260.75	812.840	59.0	.2989	1.3621	1.6220	380.8
SAT VAP	261.02	12.777	326.6	1.3248	.8342	1.0358	186.3
	280.00	11.640	346.6	1.3988	.8867	1.0736	195.4
	300.00	10.673	368.5	1.4743	.9405	1.1164	204.0
	320.00	9.876	391.2	1.5477	.9926	1.1605	212.0
	340.00	9.202	414.9	1.6194	1.0431	1.2049	219.5
	360.00	8.624	439.4	1.6895	1.0919	1.2489	226.5
	380.00	8.121	464.8	1.7582	1.1391	1.2922	233.2
	400.00	7.679	491.1	1.8256	1.1846	1.3345	239.6
	420.00	7.285	518.2	1.8917	1.2285	1.3758	245.7
	440.00	6.933	546.1	1.9566	1.2707	1.4158	251.6

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .800 MASS FRACTION R22

= .671 MOLE FRACTION R22

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	260.89	996.196	49.7	.2485	1.1391	1.3716	360.9
SAT VAP	261.36	14.751	285.7	1.1526	.6797	.8505	174.5
	280.00	13.475	301.8	1.2120	.7175	.8766	182.7
	300.00	12.365	319.6	1.2735	.7569	.9071	190.7
	320.00	11.446	338.1	1.3331	.7951	.9386	198.1
	340.00	10.670	357.2	1.3909	.8320	.9705	205.0
	360.00	10.002	376.9	1.4473	.8677	1.0022	211.5
	380.00	9.421	397.3	1.5023	.9022	1.0335	217.7
	400.00	8.908	418.2	1.5561	.9354	1.0640	223.6
	420.00	8.453	439.8	1.6088	.9673	1.0938	229.3
	440.00	8.045	462.0	1.6603	.9980	1.1226	234.8

**TABLE A.10 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-290 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .200 MASS FRACTION R22

= .113 MOLE FRACTION R22

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	283.02	573.706	113.2	.4822	1.9213	2.2753	377.9
SAT VAP	284.29	17.013	431.4	1.6035	1.2558	1.5854	207.9
	300.00	15.627	456.5	1.6895	1.3197	1.6156	217.9
	320.00	14.232	489.3	1.7953	1.3991	1.6662	229.2
	340.00	13.115	523.2	1.8980	1.4762	1.7233	239.3
	360.00	12.192	558.3	1.9982	1.5509	1.7834	248.5
	380.00	11.410	594.5	2.0963	1.6232	1.8446	257.1
	400.00	10.738	632.0	2.1925	1.6931	1.9058	265.1
	420.00	10.150	670.8	2.2869	1.7606	1.9662	272.6
	440.00	9.632	710.7	2.3798	1.8256	2.0254	279.8

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .400 MASS FRACTION R22

= .254 MOLE FRACTION R22

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	280.36	656.575	101.1	.4535	1.6570	1.9919	358.8
SAT VAP	281.64	19.238	383.9	1.4602	1.0724	1.3641	196.4
	300.00	17.432	409.2	1.5472	1.1342	1.3923	207.4
	320.00	15.898	437.5	1.6383	1.1998	1.4339	217.8
	340.00	14.664	466.6	1.7266	1.2634	1.4808	227.2
	360.00	13.640	496.7	1.8127	1.3251	1.5301	235.8
	380.00	12.773	527.8	1.8967	1.3848	1.5803	243.8
	400.00	12.024	559.9	1.9791	1.4424	1.6305	251.3
	420.00	11.370	593.1	2.0598	1.4980	1.6801	258.3
	440.00	10.792	627.1	2.1391	1.5515	1.7286	265.1

**TABLE A.10 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-290 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .600 MASS FRACTION R22

= .433 MOLE FRACTION R22

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	278.76	771.007	89.1	.4091	1.4056	1.7171	339.2
SAT VAP	279.10	22.065	337.6	1.3002	.8932	1.1471	184.5
	280.00	21.950	338.6	1.3039	.8956	1.1478	185.0
	300.00	19.740	361.8	1.3838	.9489	1.1708	196.0
	320.00	18.027	385.5	1.4603	1.0006	1.2029	205.7
	340.00	16.643	409.9	1.5343	1.0508	1.2392	214.3
	360.00	15.491	435.1	1.6063	1.0994	1.2776	222.3
	380.00	14.513	461.0	1.6764	1.1464	1.3166	229.7
	400.00	13.668	487.8	1.7449	1.1918	1.3557	236.6
	420.00	12.928	515.3	1.8120	1.2355	1.3944	243.2
	440.00	12.273	543.5	1.8777	1.2776	1.4322	249.5

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .800 MASS FRACTION R22

= .671 MOLE FRACTION R22

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	278.71	945.161	74.8	.3406	1.1707	1.4478	322.2
SAT VAP	278.99	25.472	294.3	1.1276	.7227	.9364	173.2
	280.00	25.325	295.2	1.1310	.7247	.9368	173.7
	300.00	22.814	314.1	1.1961	.7638	.9516	183.7
	320.00	20.857	333.3	1.2582	.8017	.9735	192.6
	340.00	19.270	353.0	1.3180	.8384	.9989	200.5
	360.00	17.947	373.3	1.3758	.8740	1.0250	207.8
	380.00	16.820	394.1	1.4320	.9083	1.0538	214.7
	400.00	15.845	415.4	1.4868	.9413	1.0817	221.1
	420.00	14.991	437.4	1.5403	.9732	1.1093	227.2
	440.00	14.234	459.8	1.5925	1.0037	1.1364	233.0

**TABLE A.10 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-290 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .200 MASS FRACTION R22

= .113 MOLE FRACTION R22

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	296.42	550.153	144.4	.5880	1.9670	2.3871	344.2
SAT VAP	297.65	24.387	441.9	1.5893	1.3238	1.7321	204.4
	300.00	24.021	446.0	1.6028	1.3331	1.7309	206.2
	320.00	21.431	480.7	1.7148	1.4113	1.7446	220.3
	340.00	19.492	515.9	1.8216	1.4876	1.7818	232.3
	360.00	17.958	552.0	1.9248	1.5617	1.8295	242.9
	380.00	16.700	589.1	2.0251	1.6336	1.8823	252.4
	400.00	15.640	627.3	2.1230	1.7031	1.9374	261.2
	420.00	14.731	666.6	2.2189	1.7702	1.9933	269.4
	440.00	13.940	707.0	2.3129	1.8350	2.0490	277.0

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .400 MASS FRACTION R22

= .254 MOLE FRACTION R22

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	293.52	629.030	127.9	.5453	1.6935	2.0906	327.1
SAT VAP	294.80	27.576	392.6	1.4451	1.1285	1.4894	193.3
	300.00	26.678	400.3	1.4711	1.1455	1.4870	197.1
	320.00	23.872	430.1	1.5673	1.2102	1.4994	210.0
	340.00	21.751	460.4	1.6591	1.2732	1.5301	221.0
	360.00	20.062	491.4	1.7476	1.3344	1.5692	230.8
	380.00	18.672	523.2	1.8336	1.3937	1.6124	239.7
	400.00	17.498	555.9	1.9175	1.4510	1.6575	247.8
	420.00	16.489	589.5	1.9994	1.5064	1.7033	255.5
	440.00	15.608	624.0	2.0797	1.5597	1.7489	262.6

**TABLE A.10 - SUPERHEATED VAPOR PROPERTIES OF
R-22/R-290 MIXTURE (Concluded)**

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .600 MASS FRACTION R22

 = .433 MOLE FRACTION R22

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	291.68	738.142	111.7	.4872	1.4332	1.8021	309.7
SAT VAP	292.06	31.623	344.4	1.2845	.9377	1.2513	181.8
	300.00	30.087	354.3	1.3180	.9583	1.2474	187.1
	320.00	26.996	379.3	1.3987	1.0093	1.2567	198.8
	340.00	24.639	404.7	1.4755	1.0590	1.2801	208.9
	360.00	22.752	430.6	1.5495	1.1073	1.3102	217.9
	380.00	21.192	457.1	1.6213	1.1540	1.3436	226.1
	400.00	19.872	484.3	1.6911	1.1991	1.3785	233.7
	420.00	18.734	512.3	1.7592	1.2426	1.4140	240.7
	440.00	17.740	540.9	1.8258	1.2845	1.4494	247.4

SUPERHEATED VAPOR PROPERTIES FOR R22 /R290

MIXING COEFFICIENT = .072

COMPOSITION = .800 MASS FRACTION R22

 = .671 MOLE FRACTION R22

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	291.45	905.240	93.6	.4055	1.1904	1.5164	295.0
SAT VAP	291.62	36.487	299.4	1.1114	.7555	1.0178	171.0
	300.00	34.660	307.9	1.1401	.7714	1.0133	176.0
	320.00	31.167	328.2	1.2056	.8088	1.0174	186.6
	340.00	28.484	348.7	1.2677	.8452	1.0325	195.8
	360.00	26.327	369.6	1.3273	.8804	1.0529	204.0
	380.00	24.538	390.8	1.3848	.9145	1.0761	211.6
	400.00	23.020	412.6	1.4406	.9474	1.1006	218.5
	420.00	21.710	434.9	1.4949	.9791	1.1256	225.0
	440.00	20.564	457.6	1.5478	1.0095	1.1507	231.1

TABLE A.11 - SATURATED VAPOR-LIQUID PROPERTIES OF R-22/R-12 MIXTURE

DEW/BUBBLE LINES AT T = 273.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	307.74	.08661	6.742	4420.7	22791.2	17.406	84.673	100.255	61.658	114.014	73.618
.1000	.1926	348.58	.08536	5.919	4566.1	22556.8	20.302	87.593	98.014	58.822	112.534	71.066
.2000	.3332	383.10	.08400	5.360	4676.3	22379.8	21.883	87.924	95.841	56.755	111.094	69.256
.3000	.4428	412.10	.08250	4.962	4748.1	22239.9	22.847	87.649	93.746	55.145	109.686	67.866
.4000	.5330	436.27	.08086	4.672	4778.0	22125.4	23.322	87.144	91.739	53.819	108.302	66.718
.5000	.6112	456.17	.07907	4.457	4762.0	22028.6	23.350	86.531	89.831	52.665	106.930	65.702
.6000	.6826	472.23	.07710	4.298	4695.9	21944.2	22.935	85.846	88.035	51.605	105.561	64.736
.7000	.7518	484.65	.07495	4.185	4574.7	21868.0	22.051	85.072	86.366	50.573	104.186	63.750
.8000	.8232	493.33	.07263	4.113	4393.0	21796.3	20.632	84.139	84.838	49.499	102.799	62.669
.9000	.9029	497.59	.07013	4.084	4144.9	21724.6	18.529	82.856	83.468	48.293	101.402	61.386
1.0000	1.0000	495.71	.06746	4.114	3823.7	21647.2	15.021	80.285	82.274	46.812	100.002	59.732

DEW/BUBBLE LINES AT T = 283.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	421.99	.08869	4.977	5573.8	23299.2	21.517	84.129	101.142	63.199	116.038	76.440
.1000	.1857	474.98	.08750	4.393	5704.9	23034.7	24.358	86.895	98.893	60.446	114.680	74.069
.2000	.3245	520.38	.08619	3.986	5801.1	22830.0	25.886	87.189	96.714	58.393	113.364	72.368
.3000	.4345	559.04	.08474	3.692	5859.2	22665.2	26.798	86.881	94.615	56.767	112.080	71.050
.4000	.5263	591.70	.08313	3.474	5875.6	22528.5	27.223	86.334	92.607	55.409	110.814	69.948
.5000	.6066	618.97	.08134	3.310	5846.2	22412.0	27.202	85.671	90.702	54.216	109.547	68.957
.6000	.6802	641.31	.07935	3.188	5766.6	22310.2	26.738	84.926	88.915	53.115	108.265	67.996
.7000	.7514	658.91	.07717	3.100	5631.8	22218.7	25.805	84.086	87.259	52.042	106.952	66.999
.8000	.8244	671.62	.07479	3.042	5436.4	22133.7	24.337	83.081	85.752	50.931	105.596	65.887
.9000	.9046	678.62	.07220	3.016	5174.3	22051.0	22.184	81.727	84.410	49.700	104.196	64.557
1.0000	1.0000	677.94	.06942	3.031	4839.0	21965.0	18.627	79.122	83.253	48.219	102.756	62.851

**TABLE A.11 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-12 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 293.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	565.27	.09098	3.742	6747.9	23780.0	25.548	83.658	101.924	64.768	118.281	79.681
.1000	.1791	632.68	.08988	3.318	6865.9	23485.1	28.339	86.273	99.667	62.104	117.085	77.535
.2000	.3160	691.18	.08863	3.016	6949.3	23251.5	29.820	86.523	97.481	60.076	115.938	75.992
.3000	.4263	741.66	.08723	2.793	6994.8	23060.1	30.686	86.178	95.376	58.442	114.821	74.793
.4000	.5195	784.86	.08566	2.626	6998.8	22899.1	31.065	85.586	93.366	57.060	113.715	73.781
.5000	.6017	821.42	.08388	2.499	6957.0	22760.8	31.000	84.869	91.463	55.834	112.594	72.853
.6000	.6775	851.79	.08189	2.403	6864.8	22639.7	30.491	84.062	89.682	54.696	111.431	71.930
.7000	.7507	876.13	.07967	2.333	6717.1	22531.4	29.513	83.154	88.040	53.585	110.201	70.940
.8000	.8252	894.21	.07721	2.286	6508.2	22432.0	27.999	82.078	86.554	52.440	108.885	69.806
.9000	.9059	905.05	.07453	2.264	6232.3	22337.7	25.799	80.654	85.242	51.183	107.473	68.425
1.0000	1.0000	906.42	.07162	2.271	5882.6	22243.5	22.194	78.014	84.124	49.700	105.972	66.642

DEW/BUBBLE LINES AT T = 303.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	741.67	.09354	2.858	7944.7	24228.4	29.509	83.232	102.595	66.378	120.844	83.489
.1000	.1727	825.94	.09253	2.543	8051.0	23902.6	32.256	85.695	100.326	63.812	119.869	81.632
.2000	.3075	899.99	.09137	2.314	8123.1	23638.6	33.694	85.896	98.130	61.819	118.952	80.318
.3000	.4180	964.68	.09005	2.143	8157.6	23418.5	34.520	85.509	96.018	60.188	118.069	79.309
.4000	.5124	1020.77	.08853	2.012	8150.7	23230.9	34.861	84.868	94.002	58.791	117.188	78.455
.5000	.5965	1068.84	.08678	1.912	8097.8	23068.6	34.756	84.094	92.099	57.540	116.272	77.650
.6000	.6743	1109.31	.08479	1.836	7994.1	22926.0	34.208	83.223	90.323	56.371	115.279	76.811
.7000	.7494	1142.26	.08253	1.779	7834.3	22798.9	33.188	82.244	88.694	55.226	114.167	75.862
.8000	.8256	1167.33	.07999	1.741	7612.5	22683.9	31.631	81.095	87.228	54.048	112.902	74.722
.9000	.9070	1183.38	.07719	1.721	7322.6	22577.3	29.386	79.602	85.947	52.767	111.468	73.28
1.0000	1.0000	1187.87	.07412	1.724	6958.2	22475.0	25.733	76.927	84.871	51.278	109.866	71.386

**TABLE A.11 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-12 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 313.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	955.40	.09641	2.210	9166.8	24438.6	33.409	82.824	103.143	68.047	123.880	88.080
.1000	.1665	1059.11	.09553	1.972	9263.3	24281.1	36.120	85.135	100.861	65.589	123.213	86.609
.2000	.2991	1151.33	.09449	1.796	9326.0	23985.0	37.523	85.281	98.651	63.644	122.624	85.631
.3000	.4095	1232.89	.09327	1.662	9351.5	23733.7	38.316	84.846	96.526	62.028	122.078	84.923
.4000	.5050	1304.48	.09183	1.559	9335.5	23516.9	38.623	84.152	94.502	60.627	121.529	84.334
.5000	.5907	1366.61	.09013	1.478	9273.4	23327.6	38.486	83.316	92.594	59.360	120.917	83.750
.6000	.6706	1419.58	.08814	1.417	9159.8	23160.7	37.904	82.376	90.820	58.166	120.176	83.078
.7000	.7477	1463.36	.08584	1.371	8988.9	23012.7	36.848	81.325	89.200	56.993	119.238	82.228
.8000	.8255	1497.39	.08322	1.339	8754.8	22880.4	35.251	80.101	87.755	55.785	118.046	81.105
.9000	.9077	1520.31	.08028	1.323	8451.0	22760.8	32.962	78.538	86.506	54.479	116.566	79.592
1.0000	1.0000	1529.27	.07703	1.323	8071.0	22650.7	29.261	75.827	85.474	52.982	114.800	77.527

DEW/BUBBLE LINES AT T = 323.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1210.67	.09970	1.727	10417.6	25004.1	37.263	82.408	103.558	69.795	127.629	93.783
.1000	.1604	1336.51	.09898	1.545	10506.6	24613.5	39.943	84.563	101.255	67.457	127.413	92.851
.2000	.2906	1449.72	.09810	1.407	10562.6	24282.9	41.320	84.648	99.026	65.576	127.311	92.383
.3000	.4006	1551.02	.09702	1.300	10581.7	23997.6	42.088	84.160	96.883	63.992	127.276	92.159
.4000	.4970	1641.02	.09569	1.217	10559.4	23748.0	42.372	83.406	94.842	62.600	127.238	92.018
.5000	.5844	1720.10	.09407	1.152	10490.5	23528.2	42.210	82.503	92.923	61.328	127.105	91.829
.6000	.6662	1788.37	.09212	1.101	10369.1	23333.7	41.601	81.489	91.146	60.119	126.767	91.471
.7000	.7454	1845.57	.08979	1.064	10188.8	23161.8	40.514	80.360	89.532	58.922	126.108	90.826
.8000	.8249	1890.91	.08706	1.038	9943.1	23010.1	38.881	79.059	88.105	57.689	125.026	89.770
.9000	.9082	1922.70	.08395	1.023	9625.2	22876.7	36.549	77.426	86.889	56.358	123.461	88.159
1.0000	1.0000	1937.77	.08046	1.023	9228.6	22759.2	32.799	74.677	85.906	54.848	121.412	85.819

**TABLE A.11 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-12 MIXTURE (CONTINUED)**

DEW/BUBBLE LINES AT T = 333.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1511.73	.10351	1.360	11701.8	25316.9	41.084	81.957	103.820	71.647	132.497	101.123
.1000	.1542	1662.45	.10302	1.218	11786.7	24891.1	43.745	83.951	101.490	69.446	132.971	100.990
.2000	.2818	1799.57	.10236	1.109	11839.6	24522.9	45.105	83.965	99.232	67.649	133.636	101.329
.3000	.3913	1923.72	.10149	1.023	11856.1	24199.5	45.859	83.415	97.060	66.114	134.427	101.918
.4000	.4884	2035.33	.10034	.955	11831.4	23912.7	46.130	82.594	94.994	64.751	135.240	102.570
.5000	.5773	2134.59	.09885	.902	11759.3	23657.5	45.955	81.616	93.054	63.489	135.924	103.110
.6000	.6611	2221.35	.09695	.860	11633.3	23431.0	45.329	80.521	91.264	62.277	136.288	103.361
.7000	.7424	2295.03	.09460	.828	11446.0	23231.3	44.220	79.308	89.650	61.066	136.119	103.137
.8000	.8238	2354.44	.09177	.807	11189.8	23057.7	42.555	77.925	88.238	59.811	135.227	102.246
.9000	.9083	2397.51	.08844	.795	10857.5	22909.4	40.180	76.220	87.055	58.456	133.494	100.489
1.0000	1.0000	2420.63	.08464	.794	10442.4	22785.3	36.377	73.432	86.126	56.928	130.922	97.663

DEW/BUBBLE LINES AT T = 343.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	1862.80	.10803	1.076	13026.7	25566.8	44.893	81.442	103.907	73.635	139.209	111.006
.1000	.1480	2041.14	.10786	.965	13112.3	25102.5	47.547	83.263	101.537	71.595	140.817	112.144
.2000	.2727	2205.19	.10752	.877	13167.2	24692.2	48.906	83.196	99.235	69.906	142.787	113.857
.3000	.3813	2355.43	.10696	.807	13186.9	24325.0	49.662	82.572	97.020	68.449	145.039	115.910
.4000	.4789	2492.11	.10609	.751	13165.6	23994.4	49.937	81.671	94.911	67.138	147.416	118.070
.5000	.5692	2615.16	.10482	.707	13096.3	23697.0	49.764	80.605	92.934	65.909	149.659	120.072
.6000	.6549	2724.06	.10306	.672	12970.8	23431.7	49.136	79.417	91.116	64.712	151.409	121.604
.7000	.7385	2817.75	.10073	.645	12780.2	23198.7	48.015	78.109	89.490	63.501	152.233	122.313
.8000	.8220	2894.51	.09776	.627	12515.3	22999.4	46.324	76.637	88.086	62.231	151.724	121.825
.9000	.9081	2951.70	.09414	.617	12167.9	22835.2	43.906	74.857	86.937	60.851	149.632	119.804
1.0000	1.0000	2985.21	.08992	.616	11731.2	22706.6	40.043	72.032	86.070	59.297	145.976	115.992

**TABLE A.11 - SATURATED VAPOR-LIQUID PROPERTIES
OF R-22/R-12 MIXTURE (Concluded).**

DEW/BUBBLE LINES AT T = 353.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	2268.00	.11355	.854	14403.4	25739.8	48.718	80.824	103.780	75.806	149.182	125.140
.1000	.1416	2476.63	.11385	.765	14496.8	25231.3	51.386	82.456	101.350	73.957	152.846	128.516
.2000	.2629	2670.57	.11401	.694	14562.2	24771.6	52.765	82.288	98.983	72.415	157.303	132.827
.3000	.3703	2850.21	.11395	.636	14594.5	24351.5	53.549	81.569	96.697	71.074	162.498	137.848
.4000	.4681	3015.63	.11356	.589	14586.8	23966.6	53.855	80.567	94.517	69.855	168.215	143.282
.5000	.5597	3166.43	.11270	.551	14530.5	23615.7	53.712	79.391	92.473	68.696	173.999	148.683
.6000	.6474	3301.62	.11123	.521	14415.0	23300.6	53.107	78.088	90.600	67.545	177.078	153.394
.7000	.7334	3419.48	.10900	.499	14228.2	23025.1	51.993	76.666	88.939	66.355	182.402	156.551
.8000	.8194	3517.50	.10588	.483	13958.0	22794.4	50.285	75.092	87.532	65.080	182.891	157.195
.9000	.9074	3592.22	.10185	.475	13593.9	22613.4	47.822	73.235	86.419	63.673	179.871	154.537
1.0000	1.0000	3638.86	.09698	.475	13129.0	22484.9	43.883	70.379	85.629	62.077	173.469	148.238

DEW/BUBBLE LINES AT T = 363.1 K

COMPONENT A: R22 COMPONENT B: R12

MIXING COEFFICIENT, F = .0410

XL	XV	P	VL	VV	HL	HV	SL	SV	CVL	CVV	CPL	CPV
(MOL FRAC A)		(KPA)	(L/MOL)		(KJ/KG MOL)				(KJ/KG MOL K)			
.0000	.0000	2731.38	.12054	.676	15850.5	25814.2	52.608	80.049	103.381	78.228	165.591	147.211
.1000	.1348	2972.64	.12160	.604	15964.2	25251.4	55.320	81.461	100.856	76.621	173.570	155.164
.2000	.2522	3199.22	.12260	.545	16055.0	24728.9	56.759	81.156	98.381	75.285	183.676	165.298
.3000	.3577	3411.46	.12345	.497	16117.7	24239.1	57.616	80.305	95.975	74.126	196.186	177.666
.4000	.4553	3609.31	.12400	.457	16144.3	23779.6	58.006	79.157	93.665	73.070	211.108	192.134
.5000	.5478	3792.10	.12404	.424	16123.4	23352.1	57.953	77.820	91.490	72.054	227.793	208.055
.6000	.6376	3958.29	.12329	.397	16039.6	22963.7	57.428	76.350	89.498	71.017	244.344	223.796
.7000	.7264	4105.28	.12143	.377	15873.8	22625.7	56.367	74.770	87.752	69.898	257.187	236.328
.8000	.8155	4229.37	.11819	.364	15606.1	22352.4	54.664	73.067	86.315	68.641	261.783	241.616
.9000	.9062	4325.81	.11347	.358	15220.6	22155.9	52.143	71.134	85.245	67.195	255.145	236.430
1.0000	1.0000	4388.87	.10741	.360	14710.8	22041.6	48.085	68.275	84.574	65.514	238.362	220.622

TABLE A.12 - SUPERHEATED VAPOR PROPERTIES OF R-22/R-12 MIXTURE

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .200 MASS FRACTION R12

= .152 MOLE FRACTION R12

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	231.53	1420.746	2.4	.0406	.8653	1.0167	399.5
SAT VAP	231.53	4.927	219.1	.9764	.4747	.5777	154.5
	240.00	4.736	224.0	.9974	.4861	.5879	157.4
	260.00	4.343	236.0	1.0454	.5122	.6119	163.9
	280.00	4.013	248.5	1.0916	.5373	.6355	170.1
	300.00	3.731	261.5	1.1362	.5615	.6584	176.0
	320.00	3.485	274.9	1.1794	.5847	.6806	181.6
	340.00	3.275	288.7	1.2213	.6070	.7021	187.0
	360.00	3.088	302.9	1.2621	.6282	.7227	192.3
	380.00	2.921	317.6	1.3017	.6486	.7424	197.3
	400.00	2.772	332.6	1.3402	.6679	.7613	202.3
	420.00	2.637	348.0	1.3778	.6863	.7793	207.0
	440.00	2.516	363.8	1.4145	.7038	.7964	211.7

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .400 MASS FRACTION R12

= .323 MOLE FRACTION R12

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	231.91	1430.033	5.0	.0621	.8413	.9815	383.2
SAT VAP	232.41	5.231	207.0	.9326	.4717	.5690	149.1
	240.00	5.049	211.4	.9511	.4816	.5779	151.7
	260.00	4.628	223.2	.9983	.5070	.6012	158.1
	280.00	4.275	235.4	1.0436	.5313	.6239	164.1
	300.00	3.974	248.1	1.0874	.5545	.6459	169.9
	320.00	3.714	261.2	1.1298	.5766	.6670	175.4
	340.00	3.488	274.8	1.1709	.5977	.6873	180.7
	360.00	3.288	288.7	1.2107	.6177	.7066	185.8
	380.00	3.110	303.0	1.2494	.6366	.7249	190.7
	400.00	2.951	317.7	1.2870	.6544	.7423	195.5
	420.00	2.808	332.7	1.3236	.6711	.7586	200.2
	440.00	2.678	348.1	1.3593	.6868	.7739	204.7

**TABLE A.12 - SUPERHEATED VAPOR PROPERTIES
OF R-22/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .600 MASS FRACTION R12

= .518 MOLE FRACTION R12

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	233.11	1445.020	6.2	.0688	.8221	.9492	368.3
SAT VAP	235.12	5.531	195.9	.8798	.4710	.5624	144.2
	240.00	5.407	198.7	.8914	.4772	.5680	145.8
	260.00	4.954	210.3	.9377	.5019	.5905	152.1
	280.00	4.574	222.3	.9823	.5253	.6124	158.0
	300.00	4.252	234.8	1.0253	.5475	.6334	163.6
	320.00	3.973	247.6	1.0668	.5686	.6534	168.9
	340.00	3.730	260.9	1.1070	.5884	.6725	174.1
	360.00	3.516	274.5	1.1459	.6071	.6905	179.1
	380.00	3.325	288.5	1.1837	.6246	.7074	183.9
	400.00	3.155	302.8	1.2204	.6408	.7232	188.6
	420.00	3.002	317.4	1.2561	.6559	.7379	193.1
	440.00	2.863	332.3	1.2907	.6698	.7514	197.5

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .800 MASS FRACTION R12

= .741 MOLE FRACTION R12

PRESSURE = 100.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	235.90	1465.793	6.7	.0624	.8084	.9206	354.3
SAT VAP	238.88	5.853	185.3	.8146	.4715	.5570	139.4
	240.00	5.822	186.0	.8172	.4728	.5583	139.7
	260.00	5.331	197.4	.8628	.4967	.5800	145.8
	280.00	4.920	209.2	.9065	.5193	.6010	151.6
	300.00	4.572	221.4	.9487	.5406	.6210	157.1
	320.00	4.271	234.0	.9894	.5606	.6399	162.3
	340.00	4.009	247.0	1.0287	.5792	.6578	167.3
	360.00	3.778	260.3	1.0668	.5965	.6745	172.2
	380.00	3.573	273.9	1.1037	.6126	.6899	176.8
	400.00	3.390	287.9	1.1394	.6273	.7042	181.4
	420.00	3.225	302.1	1.1741	.6407	.7172	185.8
	440.00	3.075	316.6	1.2077	.6528	.7290	190.1

**TABLE A.12 - SUPERHEATED VAPOR PROPERTIES
OF R-22/H-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .200 MASS FRACTION R12

= .152 MOLE FRACTION R12

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	266.58	1306.519	39.5	.1885	.9106	1.0959	328.8
SAT VAP	266.61	18.207	234.9	.9215	.5258	.6593	157.6
	280.00	17.074	243.8	.9541	.5424	.6694	162.9
	300.00	15.659	257.3	1.0008	.5665	.6861	170.2
	320.00	14.490	271.2	1.0457	.5896	.7038	176.9
	340.00	13.503	285.5	1.0889	.6118	.7219	183.2
	360.00	12.655	300.1	1.1306	.6330	.7399	189.1
	380.00	11.918	315.1	1.1711	.6533	.7575	194.7
	400.00	11.268	330.4	1.2104	.6726	.7747	200.0
	420.00	10.691	346.1	1.2486	.6909	.7912	205.2
	440.00	10.174	362.0	1.2858	.7082	.8071	210.1

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .400 MASS FRACTION R12

= .323 MOLE FRACTION R12

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	267.38	1313.652	41.1	.2061	.8831	1.0563	314.5
SAT VAP	268.07	19.340	222.9	.8854	.5222	.6495	152.0
	280.00	18.254	230.7	.9138	.5365	.6578	156.6
	300.00	16.724	244.0	.9598	.5595	.6735	163.9
	320.00	15.464	257.7	1.0037	.5815	.6900	170.5
	340.00	14.403	271.6	1.0461	.6025	.7069	176.6
	360.00	13.494	285.9	1.0870	.6224	.7235	182.4
	380.00	12.703	300.6	1.1265	.6412	.7397	187.9
	400.00	12.008	315.5	1.1649	.6589	.7553	193.2
	420.00	11.391	330.8	1.2021	.6755	.7702	198.2
	440.00	10.838	346.3	1.2382	.6911	.7843	203.1

**TABLE A.12 - SUPERHEATED VAPOR PROPERTIES
OF R-22/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .600 MASS FRACTION R12

= .518 MOLE FRACTION R12

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	269.24	1327.270	41.8	.2097	.8610	1.0188	301.6
SAT VAP	271.39	20.472	212.1	.8400	.5207	.6412	146.8
	280.00	19.629	217.6	.8601	.5306	.6468	150.1
	300.00	17.958	230.7	.9052	.5526	.6612	157.2
	320.00	16.589	244.1	.9484	.5735	.6765	163.8
	340.00	15.439	257.7	.9898	.5932	.6921	169.9
	360.00	14.457	271.7	1.0298	.6117	.7074	175.6
	380.00	13.604	286.0	1.0685	.6291	.7221	181.0
	400.00	12.855	300.6	1.1059	.6452	.7362	186.1
	420.00	12.191	315.5	1.1421	.6602	.7494	191.0
	440.00	11.598	330.6	1.1773	.6740	.7617	195.8

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .800 MASS FRACTION R12

= .741 MOLE FRACTION R12

PRESSURE = 400.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	273.03	1347.360	42.1	.2008	.8446	.9844	289.1
SAT VAP	275.99	21.681	201.9	.7826	.5204	.6342	141.6
	280.00	21.257	204.4	.7918	.5248	.6365	143.1
	300.00	19.409	217.3	.8361	.5458	.6494	150.3
	320.00	17.904	230.4	.8785	.5655	.6634	156.8
	340.00	16.647	243.8	.9191	.5840	.6776	162.8
	360.00	15.576	257.5	.9583	.6012	.6915	168.4
	380.00	14.649	271.5	.9960	.6171	.7047	173.7
	400.00	13.836	285.7	1.0325	.6316	.7172	178.7
	420.00	13.117	300.1	1.0678	.6449	.7287	183.6
	440.00	12.474	314.8	1.1019	.6569	.7392	188.2

**TABLE A.12 - SUPERHEATED VAPOR PROPERTIES
OF R-22/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .200 MASS FRACTION R12

= .152 MOLE FRACTION R12

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	284.29	1241.996	59.4	.2599	.9290	1.1482	294.6
SAT VAP	284.36	31.393	241.5	.9006	.5535	.7193	156.8
	300.00	28.946	252.8	.9392	.5720	.7228	163.9
	320.00	26.440	267.4	.9862	.5949	.7324	171.9
	340.00	24.413	282.1	1.0309	.6169	.7451	179.1
	360.00	22.726	297.2	1.0739	.6380	.7592	185.8
	380.00	21.292	312.5	1.1154	.6581	.7740	192.0
	400.00	20.052	328.1	1.1554	.6773	.7870	197.8
	420.00	18.967	344.1	1.1943	.6955	.8038	203.3
	440.00	18.007	360.3	1.2320	.7128	.8182	208.5

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .400 MASS FRACTION R12

= .323 MOLE FRACTION R12

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	285.35	1247.505	60.6	.2757	.8998	1.1060	281.2
SAT VAP	286.14	33.377	224.7	.8678	.5495	.7085	151.0
	300.00	31.026	239.5	.9013	.5651	.7106	157.2
	320.00	28.291	253.8	.9474	.5868	.7187	165.3
	340.00	26.092	268.3	.9913	.6075	.7300	172.4
	360.00	24.269	283.0	1.0334	.6272	.7427	179.0
	380.00	22.724	298.0	1.0739	.6459	.7561	185.1
	400.00	21.391	313.3	1.1130	.6635	.7694	190.8
	420.00	20.226	328.8	1.1509	.6800	.7826	196.2
	440.00	19.196	344.6	1.1876	.6955	.7952	201.4

**TABLE A.12 - SUPERHEATED VAPOR PROPERTIES
OF R-22/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .600 MASS FRACTION R12

= .518 MOLE FRACTION R12

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY -----	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	287.61	1259.994	60.9	.2777	.8762	1.0650	269.1
SAT VAP	289.80	35.363	219.0	.8256	.5474	.6988	145.6
	300.00	33.484	226.2	.8497	.5583	.6996	150.2
	320.00	30.460	240.2	.8951	.5788	.7058	158.2
	340.00	28.047	254.4	.9381	.5983	.7155	165.4
	360.00	26.057	268.9	.9793	.6166	.7267	171.9
	380.00	24.377	283.5	1.0190	.6338	.7384	177.9
	400.00	22.933	298.4	1.0571	.6498	.7502	183.6
	420.00	21.673	313.5	1.0940	.6646	.7616	188.9
	440.00	20.561	328.8	1.1297	.6782	.7725	194.0

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .800 MASS FRACTION R12

= .741 MOLE FRACTION R12

PRESSURE = 700.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY -----	CV (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	291.98	1279.362	61.2	.2675	.8585	1.0265	257.3
SAT VAP	294.88	37.484	209.1	.7716	.5465	.6903	140.3
	300.00	36.451	212.7	.7835	.5516	.6901	142.6
	320.00	33.044	226.5	.8281	.5710	.6940	150.7
	340.00	30.357	240.5	.8704	.5891	.7017	157.9
	360.00	28.159	254.6	.9108	.6060	.7112	164.4
	380.00	26.312	268.9	.9495	.6217	.7213	170.4
	400.00	24.731	283.4	.9868	.6361	.7313	176.0
	420.00	23.356	298.2	1.0227	.6492	.7410	181.3
	440.00	22.145	313.1	1.0574	.6610	.7500	186.2

**TABLE A.12 - SUPERHEATED VAPOR PROPERTIES
OF R-22/R-12 MIXTURE (CONTINUED)**

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .200 MASS FRACTION R12

= .152 MOLE FRACTION R12

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	296.94	1191.674	74.2	.3100	.9398	1.1959	270.5
SAT VAP	297.04	44.899	245.5	.8868	.5748	.7767	155.2
	300.00	44.099	247.8	.8945	.5782	.7745	156.8
	320.00	39.580	263.2	.9442	.6006	.7688	166.5
	340.00	36.131	278.6	.9909	.6223	.7727	174.9
	360.00	33.368	294.1	1.0353	.6431	.7813	182.4
	380.00	31.082	309.8	1.0778	.6631	.7922	189.2
	400.00	29.147	325.8	1.1188	.6821	.8044	195.5
	420.00	27.480	342.0	1.1583	.7002	.8170	201.3
	440.00	26.022	358.5	1.1966	.7174	.8298	206.9

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .400 MASS FRACTION R12

= .323 MOLE FRACTION R12

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	298.22	1195.702	75.1	.3245	.9094	1.1518	257.8
SAT VAP	299.06	47.786	233.8	.8561	.5703	.7653	149.3
	300.00	47.508	234.5	.8585	.5713	.7644	149.8
	320.00	42.493	249.7	.9074	.5926	.7559	159.6
	340.00	38.708	264.8	.9533	.6129	.7579	168.0
	360.00	35.697	280.0	.9968	.6324	.7648	175.4
	380.00	33.219	295.4	1.0384	.6508	.7742	182.2
	400.00	31.128	311.0	1.0783	.6682	.7847	188.4
	420.00	29.330	326.8	1.1169	.6846	.7957	194.2
	440.00	27.761	342.8	1.1542	.6999	.8066	199.7

**TABLE A.12 - SUPERHEATED VAPOR PROPERTIES
OF R-22/R-12 MIXTURE (Concluded)**

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .600 MASS FRACTION R12

= .518 MOLE FRACTION R12

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	300.79	1207.121	75.2	.3254	.8849	1.1077	246.1
SAT VAP	302.98	50.676	223.3	.8160	.5678	.7543	143.7
	320.00	45.968	236.0	.8569	.5847	.7447	152.2
	340.00	41.746	250.9	.9020	.6037	.7442	160.6
	360.00	38.423	265.8	.9447	.6217	.7491	168.1
	380.00	35.705	280.9	.9854	.6386	.7567	174.8
	400.00	33.422	296.1	1.0244	.6544	.7655	181.0
	420.00	31.467	311.5	1.0620	.6691	.7747	186.8
	440.00	29.766	327.1	1.0982	.6826	.7838	192.1

SUPERHEATED VAPOR PROPERTIES FOR R12 /R22

MIXING COEFFICIENT = .041

COMPOSITION = .800 MASS FRACTION R12

= .741 MOLE FRACTION R12

PRESSURE = 1000.00 KPA

	TEMP (K)	DENSITY (KG/M**3)	ENTHALPY (KJ/KG)	ENTROPY ----- (KJ/KG K)	CV ----- (KJ/KG K)	CP -----	VSND (M/S)
SAT LIQ	305.59	1225.736	75.4	.3143	.8663	1.0654	234.7
SAT VAP	308.43	53.762	213.6	.7644	.5664	.7444	138.2
	320.00	50.217	222.2	.7917	.5770	.7360	144.0
	340.00	45.403	236.8	.8361	.5946	.7320	152.7
	360.00	41.668	251.5	.8780	.6112	.7345	160.3
	380.00	38.643	266.2	.9178	.6266	.7400	167.1
	400.00	36.120	281.1	.9560	.6407	.7469	173.2
	420.00	33.970	296.1	.9926	.6536	.7542	178.9
	440.00	32.106	311.3	1.0278	.6653	.7614	184.3

APPENDIX B

TELEPHONE CONVERSATIONS

1. Telephone conversation between L. R. Grzyll of Mainstream Engineering Corp. and Dr. Mark McLinden of the National Bureau of Standards (Boulder, CO), September 19, 1989.
2. Telephone conversation between L. R. Grzyll of Mainstream Engineering Corp. and J. Mossel of ICI Americas, August 30, 1989.
3. Telephone conversation between L. R. Grzyll of Mainstream Engineering Corp. and Mr. Pete Narreau of Carlyle Compressor Division of Carrier Corp., September 21, 1989.

APPENDIX C

HEAT PUMP COMPUTER SIMULATOR SOURCE CODE

```

program binary

c      (C) Copyright Mainstream Engineering Corporation 1989

c      This is the main program for the Air Force Heat Pump
c      contract. This program is used to determine the change
c      in capacity of a refrigeration system when the pure
c      refrigerant is replaced with a binary mixture.
c      The main program simply opens the output file where results
c      are logged, calls the required subroutines, and allows
c      for the simulation to be run again if desired.

c      developed 10/12/89 - JJS

character*12 outnam
character*1 again
common/tol/tolr,itmax,lup

write(*,*)'ENTER OUTPUT FILE NAME'
read(*,22)outnam

open(lup,file = outnam,status = 'unknown')

11      continue

      call hpump1

      write(*,1000)
      read(*,1001)again
      if(again .eq. 'y' .or. again .eq. 'Y')go to 11

22      format(a12)
1000      format(2x,'RUN ANOTHER CASE? <Y,N>')
1001      format(a1)

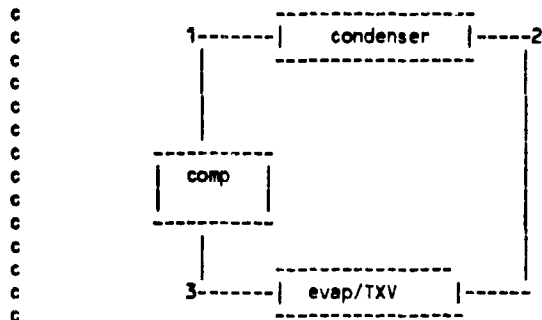
      close(lup)
      stop
      end

```

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This program simulates a heat pump model utilizing a binary mixture of refrigerants. The fluid properties are determined using the NBS code and the required thermodynamic properties are called through subroutine calls as is required.

The simple heat pump model is illustrated below. In this model, first the TXV is neglected and is treated as a generic throttling valve and the evaporator and valve are assumed one component. Then the performance is predicted assuming that a TXV, charged with fluid A, precedes the evaporator. This second analysis is performed by the subroutine TXV.



c Other Subroutines Referenced

c	Subroutine	Source
c	bconst	NBS
c	bublt	NBS
c	critx	NBS
c	espar	NBS
c	vit	NBS
c	hcvcps	NBS
c	txv	Mainstream
c	spin	NBS
c	vdot	Mainstream

c	Function	Source
c	entrop	NBS

```

real coeff(9,20), crit(5,20)
character*6 href(20)
logical lcrit,lv
common/esdata/coeff,crit
common/href1/href
common/tol/tolr,itnax,lup
common/txvdat/tevap,plotxv,xs,wcomp,cn,phi,tsup,wm
real a(3,2),b(3,2)

```

125


```

                                pressures and enthalpy.
c                                critx needs a guessed tcrit.
c                                Guess tcrit = 350.0 K
tcrit = 350.0
call critx(xmol,tcrit,pcrit,vcrit)

call bublt(tcnd,xmol,xv,phi,vcnd,vv,.true.,lcrit)
if(lcrit)then
    write(*,*)'Tcnd greater than tcrit'
    qevap = 0.0
    cop = 0.0
    go to 688
end if
call espar(0,tsub,xmol,a,b)
call vit(tsub,phi,a,b,vcnd,.true.,lv)
call hcvcps(1,tsub,vcnd,xmol,hcnd,cv,cp,vsnd)
h2 = hcnd/wm

c                                find enthalpy and entropy at
c                                evaporator outlet.
call bublt(tevap,xl,xmol,plo,vl,vevp,.false.,lcrit)
if(lcrit)then
    write(*,*)'Tevap greater than tcrit'
    qevap = 0.0
    cop = 0.0
    go to 688
end if
call espar(0,tsub,xmol,a,b)
call vit(tsub,plo,a,b,vevp,.false.,lv)
c                                vevp = evaporator specific vol.

call hcvcps(1,tsub,vevp,xmol,hevp,cv,cp,vsnd)
h3 = hevp/wm
sevp = entrop(tsub,vevp,xmol)
s3 = sevp/wm

c                                now must find compressor flow
c                                from p and s.
tcrit = tcnd
call critx(xs,tcrit,pcrit,vcrit)
if(phi .ge. pcrit) then
    qevap = 0.0
    cop = 0.0
    supno = 0.0
    go to 688
end if

c                                spin determines quality and
c                                temperature given pressure
c                                and entropy
call spin(sevp,phi,xmol,t1s,xq,xl,xv,vl,vv,sl,sv)
if(xq .ge. 1.0) then
    vl = vv
else if(xq .gt. 0.0) then
    write(lup,*)'COMPRESSOR OUTLET QUALITY = ',xq
    vl = vl + xq*(vv - vl)
else
    WRITE(LUP,*)'COMPRESSOR OUTLET SUBCOOLED'
    vl = vl
end if

```

```

c                                     now get isentropic compressor
c                                     outlet enthalpy

call hcvcp(1,t1s,v1,xmol,hcmps,cv,cp,vand)
h1s = hcmps/wm

c                                     adjust isentropic enthalpy to
c                                     true enthalpy using the comp-
c                                     ressor efficiency

h1 = h3 + (h1s - h3)/cn

flow = vflow/vevp
wcomp = 1000.0*flow*(h1 - h3)

qe vap = 1000.0*flow*(h3 - h2)
qcond = 1000.0*flow*(h1 - h3)
error = (qe vap + wcomp - qcond)/qcond

cop = qe vap/wcomp
supno = tau p - te vap

c                                     Here perform analysis as if a
c                                     TXV were there.
call txv(qtx,coptx,sup,h2,tflow,vflow,wt xv)

c                                     TXV returns the coefficient of
c                                     performance, actual evaporator
c                                     outlet superheat, and cooling
c                                     load as if a TXV were present.

c                                     All pertinent data for the txv
c                                     model has been determined by
c                                     the subroutine txv.

688      continue

c                                     send results to output file

write(lup,1004)xa,plot xv,plo
write(lup,1006)phi,phi
write(lup,1008)sup,supno
write(lup,1010)copt x,cop
write(lup,1011)wt xv,wcomp
write(lup,1012)qtx,qe vap
write(lup,1013)tflow,flow

22      continue

1000     format(//,25x,'FLUID A - ',1x,e6,2x,'FLUID B - ',1x,e6,/)
1002     format(2x,'XA [mol%]',10x,'STAT',10x,'TXV',10x,'NO TXV',/
1         2x,'-----',10x,'----',10x,'----',10x,'-----')
1004     format(2x,f5.3,10x,'P low [Kpa]',6x,f6.1,7x,f6.1)
1006     format(2x,' --- ',10x,'Phi [Kpa]',7x,f6.1,7x,f6.1)
1008     format(2x,' --- ',6x,'Superheat [C]',6x,f6.1,9x,f6.1)
1010     format(2x,' --- ',14x,'COPc',6x,f6.1,9x,f6.1)
1011     format(2x,' --- ',10x,'Wcomp [W]',6x,f9.0,4x,f9.0)
1012     format(2x,' --- ',10x,'Qe vap [W]',6x,f9.0,4x,f9.0)
1013     format(2x,' --- ',10x,'FLOW [kg/s]',4x,f7.4,5x,f7.4,/)

return
end

```

subroutine txv(qtx,cop,sup,h2,flow,vflow,wtxv)

c (C) Copyright Mainstream Engineering Corporation 1989

c this subroutine determines the capacity of a heat pump system
c as if a real txv were used as the throttling device and it was
c charged with the same fluid as was originally used in the
c system (ie. R11 or R22).

c developed 10/20/89 - JJS

real coeff(9,20), crit(5,20)

character*6 href(20)

logical lcrit,lv

common/esdata/coeff,crit

common/href1/href

common/tol/tolr,imax,lup

common/txvdat/tevap,plotxv,xa,wcomp,cn,phi,tsup,vm

real a(3,2),b(3,2)

call bublp(plotxv,xa,xvb,tbub,vlb,vvb,.true.,lcrit)

if(lcrit)then

qtx = 0.0

cop = 0.0

sup = 0.0

go to 9999

end if

call bublp(plotxv,xld,xa,tdew,vld,vvd,.false.,lcrit)

if(lcrit)then

qtx = 0.0

cop = 0.0

sup = 0.0

go to 9999

end if

sup = tsup - tdew

call espar(0,tsup,xa,a,b)

c If superheated at evaporator
c outlet, get enthalpy and
c entropy directly.

if(tsup .ge. tdew) then

call vit(tsup,plotxv,a,b,vvd,.false.,lv)

call hvcps(1,tsup,vvd,xa,hvap,cv,cp,vand)

sevp = entrop(tsup,vvd,xa)

vevp = vvd

c If two-phase at evaporator
c outlet, must iterate to determine
c the quality, enthalpy, and
c entropy. This is done by
c guessing a quality, determining
c enthalpy from the guessed quality,
c then determining temperature
c from the enthalpy and known
c pressure. When this temperature
c matches the known evaporator
c outlet temp., the iterations
c have converged.

else if (tsup .gt. tbub) then

icount = 0

xqg = (tsup - tbub)/(tdew - tbub)

call hvcps(1,tbub,vlb,xa,hbub,cv,cp,vand)

call hvcps(1,tdew,vvd,xa,hdew,cv,cp,vand)

47 continue

icount = icount + 1

```

hg1 = hhub + xqg*(hdew - hhub)
call hpin(hg1,plotxv,xa,t2,xq,xl,xv,vl,vv,hl,hv)
if(icount .lt. 200) then
  if(abs(t2 - tsup) .lt. 0.1) then
    hev = hl + xqg*(hv - hl)
  else if(t2 .lt. tsup) then
    xqg = xqg + 0.01
    if(xqg .lt. 1.0) then
      go to 47
    else
      write(lup,*)'2-PHASE TXV DID NOT CONVERGE'
      hev = hdew
      sevp = entrop(tdew,vvd,xa)
    end if
  else
    xqg = xqg - 0.006
    if(xqg .gt. 0.0) then
      go to 47
    else
      write(lup,*)'2-PHASE TXV DID NOT CONVERGE'
      hev = hhub
      sevp = entrop(thub,vlb,xa)
    end if
  end if
else
  write(lup,*)'MAX ITERATIONS EXCEEDED IN TXV'
  hev = hg1
end if
sgt = entrop(tsup,vv,xv)
sft = entrop(tsup,vl,xl)
sevp = sft + xqg*(sgt - sft)
vevp = vl + xqg*(vv - vl)
else
  call vit(tsup,plotxv,a,b,vlb,.true.,lv)
  call hvcps(1,tsup,vlb,xa,hev,cv,cp,vand)
  sevp = entrop(tsup,vlb,xa)
  vevp = vlb
end if
h3 = hev/wm
tcrit = tdew
call critx(xa,tcrit,pcrit,vcrit)
if(phi .gt. pcrit) then
  qtx = 0.0
  cop = 0.0
  sup = 0.0
  go to 9999
end if
call spin(sevp,phi,xa,t1s,xq,xl,xv,vl,vv,sl,sv)
if(xq .ge. 1.0) then
  v1 = vv
else if(xq .gt. 0.0) then
  v1 = vl + xq*(vv - vl)
else
  v1 = vl
end if
call hvcps(1,t1s,v1,xa,hcmps,cv,cp,vand)
h1s = hcmps/wm
h1 = h3 + (h1s - h3)/cn

flow = vflow/vevp
wtqv = flow*1000.0*(h1 - h3)
c flow = wcomp/(1000.0*(h1 - h3))

qtx = 1000.0*flow*(h3 - h2)
qcond = 1000.0*flow*(h1 - h3)
error = (qtx + wtqv - qcond)/qcond
cop = qtx/wtqv
9999 continue
return
end

```

```
subroutine vdot(ir1,tsup,vflow,wcomp,cn)
```

```
c      (C) Copyright Mainstream Engineering Corporation 1989
```

```
c      This subroutine determines the volumetric flow for  
c      a positive displacement machine used in hpump1.
```

```
real coeff(9,20), crit(5,20)  
character*6 href(20)  
logical lcrit,lv  
common/esdata/coeff,crit  
common/href1/href  
common/tol/tolr,ltmax,lup  
real a(3,2), b(3,2)
```

```
call bconst(ir1,ir1,0.0,0.0)  
wm = crit(1,ir1)
```

```
c                                     find enthalpy and entropy at  
c                                     evaporator outlet.
```

```
call bublt(275.0,xl,1.0,plo,vl,vevp,.false.,lcrit)  
call espar(0,tsup,1.0,a,b)  
call vit(tsup,plo,a,b,vevp,.false.,lv)
```

```
c                                     vevp = evaporator specific vol.
```

```
call hvcps(1,tsup,vevp,1.0,hevp,cv,cp,vand)  
h3 = hevp/wm  
sevp = entrop(tsup,vevp,1.0)  
s3 = sevp/wm
```

```
c                                     get condenser pressure
```

```
call bublt(323.0,1.0,xv,phi,vcd,vv,.true.,lcrit)
```

```
call spin(sevp,phi,1.0,t1s,xq,xl,xv,vl,vv,sl,sv)
```

```
if(xq .ge. 1.0) then  
    v1 = vv  
else if(xq .gt. 0.0) then  
    write(lup,*)'COMPRESSOR OUTLET QUALITY = ',xq  
    v1 = vl + xq*(vv - vl)  
else  
    write(lup,*)'COMPRESSOR OUTLET SUBCOOLED'  
    v1 = vl  
end if
```

```
c                                     now get isentropic compressor  
c                                     outlet enthalpy
```

```
call hvcps(1,t1s,v1,1.0,hcmps,cv,cp,vand)  
h1s = hcmps/wm
```

```
c                                     adjust isentropic enthalpy to  
c                                     true enthalpy using the comp-  
c                                     ressor efficiency
```

```
h1 = h3 + (h1s - h3)/cn
```

```
flow = wcomp/(1000.0*(h1 - h3))  
vflow = flow*vevp
```

```
return  
end
```


APPENDIX D

MODELING RESULTS - CONSTANT POWER COMPRESSOR OPERATION

A. INTRODUCTION

This appendix contains the modeling results assuming constant power operation of the compressor. The modeling results presented earlier in this report assumed the compressor power was the power required to supply a constant volumetric flow rate. As was stated earlier in the report, constant power operation of the compressor could be achieved by supplying the compressor with power from a DC motor (rather than AC) or by varying the speed of the compressor to change its power requirement.

TABLE D.1 - MODELING RESULTS FOR R-22/R-12 MIXTURE

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Q Evap (W)	49823.	49823.
		% Capacity Change	---	---
90.0	92.6	High Pres (kPa)	1924.1	1924.1
		Low Pres. (kPa)	527.1	529.1
		Superheat (C)	5.1	5.0
		Flow Rate (kg/s)	0.3083	0.3083
		COPc	4.0	4.0
		Q Evap (W)	49584.	49755.
		% Capacity Change	- 0.48	- 0.14
80.0	84.8	High Pres (kPa)	1903.8	1903.8
		Low Pres. (kPa)	527.1	526.2
		Superheat (C)	4.9	5.0
		Flow Rate (kg/s)	0.3224	0.3219
		COPc	4.0	4.0
		Q Evap (W)	49712.	49635.
		% Capacity Change	- 0.22	- 0.38
70.0	76.5	High Pres (kPa)	1872.4	1872.4
		Low Pres. (kPa)	527.1	516.9
		Superheat (C)	4.4	5.0
		Flow Rate (kg/s)	0.3395	0.3330
		COPc	4.0	3.9
		Q Evap (W)	50240.	49339.
		% Capacity Change	+ 0.84	- 0.97
60.0	67.7	High Pres (kPa)	1829.4	1829.4
		Low Pres. (kPa)	527.1	500.3
		Superheat (C)	3.3	5.0
		Flow Rate (kg/s)	0.3602	0.3420
		COPc	4.1	3.9
		Q Evap (W)	51238.	48818.
		% Capacity Change	+ 2.84	- 2.02
50.0	58.3	High Pres (kPa)	1773.6	1773.6
		Low Pres. (kPa)	527.1	477.2
		Superheat (C)	1.8	5.0
		Flow Rate (kg/s)	0.3855	0.3491
		COPc	4.2	3.9
		Q Evap (W)	52823.	48140.
		% Capacity Change	+ 6.02	- 3.38

TABLE D.1 - MODELING RESULTS FOR R-22/R-12 MIXTURE (Concluded).

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
40.0	48.2	High Pres (kPa)	1703.2	1703.2
		Low Pres. (kPa)	527.1	449.2
		Superheat (C)	- 0.1*	5.0
		Flow Rate (kg/s)	----	0.3553
		COPc	----	3.8
		Q Evap (W)	----	47490.
		% Capacity Change	----	- 4.68
30.0	37.5	High Pres (kPa)	1615.7	1615.7
		Low Pres. (kPa)	527.1	418.7
		Superheat (C)	- 2.4*	5.0
		Flow Rate (kg/s)	----	0.3626
		COPc	----	3.8
		Q Evap (W)	----	47111.
		% Capacity Change	----	- 5.44
20.0	25.9	High Pres (kPa)	1507.6	1507.6
		Low Pres. (kPa)	527.1	387.5
		Superheat (C)	- 5.0*	5.0
		Flow Rate (kg/s)	----	0.3730
		COPc	----	3.8
		Q Evap (W)	----	47277.
		% Capacity Change	----	- 5.11
10.0	13.4	High Pres (kPa)	1373.8	1373.8
		Low Pres. (kPa)	527.1	356.8
		Superheat (C)	- 7.7*	5.0
		Flow Rate (kg/s)	----	0.3899
		COPc	----	3.9
		Q Evap (W)	----	48351.
		% Capacity Change	----	- 2.95
0.0	0.0	High Pres (kPa)	1207.9	1207.9
		Low Pres. (kPa)	527.1	327.4
		Superheat (C)	- 10.6*	5.0
		Flow Rate (kg/s)	----	0.4187
		COPc	----	4.1
		Q Evap (W)	----	50976.
		% Capacity Change	----	+ 2.31

* Compressor will fail due to slugging

TABLE D.2 - MODELING RESULTS FOR R-22/R-115 (R-502) MIXTURE

MASS % R-22	MASS% R-502	PARAMETER	TXV	NO TXV
100.0	0.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Q Evap (W)	49823.	49823.
80.4	19.6	High Pres (kPa)	1904.1	1904.1
		Low Pres. (kPa)	527.1	506.8
		Superheat (C)	3.8	5.0
		Flow Rate (kg/s)	0.3176	0.3058
		COPc	4.1	4.0
		Q Evap (W)	51425.	49626.
		% Capacity Change	+ 3.22	- 0.40
61.0	39.0	High Pres (kPa)	1902.3	1902.3
		Low Pres. (kPa)	527.1	500.3
		Superheat (C)	3.4	5.0
		Flow Rate (kg/s)	0.3369	0.3204
		COPc	4.2	4.0
		Q Evap (W)	52057.	49669.
		% Capacity Change	+ 4.48	- 0.31
41.4	58.6	High Pres (kPa)	1946.5	1946.5
		Low Pres. (kPa)	527.1	502.4
		Superheat (C)	3.5	5.0
		Flow Rate (kg/s)	0.3513	0.3356
		COPc	4.1	3.9
		Q Evap (W)	51204.	49068.
		% Capacity Change	+ 2.77	- 1.52
21.9	78.1	High Pres (kPa)	2056.5	2056.5
		Low Pres. (kPa)	527.1	512.5
		Superheat (C)	4.2	5.0
		Flow Rate (kg/s)	0.3584	0.3491
		COPc	3.9	3.8
		Q Evap (W)	48566.	47404.
		% Capacity Change	- 2.52	- 4.86
0.0	100.0	High Pres (kPa)	2282.0	2282.0
		Low Pres. (kPa)	527.1	535.4
		Superheat (C)	5.5	5.0
		Flow Rate (kg/s)	0.3575	0.3625
		COPc	3.5	3.5
		Q Evap (W)	43657.	44221.
		% Capacity Change	- 12.4	- 11.2

TABLE D.3 - MODELING RESULTS FOR R-22/R-290 MIXTURE

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Q Evap (W)	49823.	49823.
		% Capacity Change	---	---
90.0	82.1	High Pres (kPa)	2094.2	2094.2
		Low Pres. (kPa)	527.1	583.5
		Superheat (C)	8.2**	5.0
		Flow Rate (kg/s)	0.2561	0.2823
		COPc	3.5	3.9
		Q Evap (W)	44150.	48351.
		% Capacity Change	- 11.4	- 2.95
80.0	67.1	High Pres (kPa)	2141.9	2141.9
		Low Pres. (kPa)	527.1	621.0
		Superheat (C)	10.3**	5.0
		Flow Rate (kg/s)	0.2334	0.2737
		COPc	3.4	3.9
		Q Evap (W)	42036.	48706.
		% Capacity Change	- 15.6	- 2.24
70.0	52.3	High Pres (kPa)	2138.2	2138.2
		Low Pres. (kPa)	527.1	631.6
		Superheat (C)	10.9**	5.0
		Flow Rate (kg/s)	0.2181	0.2603
		COPc	3.3	3.9
		Q Evap (W)	41459.	48824.
		% Capacity Change	- 16.8	- 2.01
60.0	43.3	High Pres (kPa)	2106.2	2106.2
		Low Pres. (kPa)	527.1	620.7
		Superheat (C)	10.4**	5.0
		Flow Rate (kg/s)	0.2069	0.2429
		COPc	3.3	3.9
		Q Evap (W)	41754.	48426.
		% Capacity Change	- 16.2	- 2.80
50.0	33.8	High Pres (kPa)	2056.8	2056.8
		Low Pres. (kPa)	527.1	600.0
		Superheat (C)	9.3**	5.0
		Flow Rate (kg/s)	0.1984	0.2254
		COPc	3.4	3.8
		Q Evap (W)	42625.	47951.
		% Capacity Change	- 14.5	- 3.76

TABLE D.3 - MODELING RESULTS FOR R-22/R-290 MIXTURE (Concluded).

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
40.0	25.4	High Pres (kPa)	1996.3	1996.3
		Low Pres. (kPa)	527.1	576.9
		Superheat (C)	8.0**	5.0
		Flow Rate (kg/s)	0.1919	0.2098
		COPc	3.5	3.8
		Q Evap (W)	43917.	47700.
		% Capacity Change	- 11.9	- 4.26
30.0	17.9	High Pres (kPa)	1928.4	1928.4
		Low Pres. (kPa)	527.1	554.9
		Superheat (C)	6.7	5.0
		Flow Rate (kg/s)	0.1870	0.1968
		COPc	3.6	3.8
		Q Evap (W)	45553.	47765.
		% Capacity Change	- 8.57	- 4.13
20.0	11.3	High Pres (kPa)	1855.6	1855.6
		Low Pres. (kPa)	527.1	534.9
		Superheat (C)	5.5	5.0
		Flow Rate (kg/s)	0.1834	0.1861
		COPc	3.8	3.9
		Q Evap (W)	47494.	48150.
		% Capacity Change	- 4.67	- 3.36
10.0	5.4	High Pres (kPa)	1779.6	1779.6
		Low Pres. (kPa)	527.1	517.1
		Superheat (C)	4.4	5.0
		Flow Rate (kg/s)	0.1810	0.1775
		COPc	4.0	3.9
		Q Evap (W)	49731.	48836.
		% Capacity Change	- 0.18	- 1.98
0.0	0.0	High Pres (kPa)	1701.6	1701.6
		Low Pres. (kPa)	527.1	501.4
		Superheat (C)	3.3	5.0
		Flow Rate (kg/s)	0.1797	0.1705
		COPc	4.2	4.0
		Q Evap (W)	52275.	49804.
		% Capacity Change	+ 4.92	- 0.04

** Potential freezing in water chiller

TABLE D.4 - MODELING RESULTS FOR R-22/R-11 MIXTURE

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Q Evap (W)	49823.	49823.
		% Capacity Change	---	---
90.0	93.5	High Pres (kPa)	1812.2	1812.2
		Low Pres. (kPa)	527.1	369.2
		Superheat (C)	- 5.8*	5.0
		Flow Rate (kg/s)	----	0.2367
		COPc	----	3.2
		Q Evap (W)	----	39673.
		% Capacity Change	----	- 20.4
80.0	86.4	High Pres (kPa)	1690.3	1690.3
		Low Pres. (kPa)	527.1	243.8
		Superheat (C)	- 16.4*	5.0
		Flow Rate (kg/s)	----	0.1959
		COPc	----	2.6
		Q Evap (W)	----	32692.
		% Capacity Change	----	- 34.4
70.0	78.8	High Pres (kPa)	1565.5	1565.5
		Low Pres. (kPa)	527.1	175.4
		Superheat (C)	- 25.5*	5.0
		Flow Rate (kg/s)	----	0.1758
		COPc	----	2.3
		Q Evap (W)	----	29132.
		% Capacity Change	----	- 41.5
60.0	70.4	High Pres (kPa)	1435.2	1435.2
		Low Pres. (kPa)	527.1	133.5
		Superheat (C)	- 33.6*	5.0
		Flow Rate (kg/s)	----	0.1665
		COPc	----	2.2
		Q Evap (W)	----	27385.
		% Capacity Change	----	- 45.0
50.0	61.4	High Pres (kPa)	1295.8	1295.8
		Low Pres. (kPa)	527.1	105.6
		Superheat (C)	- 40.9*	5.0
		Flow Rate (kg/s)	----	0.1636
		COPc	----	2.1
		Q Evap (W)	----	26726.
		% Capacity Change	----	- 46.4

TABLE D.4 - MODELING RESULTS FOR R-22/R-11 MIXTURE (concluded).

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
40.0	51.4	High Pres (kPa)	1142.6	1142.6
		Low Pres. (kPa)	527.1	85.9
		Superheat (C)	- 47.8*	5.0
		Flow Rate (kg/s)	----	0.1655
		COPc	----	2.2
		Q Evap (W)	-----	26903.
		% Capacity Change	----	- 46.0
30.0	40.5	High Pres (kPa)	969.4	969.4
		Low Pres. (kPa)	527.1	71.2
		Superheat (C)	- 54.4*	5.0
		Flow Rate (kg/s)	----	0.1724
		COPc	-----	2.2
		Q Evap (W)	-----	27948.
		% Capacity Change	-----	- 43.9
20.0	28.4	High Pres (kPa)	768.0	768.0
		Low Pres. (kPa)	527.1	59.8
		Superheat (C)	- 60.8*	5.0
		Flow Rate (kg/s)	----	0.1869
		COPc	-----	2.4
		Q Evap (W)	-----	30250.
		% Capacity Change	-----	- 39.3
10.0	15.0	High Pres (kPa)	527.6	527.6
		Low Pres. (kPa)	527.1	50.8
		Superheat (C)	- 67.2*	5.0
		Flow Rate (kg/s)	----	0.2178
		COPc	-----	2.8
		Q Evap (W)	-----	35304.
		% Capacity Change	-----	- 29.1
0.0	0.0	High Pres (kPa)	243.3	243.3
		Low Pres. (kPa)	527.1	43.5
		Superheat (C)	- 73.6*	5.0
		Flow Rate (kg/s)	----	0.3303
		COPc	-----	4.3
		Q Evap (W)	-----	53722.
		% Capacity Change	-----	+ 7.83

* Compressor will fail due to slugging

TABLE D.5 - MODELING RESULTS FOR R-22/R-13B1 MIXTURE

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	527.1	527.1
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	0.2965	0.2965
		COPc	4.0	4.0
		Q Evap (W)	49823.	49823.
		% Capacity Change	---	---
90.0	93.9	High Pres (kPa)	2018.4	2018.4
		Low Pres. (kPa)	527.1	547.0
		Superheat (C)	6.2	5.0
		Flow Rate (kg/s)	0.2993	0.3101
		COPc	3.8	3.9
		Q Evap (W)	47113.	48704.
		% Capacity Change	- 5.44	- 2.25
80.0	87.3	High Pres (kPa)	2104.0	2104.0
		Low Pres. (kPa)	527.1	569.9
		Superheat (C)	7.4**	5.0
		Flow Rate (kg/s)	0.3034	0.3267
		COPc	3.6	3.8
		Q Evap (W)	44599.	47788.
		% Capacity Change	- 10.5	- 4.08
70.0	80.1	High Pres (kPa)	2190.0	2190.0
		Low Pres. (kPa)	527.1	596.4
		Superheat (C)	8.9**	5.0
		Flow Rate (kg/s)	0.3089	0.3470
		COPc	3.4	3.8
		Q Evap (W)	42252.	47075.
		% Capacity Change	- 15.2	- 5.52
60.0	72.1	High Pres (kPa)	2276.4	2276.4
		Low Pres. (kPa)	527.1	627.2
		Superheat (C)	10.5**	5.0
		Flow Rate (kg/s)	0.3159	0.3718
		COPc	3.2	3.7
		Q Evap (W)	40044.	46567.
		% Capacity Change	- 19.6	- 6.54
50.0	63.3	High Pres (kPa)	2363.3	2363.3
		Low Pres. (kPa)	527.1	662.8
		Superheat (C)	12.2**	5.0
		Flow Rate (kg/s)	0.3246	0.4021
		COPc	3.0	3.7
		Q Evap (W)	37970.	46266.
		% Capacity Change	- 23.8	- 7.14

TABLE D.5 - MODELING RESULTS FOR R-22/R-13B1 MIXTURE (Concluded).

MASS % R-22	MOL % R-22	PARAMETER	TXV	NO TXV
40.0	53.4	High Pres (kPa)	2450.3	2450.3
		Low Pres. (kPa)	527.1	703.4
		Superheat (C)	14.2**	5.0
		Flow Rate (kg/s)	0.3350	0.4392
		COPc	2.9	3.7
		Q Evap (W)	36016.	46159.
		% Capacity Change	- 27.7	- 7.35
30.0	42.5	High Pres (kPa)	2536.7	2536.7
		Low Pres. (kPa)	527.1	748.6
		Superheat (C)	16.3**	5.0
		Flow Rate (kg/s)	0.3476	0.4839
		COPc	2.7	3.7
		Q Evap (W)	34183.	46197.
		% Capacity Change	- 31.4	- 7.28
20.0	30.1	High Pres (kPa)	2621.2	2621.2
		Low Pres. (kPa)	527.1	796.3
		Superheat (C)	18.4**	5.0
		Flow Rate (kg/s)	0.3629	0.5369
		COPc	2.6	3.7
		Q Evap (W)	32483.	46275.
		% Capacity Change	- 34.8	- 7.12
10.0	16.1	High Pres (kPa)	2700.8	2700.8
		Low Pres. (kPa)	527.1	842.6
		Superheat (C)	20.5**	5.0
		Flow Rate (kg/s)	0.3815	0.5976
		COPc	2.5	3.7
		Q Evap (W)	30943.	46260.
		% Capacity Change	- 37.9	- 7.15
0.0	0.0	High Pres (kPa)	2769.9	2769.9
		Low Pres. (kPa)	527.1	882.2
		Superheat (C)	22.2**	5.0
		Flow Rate (kg/s)	0.4047	0.6647
		COPc	2.4	3.7
		Q Evap (W)	29615.	46021.
		% Capacity Change	- 40.6	- 7.63

** Potential freezing in water chiller

TABLE D.6 - MODELING RESULTS FOR R-11/R-12 MIXTURE

MASS % R-11	MOL % R-11	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	243.3	243.3
		Low Pres. (kPa)	43.5	43.5
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	2.6426	2.6426
		COPc	4.3	4.3
		Q Evap (W)	429779.	429779.
		% Capacity Change	---	---
90.0	88.8	High Pres (kPa)	340.7	340.7
		Low Pres. (kPa)	43.5	48.3
		Superheat (C)	7.8**	5.0
		Flow Rate (kg/s)	2.0944	2.2254
		COPc	3.3	3.5
		Q Evap (W)	332596.	353189.
		% Capacity Change	- 22.6	- 17.8
80.0	77.9	High Pres (kPa)	443.3	443.3
		Low Pres. (kPa)	43.5	54.2
		Superheat (C)	10.1**	5.0
		Flow Rate (kg/s)	1.8076	2.0316
		COPc	2.8	3.1
		Q Evap (W)	280220.	314520.
		% Capacity Change	- 34.8	- 26.8
70.0	67.3	High Pres (kPa)	542.5	542.5
		Low Pres. (kPa)	43.5	61.4
		Superheat (C)	13.0**	5.0
		Flow Rate (kg/s)	1.6225	1.9326
		COPc	2.5	2.9
		Q Evap (W)	245480.	291746.
		% Capacity Change	- 42.9	- 32.1
60.0	56.9	High Pres (kPa)	639.2	639.2
		Low Pres. (kPa)	43.5	70.6
		Superheat (C)	16.1**	5.0
		Flow Rate (kg/s)	1.4889	1.8899
		COPc	2.2	2.8
		Q Evap (W)	219778.	278032.
		% Capacity Change	- 48.9	- 35.3
50.0	46.8	High Pres (kPa)	734.0	734.0
		Low Pres. (kPa)	43.5	82.6
		Superheat (C)	19.6**	5.0
		Flow Rate (kg/s)	1.3853	1.8906
		COPc	2.0	2.7
		Q Evap (W)	199450.	270884.
		% Capacity Change	- 53.6	- 37.0

TABLE D.6 - MODELING RESULTS FOR R-11/R-12 MIXTURE (Concluded).

MASS % R-11	MOL % R-11	PARAMETER	TXV	NO TXV
40.0	37.0	High Pres (kPa)	827.6	827.6
		Low Pres. (kPa)	43.5	98.9
		Superheat (C)	23.6**	5.0
		Flow Rate (kg/s)	1.3011	1.9350
		COPc	1.8	2.7
		Q Evap (W)	182639.	269778.
		% Capacity Change	- 57.5	- 37.2
30.0	27.4	High Pres (kPa)	920.9	920.9
		Low Pres. (kPa)	43.5	122.2
		Superheat (C)	28.3**	5.0
		Flow Rate (kg/s)	1.2301	2.0353
		COPc	1.7	2.8
		Q Evap (W)	168290.	275770.
		% Capacity Change	- 60.8	- 35.8
20.0	18.0	High Pres (kPa)	1014.7	1014.7
		Low Pres. (kPa)	43.5	157.9
		Superheat (C)	34.0**	5.0
		Flow Rate (kg/s)	1.1687	2.2247
		COPc	1.6	2.9
		Q Evap (W)	155748.	292340.
		% Capacity Change	- 63.8	- 32.0
10.0	8.9	High Pres (kPa)	1109.9	1109.9
		Low Pres. (kPa)	43.5	217.9
		Superheat (C)	41.9**	5.0
		Flow Rate (kg/s)	1.1143	2.5875
		COPc	1.4	3.3
		Q Evap (W)	144570.	328535.
		% Capacity Change	- 66.4	- 23.6
0.0	0.0	High Pres (kPa)	1207.9	1207.9
		Low Pres. (kPa)	43.5	327.4
		Superheat (C)	54.8**	5.0
		Flow Rate (kg/s)	1.0653	3.3493
		COPc	1.3	4.1
		Q Evap (W)	134471.	407804.
		% Capacity Change	- 68.7	- 5.11

** Potential freezing in water chiller

TABLE D.7 - MODELING RESULTS FOR R-11/R-22 MIXTURE

MASS % R-11	MOL % R-11	PARAMETER	TXV	NO TXV
100.0	100.0	High Pres (kPa)	234.3	234.3
		Low Pres. (kPa)	43.5	43.5
		Superheat (C)	5.0	5.0
		Flow Rate (kg/s)	2.6426	2.6426
		COPc	4.3	4.3
		Q Evap (W)	429779.	429779.
		% Capacity Change	---	---
90.0	85.0	High Pres (kPa)	527.6	527.6
		Low Pres. (kPa)	43.5	50.8
		Superheat (C)	8.6**	5.0
		Flow Rate (kg/s)	1.6134	1.7426
		COPc	2.6	2.8
		Q Evap (W)	261724.	282428.
		% Capacity Change	- 39.1	- 34.3
80.0	71.6	High Pres (kPa)	768.0	768.0
		Low Pres. (kPa)	43.5	59.8
		Superheat (C)	12.4**	5.0
		Flow Rate (kg/s)	1.2937	1.4948
		COPc	2.1	2.4
		Q Evap (W)	209837.	242002.
		% Capacity Change	- 51.2	- 43.7
70.0	59.5	High Pres (kPa)	969.4	969.4
		Low Pres. (kPa)	43.5	71.2
		Superheat (C)	16.2**	5.0
		Flow Rate (kg/s)	1.1126	1.3796
		COPc	1.8	2.2
		Q Evap (W)	180873.	223581.
		% Capacity Change	- 57.9	- 48.0
60.0	48.6	High Pres (kPa)	1142.6	1142.6
		Low Pres. (kPa)	43.5	85.9
		Superheat (C)	20.2**	5.0
		Flow Rate (kg/s)	0.9877	1.3239
		COPc	1.6	2.2
		Q Evap (W)	161313.	215226.
		% Capacity Change	- 62.5	- 49.9
50.0	38.6	High Pres (kPa)	1295.8	1295.8
		Low Pres. (kPa)	43.5	105.6
		Superheat (C)	24.6**	5.0
		Flow Rate (kg/s)	0.8929	1.3087
		COPc	1.5	2.1
		Q Evap (W)	146830.	213808.
		% Capacity Change	- 65.8	- 50.3

TABLE D.7 - MODELING RESULTS FOR R-11/R-22 MIXTURE (Concluded).

MASS % R-11	MOL % R-11	PARAMETER	TXV	NO TXV
40.0	29.6	High Pres (kPa)	1435.2	1435.2
		Low Pres. (kPa)	43.5	133.5
		Superheat (C)	29.4**	5.0
		Flow Rate (kg/s)	0.8166	1.3323
		COPc	1.4	2.2
		Q Evap (W)	135510.	219802.
		% Capacity Change	- 68.5	- 48.9
30.0	21.2	High Pres (kPa)	1565.5	1565.5
		Low Pres. (kPa)	43.5	175.4
		Superheat (C)	34.9**	5.0
		Flow Rate (kg/s)	0.7530	1.4068
		COPc	1.3	2.3
		Q Evap (W)	126375.	233055.
		% Capacity Change	- 70.6	- 45.8
20.0	13.6	High Pres (kPa)	1690.3	1690.3
		Low Pres. (kPa)	43.5	243.8
		Superheat (C)	41.7**	5.0
		Flow Rate (kg/s)	0.6986	1.5674
		COPc	1.2	2.6
		Q Evap (W)	118835.	261537.
		% Capacity Change	- 72.3	- 39.2
10.0	6.5	High Pres (kPa)	1812.2	1812.2
		Low Pres. (kPa)	43.5	362.9
		Superheat (C)	51.1**	5.0
		Flow Rate (kg/s)	0.6512	1.8934
		COPc	1.1	3.2
		Q Evap (W)	112521.	317381.
		% Capacity Change	- 73.8	- 26.2
0.0	0.0	High Pres (kPa)	1933.3	1933.3
		Low Pres. (kPa)	43.5	527.1
		Superheat (C)	64.4**	5.0
		Flow Rate (kg/s)	0.6093	2.3724
		COPc	1.1	4.0
		Q Evap (W)	107185.	398580.
		% Capacity Change	- 75.1	- 7.26

** Potential freezing in water chiller