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MISCIBILITY OF LUBRICANTS WITH REFRIGERANTS

Final Report

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MISCIBILITY OF LUBRICANTS WITH REFRIGERANTS

ABSTRACT

Miscibility data have been obtained for a variety of non-CFC refrigerants and their potential lubricants. Ten (10) different refrigerants and fourteen (14) different lubricants were investigated. Experiments were performed in two phases: Phase I focused on performing screening tests for miscibility using refrigerant concentrations of 10, 50 and 95 % and Phase II consisted of obtaining further refrigerant concentrations of 20, 35, 65, 80, and 90%. The complete data set is presented herein. The miscibility tests were performed in a test facility consisting of a series of miniature test cells submerged in a constant temperature bath. The bath temperature can be precisely controlled over a temperature range of -50°C to 90°C(-58°F to 194°F). The test cells are constructed to allow for complete visibility of lubricant refrigerant mixtures under all test conditions. Each of the refrigerants tested are miscible with at least one of the lubricants, with the exception of R-143a, which exhibits partial miscibility with each of the lubricants.

SCOPE

Phase I - Preliminary Screening

Miscibility tests were performed on refrigerant-lubricant mixtures for refrigerant concentrations of 10%, 50% and 95% by weight. These tests were performed by keeping the liquid phase visible at all times, by controlling temperatures to ±1°C, and by providing agitation of the test cells.

The following refrigerants were tested for miscibility in 10°C (18°F) increments over the temperature ranges indicated below:

- R-22: -50 - +60°C (-58 - +140°F)
- R-32: -50 - +60°C (-58 - +140°F)
- R-123: -50 - +60°C (-58 - +140°F)
- R-124: -50 - +90°C (-58 - +194°F)
- R-125: -50 - +60°C (-58 - +140°F)
- R-134: -50 - +60°C (-58 - +140°F)
- R-134a: -50 - +90°C (-58 - +194°F)
- R-142b: -50 - +90°C (-58 - +194°F)
- R-143a: -50 - +60°C (-58 - +140°F)
- R-152a: -50 - +90°C (-58 - +194°F)

Each of the above refrigerants was tested for miscibility with the lubricants listed below. The viscosity for the penta erythritol ester mixed acid was ISO 22, while all other lubricants had a viscosity of ISO 32.

- mineral oils (<30 ppm moisture, acid number <0.01)
  - naphthenic mineral oil

- alkylbenzenes (<30 ppm moisture, acid number <0.01)

- polyglycols(<50 ppm moisture, acid number <0.05)
  - polypropylene glycol butyl monoether
  - polypropylene glycol diol
  - modified polyglycol

- polyolesters(<50 ppm moisture, acid number <0.05)
  - penta erythritol ester mixed-acid (ISO 22)
  - penta erythritol ester mixed-acid (ISO 32)

During the above miscibility tests, the contents of each test cell were observed for signs of cloudiness, floc or precipitate formation, and liquid layer formation. These observations were made at each required temperature after equilibrium (i.e., steady state) conditions had been reached. Applicable miscibility data consists of the refrigerant/lubricant concentration, the temperature at equilibrium, and the observations of the test cell contents for evidence of immiscibility.

Phase II - Derivation Of Complete Miscibility Characteristics

Phase II consisted of additional tests made up of an expanded concentration range. In addition to Phase I refrigerant concentrations (i.e., 10%, 50%, 95%), refrigerant concentrations of 20, 35, 65, 80 and 90% were tested for miscibility.

The basis for selecting the lubricant-refrigerant combinations that were tested in Phase II is that the combination must have demonstrated single-phase miscibility in at least one of the three test points obtained in Phase I. This criteria was met by all of the refrigerant/lubricant combinations of Phase I. Therefore, each of the lubricants from Phase I was tested for miscibility in Phase II. Also, higher viscosity versions of each Phase I lubricant except the modified polyglycol and the penta erythritol ester mixed-acid were included in the Phase II test matrix. Additionally, a penta erythritol ester branched-acid (two ISO grades) was added to the test matrix. The lubricants are listed below along with their associated viscosities.

- mineral oils (30 ppm moisture, acid number <0.01)
  naphthenic mineral oil, ISO 32 and 68
- alkylbenzenes (<30 ppm moisture, acid number <0.01), ISO 32 and 68
- polyglycols (<50 ppm moisture, acid number <0.05)
  polypropylene glycol butyl monoether, ISO 32 and 68
  polypropylene glycol diol, ISO 32 and 100
  modified polyglycol, ISO 32
- polyolesters (<50 ppm moisture, acid number <0.05)
  penta erythritol ester mixed-acid, ISO 22, 32, and 100
  penta erythritol ester branched-acid, ISO 32 and 100

TEST FACILITY AND EXPERIMENTAL PROCEDURES

The test facility used in this project was designed for the purpose of measuring the miscibility of refrigerant-lubricant mixtures. Test cells with glass viewports are submerged in one of two constant temperature baths, and then the miscibility characteristics of the mixture is observed and recorded.

Test Cells

The test cells are constructed to allow for complete visibility of the lubricant/refrigerant mixture at all test conditions. Each test cell consists of a double-port seal-cap type liquid indicator, which is essentially a 1.25 inch pipe cross with sight windows screwed into opposing ports. Valves for charging the refrigerant into the cell are screwed into the other two ports. A temperature sensor can be inserted in each cell or in an adjoining reference cell exposed to the same heating or cooling conditions.

The overall volume of each test cell varies slightly; however, all were measured to have volumes around 65 ml. During charging, each cell can be filled so that the vapor space is less than 15% of the total volume. In addition, if temperature and pressure data are available, changes in the liquid concentration due to vapor space refrigerant can be calculated.

Four charged cells can be placed in a Plexiglas holder, and three such holders can be placed in a constant temperature bath to permit the testing of 12 test cells at one time.

Constant Temperature Baths

The temperature of the cells is fixed by placing them in one of two constant temperature baths. The hot bath is used to maintain temperatures from 10°C to 90°C(50°F to 194°F), while the cold bath is used for temperatures in the range of 10°C to -50°C(50°F to -58°F).

The baths are constructed of glass which allows complete visibility of the test cells and, therefore, the lubricant/refrigerant mixtures throughout the test. Figure 1 is a photograph showing an array of twelve test cells in the bath. Movable fluorescent lights are mounted behind a bath to help increase visibility.

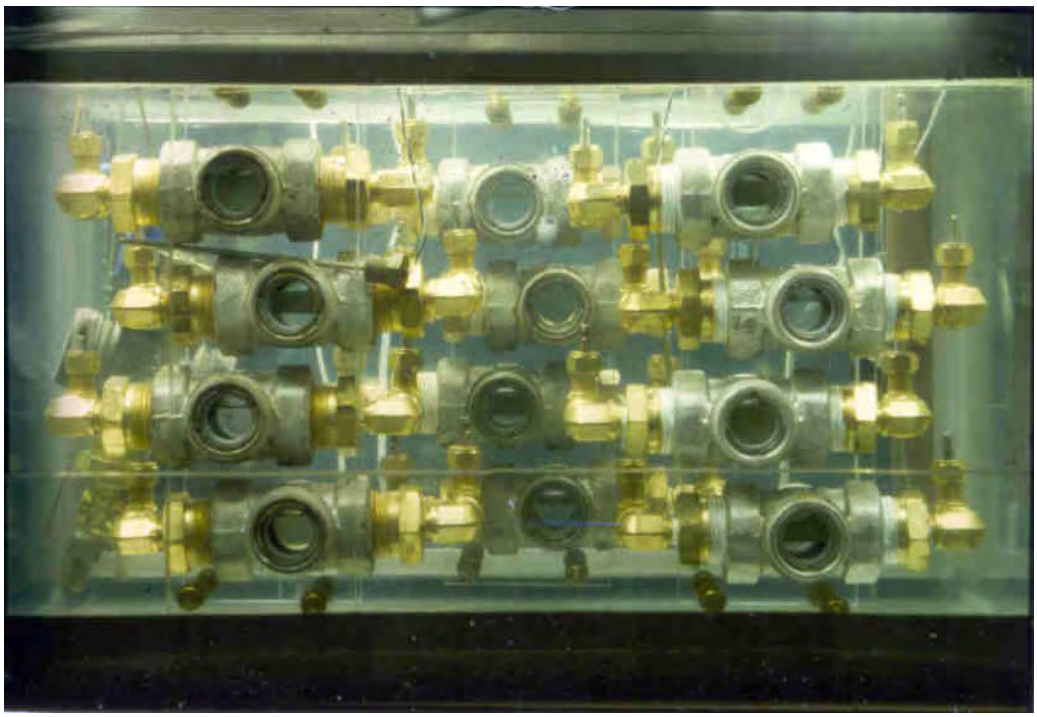

Figure 1 Photograph of test facility.

Cold Bath

The cold bath fluid is composed of 65% pure ethylene glycol and 35% water. Pure ethylene glycol is used so that the bath fluid will be transparent. The bath is cooled with the use of an R-502 refrigeration system. A temperature controller and a heater are installed to regulate the bath temperature.

The bath is insulated on all sides to ensure a uniform temperature. The insulation on the front and back of the bath consists of a double-paned Plexiglass window mounted on the glass bath. Condensation is prevented by using a nitrogen purge of the dead air spaces. Insulation on the other sides is provided by 2 inches of styrofoam.

Hot Bath

The hot bath fluid is water with rust inhibitor added. Two inch styrofoam provides the insulation on the ends of the bath, while the insulation on the front and back of the bath is provided by a single Plexiglass window mounted on the glass leaving a half-inch air space.

Instrumentation

The precise temperature of the bath fluid is measured by two internal resistance temperature detectors (RTD). These primary temperature probes consist of a platinum RTD connected to a signal conditioner/current transmitter that provide a linear response over the temperature range -51°C (-60°F) to 149°C (300°F). The RTD's have an accuracy of ±0.1°C. A microcomputer and data acquisition hardware under the direction of a data acquisition program monitors and records signals from all instruments.

One cell in each bath is assembled with an internal RTD to determine equilibrium (i.e., steady state) conditions. The cell is charged with pure lubricant to provide a "worst case" heat transfer situation. The temperature difference between the internal RTD and the bath temperature indicates when thermal equilibrium between the cell and the bath has been achieved. Steady state conditions are typically achieved about thirty minutes after a change (e.g., 5°-10°C) in the circulating bath temperature.

Experimental Procedure

Experimental procedures have been developed for measuring refrigerant-lubricant miscibility by using the test facility described previously. The cells start out with the front and back windows removed for cleaning. After cleaning, the back window is installed and tightened. The prescribed amount of lubricant is injected with a syringe through the front window space. The front window is then replaced and tightened. A vacuum pump is hooked up to one of the valves and a vacuum is pulled to remove any dissolved moisture or air. Fittings are retightened if a failure to hold either a vacuum or a set pressure indicates that this is necessary.

Refrigerant is then injected into the cell from the refrigerant canister by using a manifold that allows for the evacuation of the connecting lines. The cells are weighed on a scale before and after the injection of the lubricant and the refrigerant. The scale has an uncertainty of ±0.01 gram. The concentration of the liquid in each cell is calculated from the masses of refrigerant and lubricant injected. The uncertainty in the concentration measurements is ±0.5% . It is important to note that since the refrigerant vapor density changes as the temperature and pressure change, then the refrigerant vapor mass also varies. As a result, the liquid concentration varies slightly as the temperature and pressure change. For the experimental approach presented here, the vapor volumes are kept small; less than 15% of the total space is vapor. Therefore, the overall variation in refrigerant concentration as temperature and pressure are changed during any particular test are small. Once the desired amounts of lubricant and refrigerant have been injected into the cell, it is ready for testing.

The cells are then placed in the bath and heated or cooled to the desired temperature. The desired temperatures are 10°C increments from either 90°C to -50°C or 60°C to -50°C, depending on the refrigerant being tested. Steady state conditions are assumed when two conditions are met: first, the bath temperature is within ±0.5°C of the setpoint temperature and second, the difference between the instrumented cell and the bath temperature is within 0.5°C. At this point the characteristics of the fluid in each cell are noted.

After testing the cells through the temperature range, the cells are removed from the bath. The refrigerant/lubricant mixture is drained through one of the valves, and the cell is rinsed three times with R-113. The final cleaning of the cell is accomplished by removing the front and back window and rinsing with R-113 to remove traces of lubricant. The windows and seals are then cleaned and visually examined for defects.

SIGNIFICANT RESULTS

Test Results

Miscibility data have been obtained for R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a, and the following lubricants:

- naphthenic mineral oil (ISO 32)
- alkylbenzene (ISO 32)
- polypropylene glycol butyl monoether (ISO 32)
- polypropylene glycol diol (ISO 32)
- modified polyglycol (ISO 32)
- penta erythritol ester mixed-acid (ISO 22)
- penta erythritol ester mixed-acid (ISO 32)
- penta erythritol ester branched-acid (ISO 32)
- naphthenic mineral oil (ISO 68)

- alkylbenzene (ISO 68)
- polypropylene glycol butyl monoether (ISO 58)
- polypropylene glycol diol (ISO 100)
- penta erythritol ester mixed-acid (ISO 100)
- penta erythritol ester branched-acid (ISO 100)

These tests were performed at refrigerant concentrations of approximately 10%, 20%, 35%, 50%, 65%, 80%, 90%, and 95% over a temperature range of -50°C to 90°C (tests are concluded at 60°C for the higher pressure refrigerants as specified in the Work Statement). According to the Work Statement, when cloudiness, precipitate formation, or formation of a second liquid phase is noticed, the mixture is considered immiscible. However, in the following discussion, when cloudiness or precipitate formation was observed, it will be noted as such, but when the mixture separated into two liquid phases, it will be noted as immiscible. The observations for each refrigerant/lubricant pair are provided below. These data are summarized and also presented in Tables 1 through 10, with each table containing the data for a specific refrigerant with all of the lubricants. Appendix A contains tables of data for each refrigerant and lubricant pair.

Refrigerant Concentration

The refrigerant concentrations given in Tables 1 through 10 are nominal values for each lubricant-refrigerant test condition. The measured (actual) concentration may vary from the nominal concentration by ±4% (0.04). Measured concentrations are calculated as previously described and are included in the tables in Appendix A. The measured concentration represents the concentration that exists in the cell when the cell is at its lowest temperature. At this temperature, essentially all of the refrigerant in the cell is in the liquid phase. As the temperature is raised in each cell, the density of the vapor phase increases which results in the transport of refrigerant from the liquid phase to the vapor phase and, hence, an increase in lubricant concentration. However, the volume of the vapor phase decreases due to thermal expansion which diminishes some of the impact of this lubricant concentration increase.

These changes in the liquid composition with temperature are small since the vapor volume in each cell is minimized during charging. However, in order to cover the entire temperature range, a 10 to 20% vapor space is required due to thermal expansion and contraction. For this required vapor space, changes in liquid composition are noticeable for refrigerant concentrations lower than 30% . For example, for a 10% R-134a mixture with a 15% vapor volume, the liquid concentration could decrease up to 2.5% from its initial value.

R-22

Naphthenic Mineral Oil (ISO 32) The 12%, 20%, and 95% refrigerant mixtures were miscible throughout the test temperature range. The 36%, 47%, 68%, 81%, and 90%

refrigerant mixtures were immiscible at temperatures below -40.3°C, -30.1°C, -20.5°C, -9.7°C, and -19.6°C, respectively.

Alkylbenzene (ISO 32) All eight concentrations were miscible throughout the test temperature range**.**

Polypropylene Glycol Butyl Monoether (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Modified Polyglycol (ISO 32) The 9%, 68%, 81% , 91%, and 95% refrigerant mixtures were miscible throughout the test temperature range. The 23% , 39% , and 49% refrigerant mixtures became hazy at temperatures below -19.6°C, -19.6°C, and -29.8°C, respectively.

Penta Erythritol Ester Mixed-Acid (ISO 22) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Naphthenic Mineral Oil (ISO 68) The 12% and 22% refrigerant mixtures were miscible throughout the test temperature range. The 36%, 51%, 64%, 80%, 90%, and 95% refrigerant mixtures were immiscible at temperatures below -29.9°C, -10.5°C, 0.0°C, 10.9°C, -10.5°C, and -10.5°C, respectively.

Alkylbenzene (ISO 68) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 58) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Table 1 provides a summary of the test data for each lubricant and R-22 pair. All of the lubricants are completely miscible with R-22 except for the naphthenic mineral oils (ISO 32 and 68) and the modified polyglycol, which are all partially miscible with R-22.

Table 1 Summary of miscibility data for R-22 and 14 lubricants.

	R-22							
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	M	M	-40°C	-30°C	-20°C	-10°C	-20°C	M
alkylbenzene (ISO 32)	M	M	M	M	M	M	M	M
polypropylene glycol butyl monoether (ISO 32)	M	M	M	M	M	M	M	M
polypropylene glycol diol (ISO 32)	M	M	M	M	M	M	M	M
modified polyglycol (ISO 32)	M	-20°C	-20°C	-30°C	M	M	M	M
penta erythritol ester mixed-acid (ISO 22)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 32)	M	M	M	M	M	M	M	M
naphthenic mineral oil (ISO 68)	M	M	-30°C	-10°C	0°C	10°C	-10°C	-10°C
alkylbenzene (ISO 68)	M	M	M	M	M	M	M	M
polypropylene glycol butyl monoether (ISO 58)	M	M	M	M	M	M	M	M
polypropylene glycol diol (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 100)	M	M	M	M	M	M	M	M

Notes: M -- miscible over the complete test temperature range
I -- immiscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature

R-32

Naphthenic Mineral Oil (ISO 32) The 9% refrigerant mixture was immiscible below -0.2°C. The seven other concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 32) The 13% refrigerant mixture was immiscible below 20.5°C. The seven other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 32) The 14%, 20%, and 34% refrigerant mixtures were miscible throughout the test temperature range. The 53%, 63%, and 94% refrigerant mixtures became immiscible at temperatures below -30.4°C, -0.1°C, and -19.6°C, respectively. Also, the 53%, 63%, and 94% refrigerant mixtures became immiscible at temperatures above 55.4°C, 30.0°C, and 38.7°C, respectively. The 80% and 89% refrigerant mixtures were immiscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Modified Polyglycol (ISO 32) The 12% and 94% refrigerant mixtures were miscible throughout the test temperature range. The 21%, 34%, 48%, and 65% refrigerant mixtures became hazy at temperatures below -40.1°C, -0.1°C, 10.4°C, and -0.1°C, respectively. Also, the 65% refrigerant mixture became immiscible at temperatures above 60.4°C. The 80% and 90% refrigerant mixtures became immiscible at temperatures above 60.4°C.

Penta Erythritol Ester Mixed-Acid (ISO 22) The 14% and 20% refrigerant mixtures were miscible throughout the test temperature range. The 35%, 49%, 65%, 79%, 90%, and 95% refrigerant mixtures became immiscible at temperatures below -49.3°C, -19.6°C, -0.3°C, -0.3 °C, -10.5°C and -30.4°C, respectively. Also, the 65% and 79% refrigerant mixtures became immiscible at temperatures above 49.9°C.

Penta Erythritol Ester Mixed-Acid (ISO 32) The 11%, 21%, and 34% refrigerant mixtures were miscible throughout the test temperature range. The 48%, 61%, 79%, 90%, and 95% refrigerant mixtures became hazy at temperatures below -40.1°C, -29.7°C, -19.6°C, -19.9°C, and -19.6°C, respectively.

Penta Erythritol Ester Branched-Acid (ISO 32) The 12%, 20%, and 36% refrigerant mixtures were miscible throughout the test temperature range. The 51%, 65%, 79%, 90%, and 94% refrigerant mixtures became immiscible at temperatures below -30.0°C, -19.9°C, -19.9°C, -30.0°C, and -40.5°C, respectively.

Naphthenic Mineral Oil (ISO 68) The 10% refrigerant mixture was immiscible below 30.0°C. The seven other concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 68) The 12% refrigerant mixture was immiscible below 9.7°C. The seven other concentrations were immiscible throughout the test temperature range**.**

Polypropylene Glycol Butyl Monoether (ISO 58) The 12%, 21%, and 32% refrigerant mixtures were miscible throughout the test temperature range. The 47% refrigerant mixture became immiscible at temperatures below -19.8°C. The four other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 100) The 12%, 21%, and 36% refrigerant mixtures were miscible throughout the test temperature range. The 49% refrigerant mixture became immiscible at temperatures below -40.3 °C. Also, the 49% refrigerant mixture became immiscible at temperatures above 49.8°C. The four other concentrations were immiscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 100) The 12% and 21% refrigerant mixtures were miscible throughout the test temperature range. The 35%, 51%, and 94% refrigerant mixtures became immiscible at temperatures below -30.1°C, 9.9°C, and -0.3°C, respectively. The 65%, 78%, and 89% refrigerant mixtures were immiscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 100) The 12%, 21% , and 35% refrigerant mixtures were miscible throughout the test temperature range. The 51% and 65% refrigerant mixtures became immiscible at temperatures below -40.3°C, and -20.1°C, respectively. Also, the 65% refrigerant mixture became immiscible at temperatures above 49.8°C. The three other concentrations were immiscible throughout the test temperature range.

Table 2 provides a summary of the test data for each lubricant and R-32 pair. The polypropylene glycol diol (ISO 32) lubricant is completely miscible with R-32. The rest of the lubricants are partially miscible with R-32.

Table 2 Summary of miscibility data for R-32 and 14 lubricants.

R-32								
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	0°C	I	I	I	I	I	I	I
alkylbenzene (ISO 32)	20°C	I	I	I	I	I	I	I
polypropylene glycol butyl monoether (ISO 32)	M	M	M	>60°C -30°C	>30°C 0°C	I	I	>40°C -20°C
polypropylene glycol diol (ISO 32)	M	M	M	M	M	M	M	M
modified polyglycol (ISO 32)	M	-40°C	0°C	10°C	>60°C 0°C	>60°C	>60°C	M
penta erythritol ester mixed-acid (ISO 22)	M	M	-50°C	-20°C	>50°C 0°C	>50°C 0°C	-10°C	-30°C
penta erythritol ester mixed-acid (ISO 32)	M	M	M	-40°C	-30°C	-20°C	-20°C	-20°C
penta erythritol ester branched-acid (ISO 32)	M	M	M	-30°C	-20°C	-20°C	-30°C	-40°C
naphthenic mineral oil (ISO 68)	30°C	I	I	I	I	I	I	I
alkylbenzene (ISO 68)	10°C	I	I	I	I	I	I	I
polypropylene glycol butyl monoether (ISO 58)	M	M	M	-20°C	I	I	I	I
polypropylene glycol diol (ISO 100)	M	M	M	>50°C -40°C	I	I	I	I
penta erythritol ester mixed-acid (ISO 100)	M	M	-30°C	10°C	I	I	I	0°C
penta erythritol ester branched-acid (ISO 100)	M	M	M	-40°C	>50°C -20°C	I	I	I

Notes: M -- miscible over the complete test temperature range
I -- immiscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature
>--°C -- the mixture was immiscible at and above this temperature

R-123

Naphthenic Mineral Oil (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Alkylbenzene (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Modified Polyglycol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 22) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Naphthenic Mineral Oil (ISO 68) The 11%, 21%, 38%, and 95% concentrations were miscible throughout the test temperature range. The 47%, 63%, 80%, and 89% concentrations became hazy at temperatures below -47.7°C, -47.7°C, -40.3°C, and -47.7°C, respectively.

Alkylbenzene (ISO 68) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 58) The 38%, 48%, 64%, 78%, 90%, and 95% concentrations were miscible throughout the test temperature range. The 13% and 21% concentrations became immiscible at temperatures above 49.9°C and 20.1 °C, respectively.

Polypropylene Glycol Diol (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Table 3 provides a summary of the test data for each lubricant and R-123 pair. All of the lubricants are completely miscible with R-123 except for the naphthenic mineral oil (ISO 68) and the polypropylene glycol butyl monoether (ISO 58), which are all partially miscible with R-123.

Table 3 Summary of miscibility data for R-123 and 14 lubricants.

R-123								
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	M	M	M	M	M	M	M	M
alkylbenzene (ISO 32)	M	M	M	M	M	M	M	M
polypropylene glycol butyl monoether (ISO 32)	M	M	M	M	M	M	M	M
polypropylene glycol diol (ISO 32)	M	M	M	M	M	M	M	M
modified polyglycol (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 22)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 32)	M	M	M	M	M	M	M	M
naphthenic mineral oil (ISO 68)	M	M	M	-50°C	-50°C	-40°C	-50°C	M
alkylbenzene (ISO 68)	M	M	M	M	M	M	M	M
polypropylene glycol butyl monoether (ISO 58)	>50°C	>20°C	M	M	M	M	M	M
polypropylene glycol diol (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 100)	M	M	M	M	M	M	M	M

Notes: M -- miscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature
>--°C -- the mixture was immiscible at and above this temperature

R-124

Naphthenic Mineral Oil (ISO 32) The 11% refrigerant mixture was miscible throughout the test temperature range. The 23%, 36%, 52%, 66%, 81%, 90%, and 96% refrigerant mixtures were immiscible at temperatures below -46.6°C, -20.3°C, -0.1°C, 19.7°C, 19.7°C, 20.5°C, and -30.0°C, respectively.

Alkylbenzene (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Modified Polyglycol (ISO 32) The 9%, 19%, 90%, and 94% refrigerant mixtures were miscible throughout the test temperature range. The 37%, 50%, 67%, and 81% refrigerant mixtures became hazy at temperatures below -20.3°C, -30.1°C, -10.2°C, and -20.3°C, respectively.

Penta Erythritol Ester Mixed-Acid (ISO 22) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Naphthenic Mineral Oil (ISO 68) The 12% refrigerant mixture was miscible throughout the test temperature range. The 22%, 37%, 50%, 66%, 80%, 90%, and 95% refrigerant mixtures were immiscible at temperatures below -48.6°C, 0.0°C, 20.1 °C, 39.5°C, 49.8°C, 39.5°C and 20.1°C, respectively.

Alkylbenzene (ISO 68) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 58) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Table 4 provides a summary of the test data for each lubricant and R-124 pair. All of the lubricants are completely miscible with R-124 except for the naphthenic mineral oils (ISO 32 and 68) and the modified polyglycol (ISO 32), which are all partially miscible with R-124.

Table 4 Summary of miscibility data for R-124 and 14 lubricants.

	R-124							
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	M	-50°C	-20°C	0°C	20°C	20°C	20°C	-30°C
alkylbenzene (ISO 32)	M	M	M	M	M	M	M	M
polypropylene glycol butyl monoether (ISO 32)	M	M	M	M	M	M	M	M
polypropylene glycol diol (ISO 32)	M	M	M	M	M	M	M	M
modified polyglycol (ISO 32)	M	M	-20°C	-30°C	-10°C	-20°C	M	M
penta erythritol ester mixed-acid (ISO 22)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 32)	M	M	M	M	M	M	M	M
naphthenic mineral oil (ISO 68)	M	-50°C	0°C	20°C	40°C	50°C	40°C	20°C
alkylbenzene (ISO 68)	M	M	M	M	M	M	M	M
polypropylene glycol butyl monoether (ISO 58)	M	M	M	M	M	M	M	M
polypropylene glycol diol (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 100)	M	M	M	M	M	M	M	M

Notes: M -- miscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature

R-125

Naphthenic Mineral Oil **(**ISO 32) The 11% refrigerant mixture was immiscible below 30.1°C. The seven other concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 32) The 13% refrigerant mixture was immiscible below -0.6°C. The seven other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 32) The 12%, 23%, 37% and 52% refrigerant mixtures were miscible throughout the test temperature range. The 65%, 82%, 90%, and 94% refrigerant mixtures became immiscible at temperatures above 59.8°C, 49.8°C, 49.6°C, and 49.6°C**,** respectively.

Polypropylene Glycol Diol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Modified Polyglycol (ISO 32) The 11% refrigerant mixture was miscible throughout the test temperature range. The 20%, 36%, 49%, and 67% refrigerant mixtures became hazy at temperatures below -30.1°C, -30.1°C, -0.4°C, and -0.4°C, respectively. The 82%, 90%, and 95% refrigerant mixtures became immiscible at temperatures above 39.7°C, 29.9°C, and 40.5°C, respectively.

Penta. Erythritol Ester Mixed-Acid (ISO 22) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Naphthenic Mineral Oil (ISO 68) The 12%, 23%, and 31% refrigerant mixtures were immiscible below 30.1°C, 50.0°C, 50.0°C, respectively. The five other concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 68) The 14%, 22%, 36%, and 48% refrigerant mixtures were immiscible below 20.5°C, 40.1°C, 50.0°C, 50.0°C, respectively. The four other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 58) The 10%, 21%, 35% and 50% refrigerant mixtures were miscible throughout the test temperature range. The 65%, 80%, 89%, and 95% refrigerant mixtures became immiscible at temperatures above 49.9°C, 40.1°C, 40.1°C, and 40.1°C, respectively.

Polypropylene Glycol Diol (ISO 100) The 12%, 23%, 37%, 51%, and 61% refrigerant mixtures were miscible throughout the test temperature range. The 80%, 90%, and 94% refrigerant mixtures became immiscible at temperatures above 39.8°C.

Penta Erythritol Ester Mixed-Acid (ISO 100) The 13%, 18%, 36% and 50% refrigerant mixtures were miscible throughout the test temperature range. The 66%, 79%, 89%, and 95% refrigerant mixtures became immiscible at temperatures above 59.4°C.

Penta Erythritol Ester Branched-Acid (ISO 100) The 12%, 17%, 36%, 51%, and 64% refrigerant mixtures were miscible throughout the test temperature range. The 77%, 89%, and 95% refrigerant mixtures became immiscible at temperatures above 60.1°C, 49.6°C, and 39.8°C, respectively.

Table 5 provides a summary of the test data for each lubricant and R-125 pair. The polypropylene glycol diol (ISO 32), penta erythritol ester mixed-acid (ISO 22), penta erythritol ester mixed-acid (ISO 32), and the penta erythritol ester branched-acid (ISO 32) lubricants are completely miscible with R-125. The rest of the lubricants are partially miscible with R-125.

Table 5 Summary of miscibility data for R-125 and 14 lubricants.

R-125								
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	30°C	I	I	I	I	I	I	I
alkylbenzene (ISO 32)	0°C	I	I	I	I	I	I	I
polypropylene glycol butyl monoether (ISO 32)	M	M	M	M	>60°C	>50°C	>50°C	>50°C
polypropylene glycol diol (ISO 32)	M	M	M	M	M	M	M	M
modified polyglycol (ISO 32)	M	-30°C	-30°C	0°C	0°C	>40°C	>30°C	>40°C
penta erythritol ester mixed-acid (ISO 22)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 32)	M	M	M	M	M	M	M	M
naphthenic mineral oil (ISO 68)	30°C	50°C	50°C	I	I	I	I	I
alkylbenzene (ISO 68)	20°C	40°C	50°C	50°C	I	I	I	I
polypropylene glycol butyl monoether (ISO 58)	M	M	M	M	>50°C	>40°C	>40°C	>40°C
polypropylene glycol diol (ISO 100)	M	M	M	M	M	>40°C	>40°C	>40°C
penta erythritol ester mixed-acid (ISO 100)	M	M	M	M	>60°C	>60°C	>60°C	>60°C
penta erythritol ester branched-acid (ISO 100)	M	M	M	M	M	>60°C	>50°C	>60°C

Notes: M -- miscible over the complete test temperature range
I -- immiscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature
>--°C -- the mixture was immiscible at and above this temperature

R-134

Naphthenic Mineral Oil (ISO 32) All eight concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 32) The 11% refrigerant mixture was immiscible below -9.3°C. The seven other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 32) The 12%, 20%, 32%, 50%, 67%, and 78% refrigerant mixtures were miscible throughout the test temperature range. The 88% and 96% refrigerant mixtures were hazy at temperatures below -39.9°C and -20.8°C, respectively.

Polypropylene Glycol Diol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Modified Polyglycol (ISO 32) The 9%, 89%, and 95% refrigerant mixtures were miscible throughout the test temperature range. The 23%, 37%, 48%, 64%, and 79% refrigerant mixtures became hazy at temperatures below -20.3°C, -20.3°C, -0.4°C, -19.6°C, and -39.8°C, respectively.

Penta Erythritol Ester Mixed-Acid (ISO 22) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Naphthenic Mineral Oil (ISO 68) The 7% refrigerant mixture was immiscible below 10.4°C. The seven other concentrations were immiscible throughout the test temperature range.

A1ky1benzene(ISO 68) The 9% refrigerant mixture was immiscible below -19.8°C. The seven other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 58) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Table 6 provides a summary of the test data for each lubricant and R-134 pair. All of the lubricants are completely miscible with R-134 except for the naphthenic mineral oils (ISO 32 and 68), the alkylbenzene lubricants (ISO 32 and 68), the polypropylene glycol butyl monoether (ISO 32),

and the modified polyglycol (ISO 32), which are all partially miscible or completely immiscible with R-134.

Table 6 Summary of miscibility data for R-134 and 14 lubricants.

	R-134							
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	I	I	I	I	I	I	I	I
alkylbenzene (ISO 32)	-10°C	I	I	I	I	I	I	I
polypropylene glycol butyl monoether (ISO 32)	M	M	M	M	M	M	-40°C	-20°C
polypropylene glycol diol (ISO 32)	M	M	M	M	M	M	M	M
modified polyglycol (ISO 32)	M	-20°C	-20°C	0°C	-20°C	-40°C	M	M
penta erythritol ester mixed-acid (ISO 22)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 32)	M	M	M	M	M	M	M	M
naphthenic mineral oil (ISO 68)	10°C	I	I	I	I	I	I	I
alkylbenzene (ISO 68)	-20°C	I	I	I	I	I	I	I
polypropylene glycol butyl monoether (ISO 58)	M	M	M	M	M	M	M	M
polypropylene glycol diol (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 100)	M	M	M	M	M	M	M	M

Notes: M -- miscible over the complete test temperature range
I -- immiscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature

R-134a

Naphthenic Mineral Oil (ISO 32) The 10% and 21% refrigerant mixtures were immiscible below 19.9°C, and 79.9°C, respectively. The six other concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 32) The 13% and 18% refrigerant mixtures were immiscible below -0.2°C, and 30.1°C, respectively. The six other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 32) The 9%, 21%, 37%, 51% and 62% refrigerant mixtures were miscible throughout the test temperature range. The 81%, 89%, and 95% refrigerant mixtures became immiscible at temperatures above 70.1°C, 60.0°C, and 80.0°C, respectively.

Polypropylene Glycol Diol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Modified Polyglycol (ISO 32) The 10%, 63%, 81%, 90%, and 95% refrigerant mixtures were miscible throughout the test temperature range. The 22%, 37%, and 52% refrigerant mixtures became hazy at temperatures below -19.5°C, 0.5°C, and 0.1°C, respectively.

Penta Erythritol Ester Mixed-Acid (ISO 22) The 12%, 20%, 36%, 51%, and 95% refrigerant mixtures were miscible throughout the test temperature range. The 69%, 78%, and 91% refrigerant mixtures became immiscible at temperatures below -49.5°C.

Penta Erythritol Ester Mixed-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Naphthenic Mineral Oil (ISO 68) The 10% refrigerant mixture was immiscible below 11.1°C. The seven other concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 68) The 11% and 21% refrigerant mixtures were immiscible below -10.2°C, and 60.2°C, respectively. The six other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 58) The 12%, 17%, 32%, and 50% refrigerant mixtures were miscible throughout the test temperature range. The 64%, 79%, 90%, and 95% refrigerant mixtures became immiscible at temperatures above 70.1°C, 49.9°C, 49.9°C, and 59.9°C, respectively.

Polypropylene Glycol Diol (ISO 100) The 9%, 20%, 37%, and 52% refrigerant mixtures were miscible throughout the test temperature range. The 66%, 77%, 90%, and 94% refrigerant mixtures became immiscible at temperatures above 60.4°C, 60.4°C, 60.4°C, and 69.5°C, respectively.

Penta Erythritol Ester Mixed-Acid (ISO 100) The 12%, 18%, 36%, and 52% refrigerant mixtures were miscible throughout the test temperature range. The 64%, 81%, 89%, and 95% refrigerant mixtures became immiscible at temperatures below -39.6°C, -39.6°C, -30.0°C, and -9.7°C, respectively.

Penta Erythritol Ester Branched-Acid (ISO 100) The 10%, 18%, 34%, 51% and 64% refrigerant mixtures were miscible throughout the test temperature range. The 79%, 90%, and 95% refrigerant mixtures became immiscible at temperatures above 80.2°C, 60.4°C, and 60.4°C, respectively.

Table 7 provides a summary of the test data for each lubricant and R-134a pair. The polypropylene glycol diol (ISO 32), penta erythritol ester mixed-acid (ISO 22), penta erythritol ester mixed-acid (ISO 32), and the penta erythritol ester branched-acid (ISO 32) lubricants are completely miscible with R-134a. The rest of the lubricants are partially miscible with R-134a.

Table 7 Summary of miscibility data for R-134a and 14 lubricants.

	R-134a							
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	20°C	80°C	I	I	I	I	I	I
alkylbenzene (ISO 32)	0°C	30°C	I	I	I	I	I	I
polypropylene glycol butyl monoether (ISO 32)	M	M	M	M	M	>70°C	>60°C	>80°C
polypropylene glycol diol (ISO 32)	M	M	M	M	M	M	M	M
modified polyglycol (ISO 32)	M	-20°C	0°C	0°C	M	M	M	M
penta erythritol ester mixed-acid (ISO 22)	M	M	M	M	-50°C	-50°C	-50°C	M
penta erythritol ester mixed-acid (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 32)	M	M	M	M	M	M	M	M
naphthenic mineral oil (ISO 68)	10°C	I	I	I	I	I	I	I
alkylbenzene (ISO 68)	-10°C	60°C	I	I	I	I	I	I
polypropylene glycol butyl monoether (ISO 58)	M	M	M	M	>70°C	>50°C	>50°C	>60°C
polypropylene glycol diol (ISO 100)	M	M	M	M	>60°C	>60°C	>60°C	>70°C
penta erythritol ester mixed-acid (ISO 100)	M	M	M	M	-40°C	-40°C	-30°C	-10°C
penta erythritol ester branched-acid (ISO 100)	M	M	M	M	M	>80°C	>60°C	>60°C

Notes:
M -- miscible over the complete test temperature range
I -- immiscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature
>--°C -- the mixture was immiscible at and above this temperature

R-142b

Naphthenic Mineral Oil (ISO 32) The 9%, 24%, 36%, 90% and 95% refrigerant mixtures were miscible throughout the test temperature range. The 50%, 66%, and 80% refrigerant mixtures became immiscible at temperatures below -49.3°C, -40.3°C, and -40.3°C, respectively.

Alkylbenzene (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Modified Polyglycol (ISO 32) The 9%, 53%, 80%, 91% and 95% refrigerant mixtures were miscible throughout the test temperature range. The 23%, 37%, and 68% refrigerant mixtures became hazy at temperatures below -39.9°C, -39.9°C, and -46.4°C, respectively.

Penta Erythritol Ester Mixed-Acid (ISO 22) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Naphthenic Mineral Oil (ISO 68) The 9% and 94% refrigerant mixtures were miscible throughout the test temperature range. The 21%, 36%, 48%, 65%, 79%, and 89% refrigerant mixtures became immiscible at temperatures below -46.1°C, -40.3°C, -30.1°C, -30.1°C, -30.1°C, and -40.3°C, respectively.

Alkylbenzene (ISO 68) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 58) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Table 8 provides a summary of the test data for each lubricant and R-142b pair. All of the lubricants are completely miscible with R-142b except for the naphthenic mineral oils (ISO 32 and 68) and the modified polyglycol (ISO 32), which are all partially miscible with R-142b.

Table 8 Summary of miscibility data for R-142b and 14 lubricants.

	R-142b							
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	M	M	M	-50°C	-40°C	-40°C	M	M
alkylbenzene (ISO 32)	M	M	M	M	M	M	M	M
polypropylene glycol butyl monoether (ISO 32)	M	M	M	M	M	M	M	M
polypropylene glycol diol (ISO 32)	M	M	M	M	M	M	M	M
modified polyglycol (ISO 32)	M	-40°C	-40°C	M	-50°C	M	M	M
penta erythritol ester mixed-acid (ISO 22)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 32)	M	M	M	M	M	M	M	M
naphthenic mineral oil (ISO 68)	M	-50°C	-40°C	-30°C	-30°C	-30°C	-40°C	M
alkylbenzene (ISO 68)	M	M	M	M	M	M	M	M
polypropylene glycol butyl monoether (ISO 58)	M	M	M	M	M	M	M	M
polypropylene glycol diol (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 100)	M	M	M	M	M	M	M	M

Notes: M -- miscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature

R-143a

Naphthenic Mineral Oil (ISO 32) The 14% and 16% refrigerant mixtures were immiscible below 40.2°C, and 10.8°C, respectively. The six other concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 32) The 14% and 17% refrigerant mixtures were immiscible below -0.2°C, and 40.1 °C, respectively. The six other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 32) The 13% and 23% refrigerant mixtures were miscible throughout the test temperature range. The 34% refrigerant mixture became immiscible at temperatures below -9.7°C. The five other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 32) The 13% and 23% refrigerant mixtures were miscible throughout the test temperature range. The 34% refrigerant mixture became immiscible at temperatures below -0.2°C. The five other concentrations were immiscible throughout the test temperature range.

Modified Polyglycol (ISO 32) The 13%, 23%, and 37% refrigerant mixtures became hazy at temperatures below -39.6°C, -49.9°C, and -40.2°C, respectively. The five other concentrations were immiscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 22) The 8% and 20% refrigerant mixtures were miscible throughout the test temperature range. The 38% refrigerant mixture became immiscible at temperatures below -9.9°C. The five other concentrations were immiscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 32) The 14%, 22%, and 33% refrigerant mixtures were miscible throughout the test temperature range. The 95% refrigerant mixture became immiscible at temperatures above 40.1°C, and below -40.3°C. The four other concentrations were immiscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 32) The 13%, 22%, and 34% refrigerant mixtures were miscible throughout the test temperature range. The 51% refrigerant mixture became immiscible at temperatures above 29.8°C, and below -0.4°C. The 95% refrigerant mixture became immiscible at temperatures above 49.6°C, and below -48.6°C. The three other concentrations were immiscible throughout the test temperature range.

Naphthenic Mineral Oil (ISO 68) The 6% refrigerant mixture was immiscible below -30.0°C. The seven other concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 68) The 12% and 22% refrigerant mixtures were immiscible below -30.0°C, and 39.5°C, respectively. The six other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Butyl Monoether (ISO 58) The 11% and 23% refrigerant mixtures were miscible throughout the test temperature range. The six other concentrations were immiscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 100) The 13%, 21%, and 35% refrigerant mixtures were miscible throughout the test temperature range. The 50% refrigerant mixture became immiscible at temperatures above 29.9°C, and below 0.2°C. The four other concentrations were immiscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 100) The 11% and 20% refrigerant mixtures were miscible throughout the test temperature range. The 36% refrigerant mixture became immiscible at temperatures below -10.1°C. The five other concentrations were immiscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 100) The 7% and 18% refrigerant mixtures were miscible throughout the test temperature range. The 34% refrigerant mixture became immiscible at temperatures below 40.3°C. The five other concentrations were immiscible throughout the test temperature range.

Table 9 provides a summary of the test data for each lubricant and R-143a pair. All of the lubricants are partially miscible with R-143a.

Table 9 Summary of miscibility data for R-143a and 14 lubricants.

R-143a								
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	40°C	10°C	I	I	I	I	I	I
alkylbenzene (ISO 32)	0°C	40°C	I	I	I	I	I	I
polypropylene glycol butyl monoether (ISO 32)	M	M	-10°C	I	I	I	I	I
polypropylene glycol diol (ISO 32)	M	M	0°C	I	I	I	I	I
modified polyglycol (ISO 32)	-40°C	-50°C	-40°C	>20°C 0°C	I	I	I	I
penta erythritol ester mixed-acid (ISO 22)	M	M	-10°C	I	I	I	I	I
penta erythritol ester mixed-acid (ISO 32)	M	M	M	I	I	I	I	>40°C -40°C
penta erythritol ester branched-acid (ISO 32)	M	M	M	>30°C 0°C	I	I	I	>50°C -50°C
naphthenic mineral oil (ISO 68)	-30°C	I	I	I	I	I	I	I
alkylbenzene (ISO 68)	-30°C	40°C	I	I	I	I	I	I
polypropylene glycol butyl monoether (ISO 58)	M	M	I	I	I	I	I	I
polypropylene glycol diol (ISO 100)	M	M	M	>30°C 0°C	I	I	I	I
penta erythritol ester mixed-acid (ISO 100)	M	M	-10°C	I	I	I	I	I
penta erythritol ester branched-acid (ISO 100)	M	M	40°C	I	I	I	I	I

Notes: M -- miscible over the complete test temperature range
I -- immiscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature
>--°C -- the mixture was immiscible at and above this temperature

R-152a

Naphthenic Mineral Oil (ISO 32) The 13%, 22%, and 95% refrigerant mixtures became immiscible at temperatures below 10.3°C, 50.2°C, and 50.0°C, respectively. The five other concentrations were immiscible throughout the test temperature range.

Alkylbenzene (ISO 32) The 12%, 21%, 33%, 47%, 66%, 79%, 90%, and 96% refrigerant mixtures were immiscible at temperatures below -40.2°C, -10.1°C, 10.0°C, 40.5°C, 50.3°C, 50.3°C, 30.4°C, and -9.7°C, respectively.

Polypropylene Glycol Butyl Monoether (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Polypropylene Glycol Diol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Modified Polyglycol (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 22) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Mixed-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 32) All eight concentrations were miscible throughout the test temperature range.

Naphthenic Mineral Oil (ISO 68) The 13% and 16% refrigerant mixtures became immiscible at temperatures below 19.8°C and 30.1°C, respectively. The six other concentrations were immiscible throughout the test temperature range.

Alky1benzene (ISO 68) The 8% refrigerant mixture was miscible throughout the test temperature range. The 20%, 37%, 51%, 63%, 80%, 90%, and 94% refrigerant mixtures were immiscible at temperatures below -10.2°C, 30.1°C, 49.9°C, 49.7°C, 49.7°C, 30.0°C, and 10.4°C, respectively.

Polypropylene Glycol Butyl Monoether (ISO 58) The 10%, 16%, 36%, 49%, 65%, and 95% refrigerant mixtures were miscible throughout the test temperature range. The 80% and 90% refrigerant mixtures became immiscible at temperatures above 80.2°C and 90.0°C, respectively.

Polypropylene Glycol Diol (ISO 100) The 13%, 22%, 37%, 51%, 66%, and 94% refrigerant mixtures were miscible throughout the test temperature range. The 81% and 90% refrigerant mixtures became immiscible at temperatures above 69.7°C and 88.9°C, respectively.

Penta Erythritol Ester Mixed-Acid (ISO 100) All eight concentrations were miscible throughout the test temperature range.

Penta Erythritol Ester Branched-Acid (ISO 100) The 10%, 22%, 37%, 52%, 65%, and 79% refrigerant mixtures were miscible throughout the test temperature range. The 90% and 95% refrigerant mixtures became immiscible at temperatures above 88.9°C.

Table 10 provides a summary of the test data for each lubricant and R-152a pair. The polypropylene glycol butyl monoether (ISO 32), polypropylene glycol diol (ISO 32), modified polyglycol (ISO 32), penta erythritol ester mixed-acid (ISO 22), penta erythritol ester mixed acid (ISO 32), and the penta erythritol ester branched-acid (ISO 32) lubricants are completely miscible with R-152a. The rest of the lubricants are partially miscible with R-152a.

Table 10 Summary of miscibility data for R-152a and 14 lubricants.

	R-152a							
	nominal refrigerant concentration							
lubricant	10%	20%	35%	50%	65%	80%	90%	95%
naphthenic mineral oil (ISO 32)	10°C	50°C	I	I	I	I	I	50°C
alkylbenzene (ISO 32)	-40°C	-10°C	10°C	40°C	50°C	50°C	30°C	-10°C
polypropylene glycol butyl monoether (ISO 32)	M	M	M	M	M	M	M	M
polypropylene glycol diol (ISO 32)	M	M	M	M	M	M	M	M
modified polyglycol (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 22)	M	M	M	M	M	M	M	M
penta erythritol ester mixed-acid (ISO 32)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 32)	M	M	M	M	M	M	M	M
naphthenic mineral oil (ISO 68)	20°C	30°C	I	I	I	I	I	50°C
alkylbenzene (ISO 68)	M	-10°C	30°C	50°C	50°C	50°C	30°C	10°C
polypropylene glycol butyl monoether (ISO 58)	M	M	M	M	M	>80°C	>90°C	M
polypropylene glycol diol (ISO 100)	M	M	M	M	M	>70°C	>90°C	M
penta erythritol ester mixed-acid (ISO 100)	M	M	M	M	M	M	M	M
penta erythritol ester branched-acid (ISO 100)	M	M	M	M	M	M	>90°C	>90°C

Notes:
M -- miscible over the complete test temperature range
I -- immiscible over the complete test temperature range
--°C -- the mixture was immiscible at and below this temperature
>--°C -- the mixture was immiscible at and above this temperature

Miscibility Plots

A convenient presentation of miscibility data for a refrigerant/lubricant pair is a plot of temperature versus refrigerant concentration. The temperature at which a change in the miscibility characteristics occurred is plotted for each refrigerant concentration tested (10, 20, 35, 50, 65, 80, 90, and 95%). A smooth curve is drawn through these actual data points resulting in a miscibility curve. Regions of miscibility and immiscibility are noted on each plot.

Some refrigerant/lubricant combinations were found to be completely miscible over the test temperature range. Therefore, a miscibility plot is not presented. Plots for each refrigerant/ lubricant pair that exhibits any immiscibility are presented in Figures 2 through 73. A summary of the characteristics of each refrigerant/lubricant pair follows.

R-22

R-22 was found to be completely miscible over the temperature range -50°C to 60°C with the following lubricants:

- alkylbenzene (ISO 32)
- polypropylene glycol butyl monoether (ISO 32)
- polypropylene glycol diol (ISO 32)
- penta erythritol ester mixed-acid (ISO 22)
- penta erythritol ester mixed-acid (ISO 32)
- penta erythritol ester branched-acid (ISO 32)
- alkylbenzene (ISO 68)
- polypropylene glycol butyl monoether (ISO 58)
- polypropylene glycol diol (ISO 100)
- penta erythritol ester mixed-acid (ISO 100)
- penta erythritol ester branched-acid (ISO 100)

Figure 2 shows a miscibility plot for R-22 and the ISO 32 naphthenic mineral oil. Figure 3 shows a miscibility plot for R-22 and the ISO 32 modified polyglycol. Figure 4 shows a miscibility plot for R-22 and the ISO 68 naphthenic mineral oil.

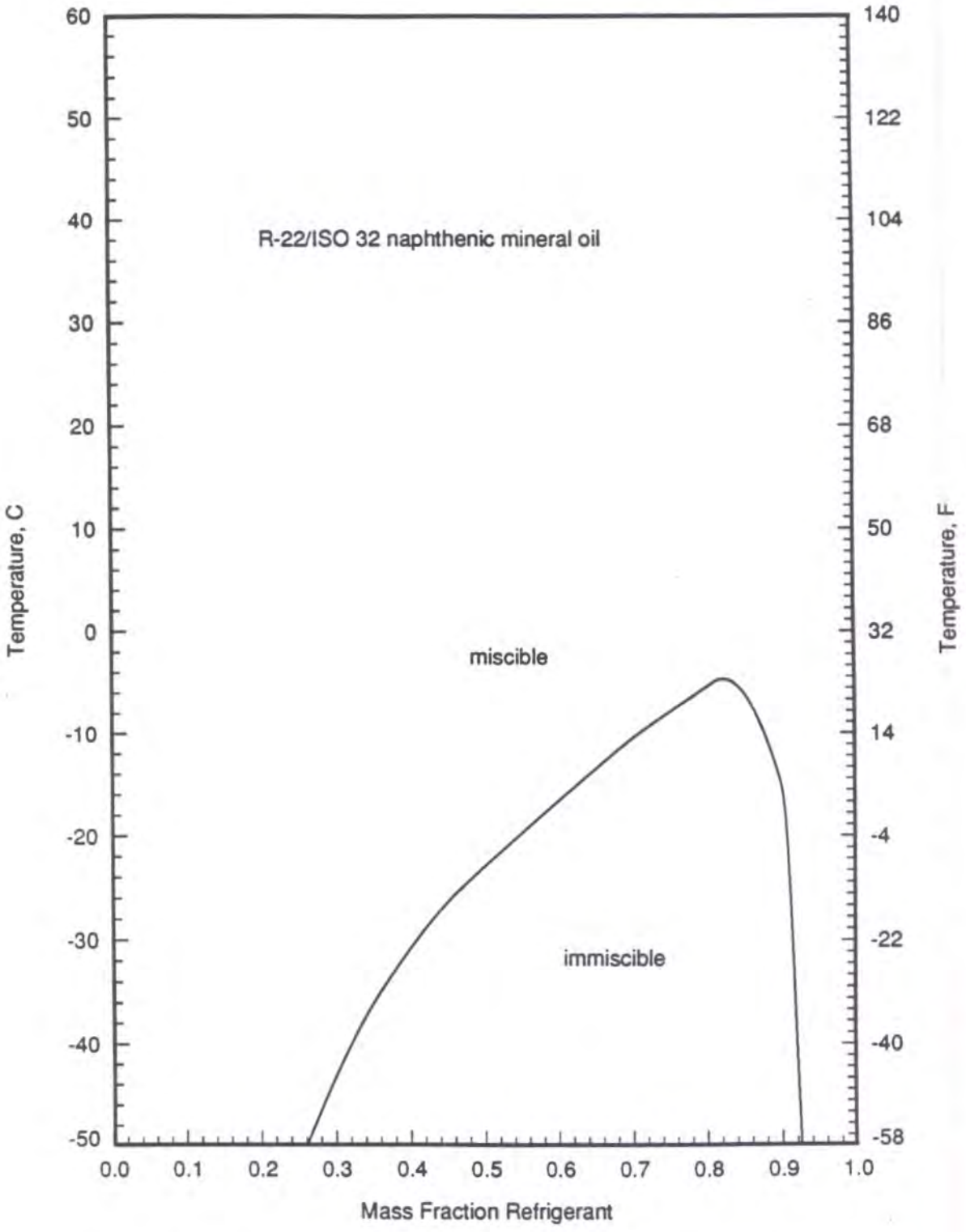

Figure 2 Miscibility plot for R-22/ISO 32 naphthenic mineral oil mixtures.

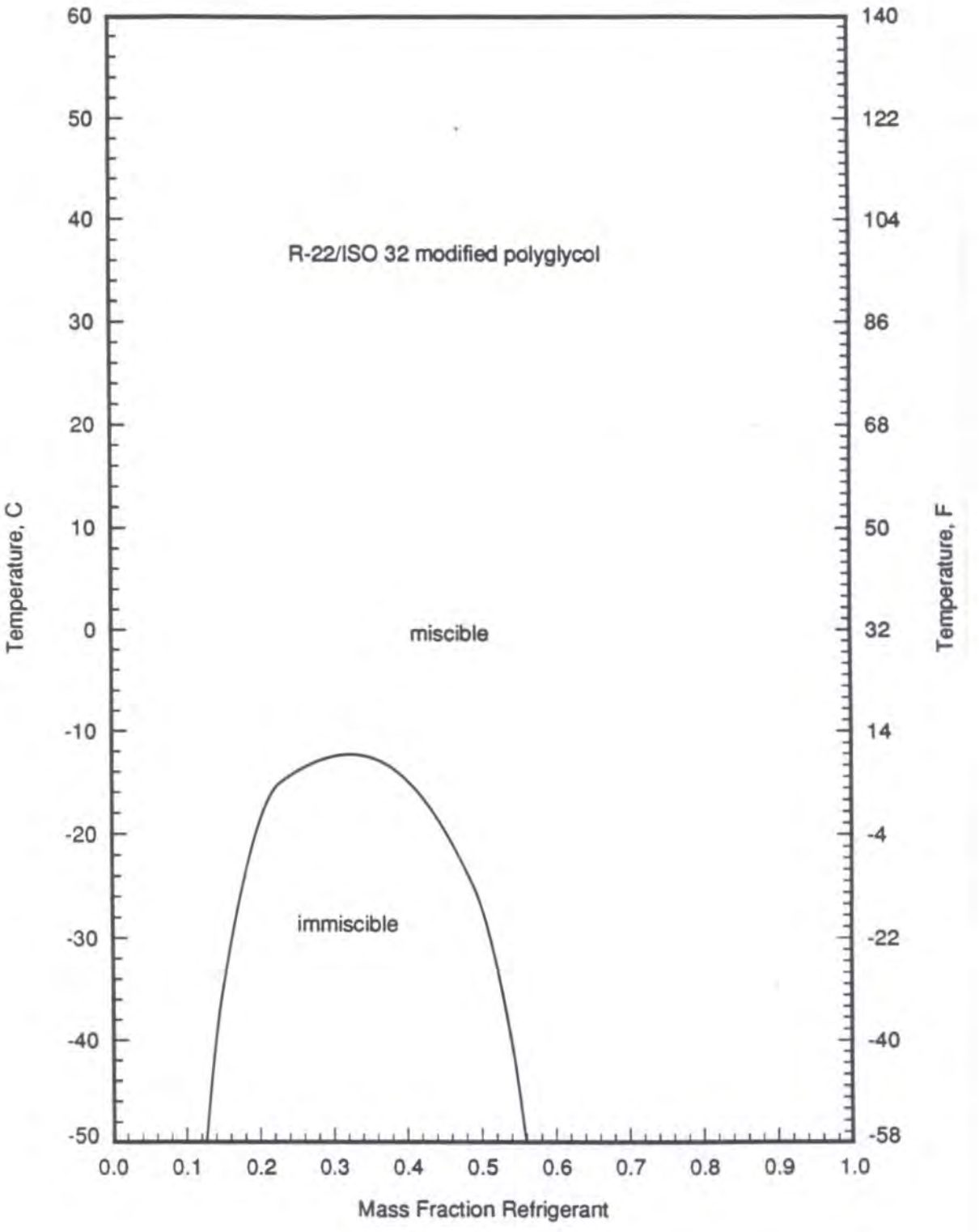

Figure 3 Miscibility plot for R-22/ISO 32 modified polyglycol mixtures.

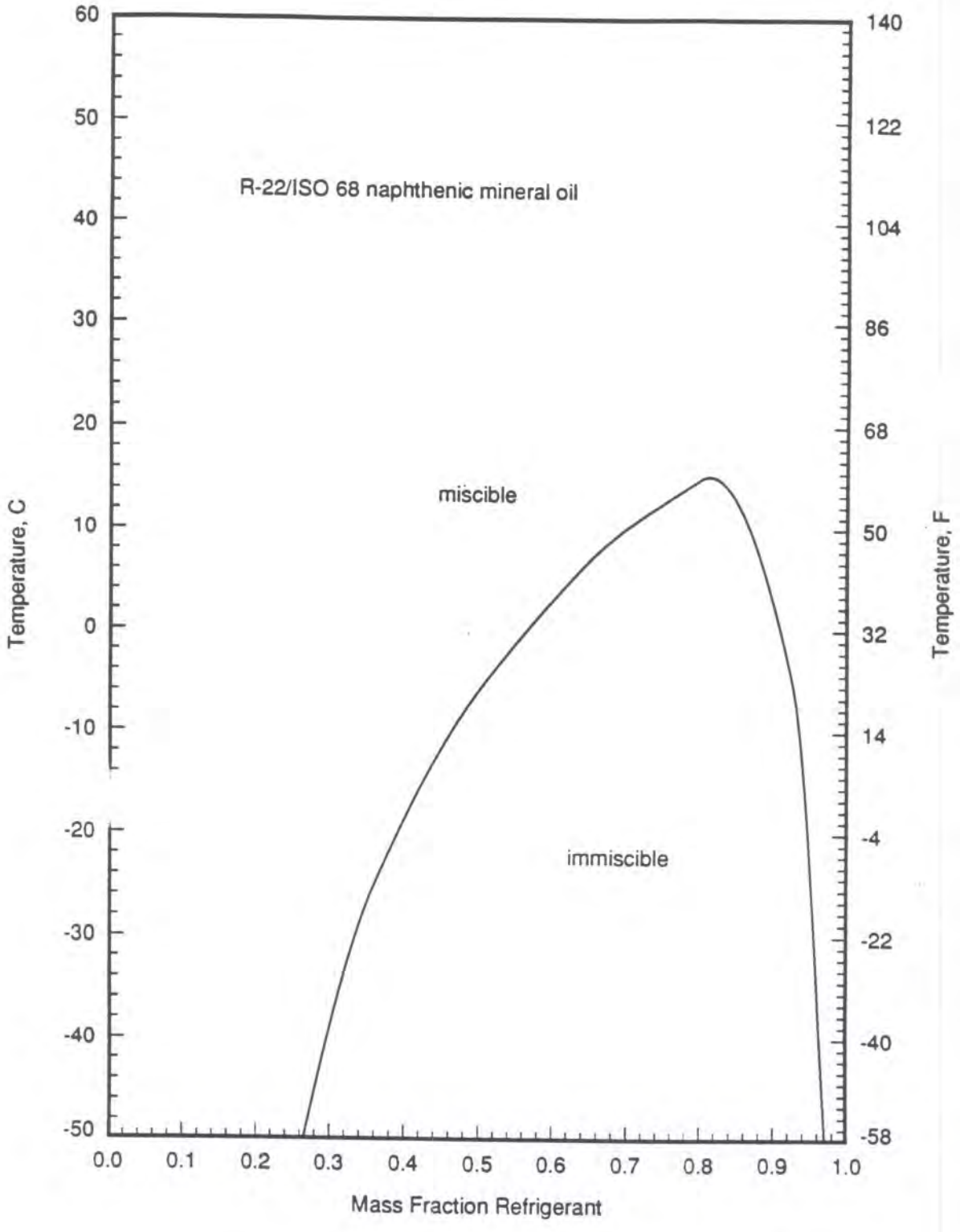

Figure 4 Miscibility plot for R-22/ISO 68 naphthenic mineral oil mixtures.

R-32

R-32 was found to be completely miscible over the temperature range -50°C to 60°C with the following lubricant:

- polypropylene glycol diol (ISO 32)

Figure 5 shows a miscibility plot for R-32 and the ISO 32 naphthenic mineral oil. Figure 6 shows a miscibility plot for R-32 and the ISO 32 alkylbenzene. Figure 7 shows a miscibility plot for R-32 and the ISO 32 polypropylene glycol butyl monoether. Figure 8 shows a miscibility plot for R-32 and the ISO 32 modified polyglycol. Figure 9 shows a miscibility plot for R-32 and the ISO 22 penta erythritol ester mixed-acid. Figure 10 shows a miscibility plot for R-32 and the ISO 32 penta erythritol ester mixed-acid. Figure 11 shows a miscibility plot for R-32 and the ISO 32 penta erythritol ester branched-acid. Figure 12 shows a miscibility plot for R-32 and the ISO 68 naphthenic mineral oil. Figure 13 shows a miscibility plot for R-32 and the ISO 68 alkylbenzene. Figure 14 shows a miscibility plot for R-32 and the ISO 58 polypropylene glycol butyl monoether. Figure 15 shows a miscibility plot for R-32 and the ISO 100 polypropylene glycol diol. Figure 16 shows a miscibility plot for R-32 and the ISO 100 penta erythritol ester mixed-acid. Figure 17 shows a miscibility plot for R-32 and the ISO 100 penta erythritol ester branched-acid.

R-123

R-123 was found to be completely miscible over the temperature range -50°C to 60°C with the following lubricants:

- naphthenic mineral oil (ISO 32)
- alkylbenzene (ISO 32)
- polypropylene glycol butyl monoether (ISO 32)
- polypropylene glycol diol (ISO 32)
- modified polyglycol (ISO 32)
- penta erythritol ester mixed-acid (ISO 22)
- penta erythritol ester mixed-acid (ISO 32)
- penta erythritol ester branched-acid (ISO 32)
- alkylbenzene (ISO 68)
- polypropylene glycol diol (ISO 100)
- penta erythritol ester mixed-acid (ISO 100)
- penta erythritol ester branched-acid (ISO 100)

Figure 18 shows a miscibility plot for R-123 and the ISO 68 naphthenic mineral oil. Figure 19 shows a miscibility plot for R-123 and the ISO 58 polypropylene glycol butyl monoether.

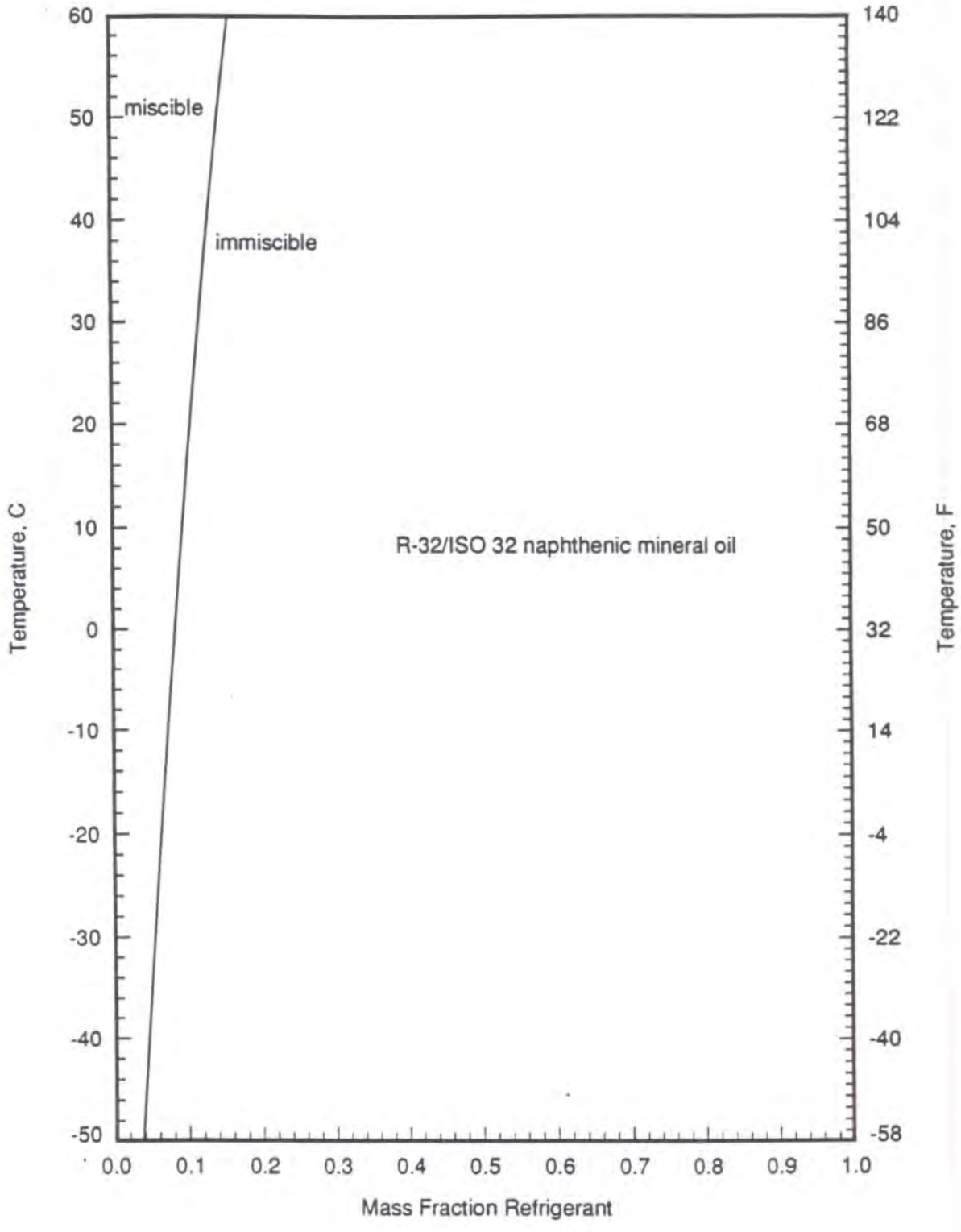

Figure 5 Miscibility plot for R-32/ISO 32 naphthenic mineral oil mixtures.

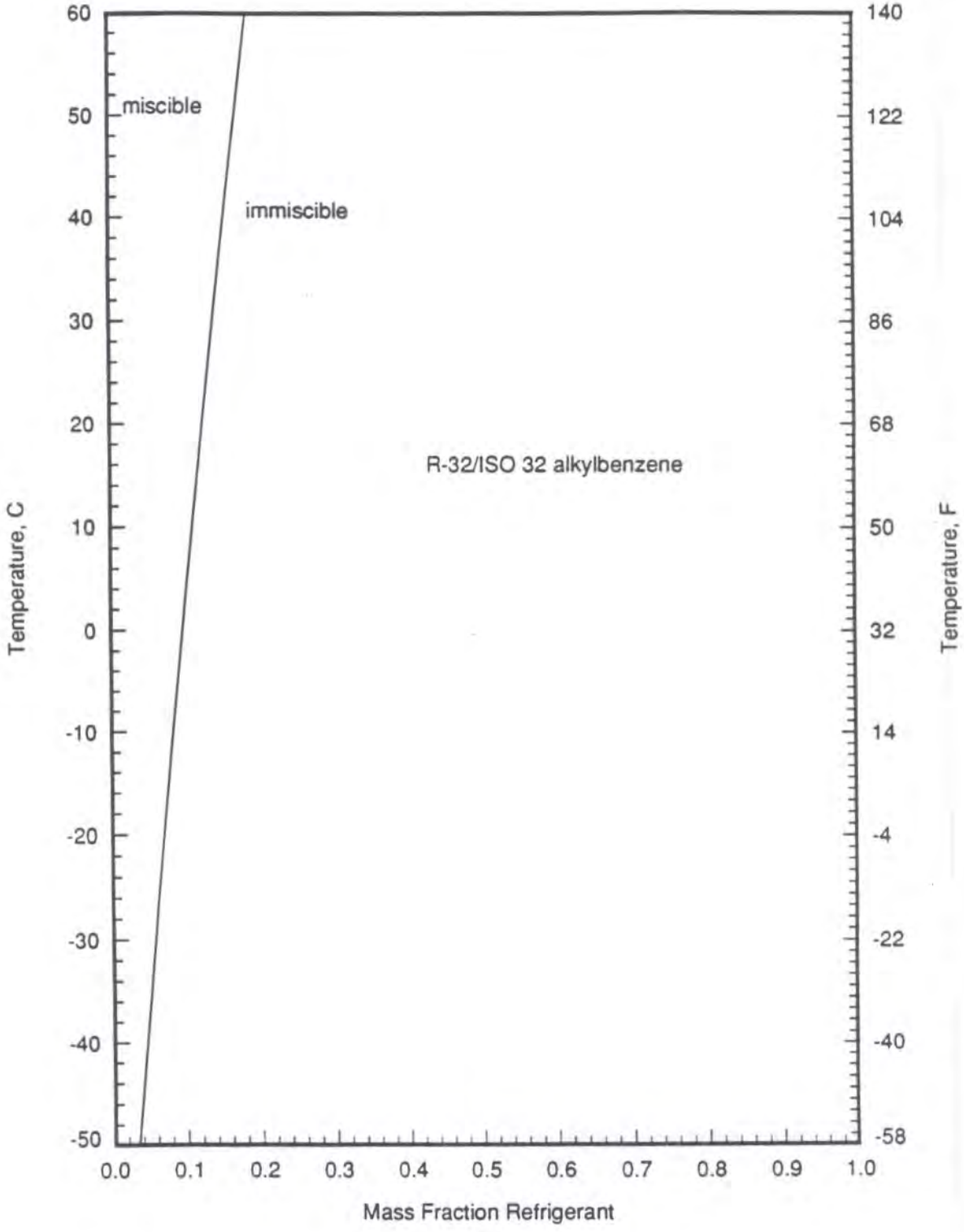

Figure 6 Miscibility plot for R-32/ISO 32 alkylbenzene mixtures.

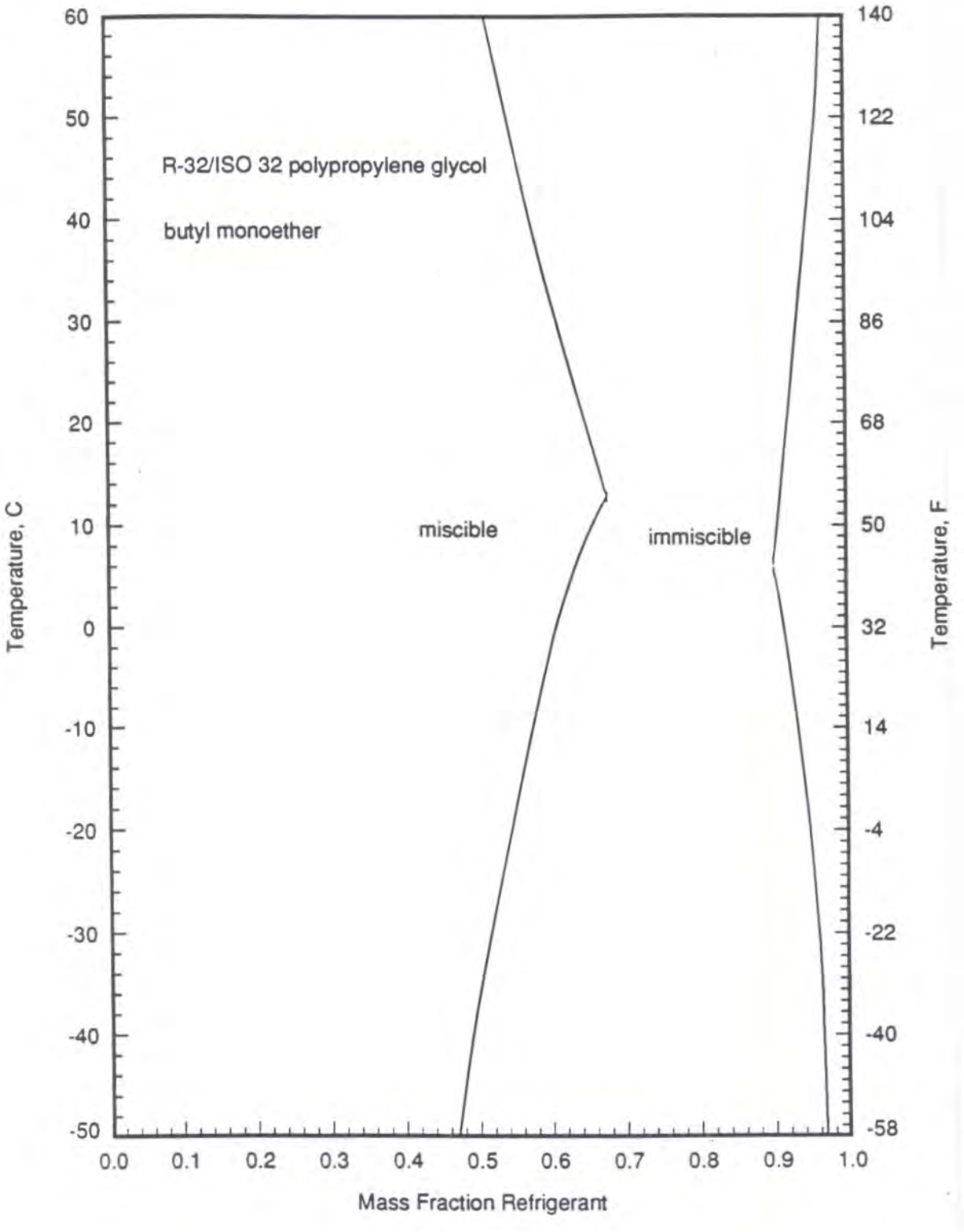

Figure 7 Miscibility plot for R-32/ISO 32 polypropylene glycol butyl monoether mixtures.

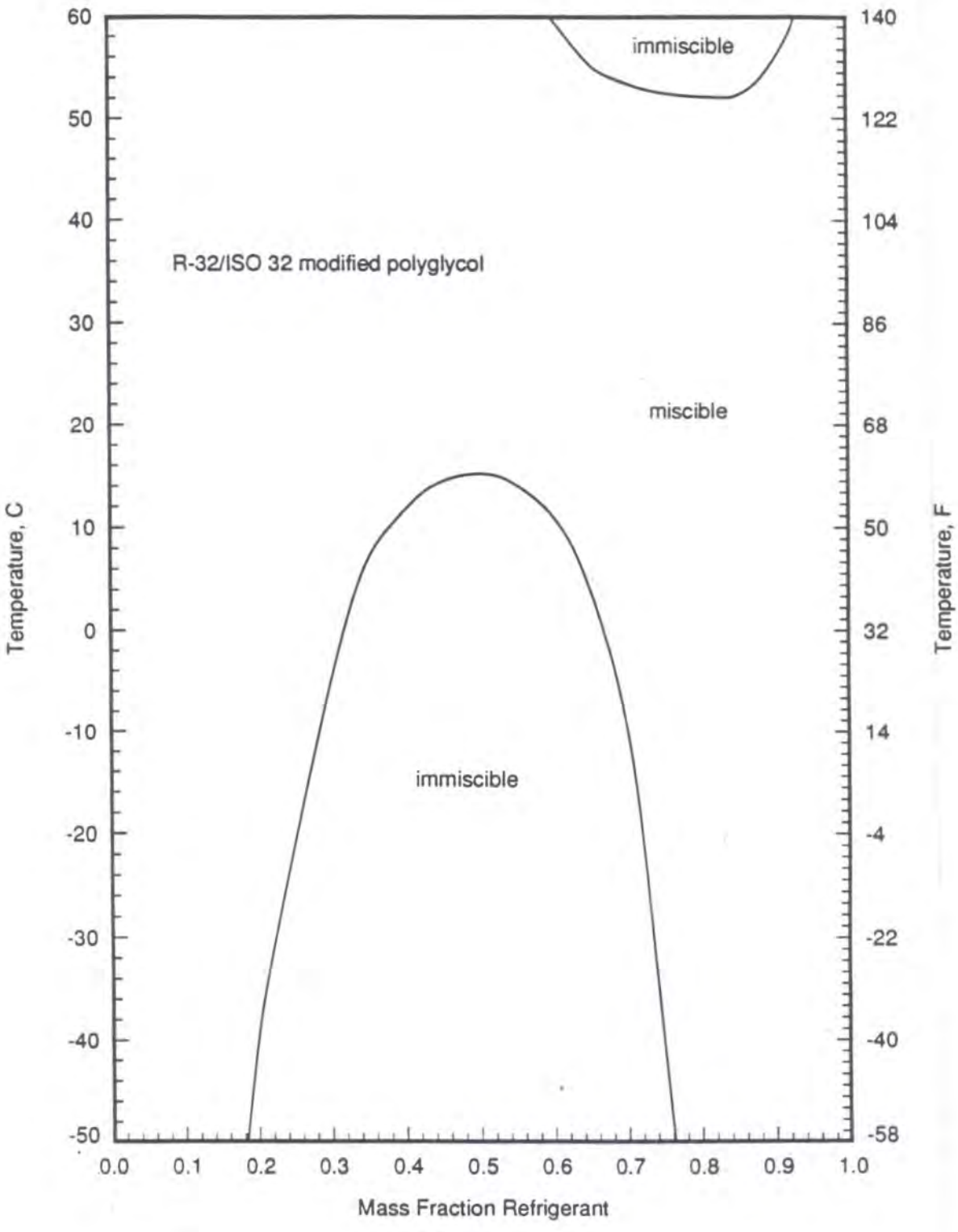

Figure 8 Miscibility plot for R-32/ISO 32 modified polyglycol mixtures.

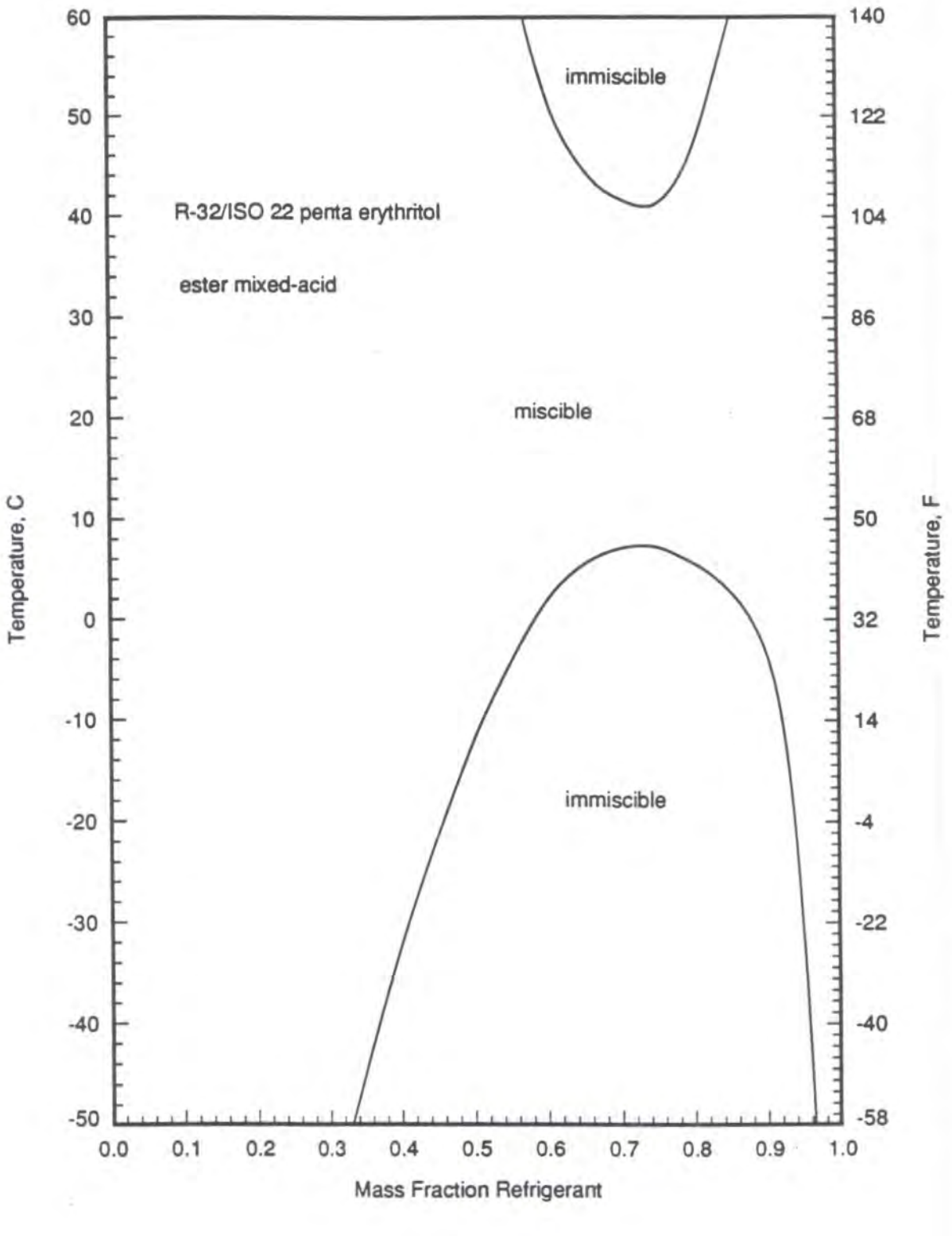

Figure 9 Miscibility plot for R-32/ISO 22 penta erythritol ester mixed-acid mixtures.

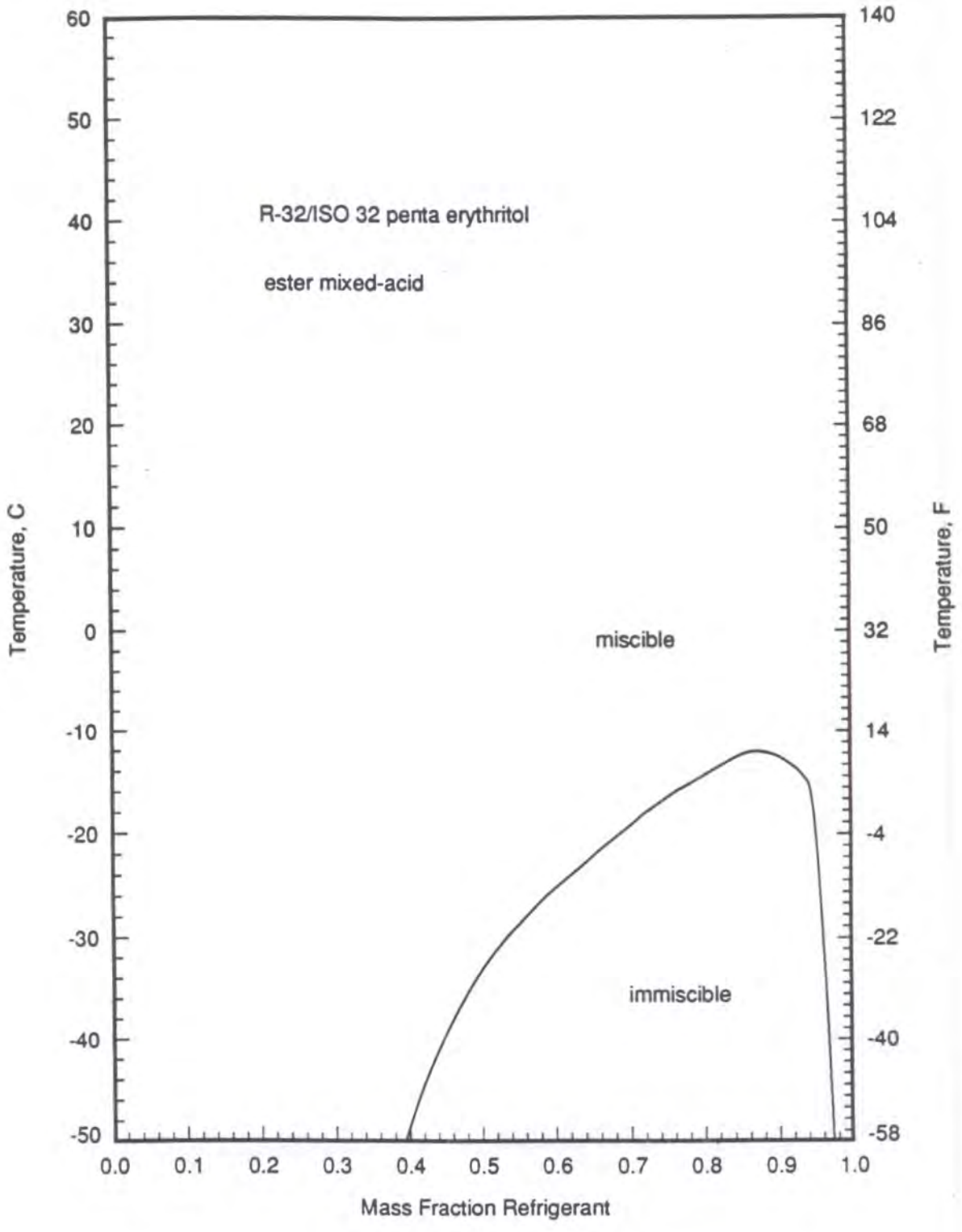

Figure 10 Miscibility plot for R-32/ISO 32 penta erythritol ester mixed-acid mixtures.

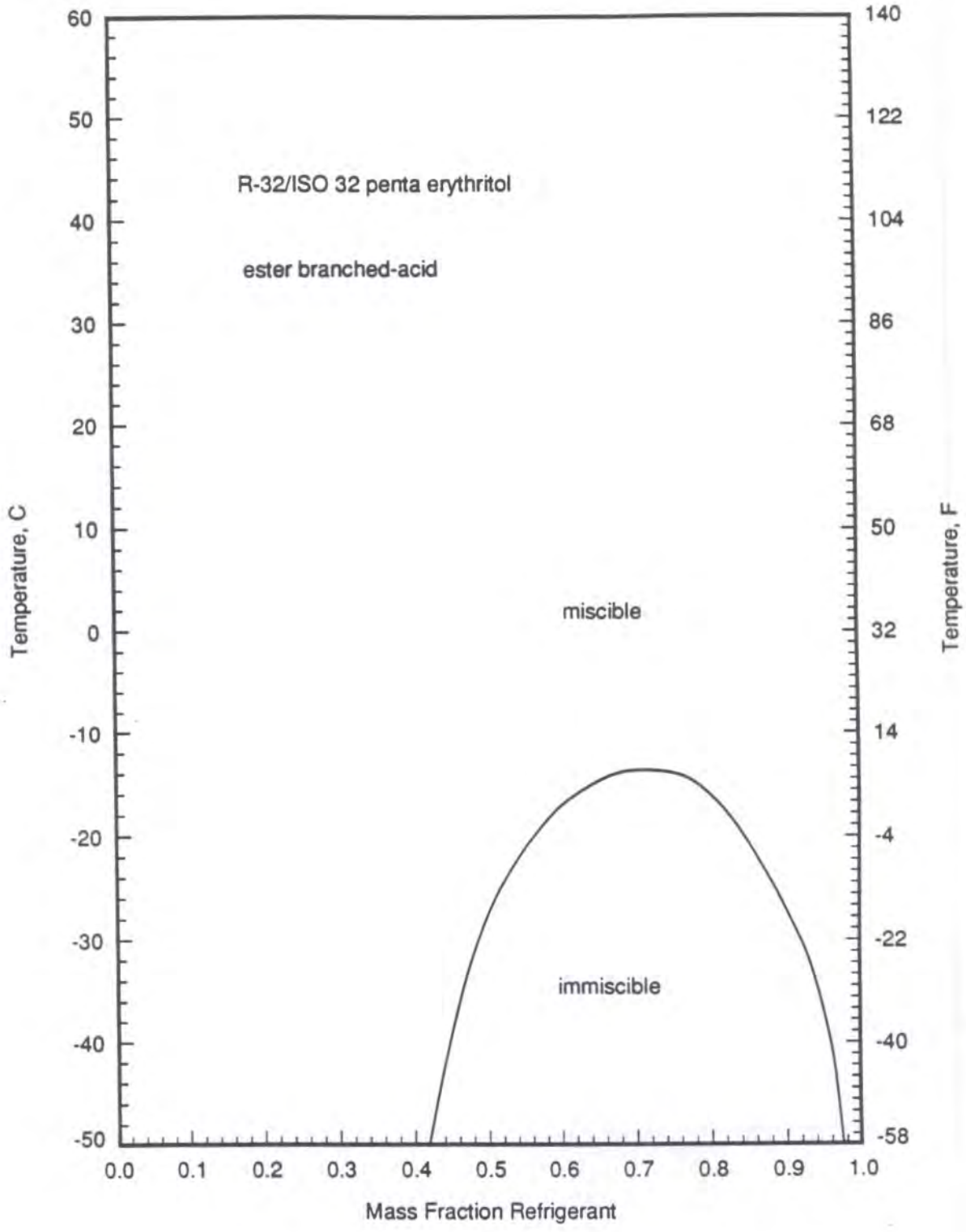

Figure 11 Miscibility plot for R-32/ISO 32 penta erythritol ester branched-acid mixtures.

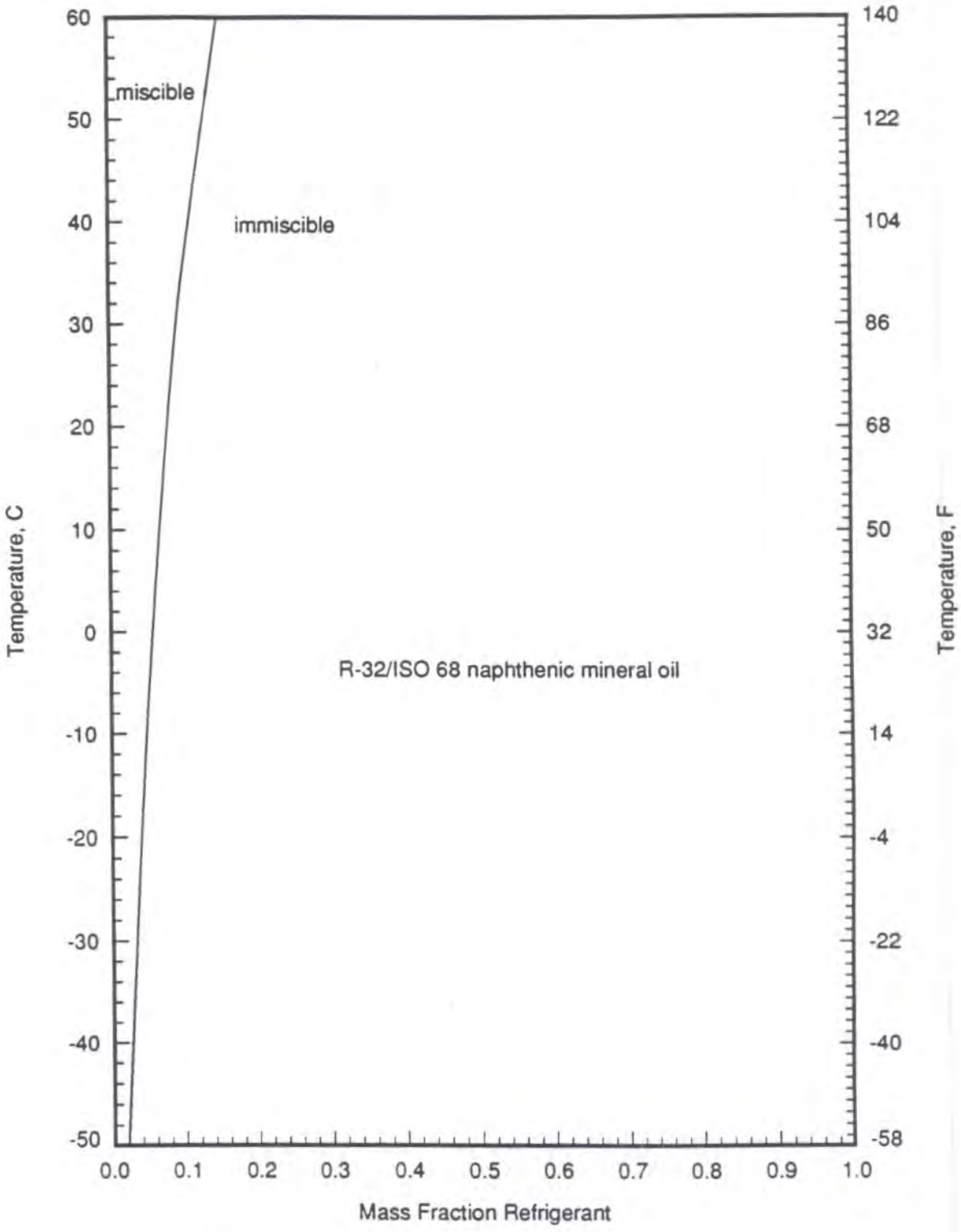

Figure 12 Miscibility plot for R-32/IS0 68 naphthenic mineral oil mixtures.

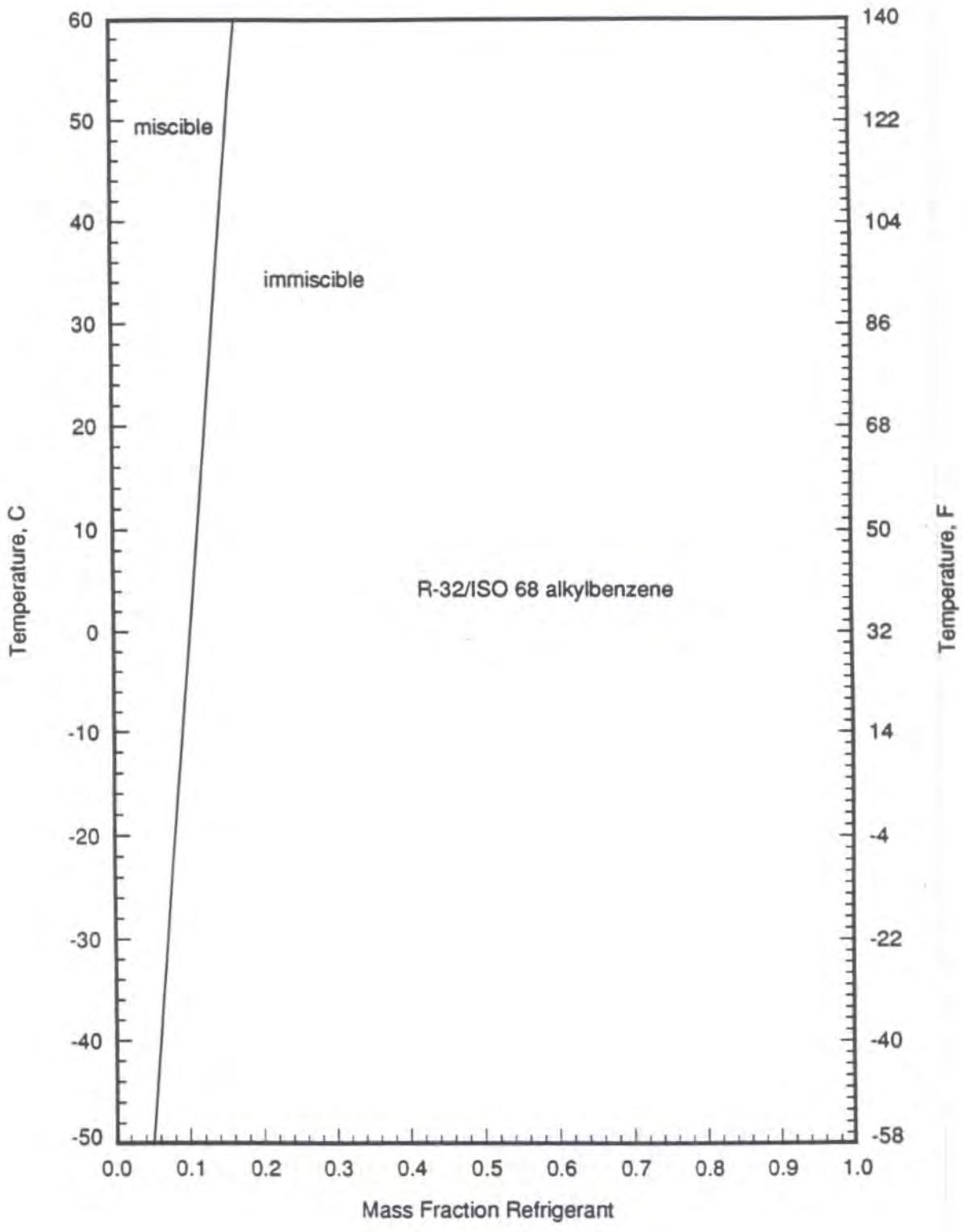

Figure 13 Miscibility plot for R-32/ISO 68 alkylbenzene mixtures.

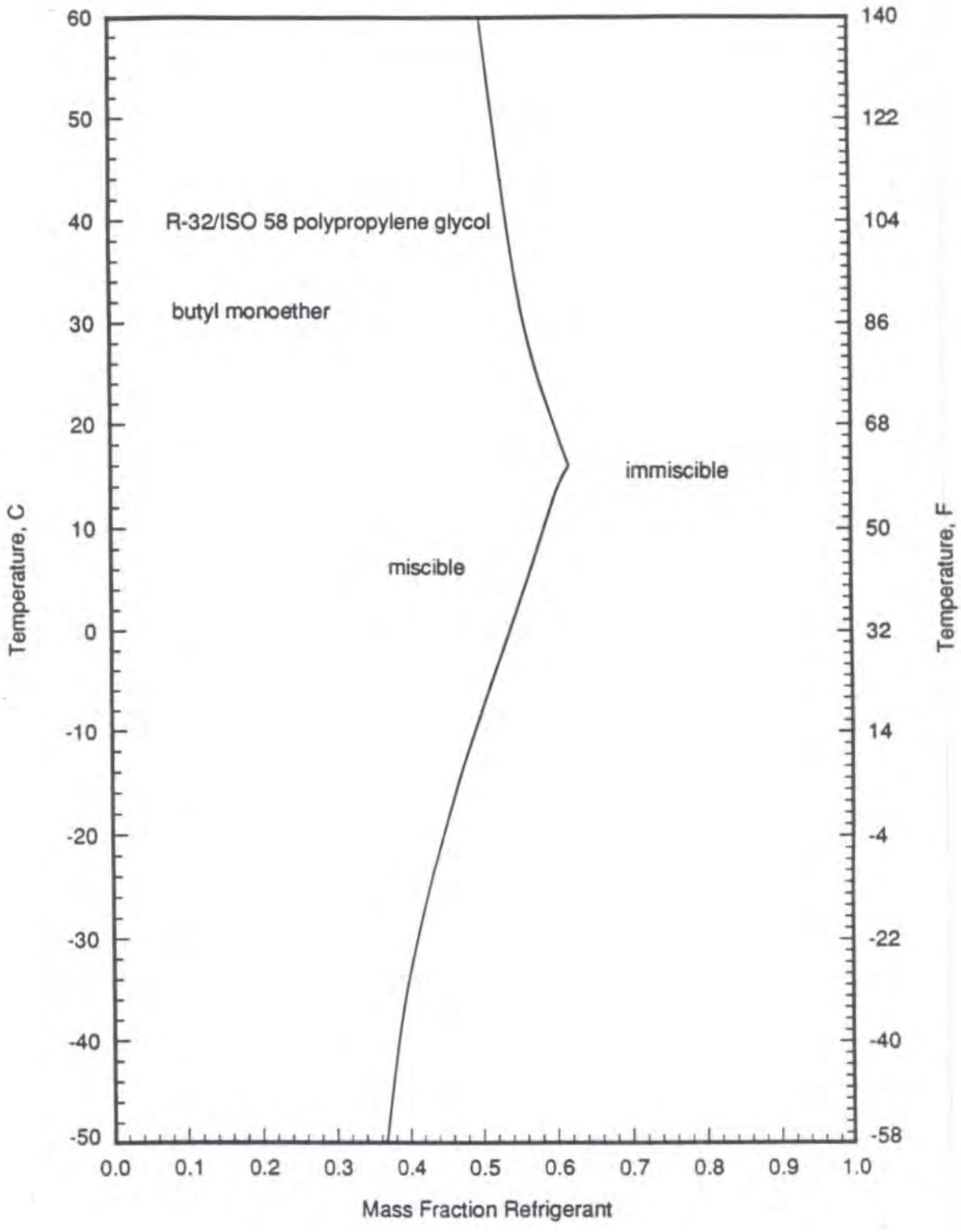

Figure 14 Miscibility plot for R-32/ISO 58 polypropylene glycol butyl monoether mixtures.

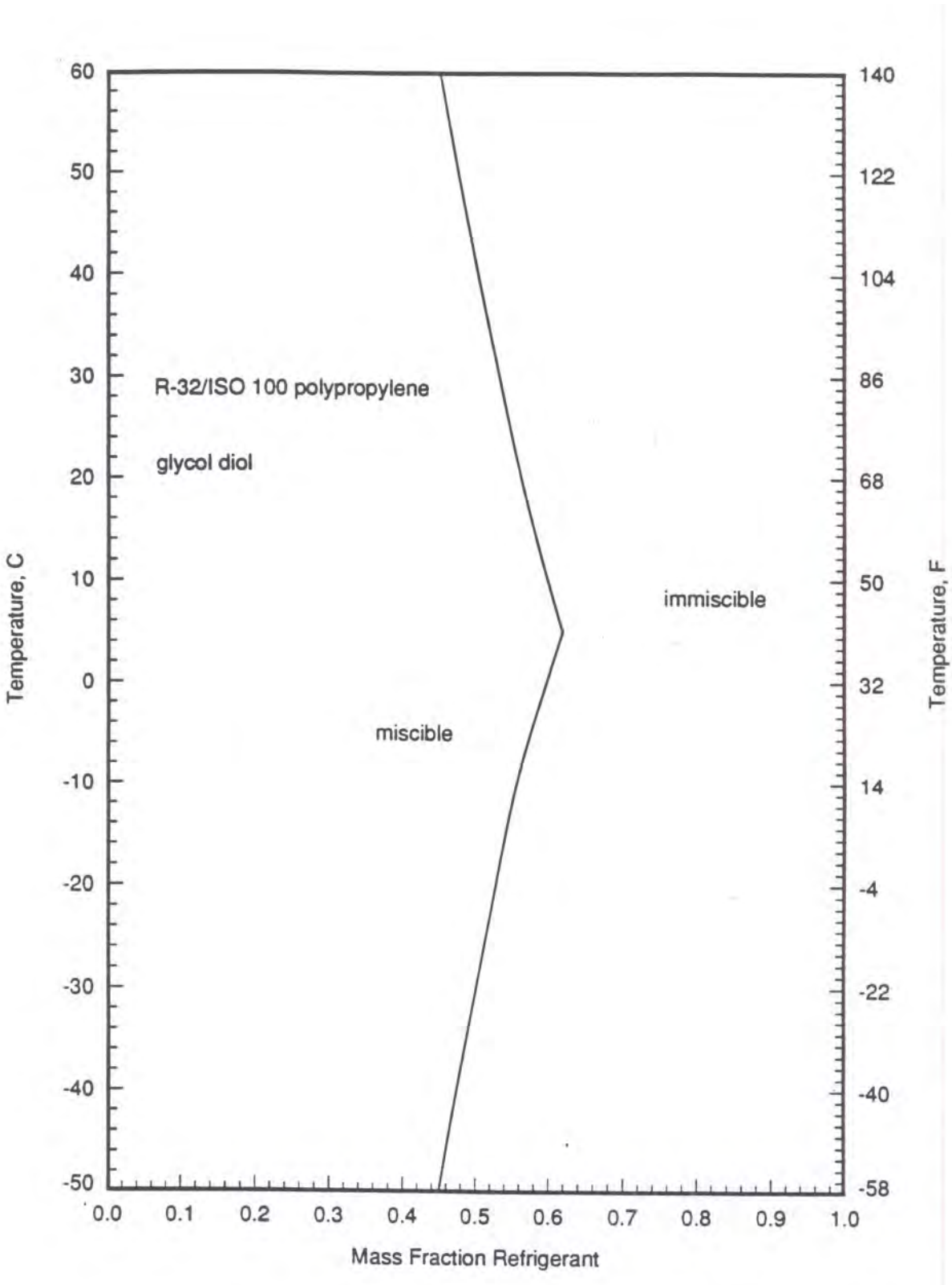

Figure 15 Miscibility plot for R-32/ISO 100 polypropylene glycol diol mixtures.

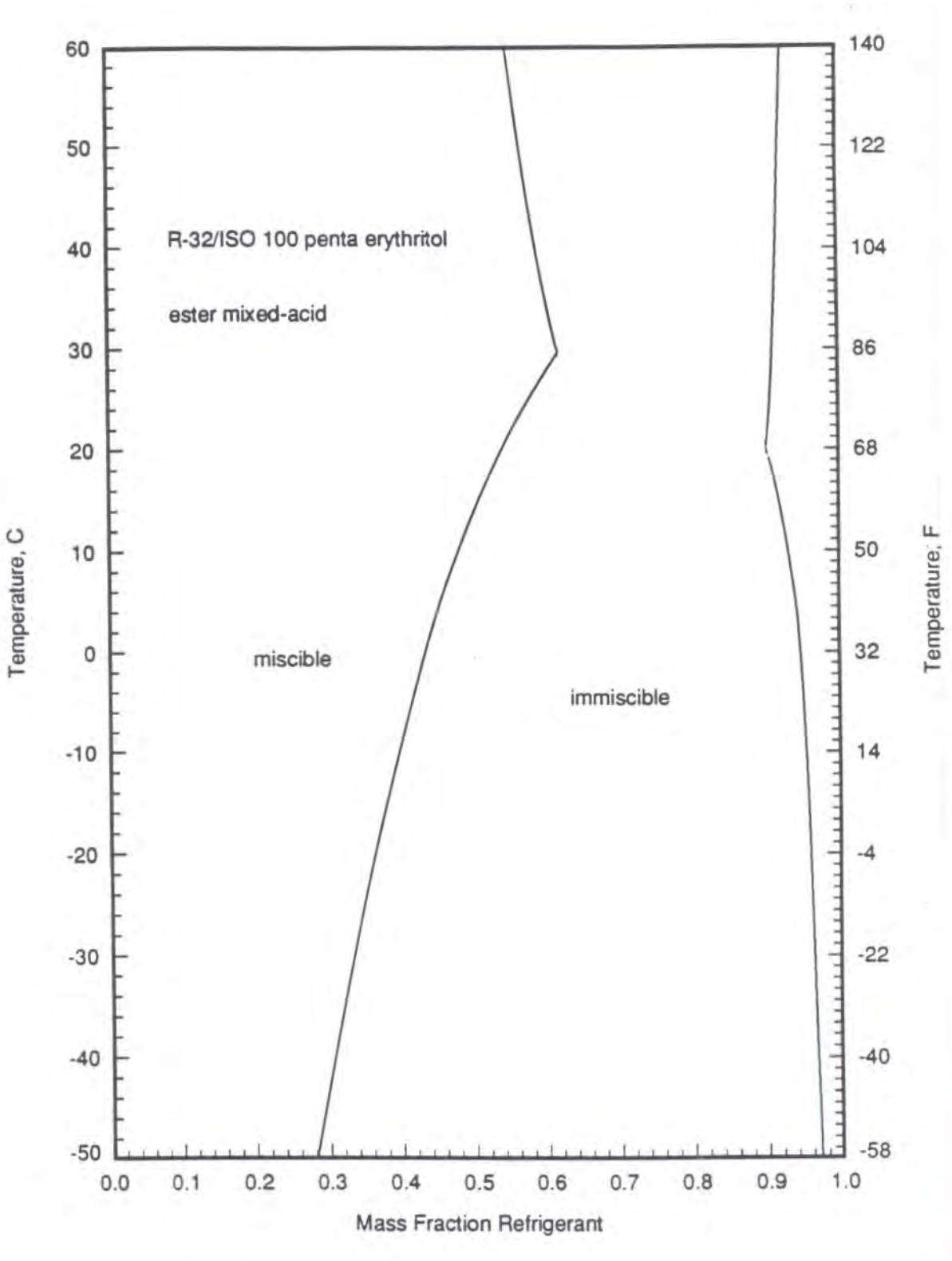

Figure 16 Miscibility plot for R-32/ISO 100 penta erythritol ester mixed-acid mixtures.

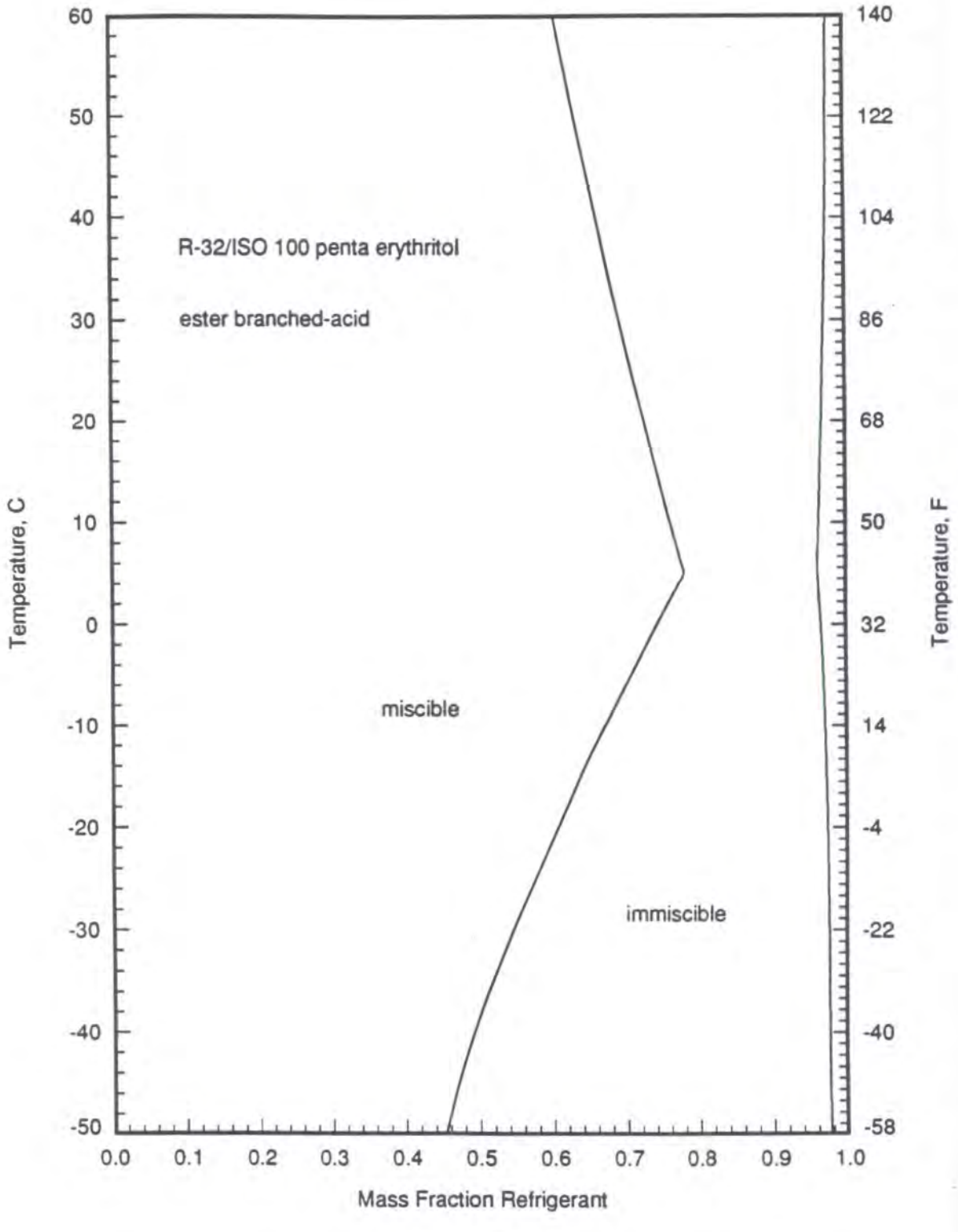

Figure 17 Miscibility plot for R-32/ISO 100 penta erythritol ester branched-acid mixtures.

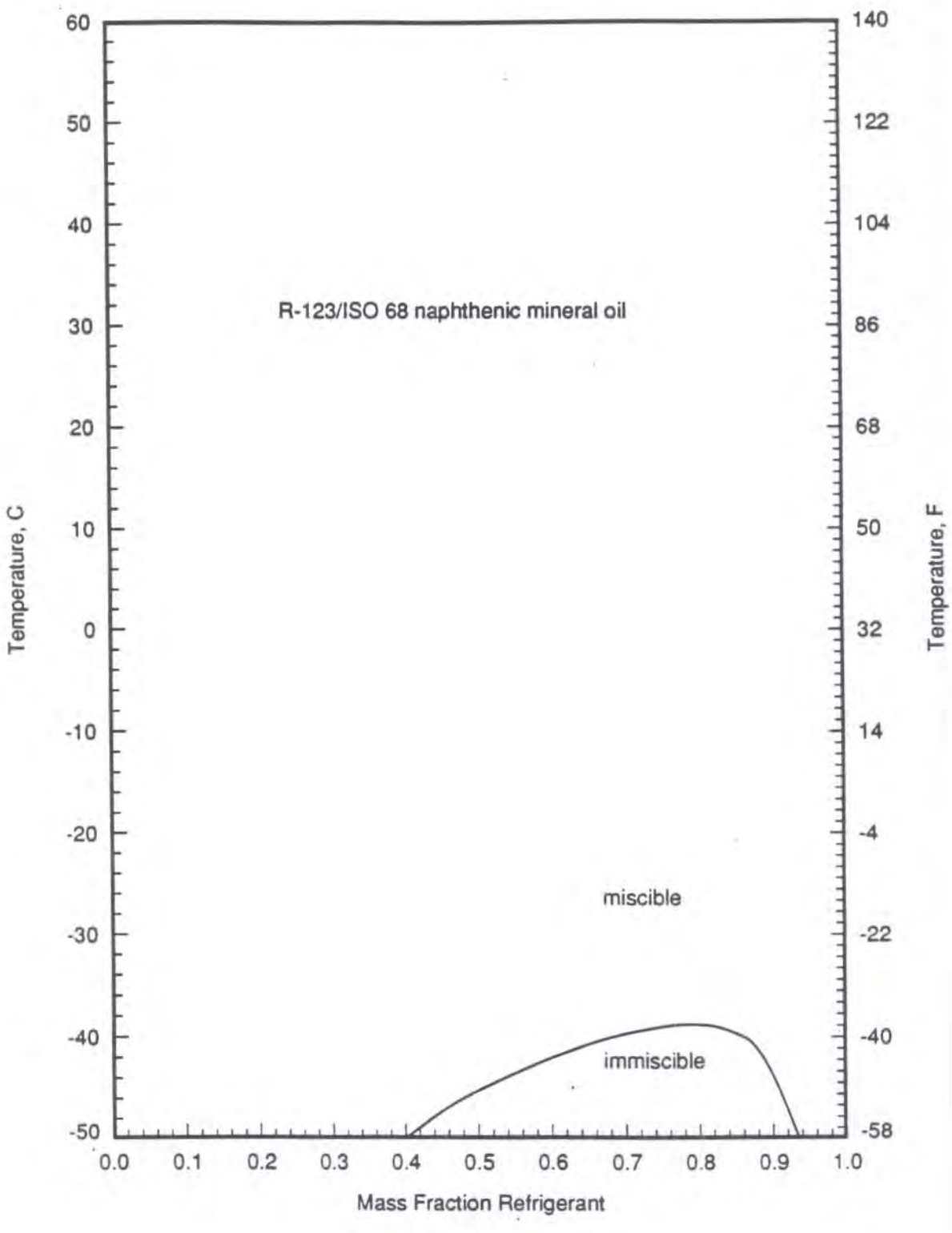

Figure 18 Miscibility plot for R-123/ISO 68 naphthenic mineral oil mixtures.

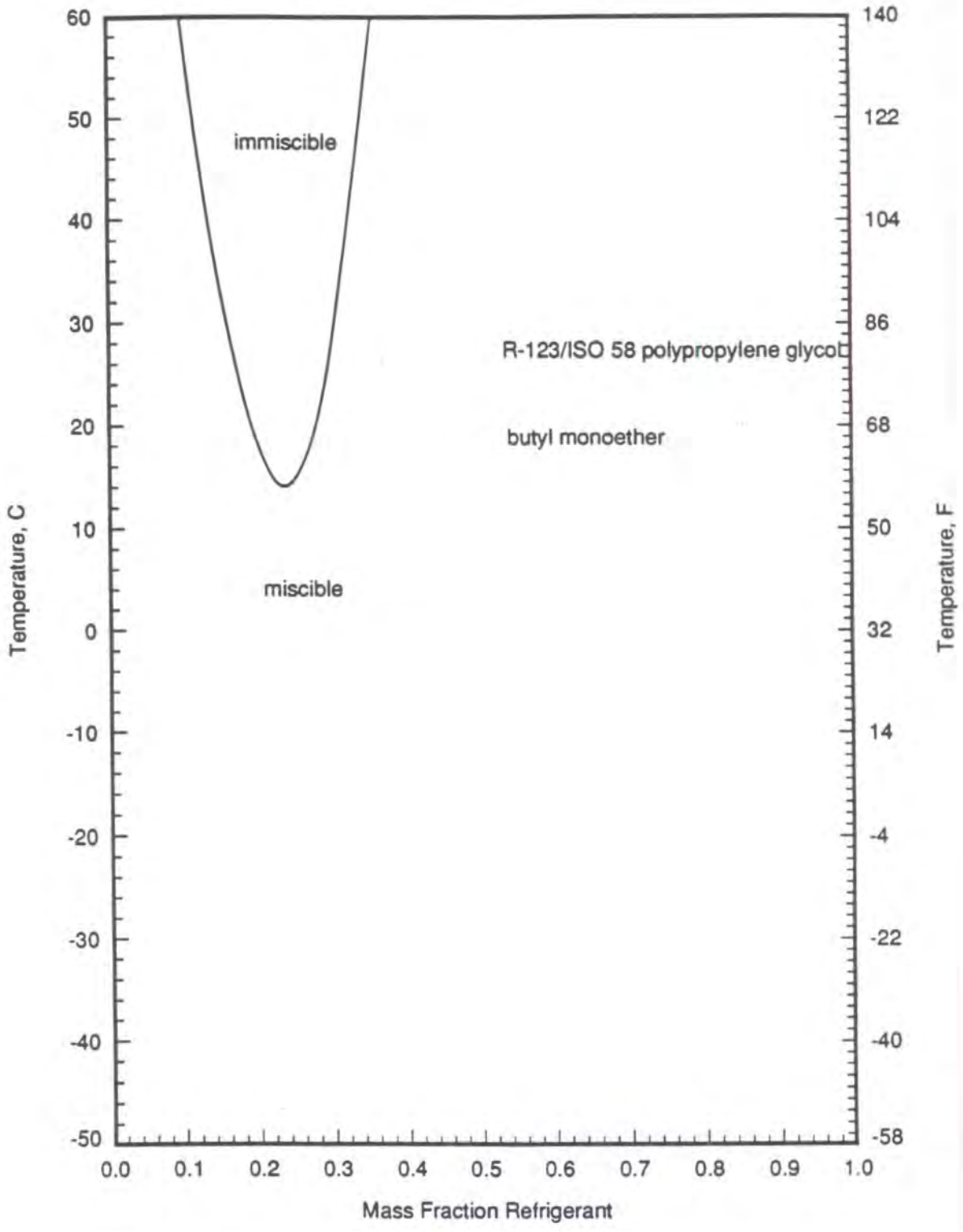

Figure 19 Miscibility plot for R-123/ISO 58 polypropylene glycol butyl monoether mixtures.

R-124

R-124 was found to be completely miscible over the temperature range -50°C to 90°C with the following lubricants:

- alkylbenzene (ISO 32)
- polypropylene glycol butyl monoether (ISO 32)
- polypropylene glycol diol (ISO 32)
- penta erythritol ester mixed-acid (ISO 22)
- penta erythritol ester mixed-acid (ISO 32)
- penta erythritol ester branched-acid (ISO 32)
- alkylbenzene (ISO 68)
- polypropylene glycol butyl monoether (ISO 58)
- polypropylene glycol diol (ISO 100)
- penta erythritol ester mixed-acid (ISO 100)
- penta erythritol ester branched-acid (ISO 100)

Figure 20 shows a miscibility plot for R-124 and the ISO 32 naphthenic mineral oil. Figure 21 shows a miscibility plot for R-124 and the ISO 32 modified polyglycol. Figure 22 shows a miscibility plot for R-124 and the ISO 68 naphthenic mineral oil.

R-125

R-125 was found to be completely miscible over the temperature range -50°C to 60°C with the following lubricants:

- polypropylene glycol diol (ISO 32)
- penta erythritol ester mixed-acid (ISO 22)
- penta erythritol ester mixed-acid (ISO 32)
- penta erythritol ester branched-acid (ISO 32)

Figure 23 shows a miscibility plot for R-125 and the ISO 32 naphthenic mineral oil. Figure 24 shows a miscibility plot for R-125 and the ISO 32 alkylbenzene. Figure 25 shows a miscibility plot for R-125 and the ISO 32 polypropylene glycol butyl monoether. Figure 26 shows a miscibility plot for R-125 and the ISO 32 modified polyglycol. Figure 27 shows a miscibility plot for R-125 and the ISO 68 naphthenic mineral oil. Figure 28 shows a miscibility plot for R-125 and the ISO 68 alkylbenzene. Figure 29 shows a miscibility plot for R-125 and the ISO 58 polypropylene glycol butyl monoether. Figure 30 shows a miscibility plot for R-125 and the ISO 100 polypropylene glycol diol. Figure 31 shows a miscibility plot for R-125 and the ISO 100 penta erythritol ester mixed-acid. Figure 32 shows a miscibility plot for R-125 and the ISO 100 penta erythritol ester branched-acid.

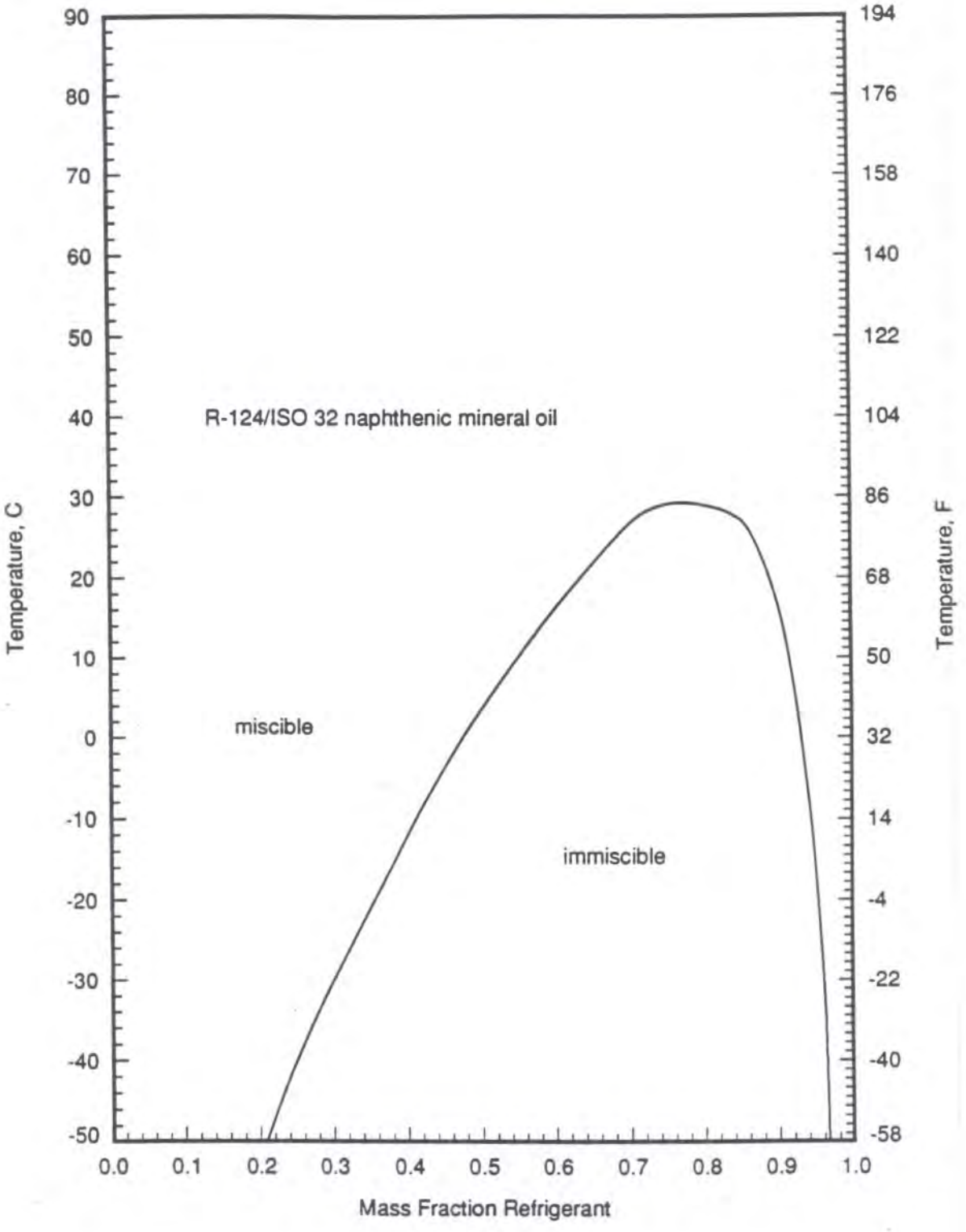

Figure 20 Miscibility plot for R-124/ISO 32 naphthenic mineral oil mixtures.

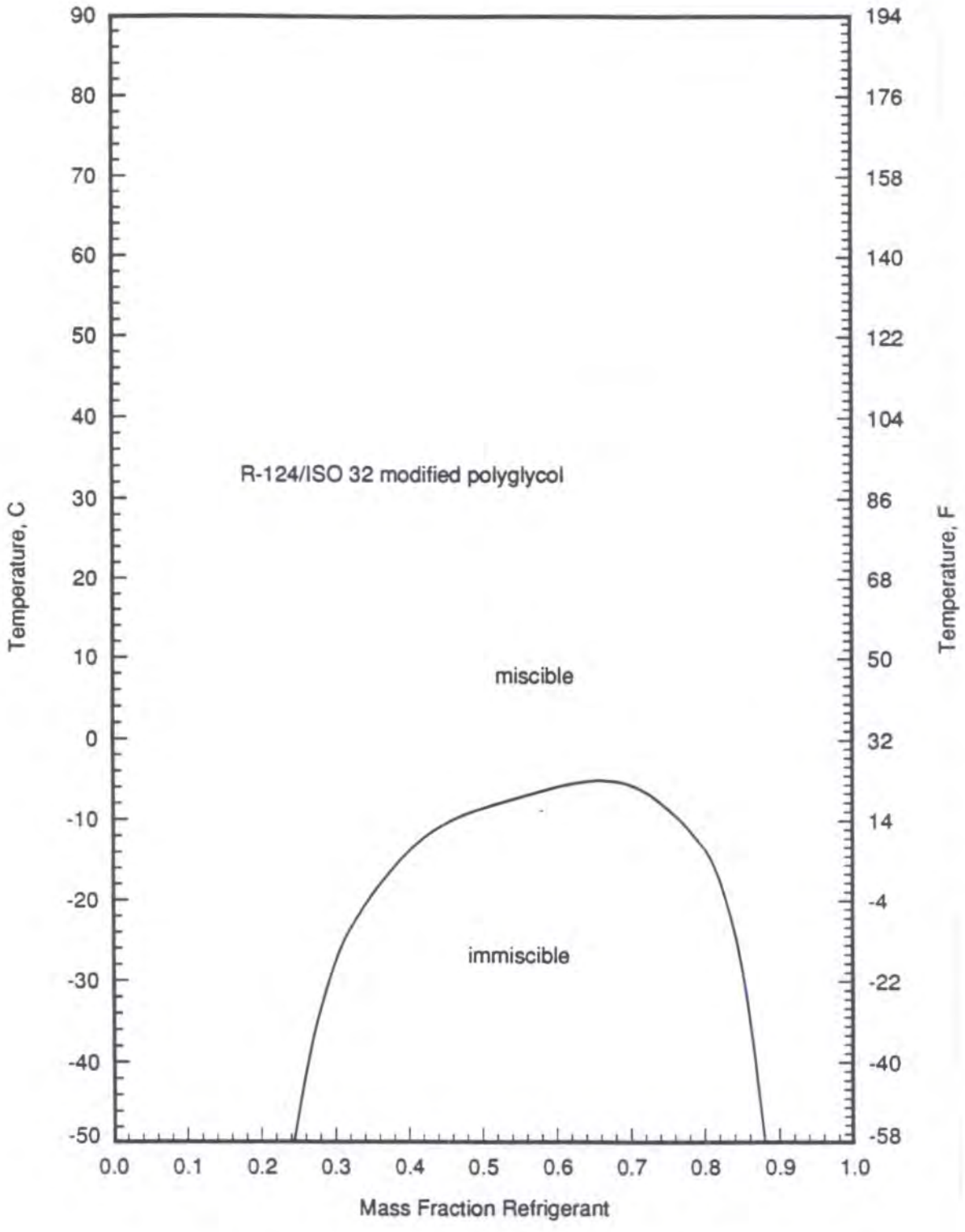

Figure 21 Miscibility plot for R-124/ISO 32 modified polyglycol mixtures.

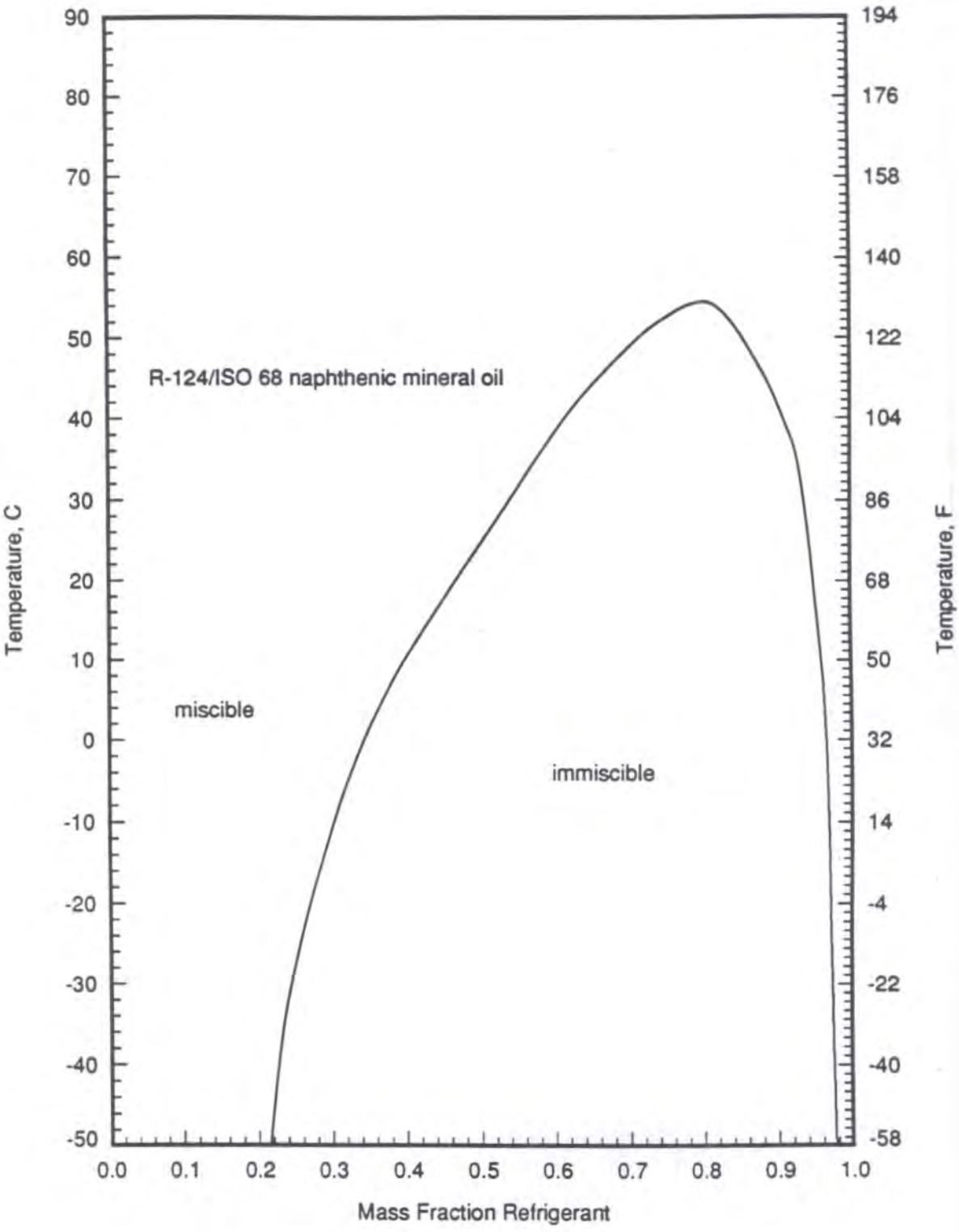

Figure 22 Miscibility plot for R-124/ISO 68 naphthenic mineral oil mixtures.

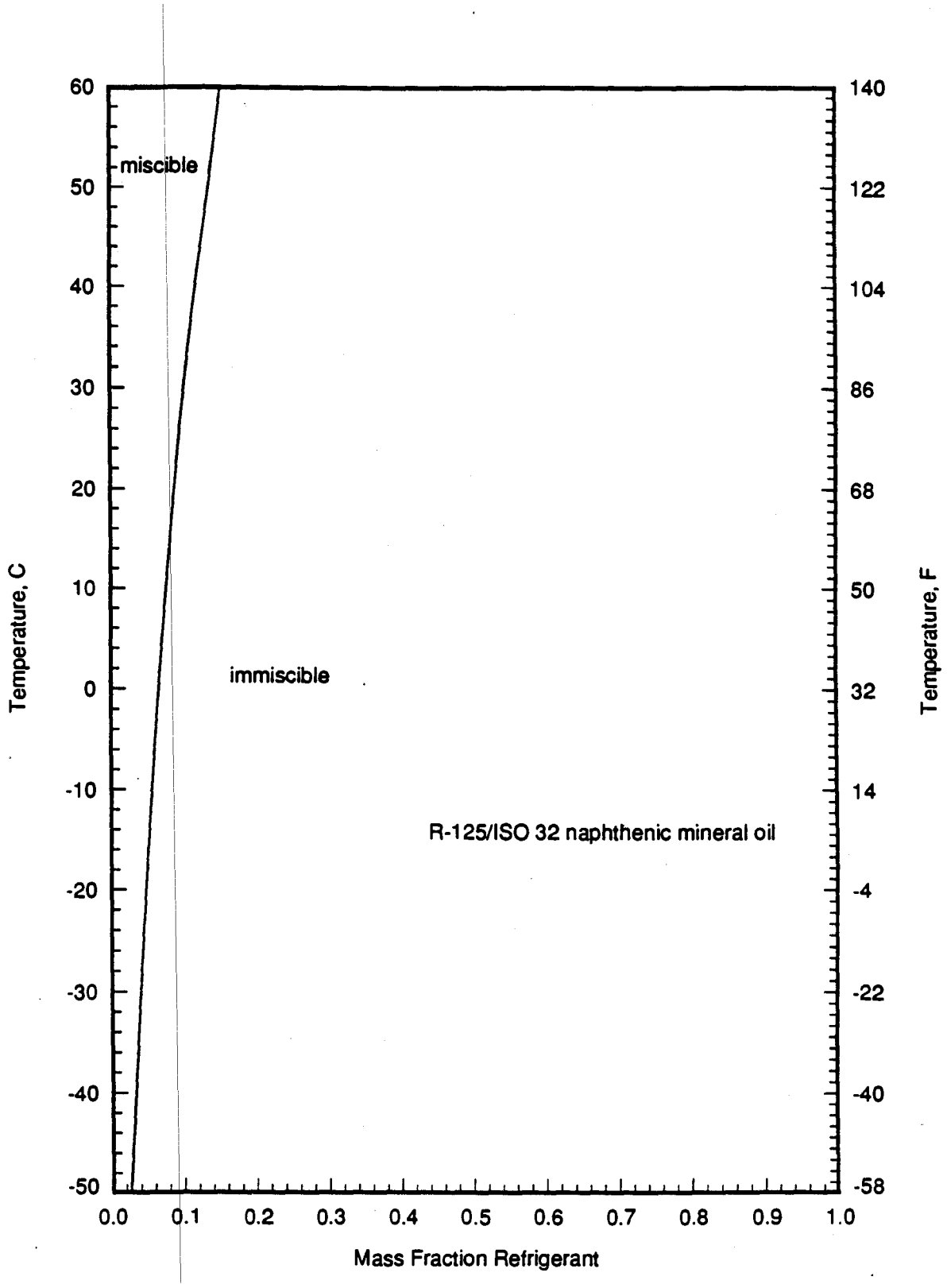

Figure 23 Miscibility plot for R-125/ISO 32 naphthenic mineral oil mixtures.

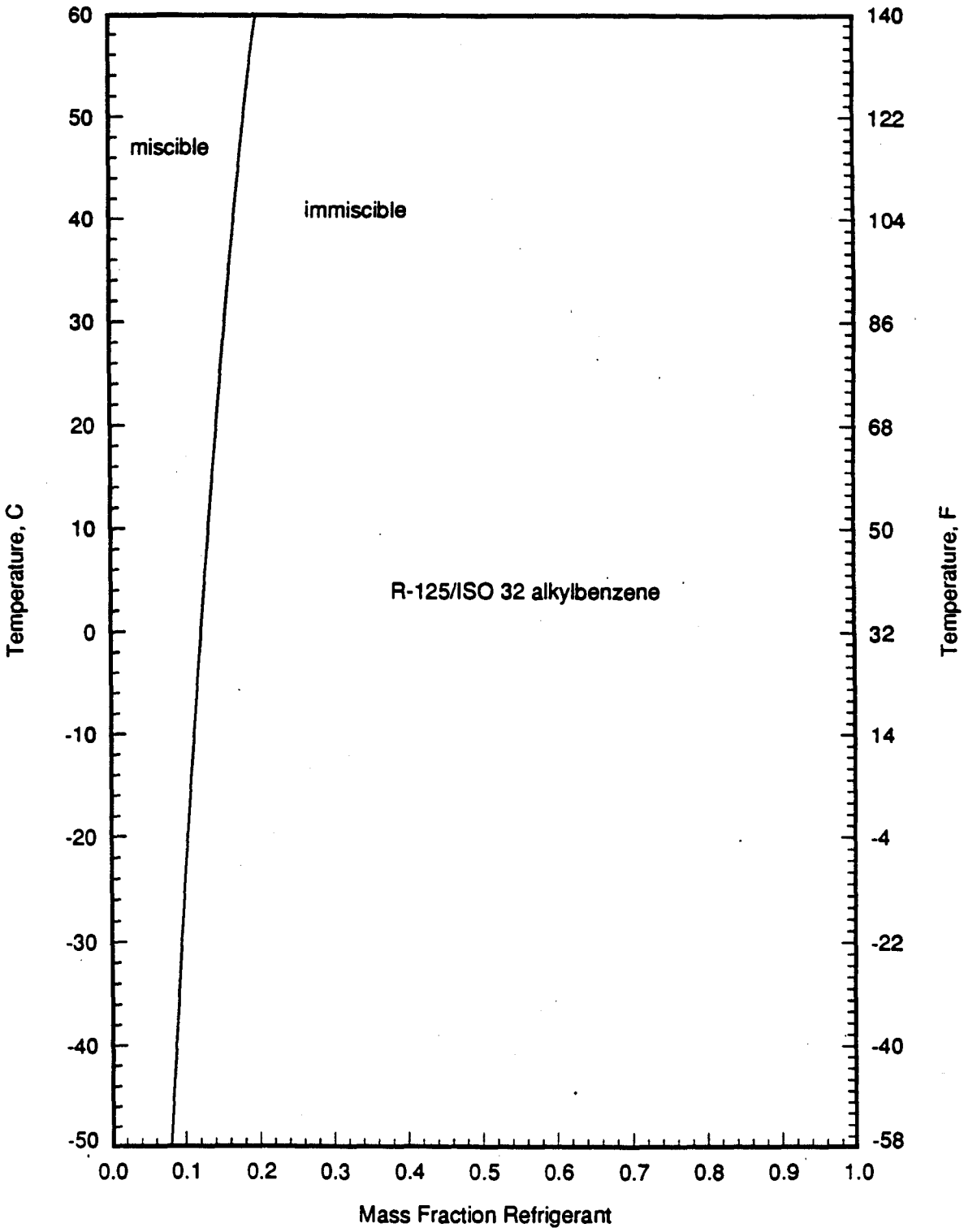

Figure 24 Miscibility plot for R-125/ISO 32 alkylbenzene mixtures.

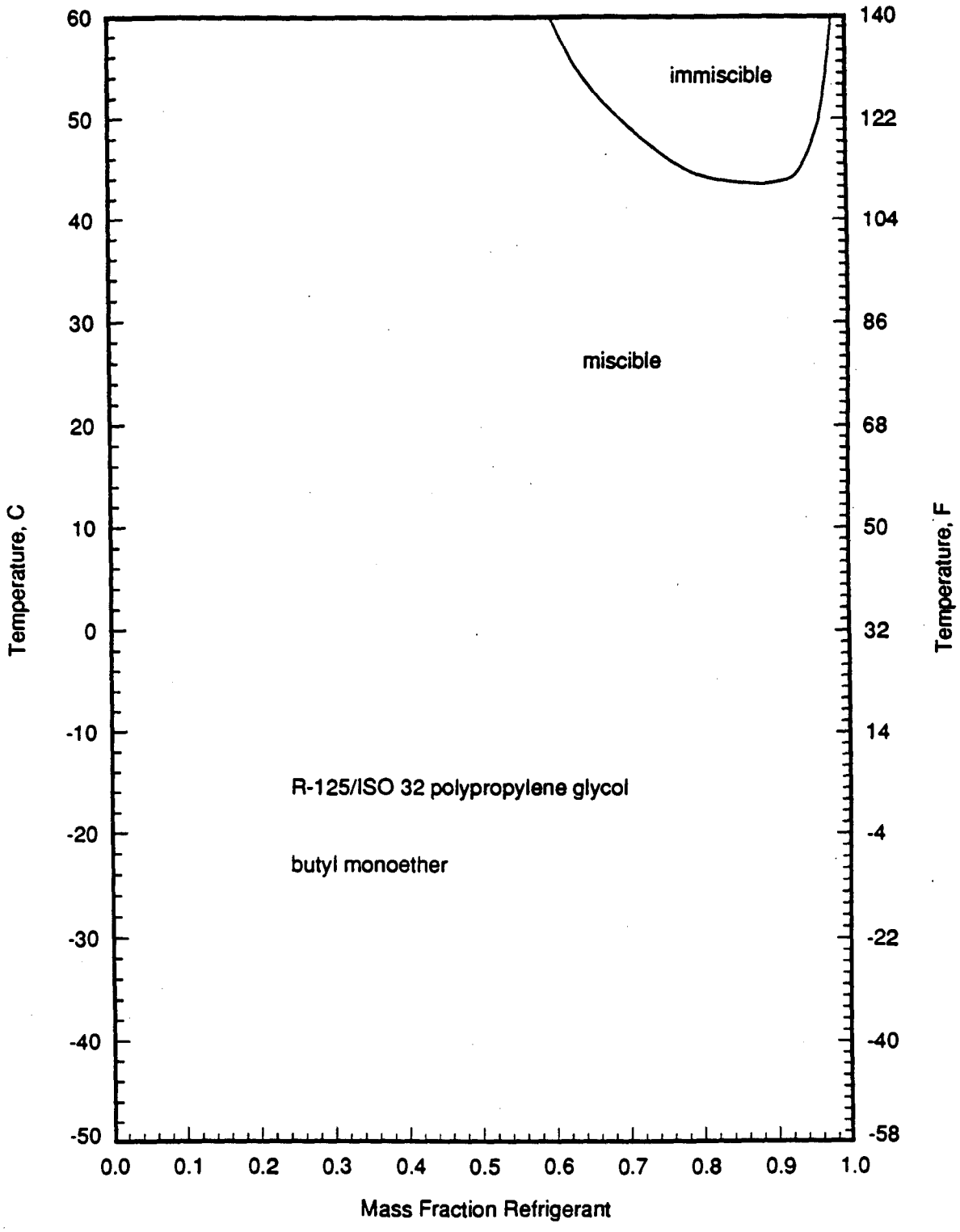

Figure 25 Miscibility plot for R-125/ISO 32 polypropylene glycol butyl monoether mixtures.

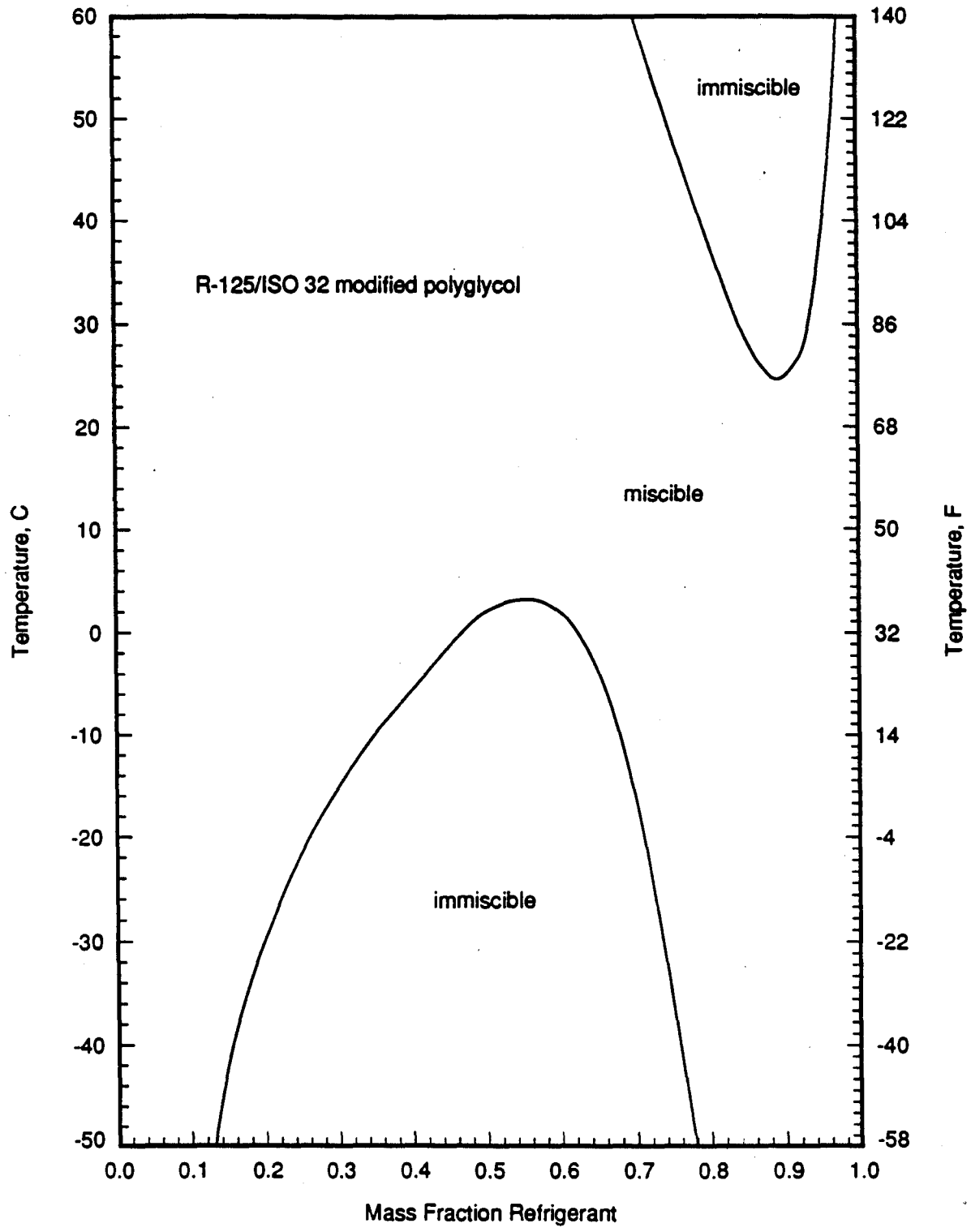

Figure 26 Miscibility plot for R-125/ISO 32 modified polyglycol mixtures.

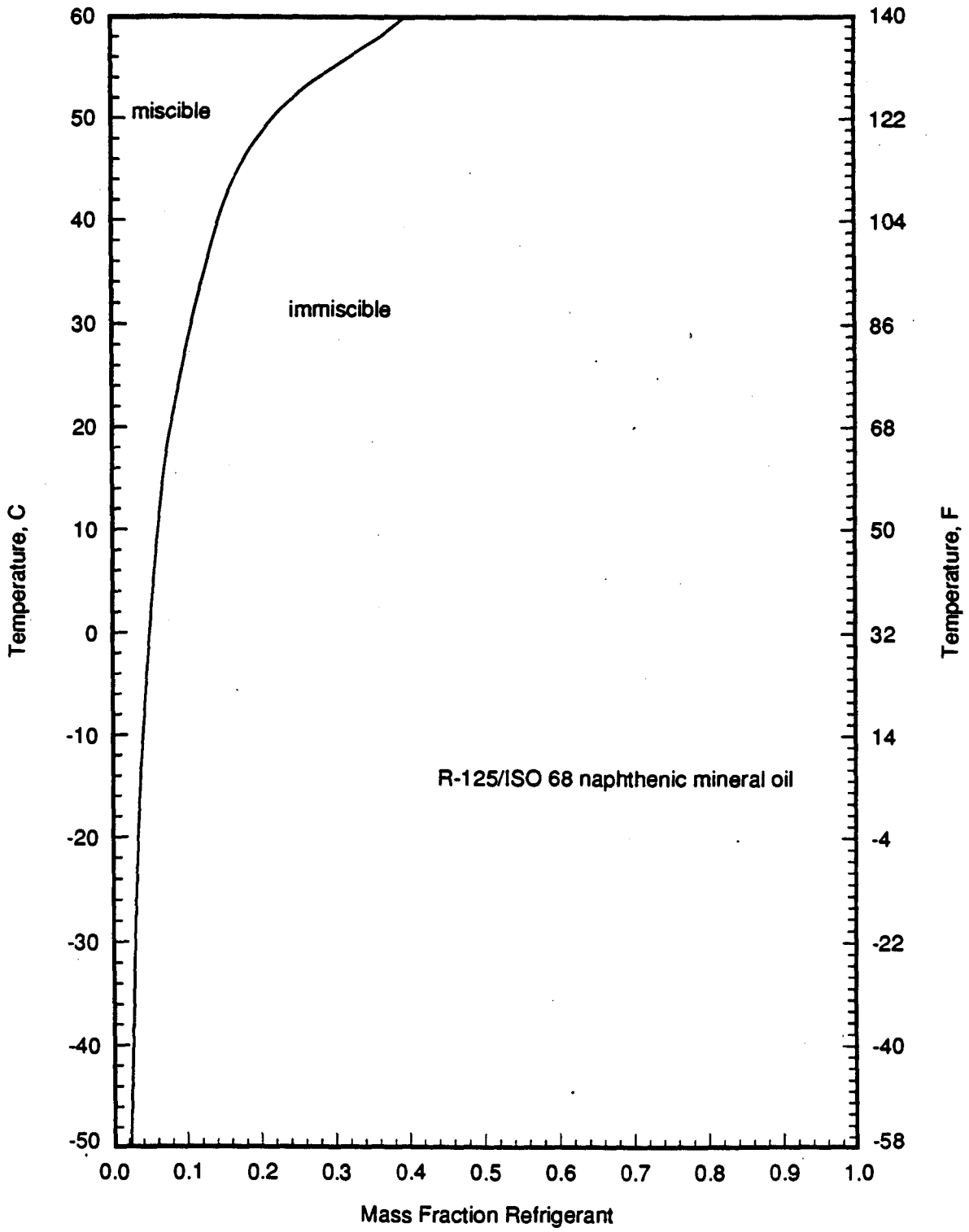

Figure 27 Miscibility plot for R-125/ISO 68 naphthenic mineral oil mixtures.

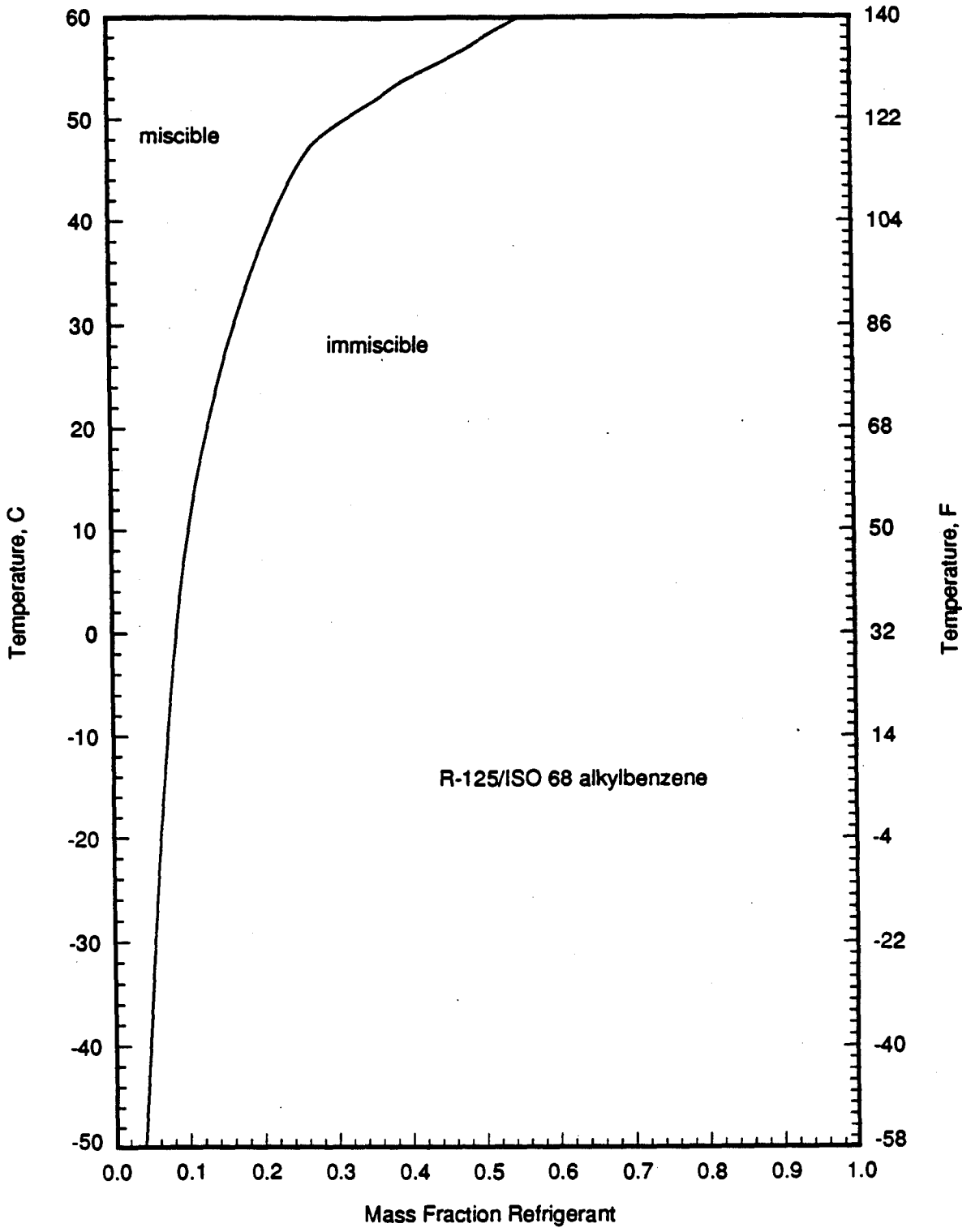

Figure 28 Miscibility plot for R-125/ISO 68 alkylbenzene mixtures.

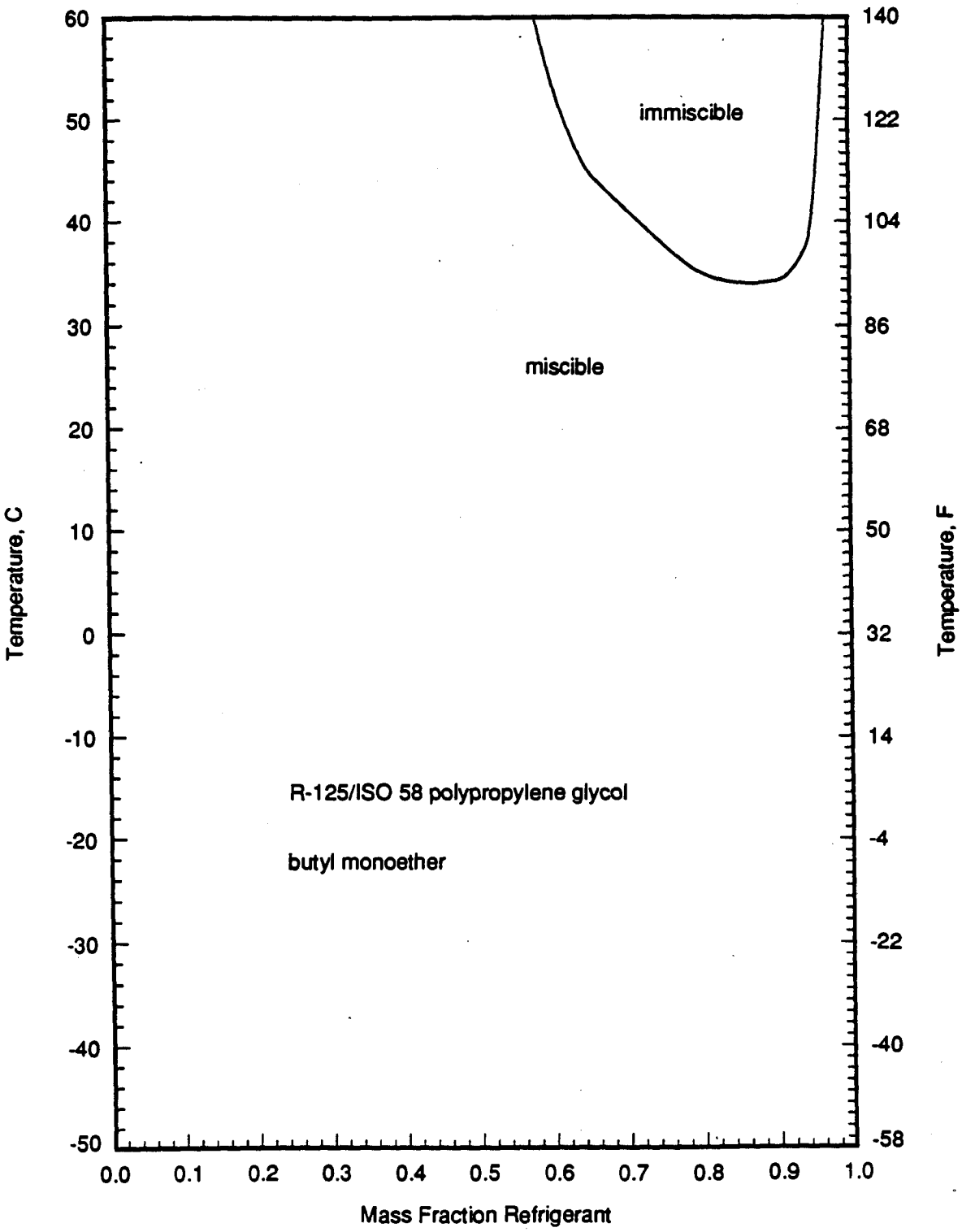

Figure 29 Miscibility plot for R-125/ISO 58 polypropylene glycol butyl monoether mixtures.

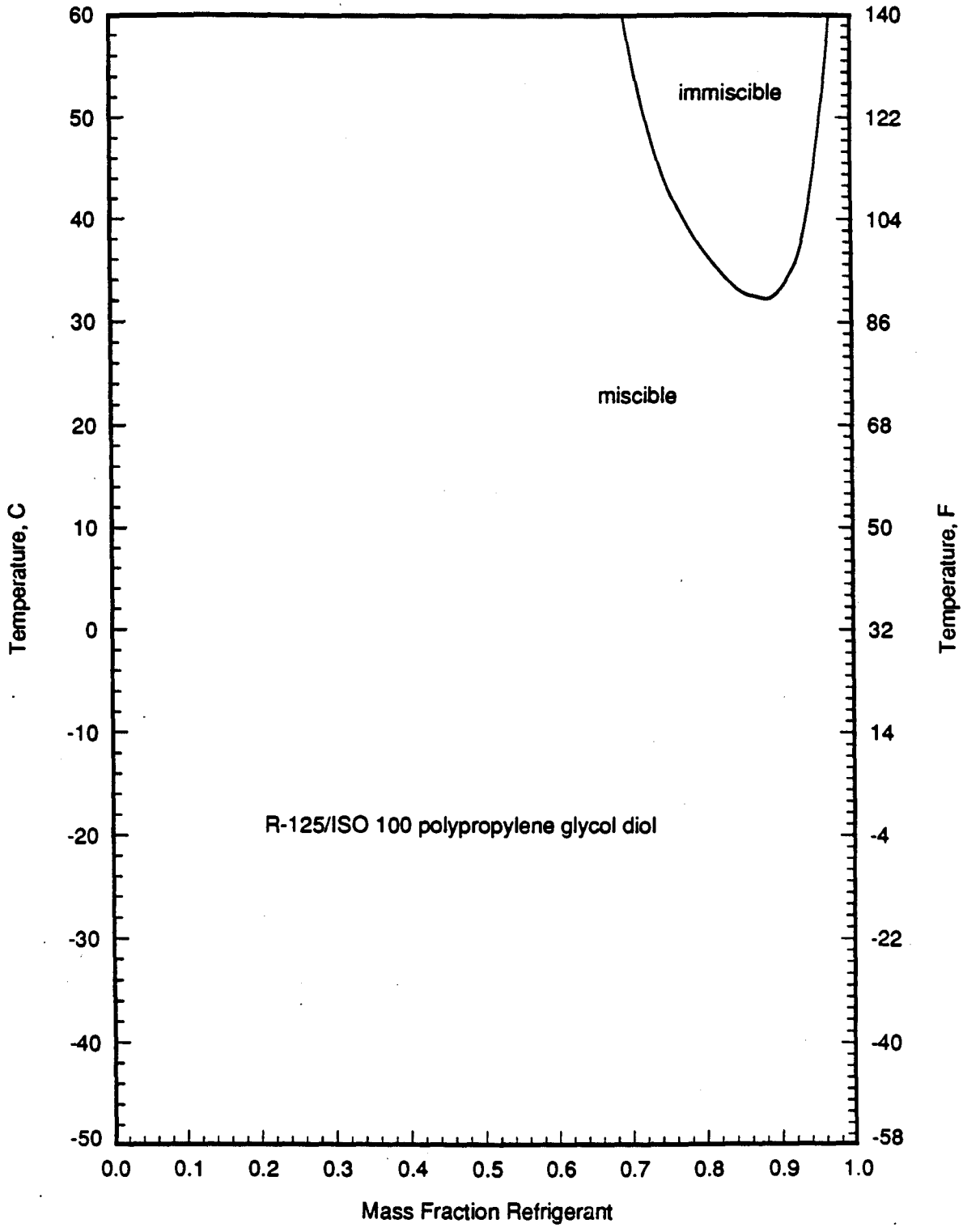

Figure 30 Miscibility plot for R-125/ISO 100 polypropylene glycol diol mixtures.

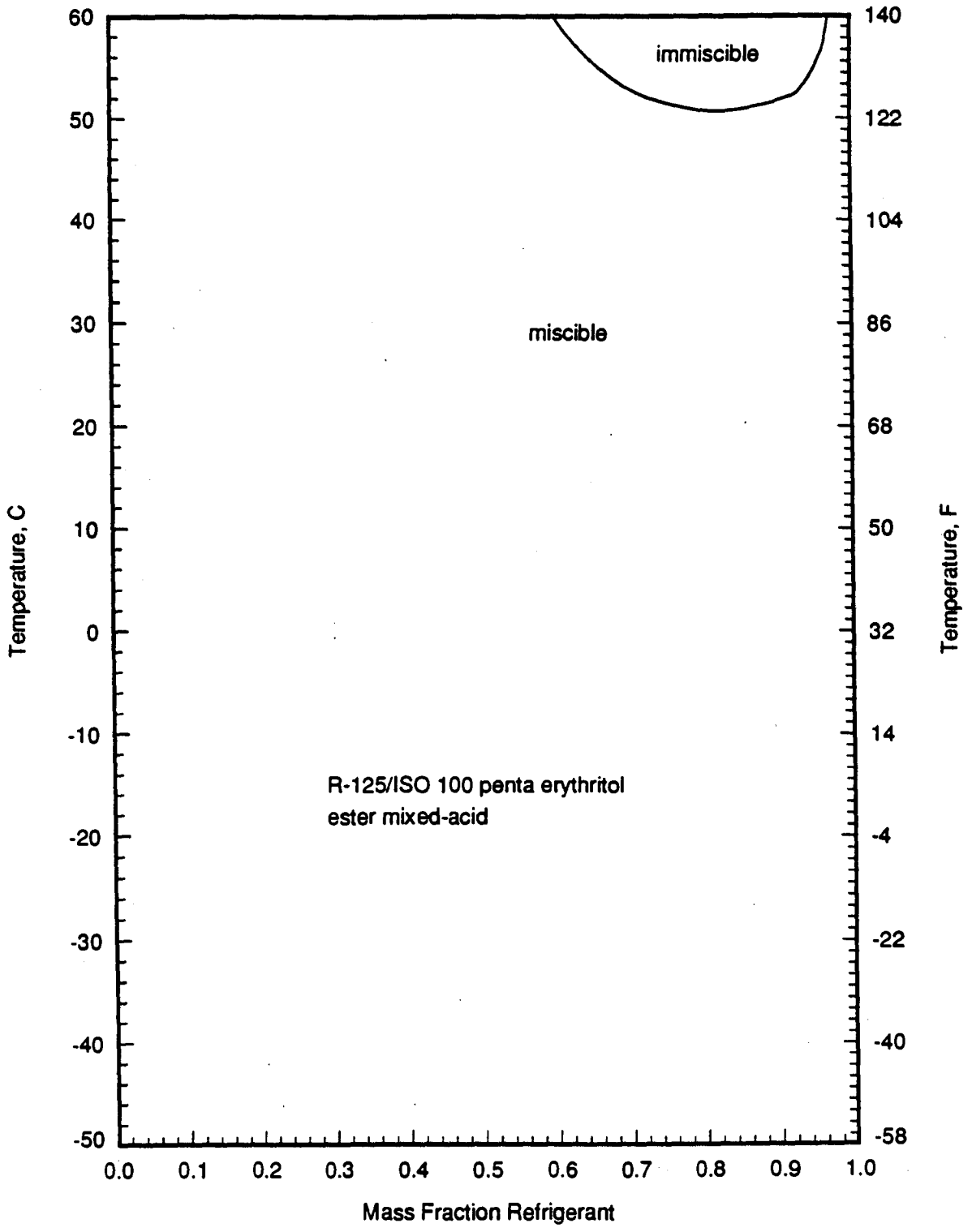

Figure 31 Miscibility plot for R-125/ISO 100 penta erythritol ester mixed-acid mixtures.

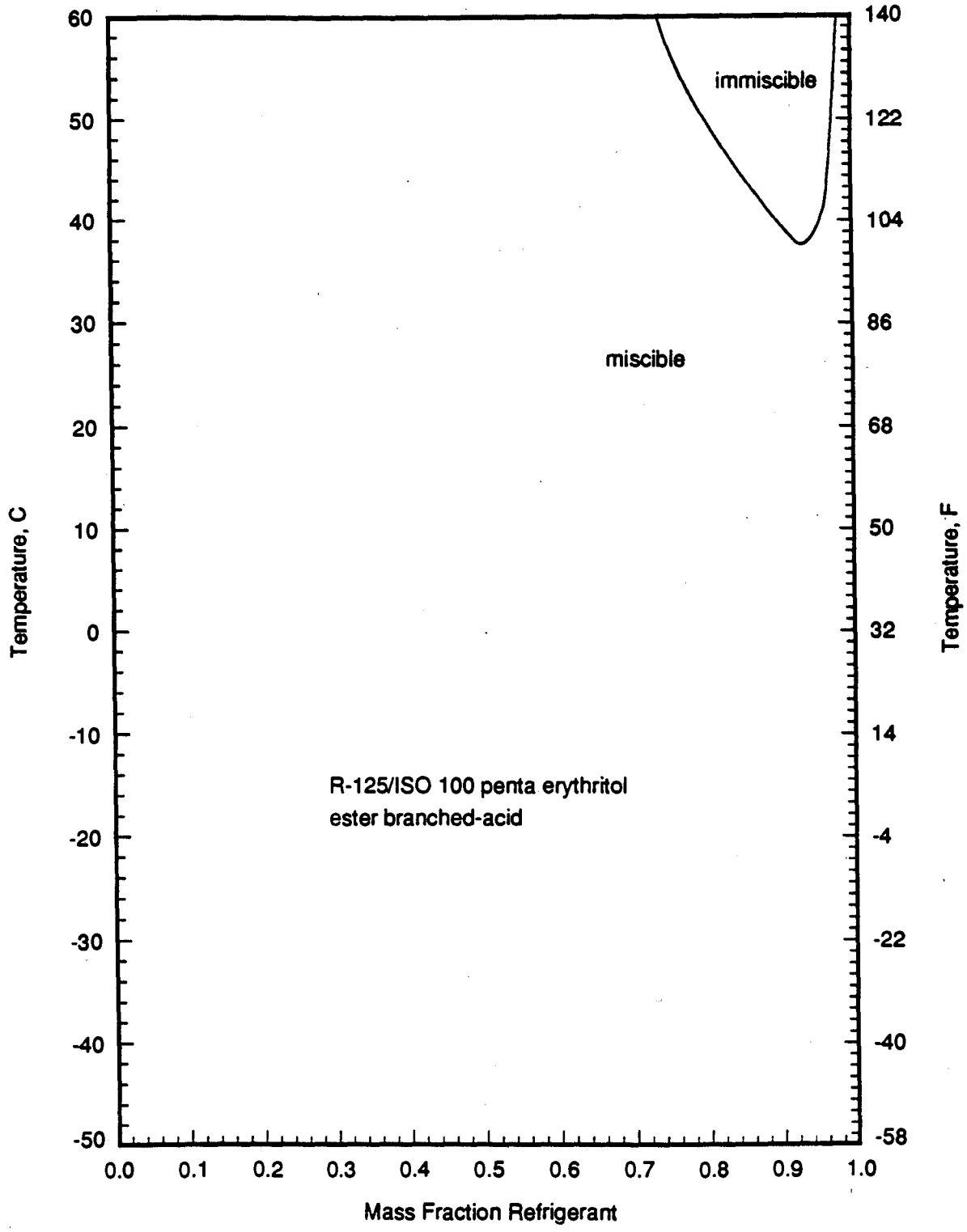

Figure 32 Miscibility plot for R-125/ISO 100 penta erythritol ester branched-acid mixtures.

R-134

R-134 was found to be completely miscible over the temperature range -50°C to 60°C with the following lubricants:

- polypropylene glycol diol (ISO 32)
- penta erythritol ester mixed-acid (ISO 22)
- penta erythritol ester mixed-acid (ISO 32)
- penta erythritol ester branched-acid (ISO 32)
- polypropylene glycol butyl monoether (ISO 58)
- polypropylene glycol diol (ISO 100)
- penta erythritol ester mixed-acid (ISO 100)
- penta erythritol ester branched-acid (ISO 100)

Figure 33 shows a miscibility plot for R-134 and the ISO 32 naphthenic mineral oil. Figure 34 shows a miscibility plot for R-134 and the ISO 32 alkylbenzene. Figure 35 shows a miscibility plot for R-134 and the ISO 32 polypropylene glycol butyl monoether. Figure 36 shows a miscibility plot for R-134 and the ISO 32 modified polyglycol. Figure 37 shows a miscibility plot for R-134 and the ISO 68 naphthenic mineral oil. Figure 38 shows a miscibility plot for R-134 and the ISO 68 alkylbenzene.

R-134a

R-134a was found to be completely miscible over the temperature range -50°C to 90°C with the following lubricants:

- polypropylene glycol diol (ISO 32)
- penta erythritol ester mixed-acid (ISO 32)
- penta erythritol ester branched-acid (ISO 32)

Figure 39 shows a miscibility plot for R-134a and the ISO 32 naphthenic mineral oil. Figure 40 shows a miscibility plot for R-134a and the ISO 32 alkylbenzene. Figure 41 shows a miscibility plot for R-134a and the ISO 32 polypropylene glycol butyl monoether. Figure 42 shows a miscibility plot for R-134a and the ISO 32 modified polyglycol. Figure 43 shows a miscibility plot for R-134a and the ISO 22 penta erythritol ester mixed-acid. Figure 44 shows a miscibility plot for R-134a and the ISO 68 naphthenic mineral oil. Figure 45 shows a miscibility plot for R-134a and the ISO 68 alkylbenzene. Figure 46 shows a miscibility plot for R-134a and the ISO 58 polypropylene glycol butyl monoether. Figure 47 shows a miscibility plot for R-134a and the ISO 100 polypropylene glycol diol. Figure 48 shows a miscibility plot for R-134a and the ISO 100 penta erythritol ester mixed-acid. Figure 49 shows a miscibility plot for R-134a and the ISO 100 penta erythritol ester branched-acid.

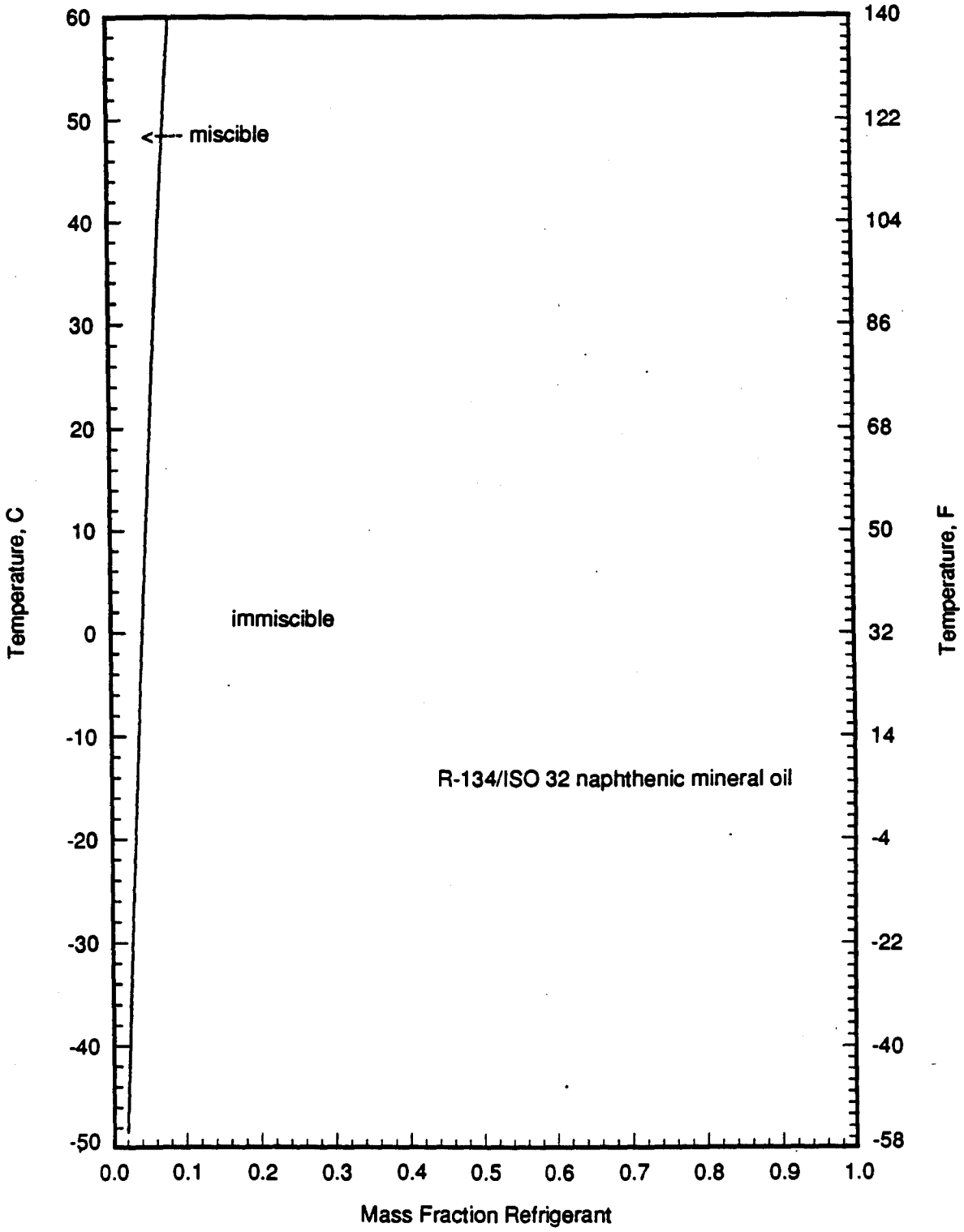

Figure 33 Miscibility plot for R-134/ISO 32 naphthenic mineral oil mixtures.

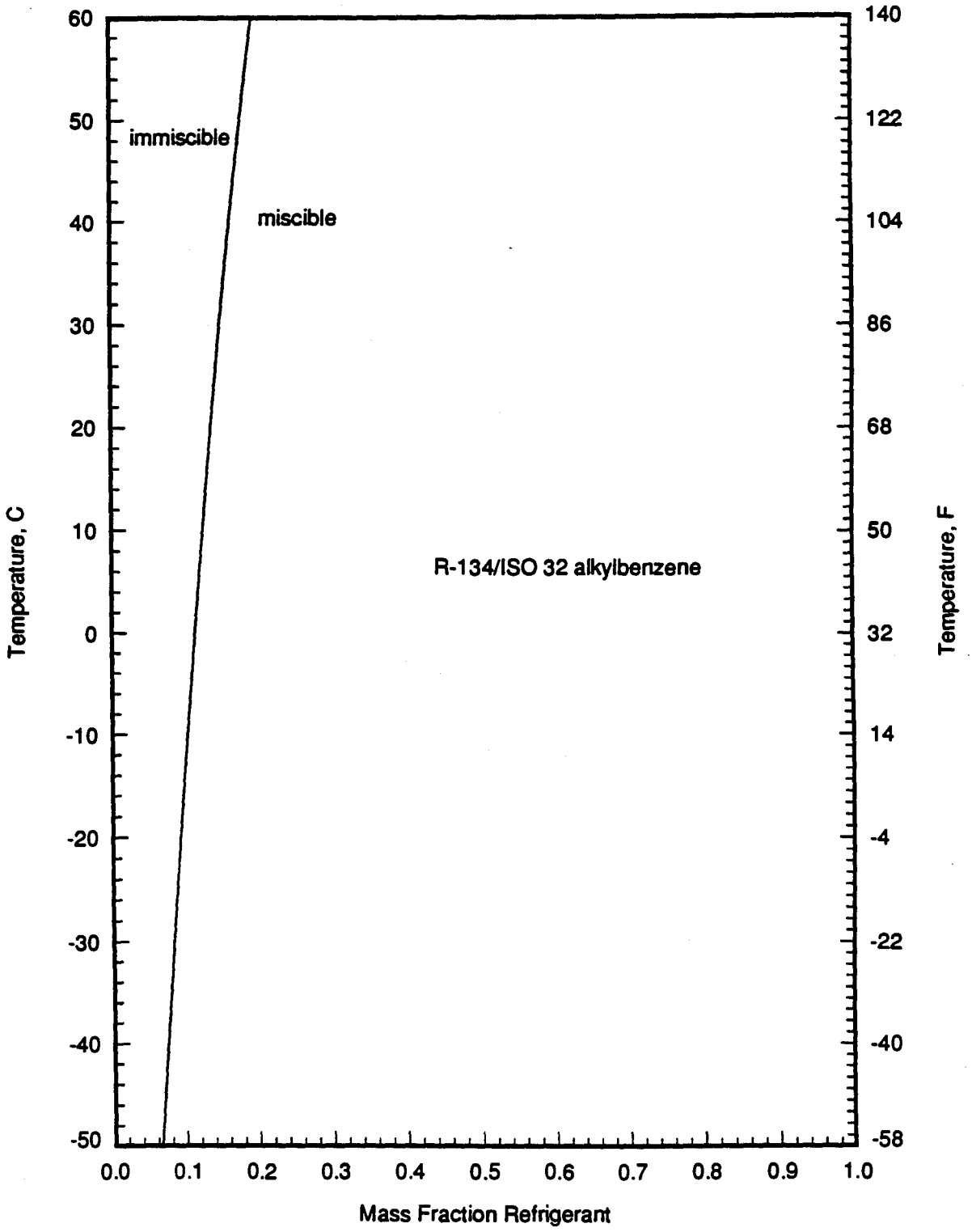

Figure 34 Miscibility plot for R-134/ISO 32 alkylbenzene mixtures.

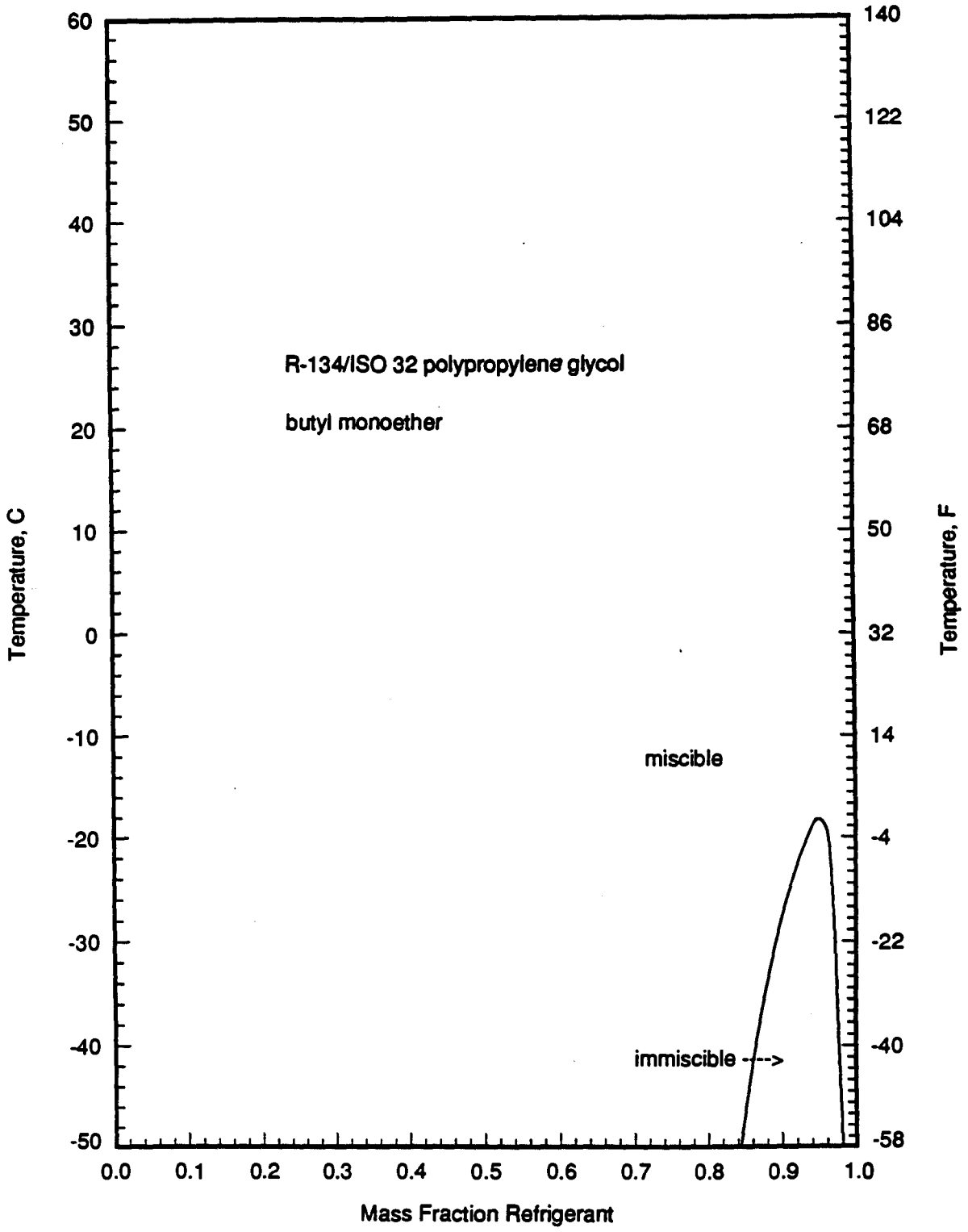

Figure 35 Miscibility plot for R-134/ISO 32 polypropylene glycol butyl monoether mixtures.

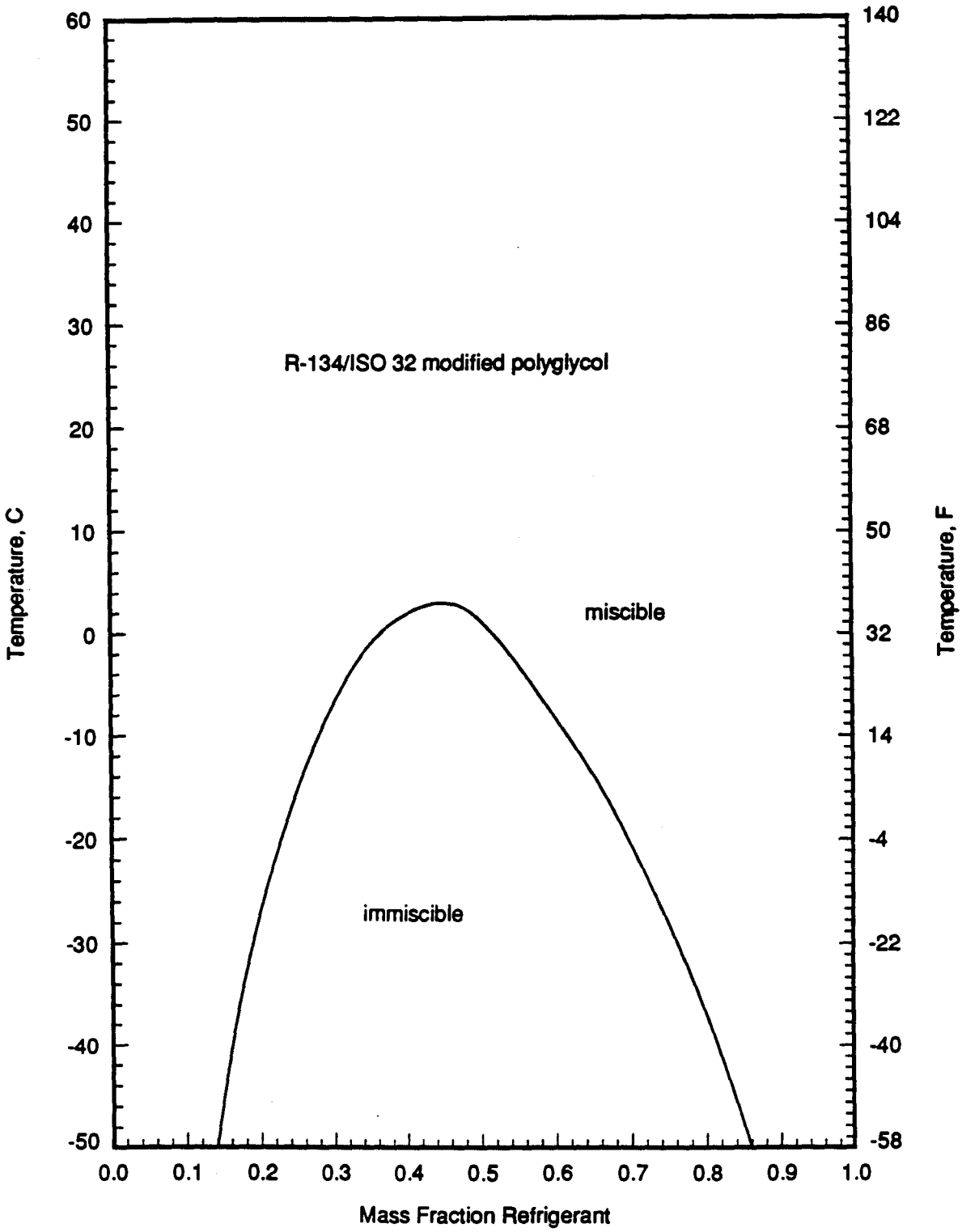

Figure 36 Miscibility plot for R-134/ISO 32 modified polyglycol mixtures.

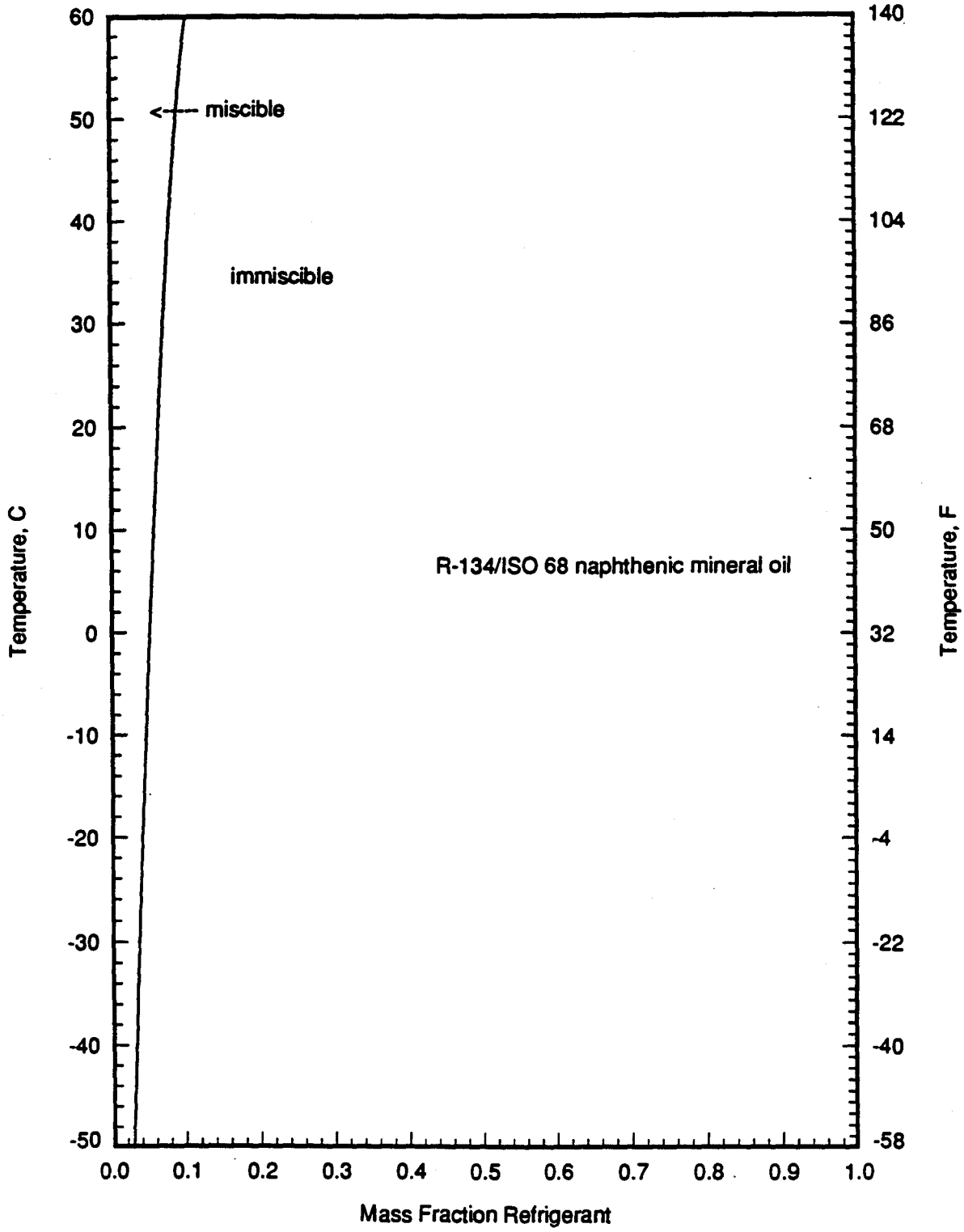

Figure 37 Miscibility plot for R-134/ISO 68 naphthenic mineral oil mixtures.

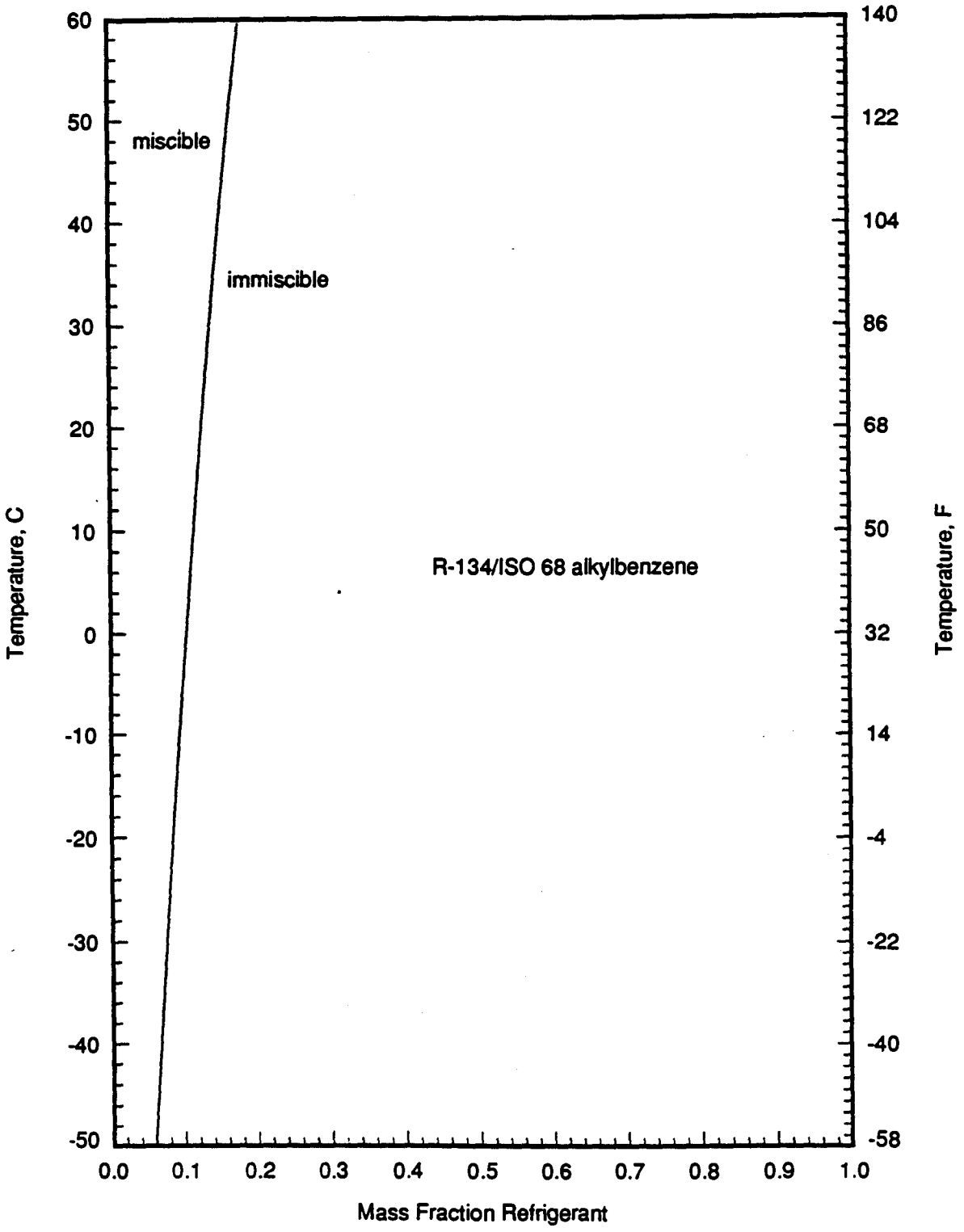

Figure 38 Miscibility plot for R-134/ISO 68 alkylbenzene mixtures.

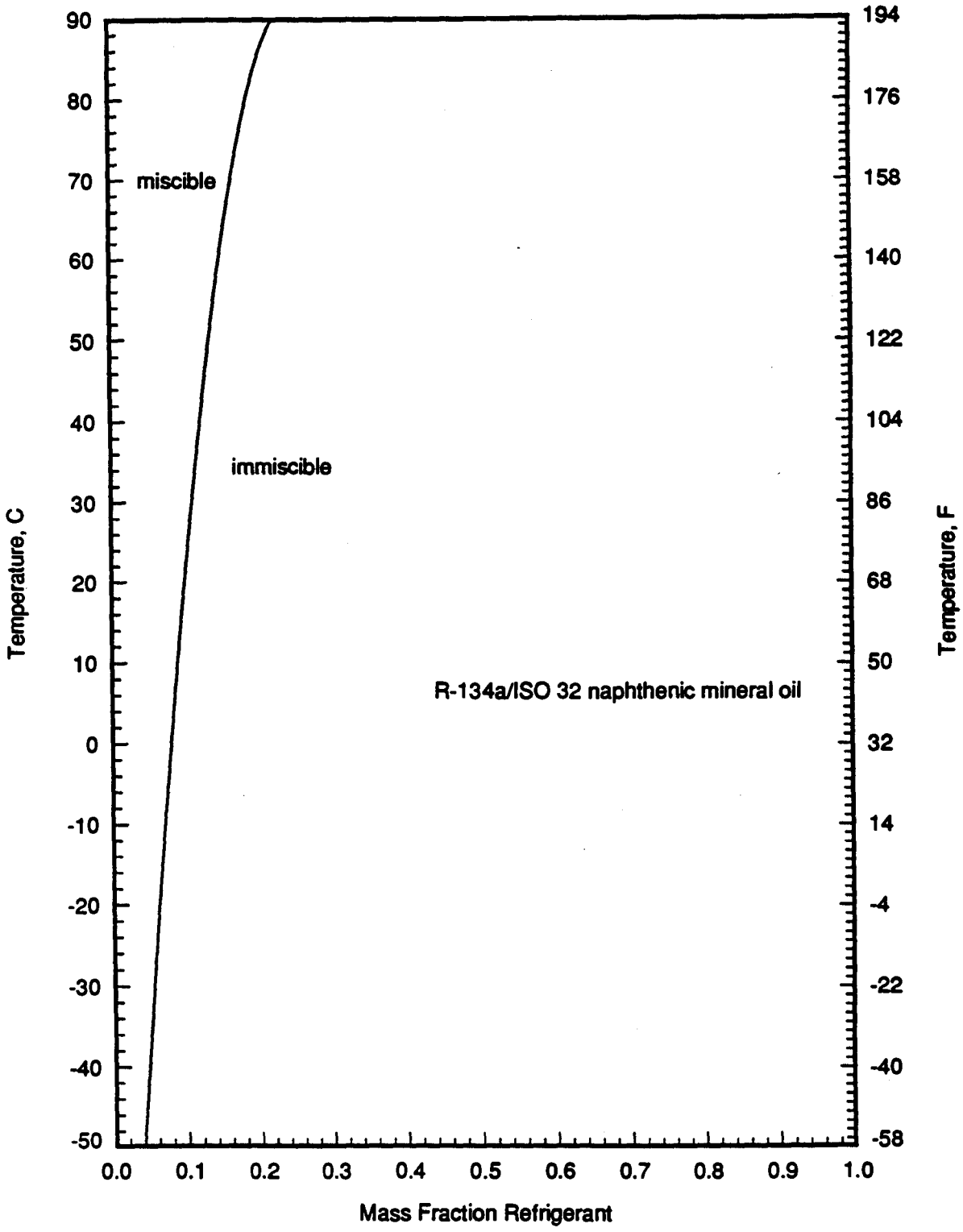

Figure 39 Miscibility plot for R-134a/ISO 32 naphthenic mineral oil mixtures.

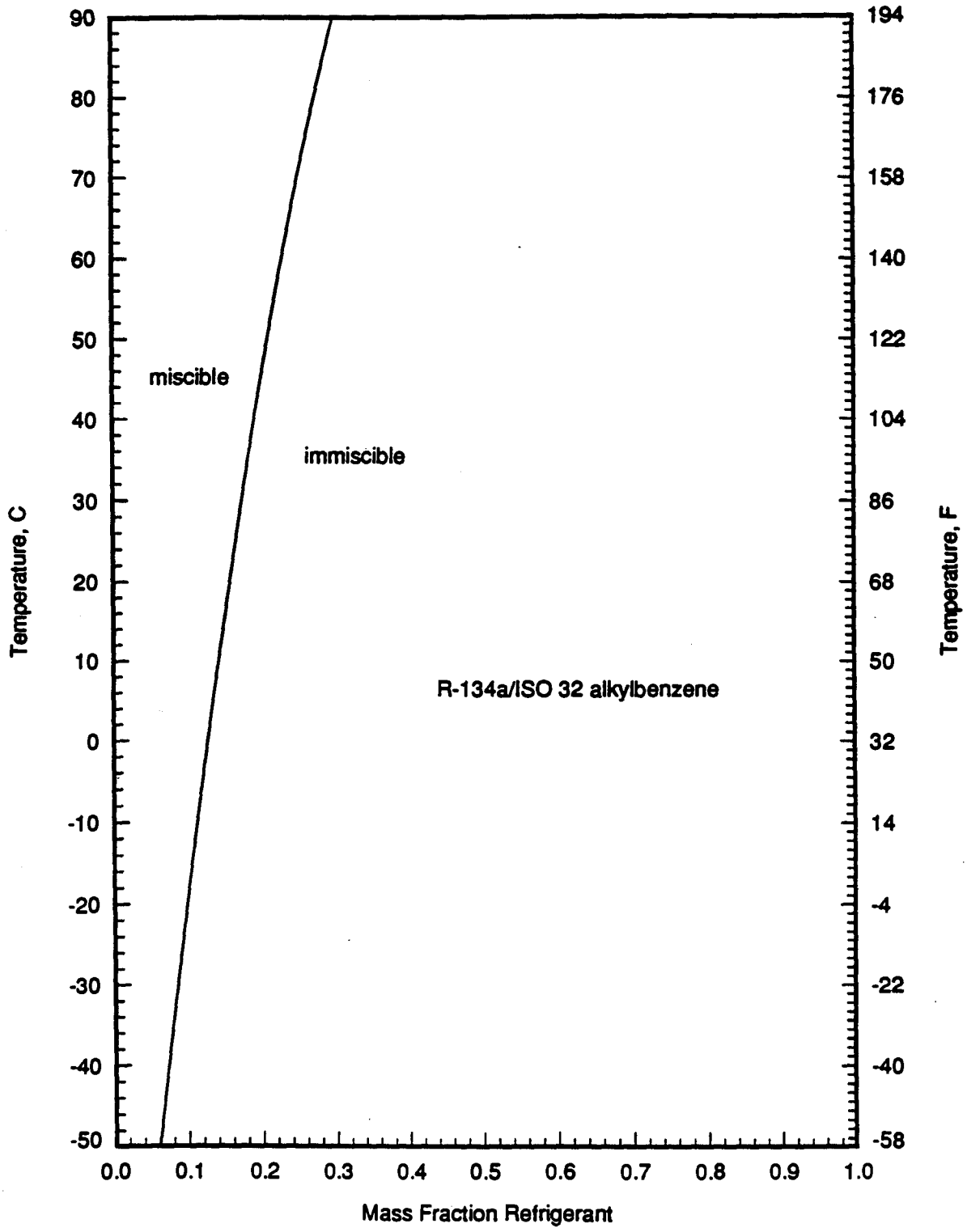

Figure 40 Miscibility plot for R-134a/ISO 32 alkylbenzene mixtures.

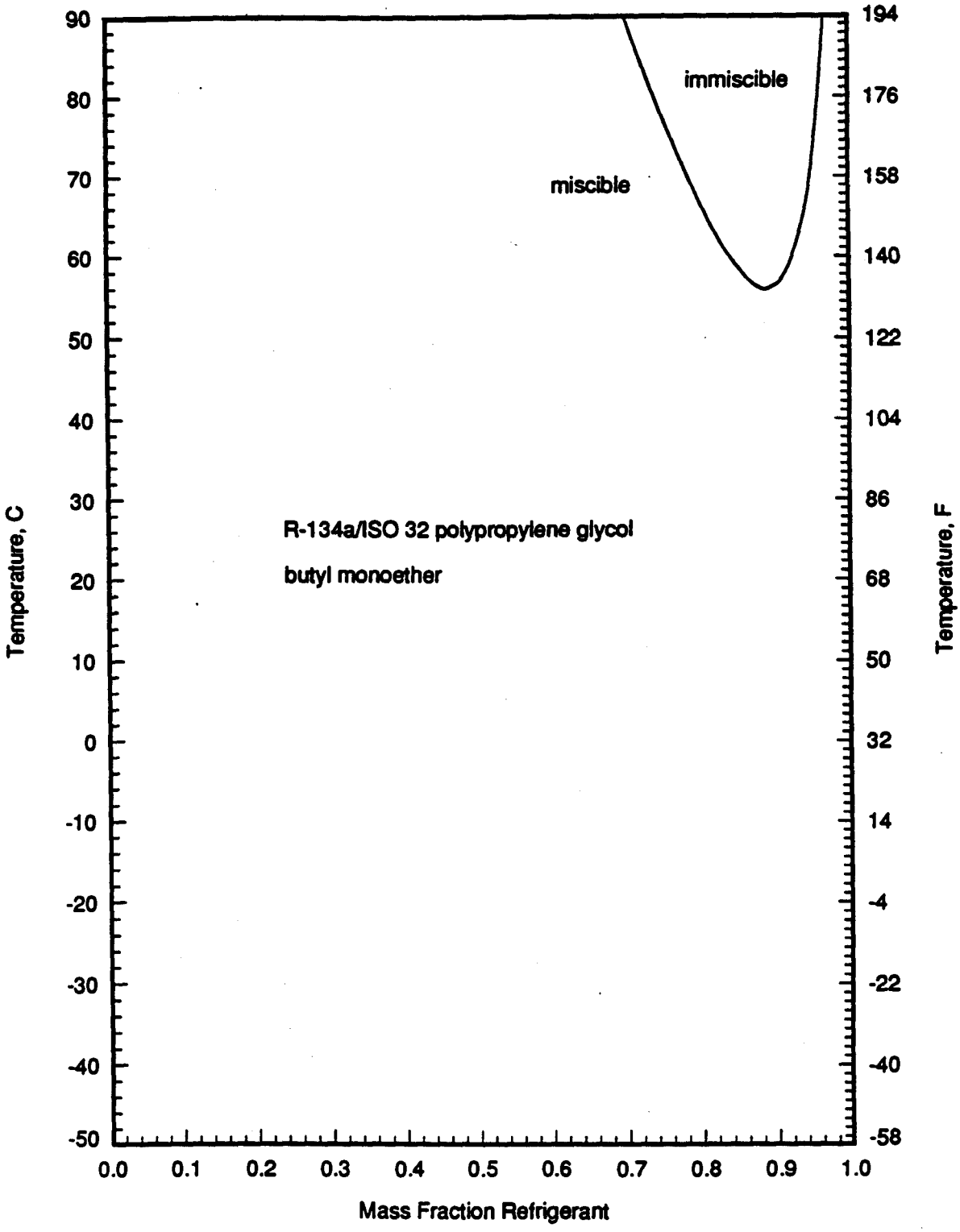

Figure 41 Miscibility plot for R-134a/ISO 32 polypropylene glycol butyl monoether mixtures.

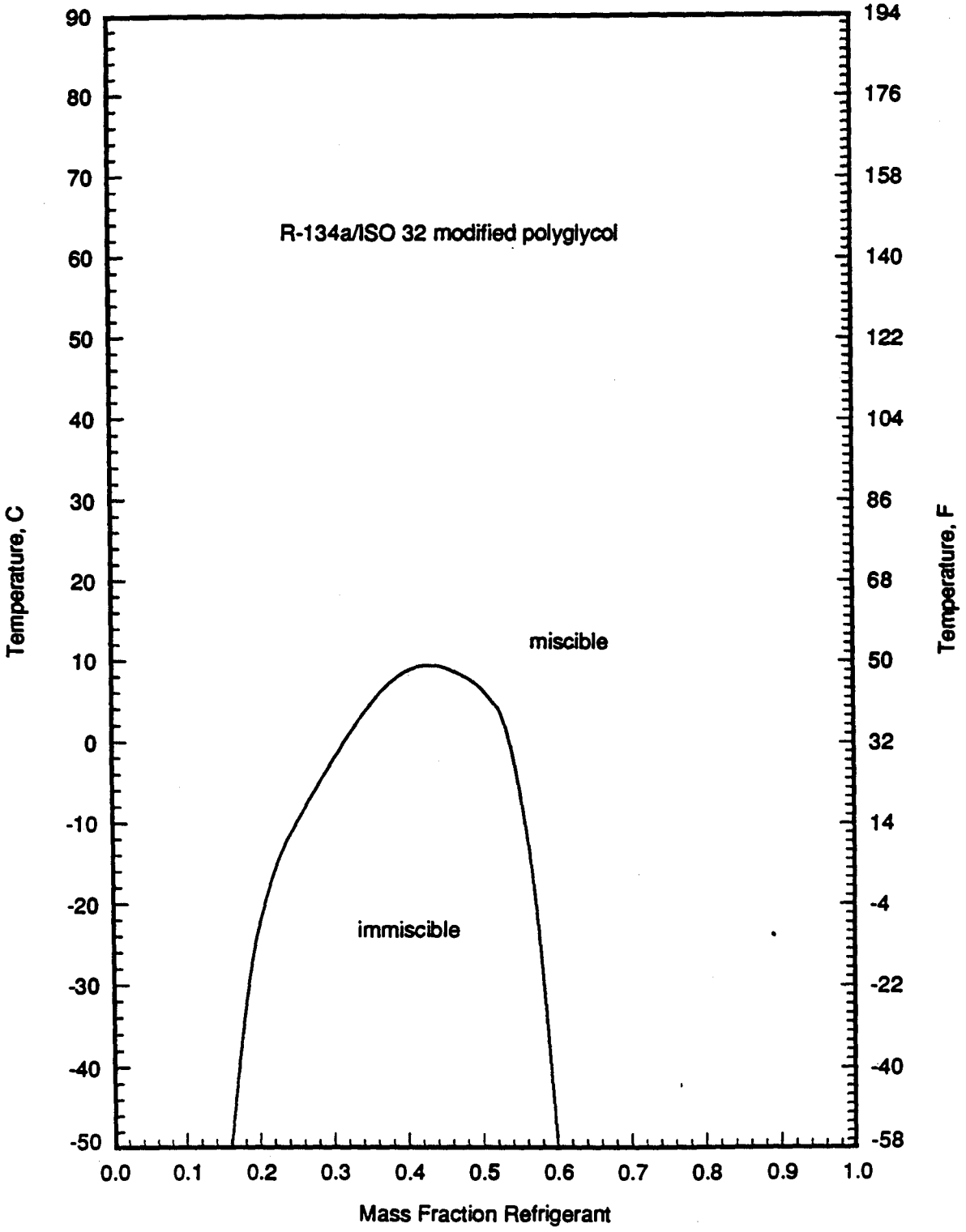

Figure 42 Miscibility plot for R-134a/ISO 32 modified polyglycol mixtures.

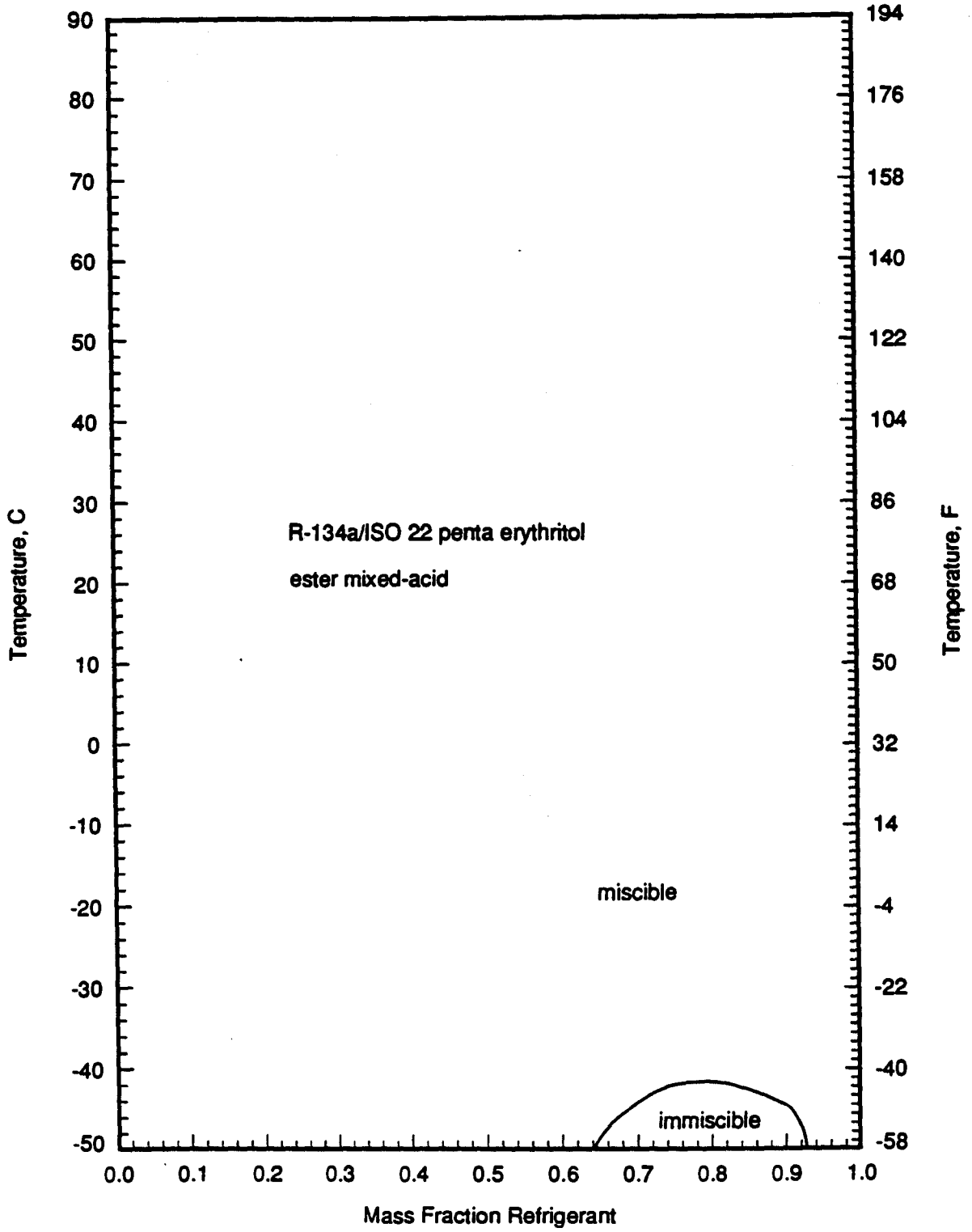

Figure 43 Miscibility plot for R-134a/ISO 22 penta erythritol ester mixed-acid mixtures.

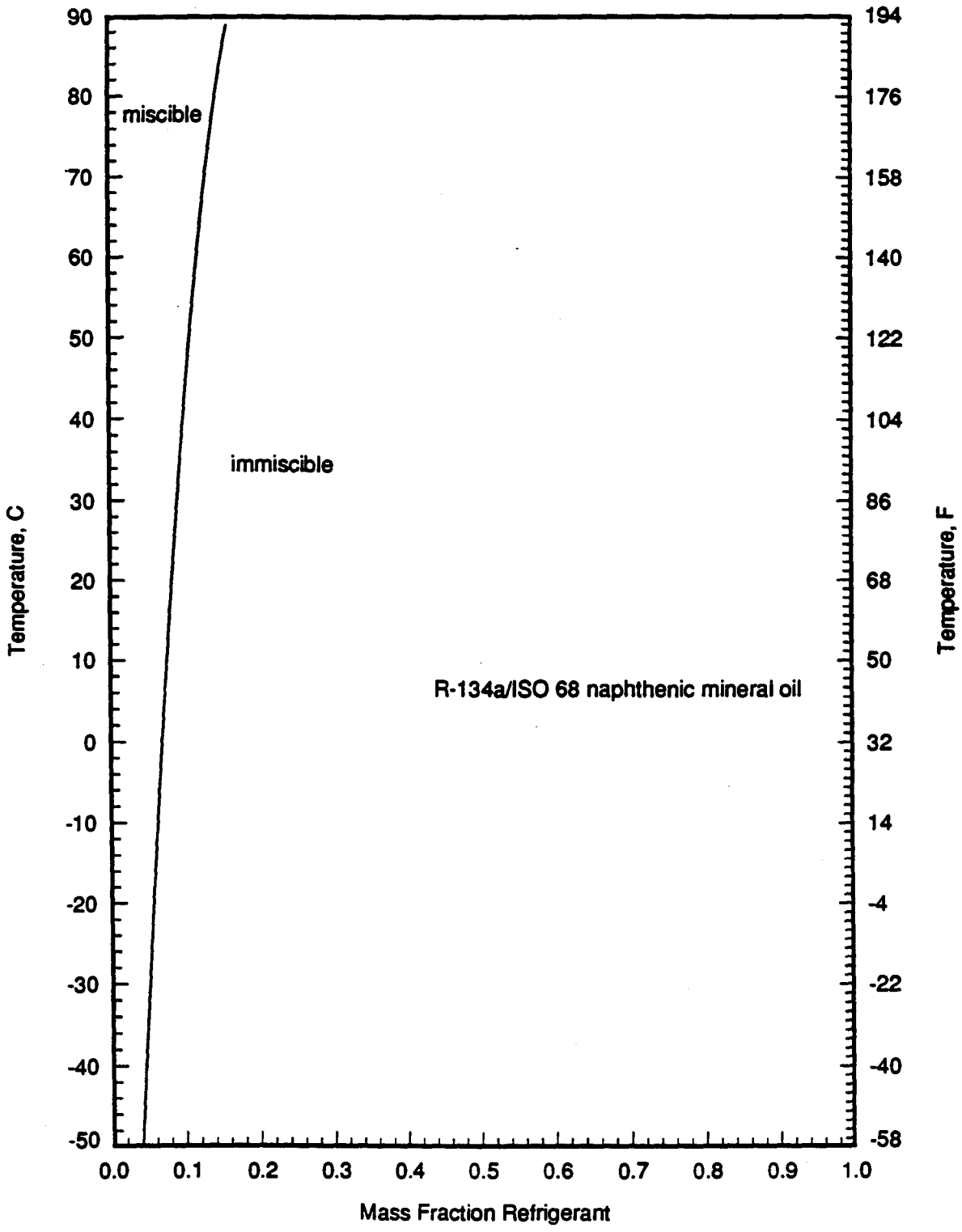

Figure 44 Miscibility plot for R-134a/ISO 68 naphthenic mineral oil mixtures.

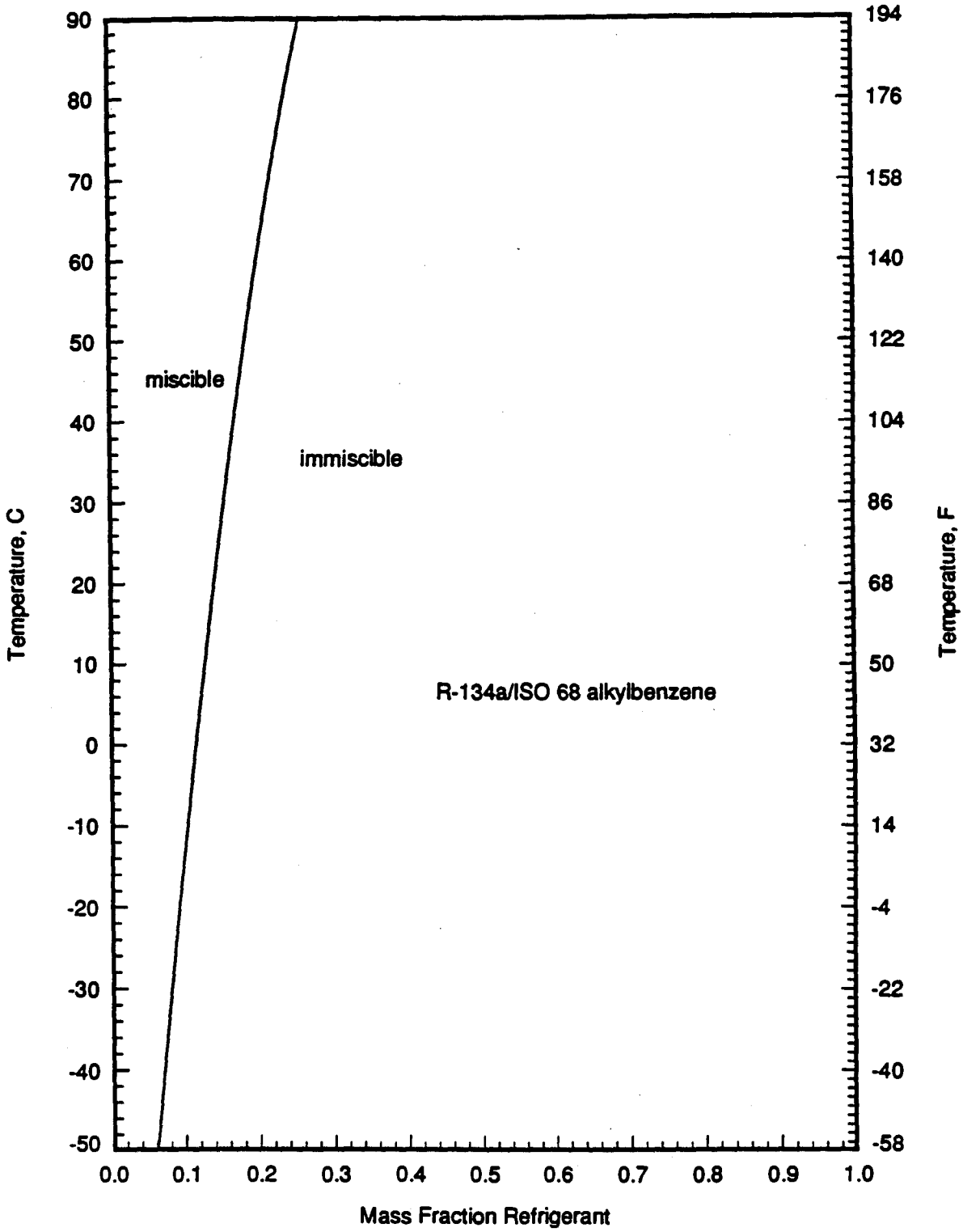

Figure 45 Miscibility plot for R-134a/ISO 68 alkylbenzene mixtures.

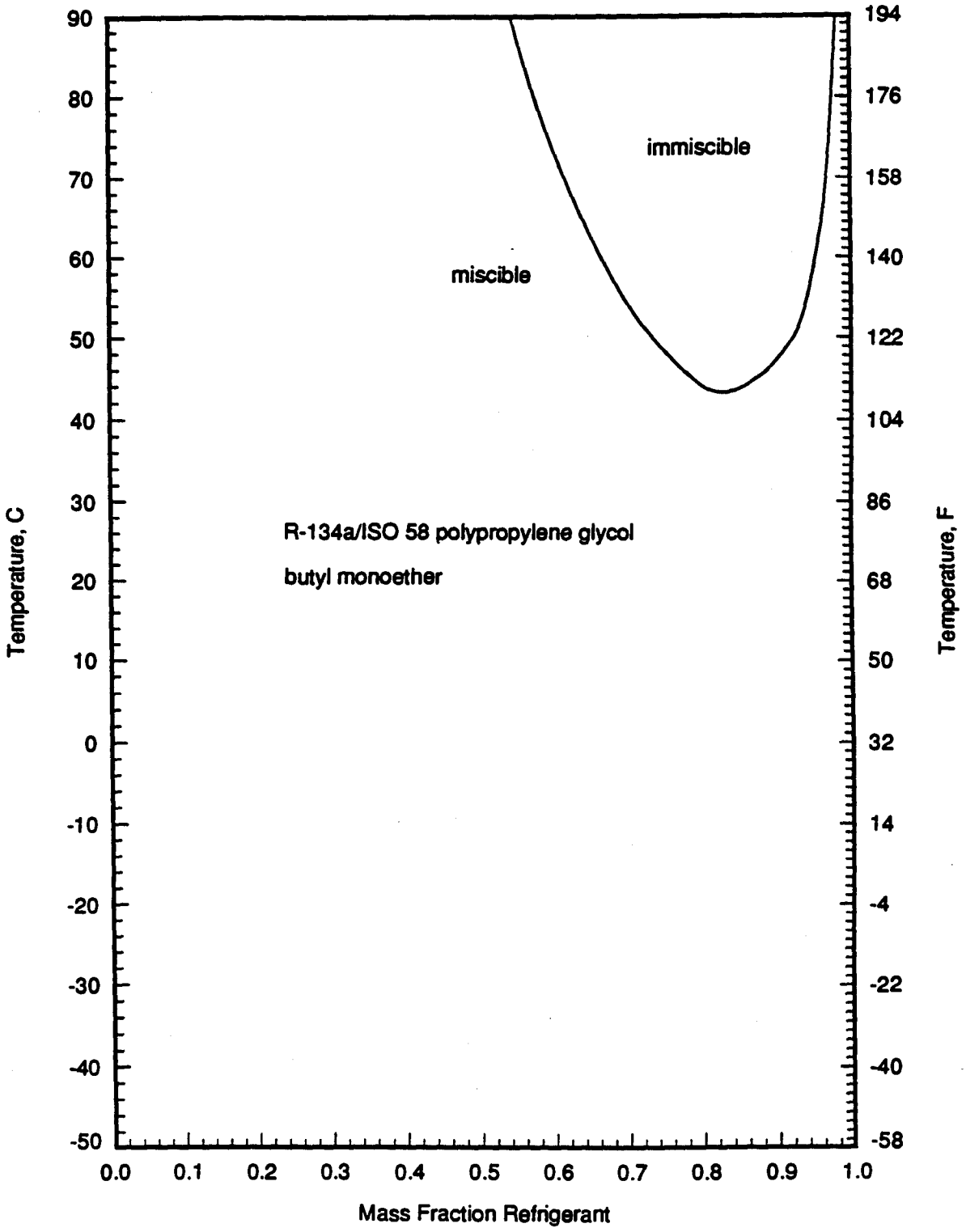

Figure 46 Miscibility plot for R-134a/ISO 58 polypropylene glycol butyl monoether mixtures.

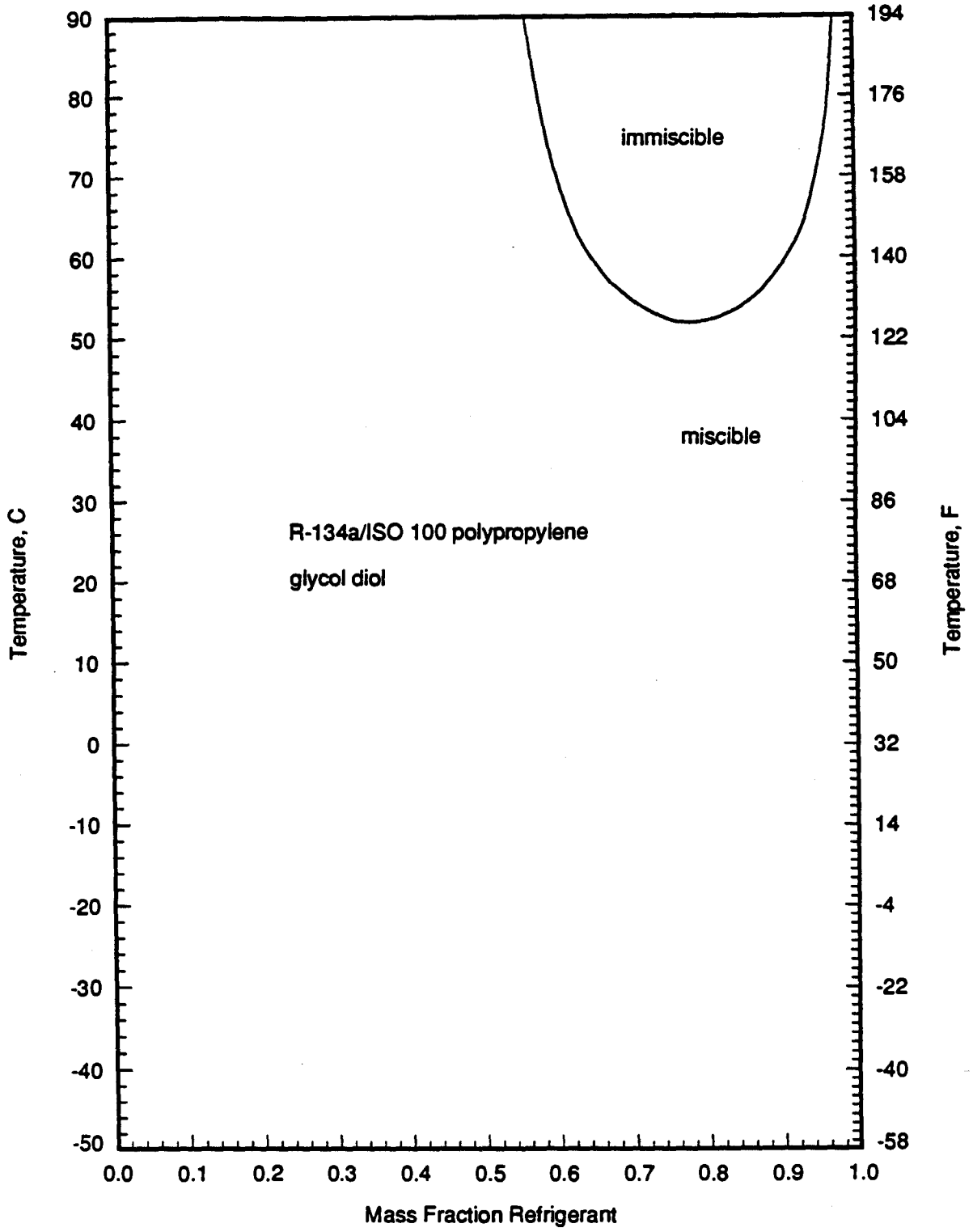

Figure 47 Miscibility plot for R-134a/ISO 100 polypropylene glycol diol mixtures.

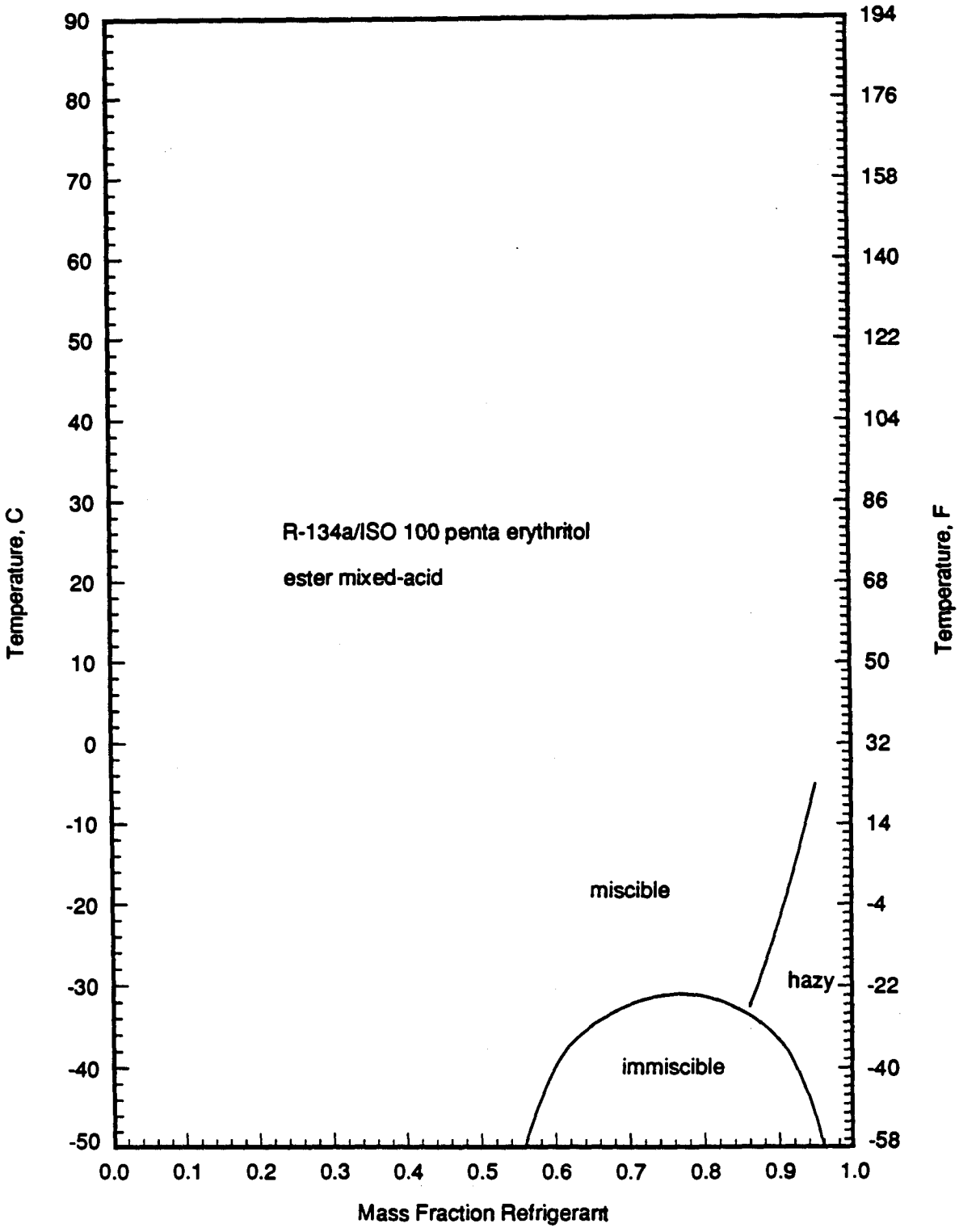

Figure 48 Miscibility plot for R-134a/ISO 100 penta erythritol ester mixed-acid mixtures.

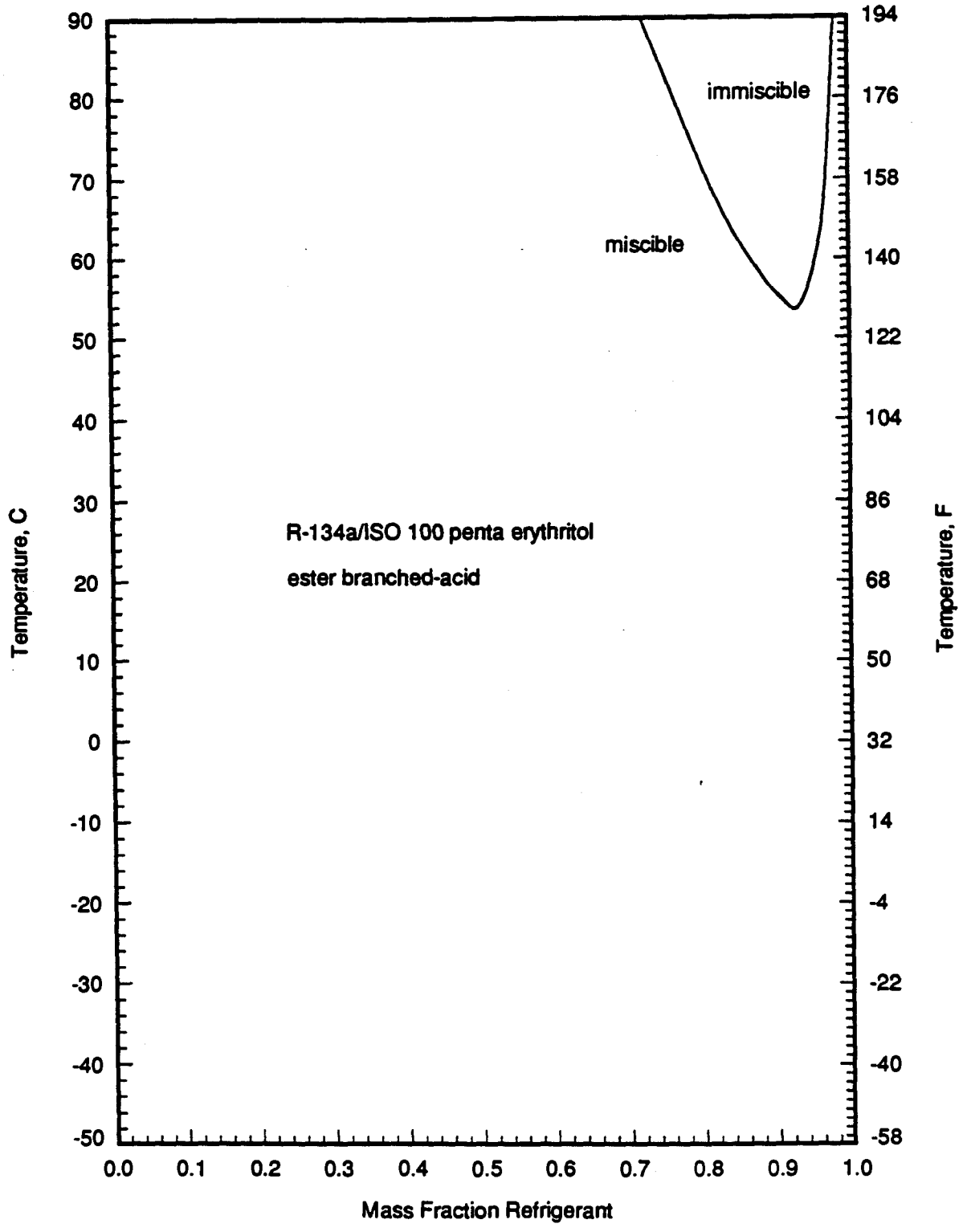

Figure 49 Miscibility plot for R-134a/ISO 100 penta erythritol ester branched-acid mixtures.

R-142b

R-142b was found to be completely miscible over the temperature range -50°C to 90°C with the following lubricants:

- alkylbenzene (ISO 32)
- polypropylene glycol butyl monoether (ISO 32)
- polypropylene glycol diol (ISO 32)
- penta erythritol ester mixed-acid (ISO 22)
- penta erythritol ester mixed-acid (ISO 32)
- penta erythritol ester branched-acid (ISO 32)
- alkylbenzene (ISO 68)
- polypropylene glycol butyl monoether (ISO 58)
- polypropylene glycol diol (ISO 100)
- penta erythritol ester mixed-acid (ISO 100)
- penta erythritol ester branched-acid (ISO 100)

Figure 50 shows a miscibility plot for R-142b and the ISO 32 naphthenic mineral oil. Figure 51 shows a miscibility plot for R-142b and the ISO 32 modified polyglycol. Figure 52 shows a miscibility plot for R-142b and the ISO 68 naphthenic mineral oil.

R-143a

R-143a was found to be completely immiscible over the temperature range -50°C to 60°C with all of the lubricants.

Figure 53 shows a miscibility plot for R-143a and the ISO 32 naphthenic mineral oil. Figure 54 shows a miscibility plot for R-143a and the ISO 32 alkylbenzene. Figure 55 shows a miscibility plot for R-143a and the ISO 32 polypropylene glycol butyl monoether. Figure 56 shows a miscibility plot for R-143a and the ISO 32 polypropylene glycol diol. Figure 57 shows a miscibility plot for R-143a and the ISO 32 modified polyglycol. Figure 58 shows a miscibility plot for R-143a and the ISO 22 penta erythritol ester mixed-acid. Figure 59 shows a miscibility plot for R-143a and the ISO 32 penta erythritol ester mixed-acid. Figure 60 shows a miscibility plot for R-143a and the ISO 32 penta erythritol ester branched-acid. Figure 61 shows a miscibility plot for R-143a and the ISO 68 naphthenic mineral oil. Figure 62 shows a miscibility plot for R-143a and the ISO 68 alkylbenzene. Figure 63 shows a miscibility plot for R-143a and the ISO 58 polypropylene glycol butyl monoether. Figure 64 shows a miscibility plot for R-143a and the ISO 100 polypropylene glycol diol. Figure 65 shows a miscibility plot for R-143a and the ISO 100 penta erythritol ester mixed-acid. Figure 66 shows a miscibility plot for R-143a and the ISO 100 penta erythritol ester branched-acid.

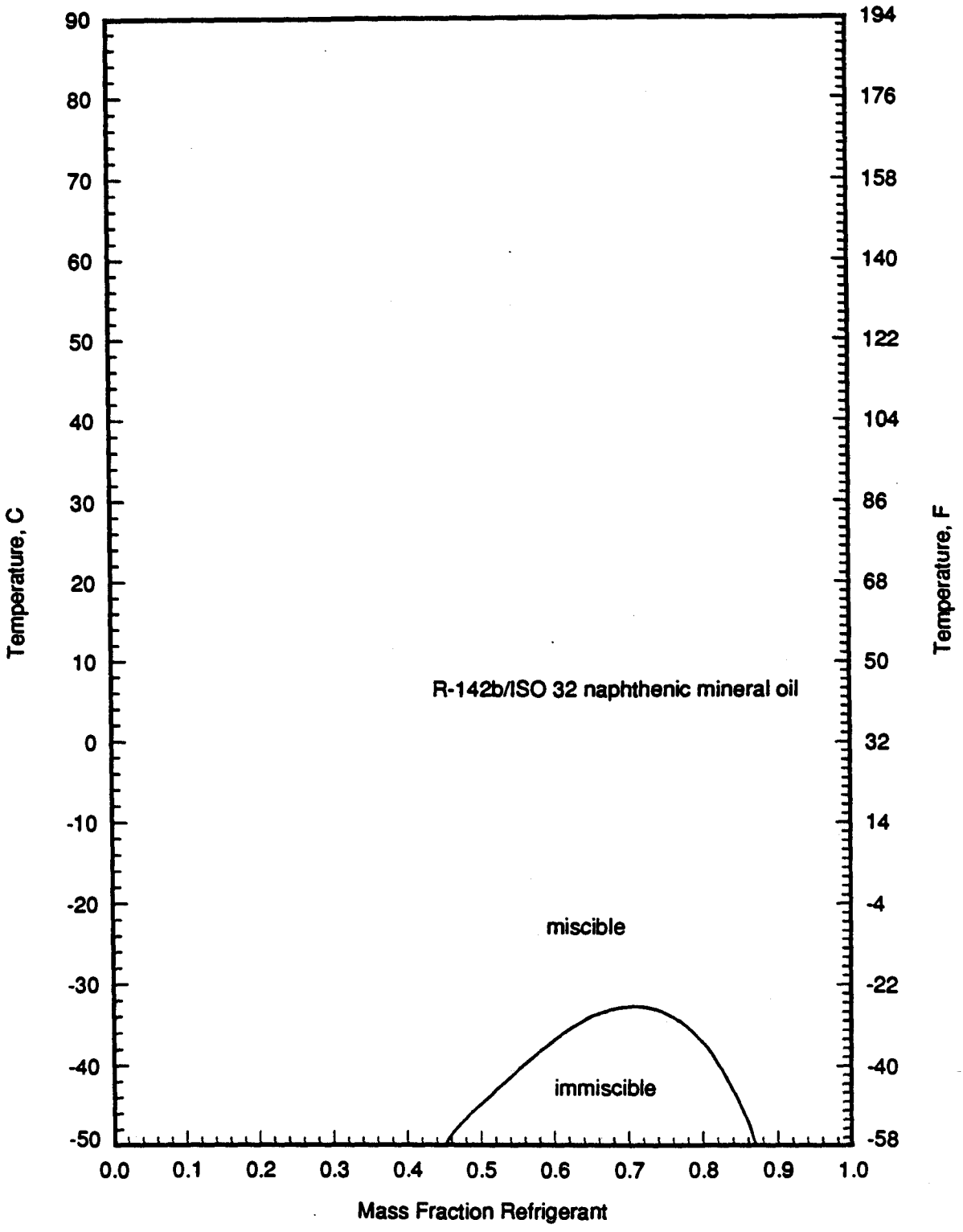

Figure 50 Miscibility plot for R-142b/ISO 32 naphthenic mineral oil mixtures.

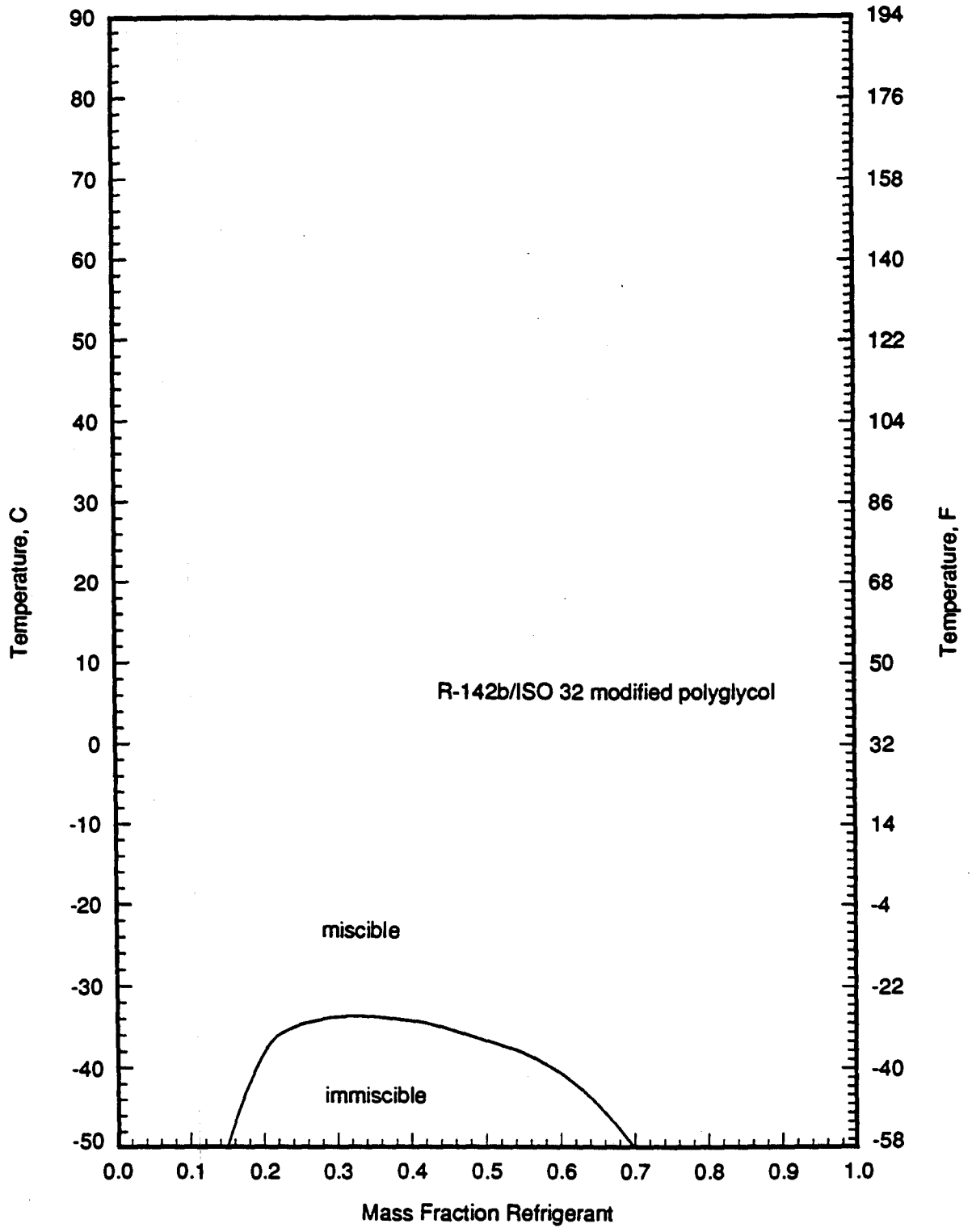

Figure 51 Miscibility plot for R-142b/ISO 32 modified polyglycol mixtures.

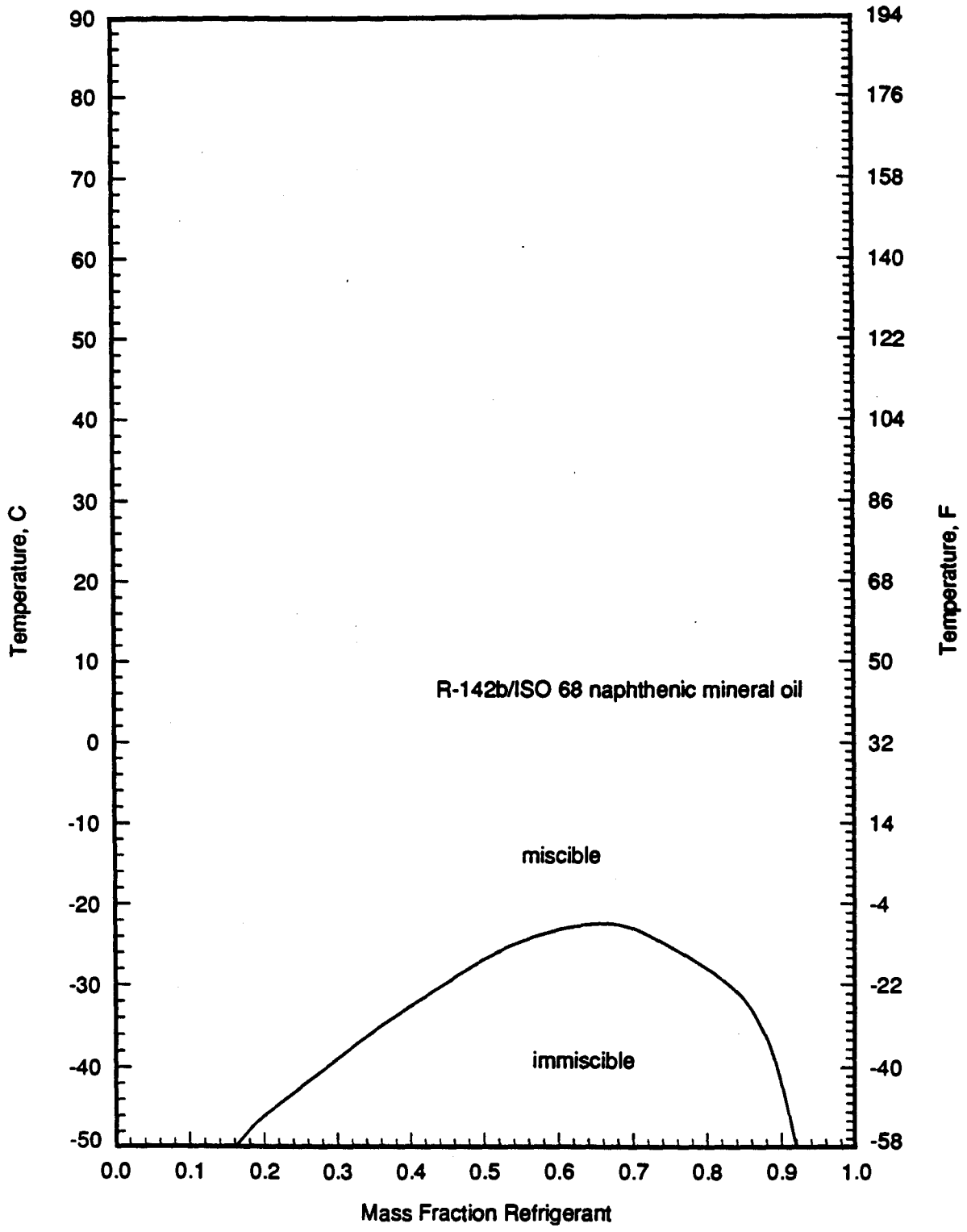

Figure 52 Miscibility plot for R-142b/ISO 68 naphthenic mineral oil mixtures.

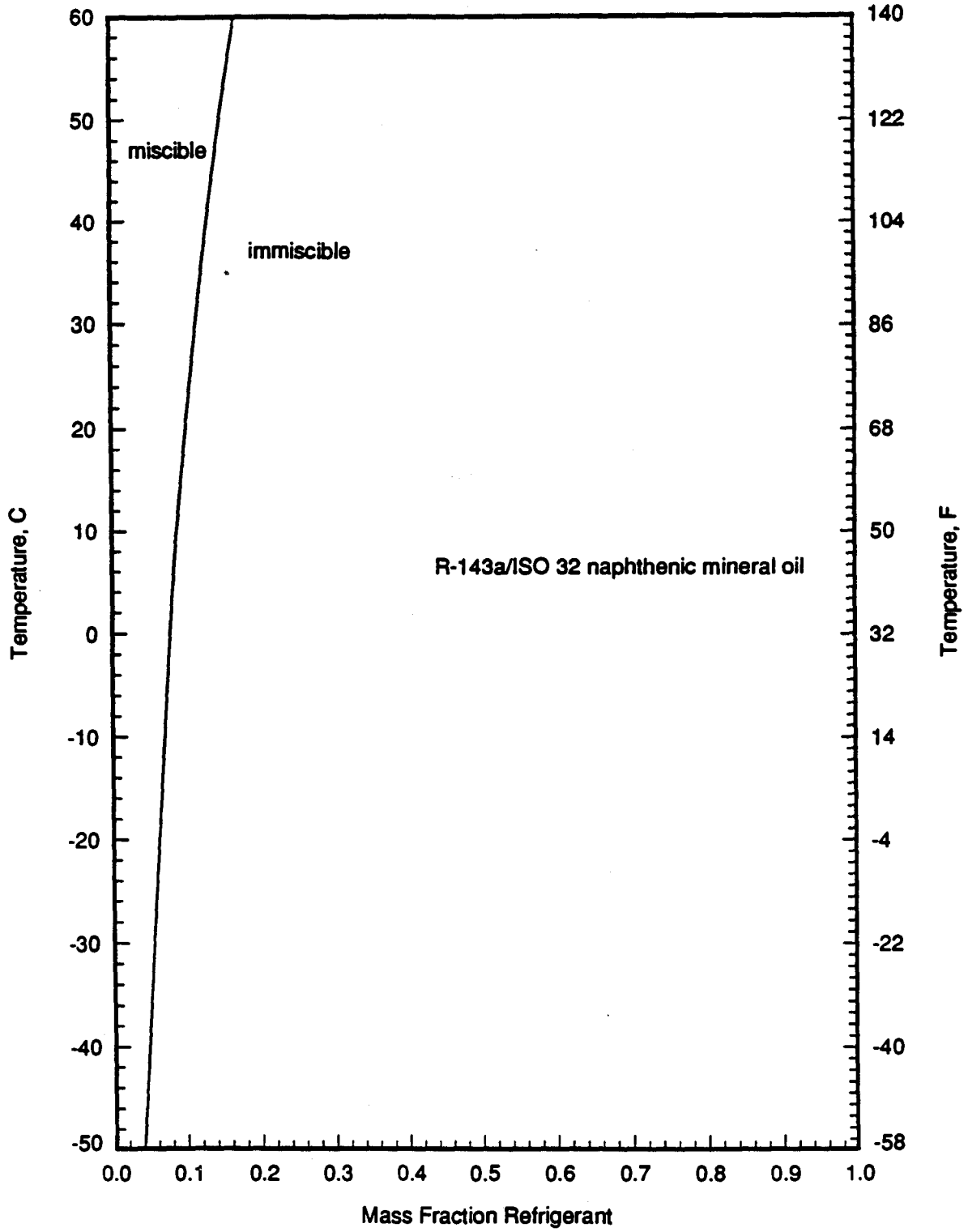

Figure 53 Miscibility plot for R-143a/ISO 32 naphthenic mineral oil mixtures.

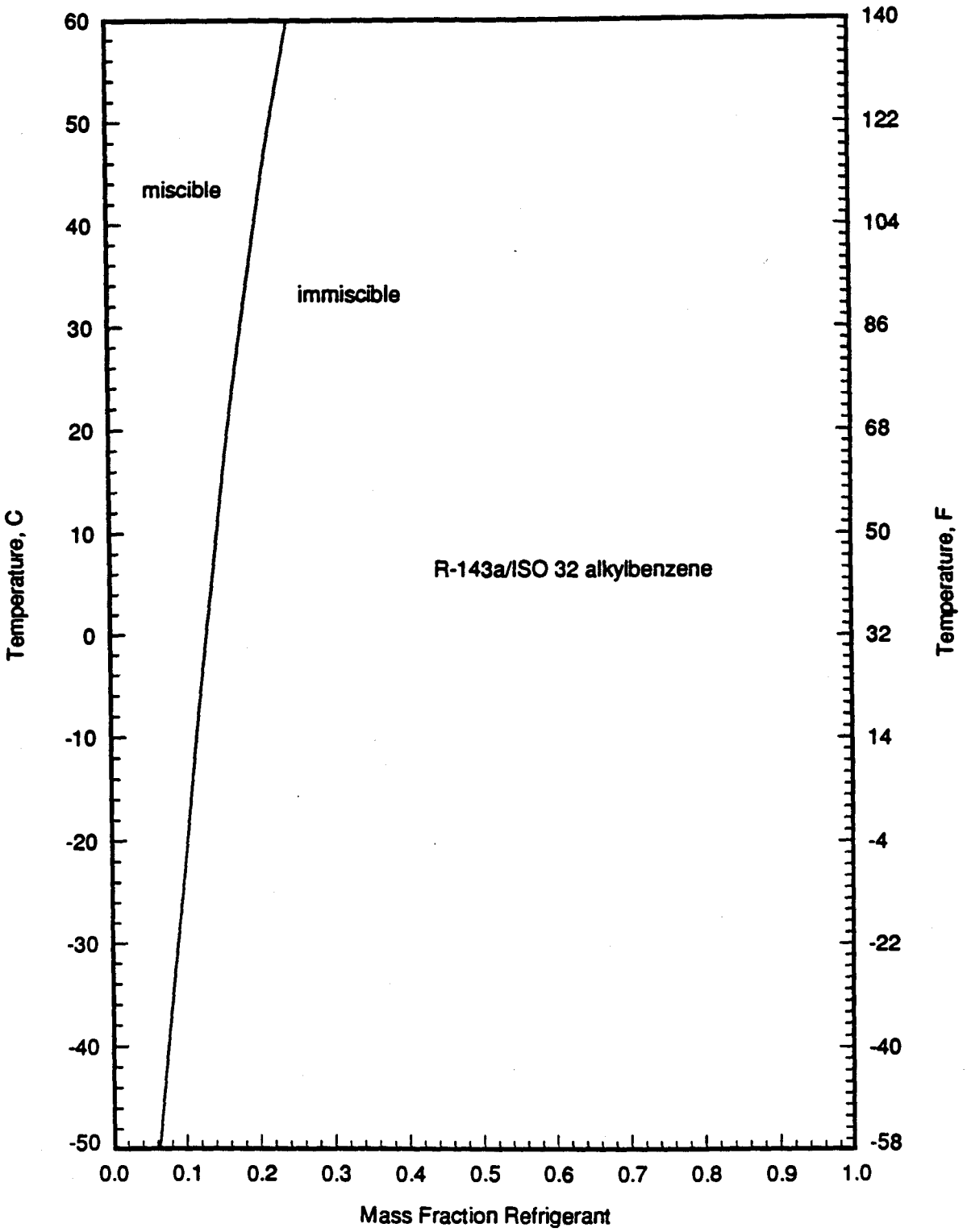

Figure 54 Miscibility plot for R-143a/ISO 32 alkylbenzene mixtures.

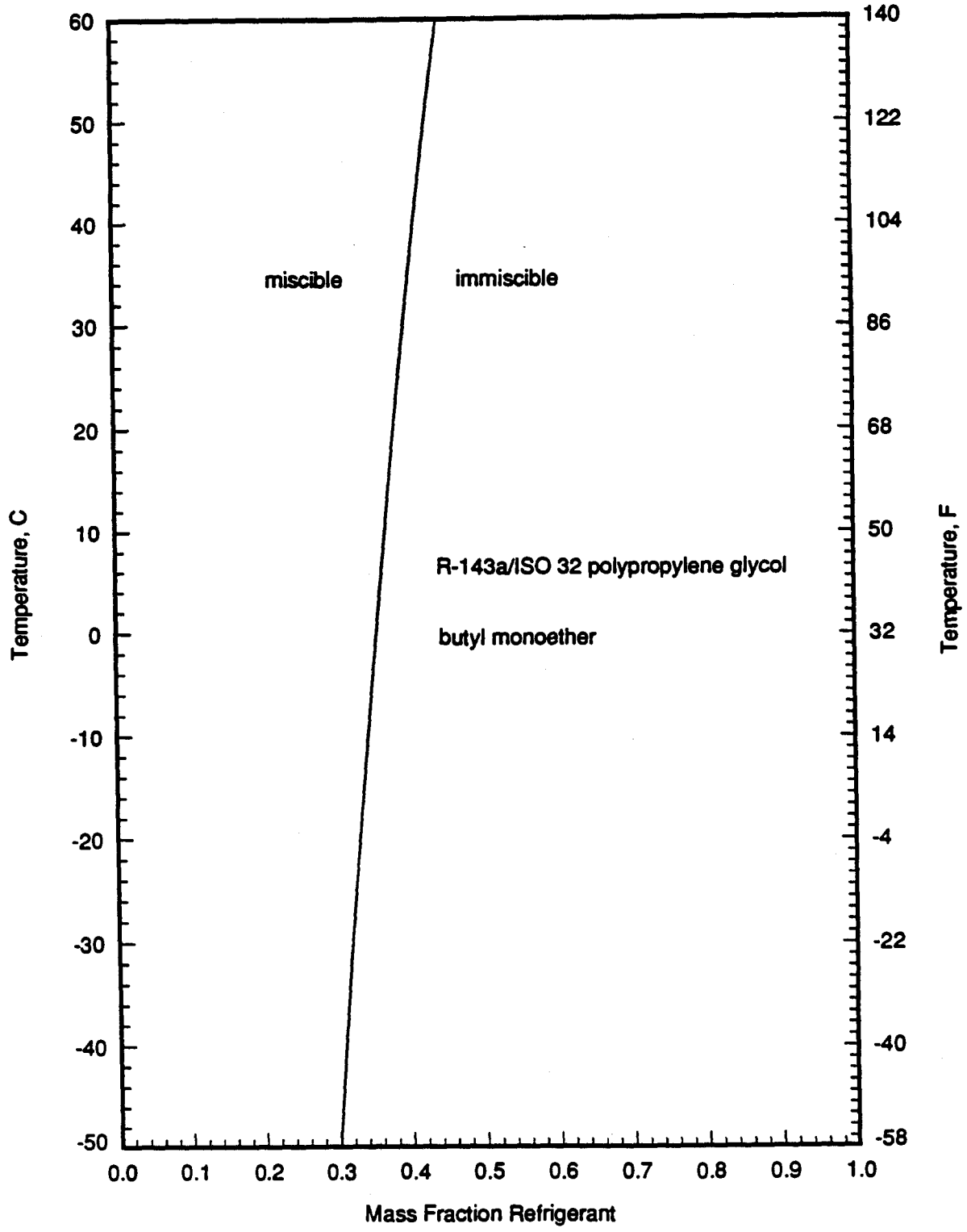

Figure 55 Miscibility plot for R-143a/IS0 32 polypropylene glycol butyl monoether mixtures.

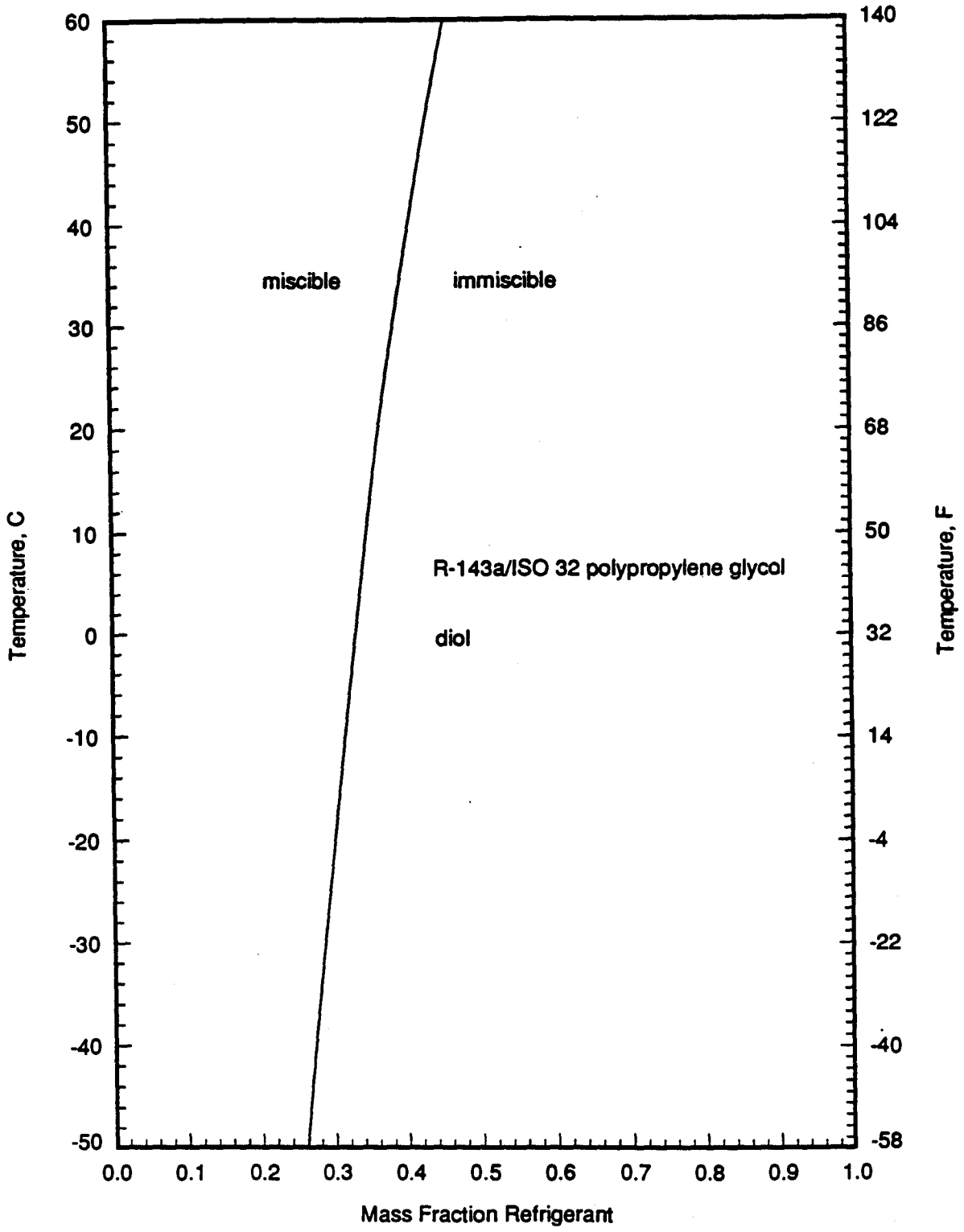

Figure 56 Miscibility plot for R-143a/ISO 32 polypropylene glycol diol mixtures.

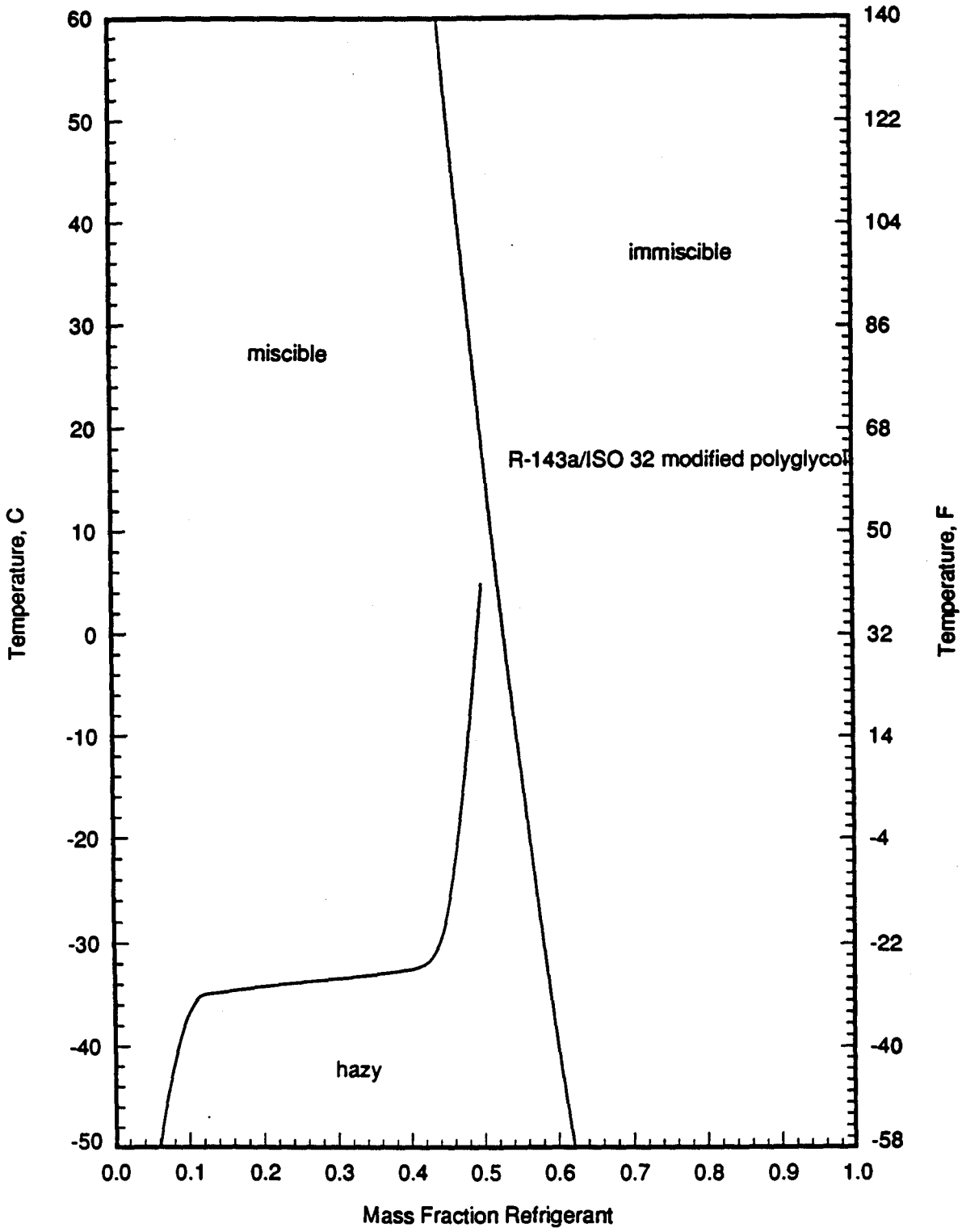

Figure 57 Miscibility plot for R-143a/ISO 32 modified polyglycol mixtures.

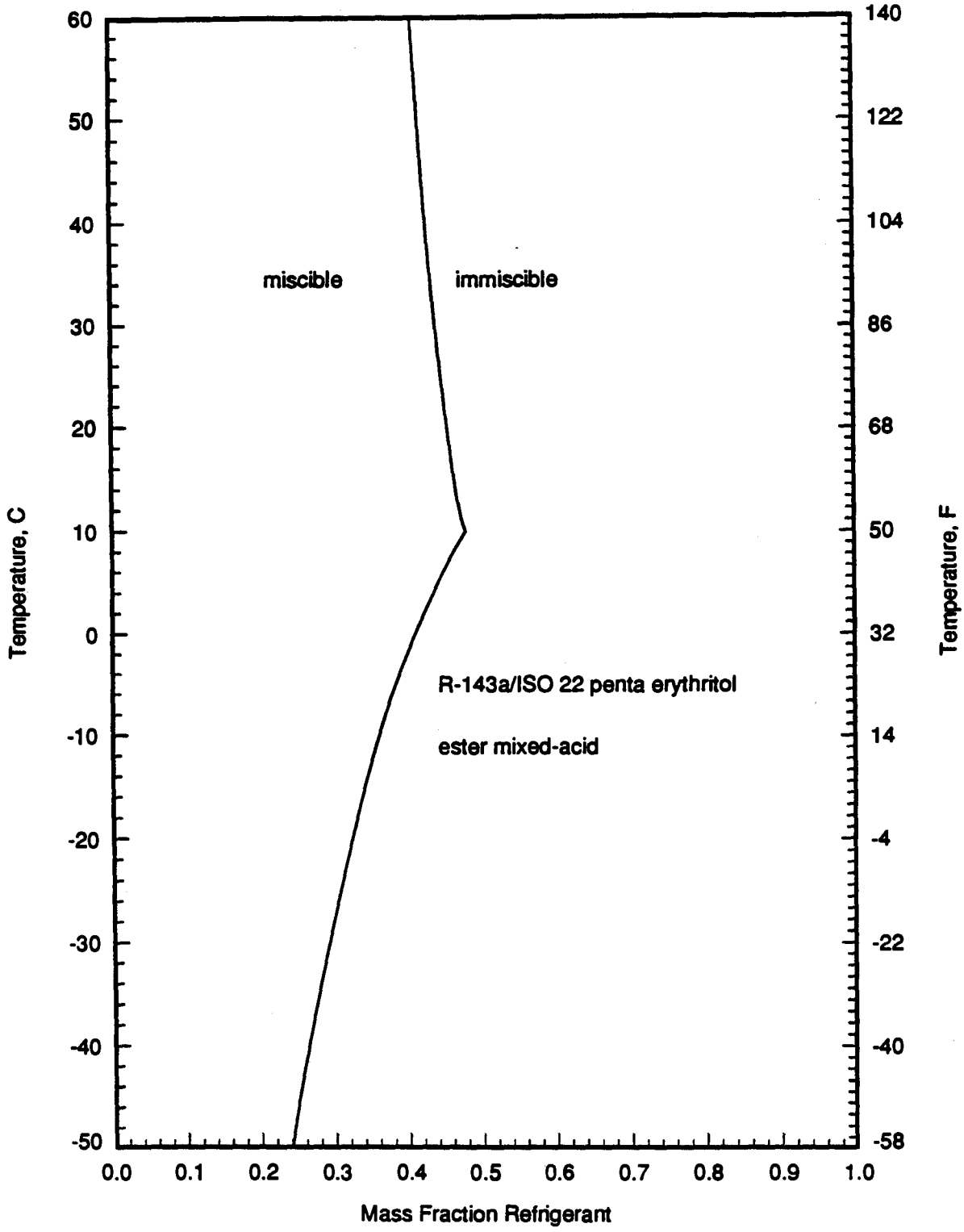

Figure 58 Miscibility plot for R-143a/ISO 22 penta erythritol ester mixed-acid mixtures.

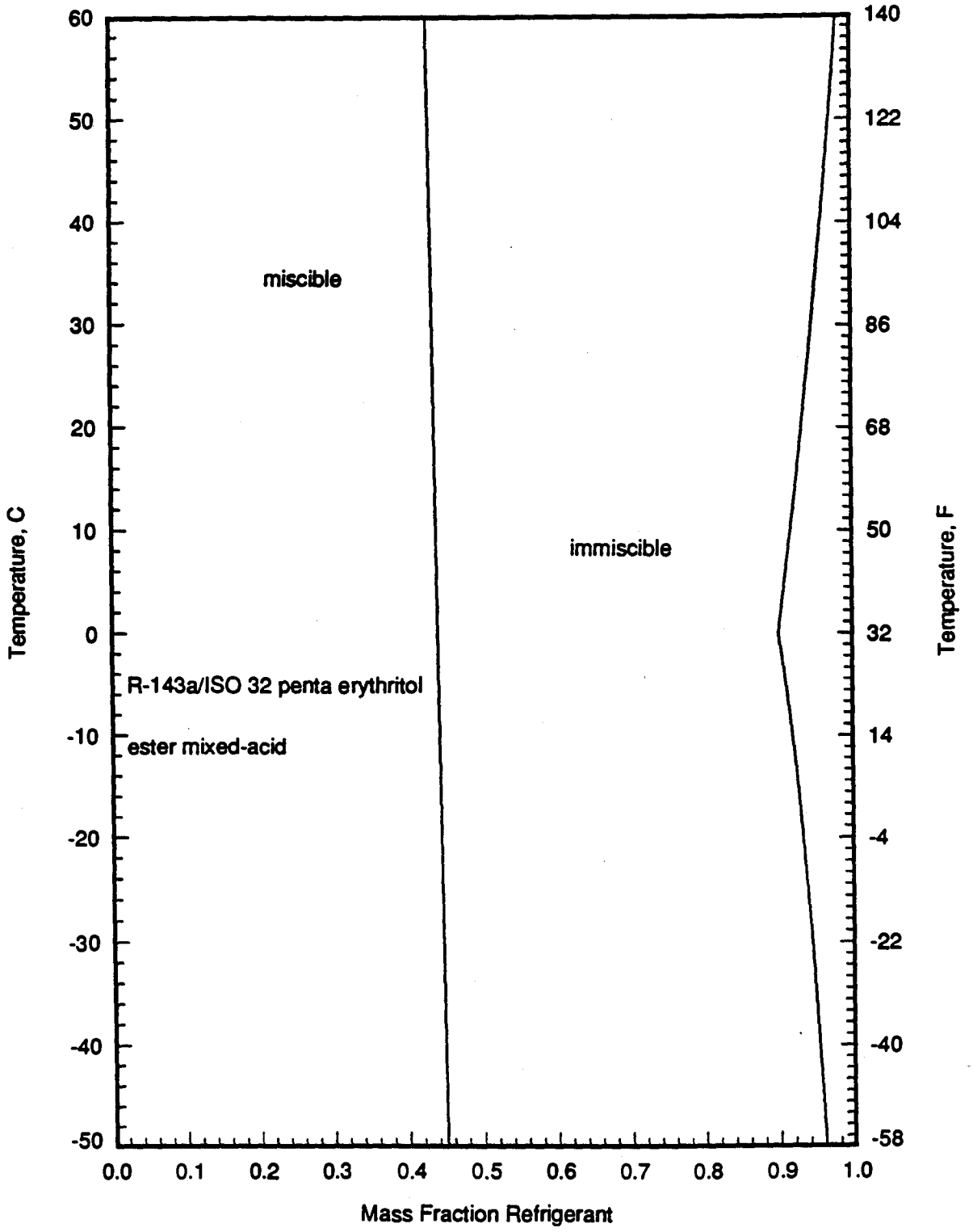

Figure 59 Miscibility plot for R-143a/ISO 32 penta erythritol ester mixed-acid mixtures.

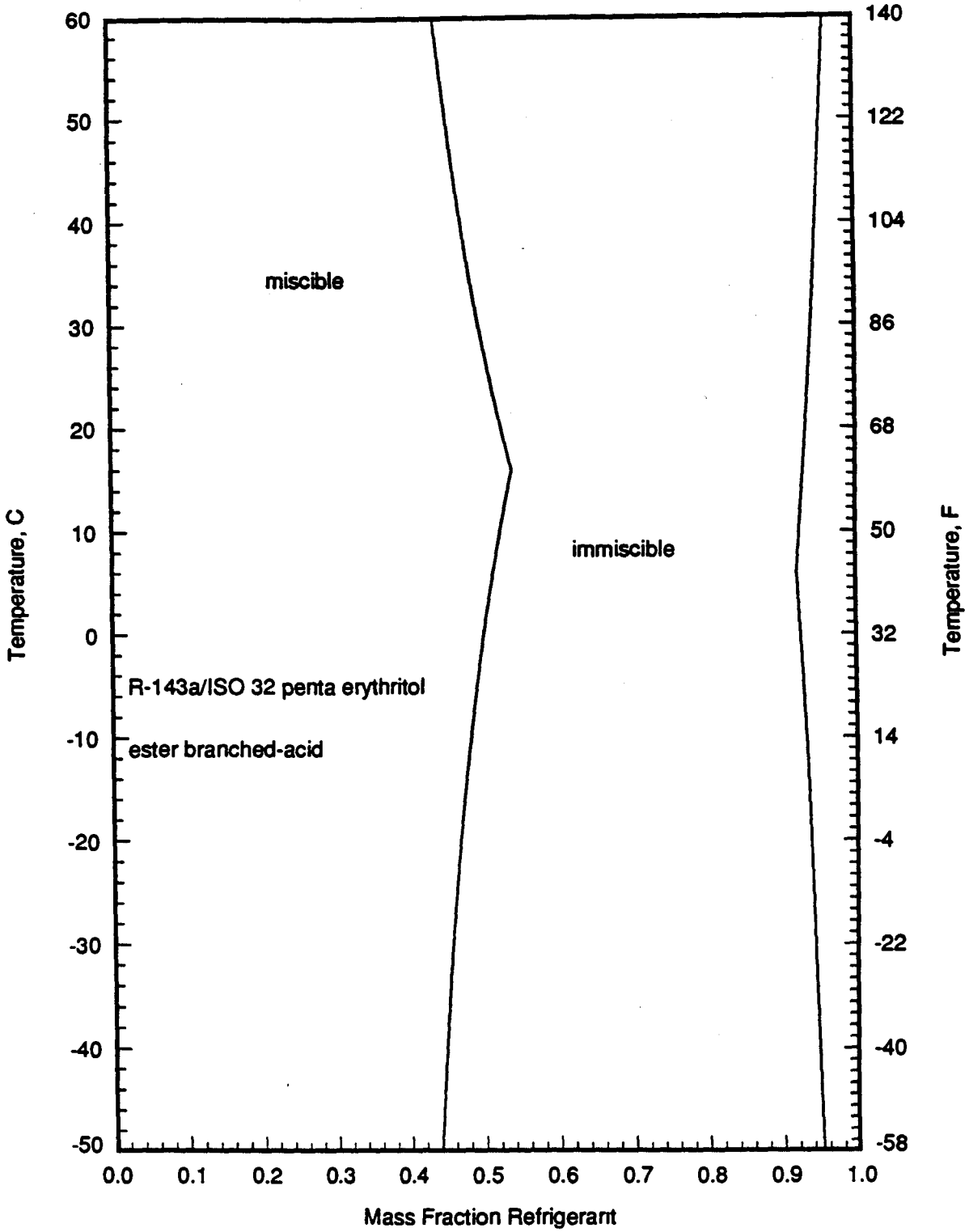

Figure 60 Miscibility plot for R-143a/ISO 32 penta erythritol ester branched-acid mixtures.

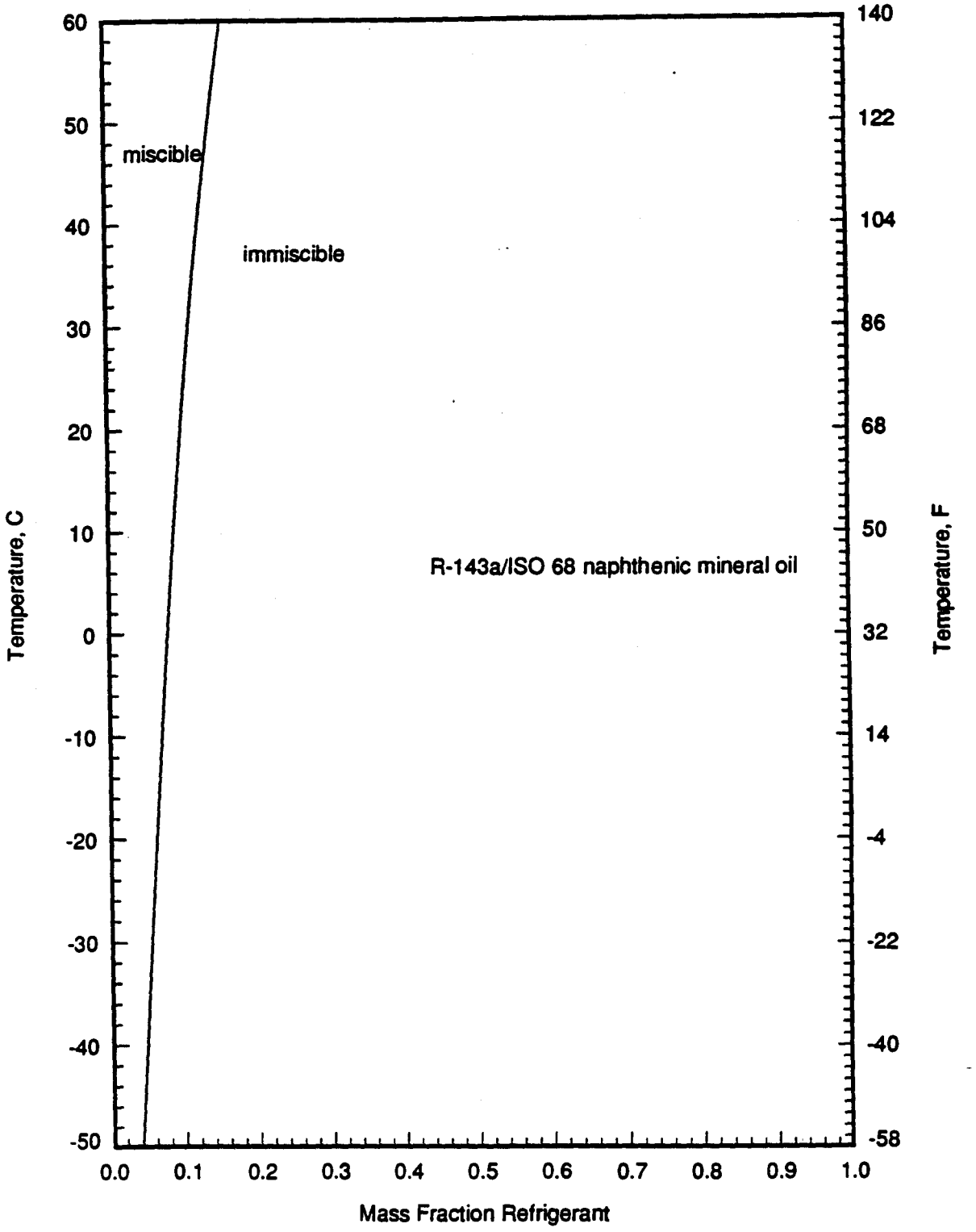

Figure 61 Miscibility plot for R-143a/ISO 68 naphthenic mineral oil mixtures.

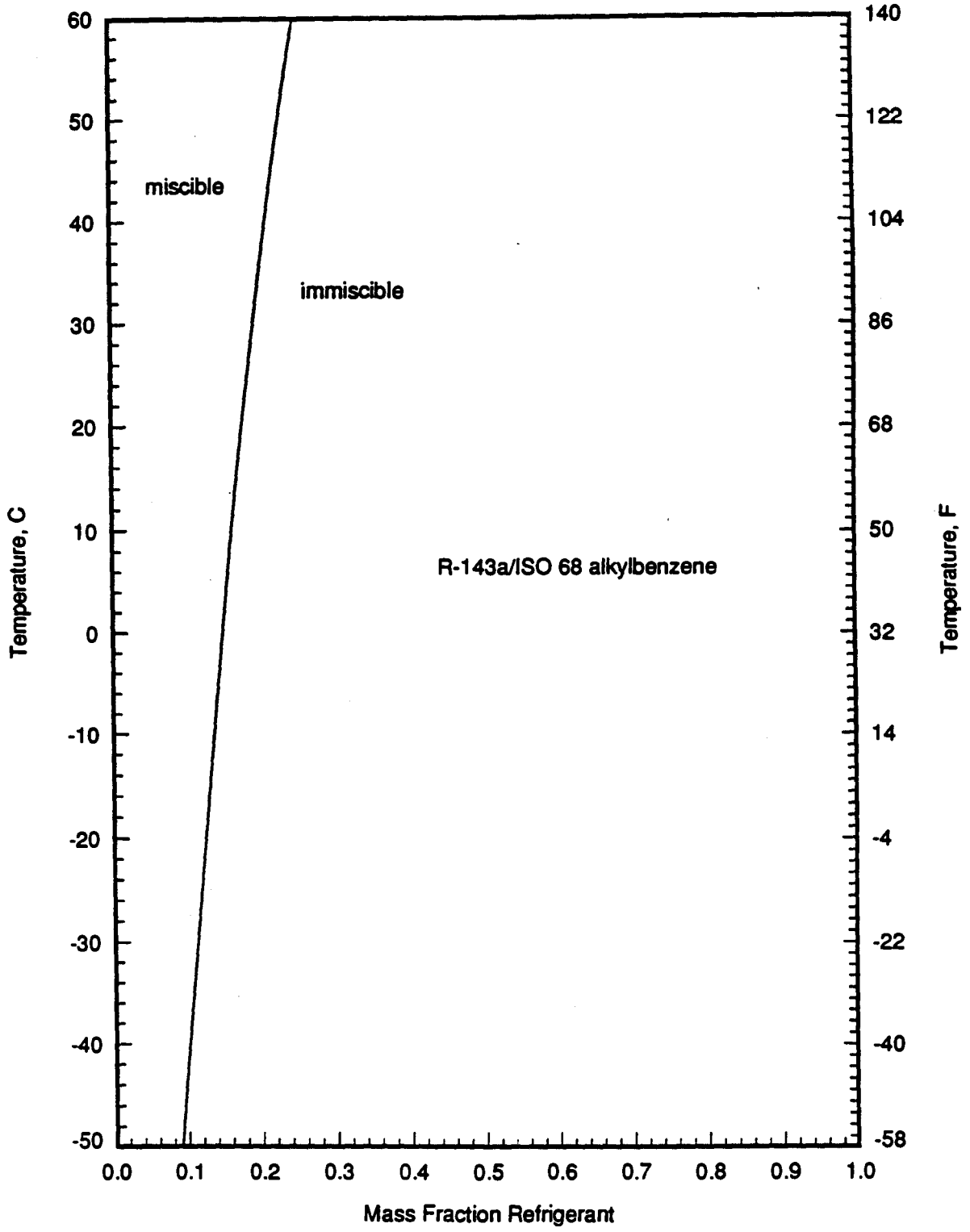

Figure 62 Miscibility plot for R-143a/ISO 68 alkylbenzene mixtures.

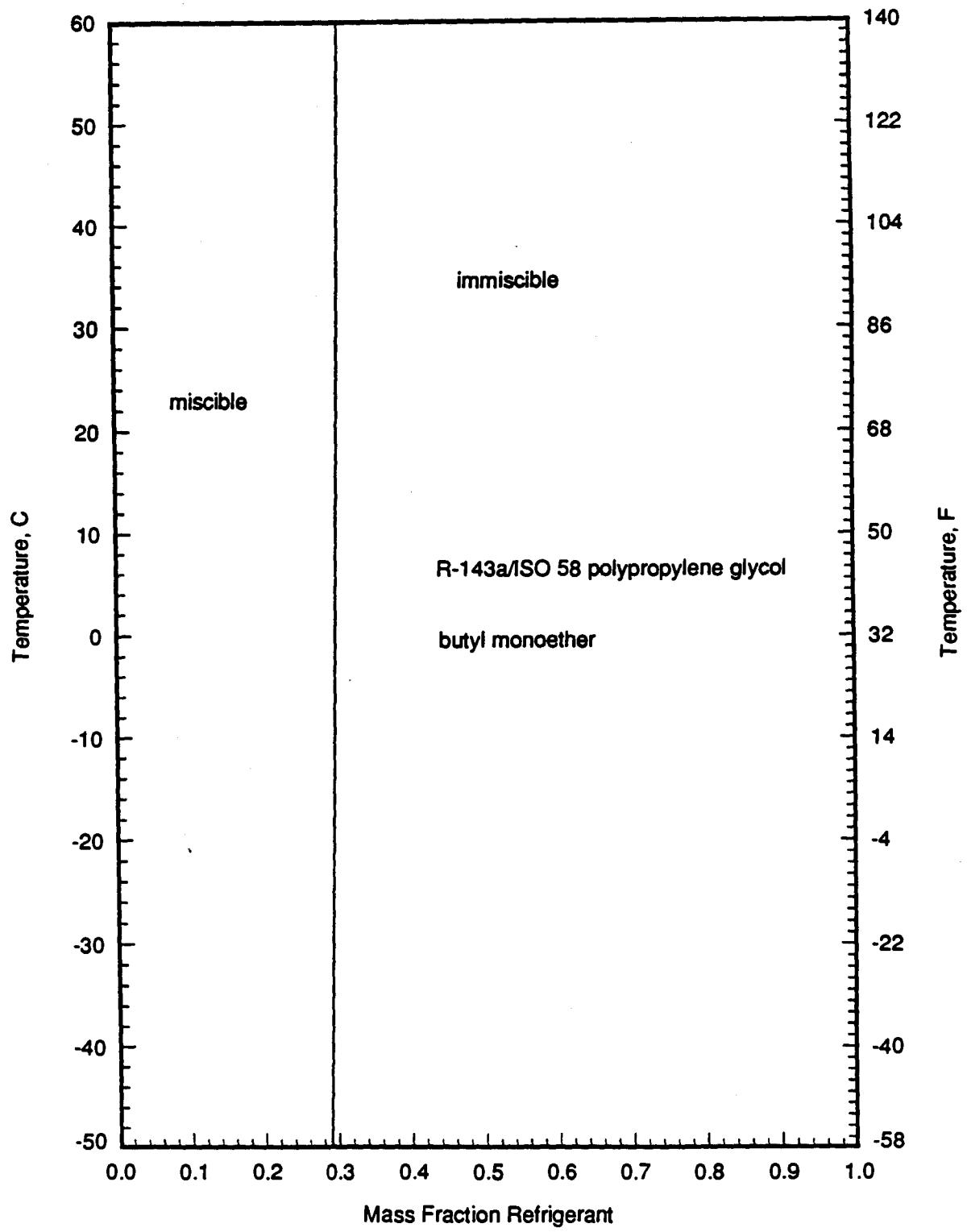

Figure 63 Miscibility plot for R-143a/ISO 58 polypropylene glycol butyl monoether mixtures.

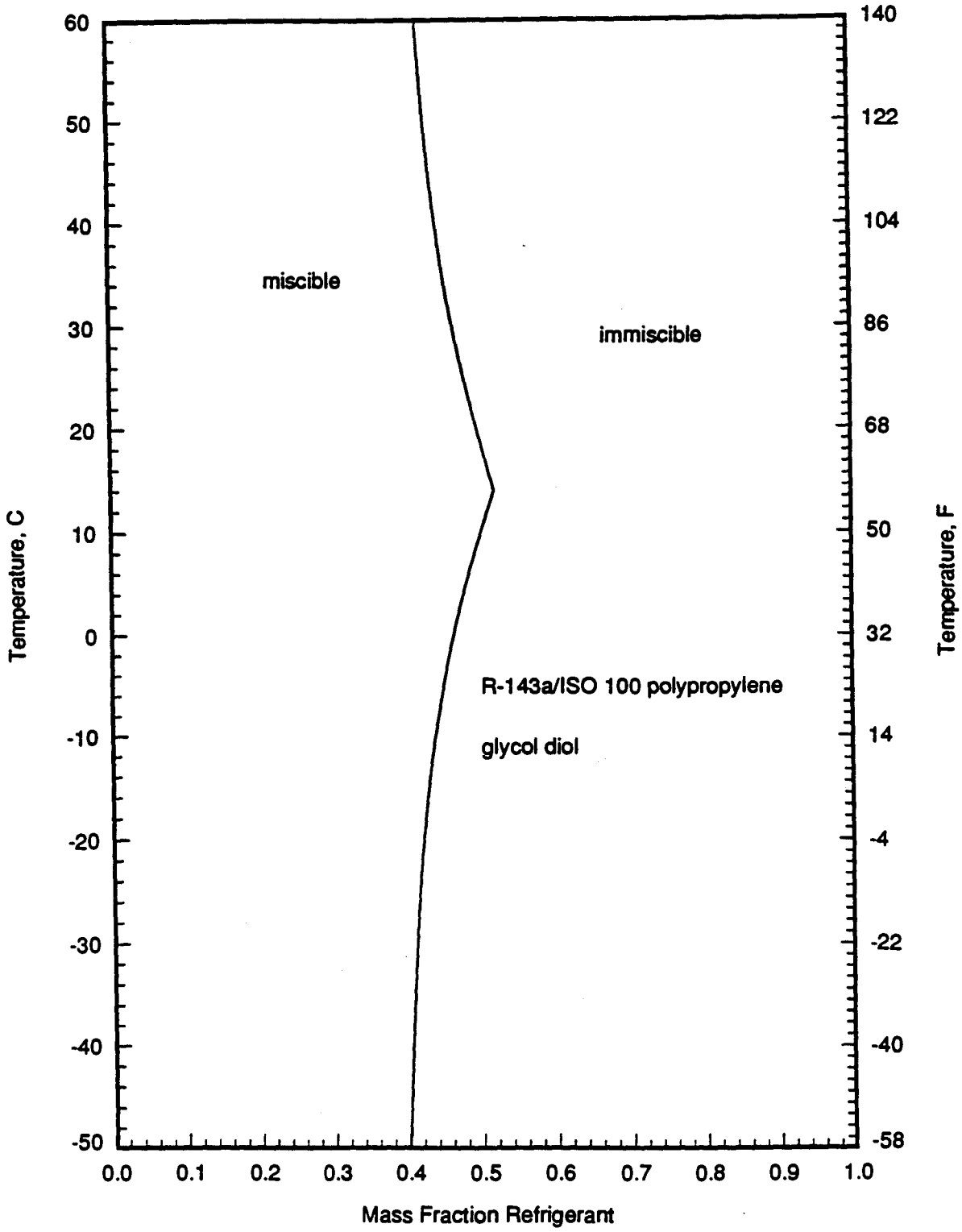

Figure 64 Miscibility plot for R-143a/ISO 100 polypropylene glycol diol mixtures.

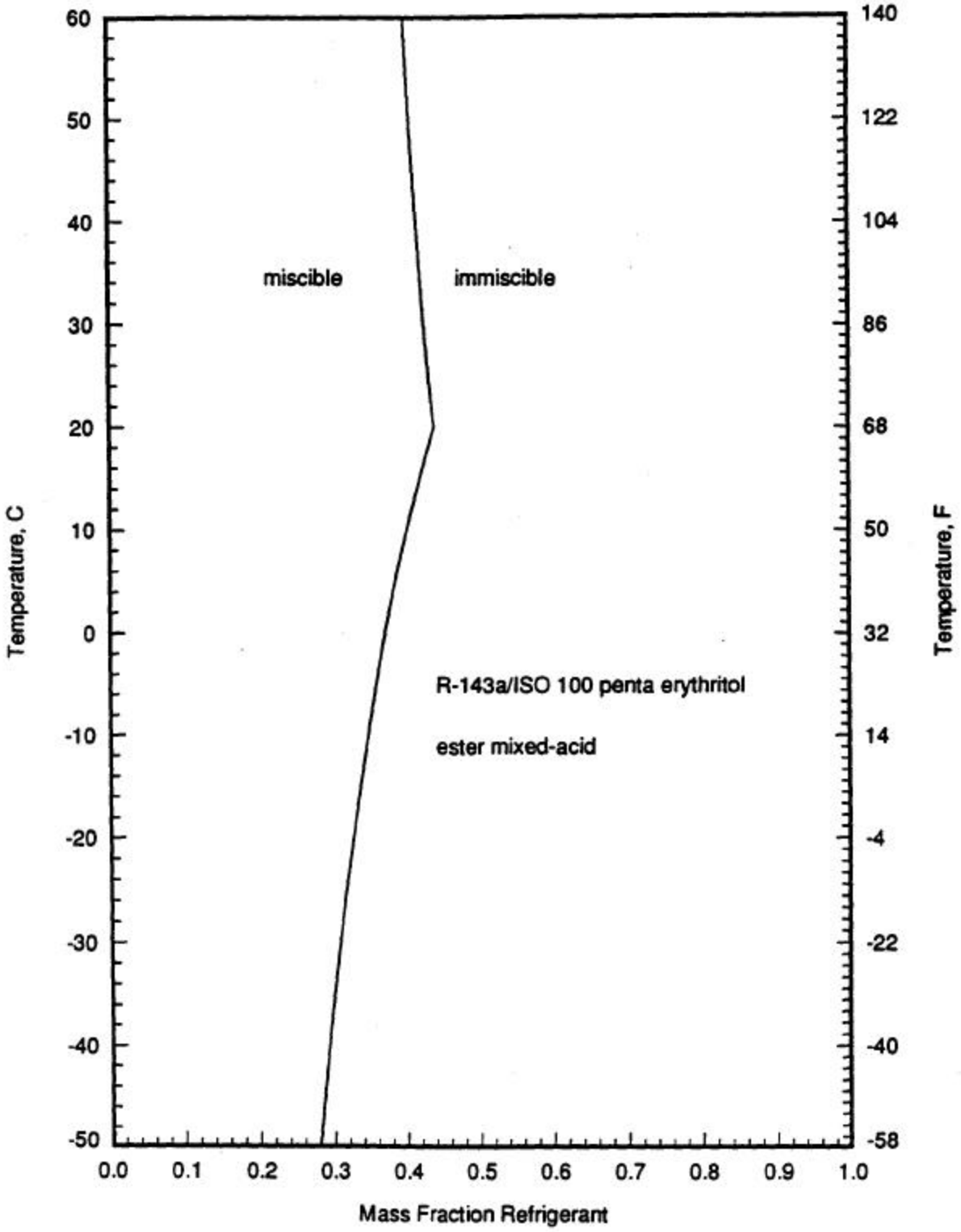

Figure 65 Miscibility plot for R-143a/ISO 100 penta erythritol ester mixed-acid mixtures.

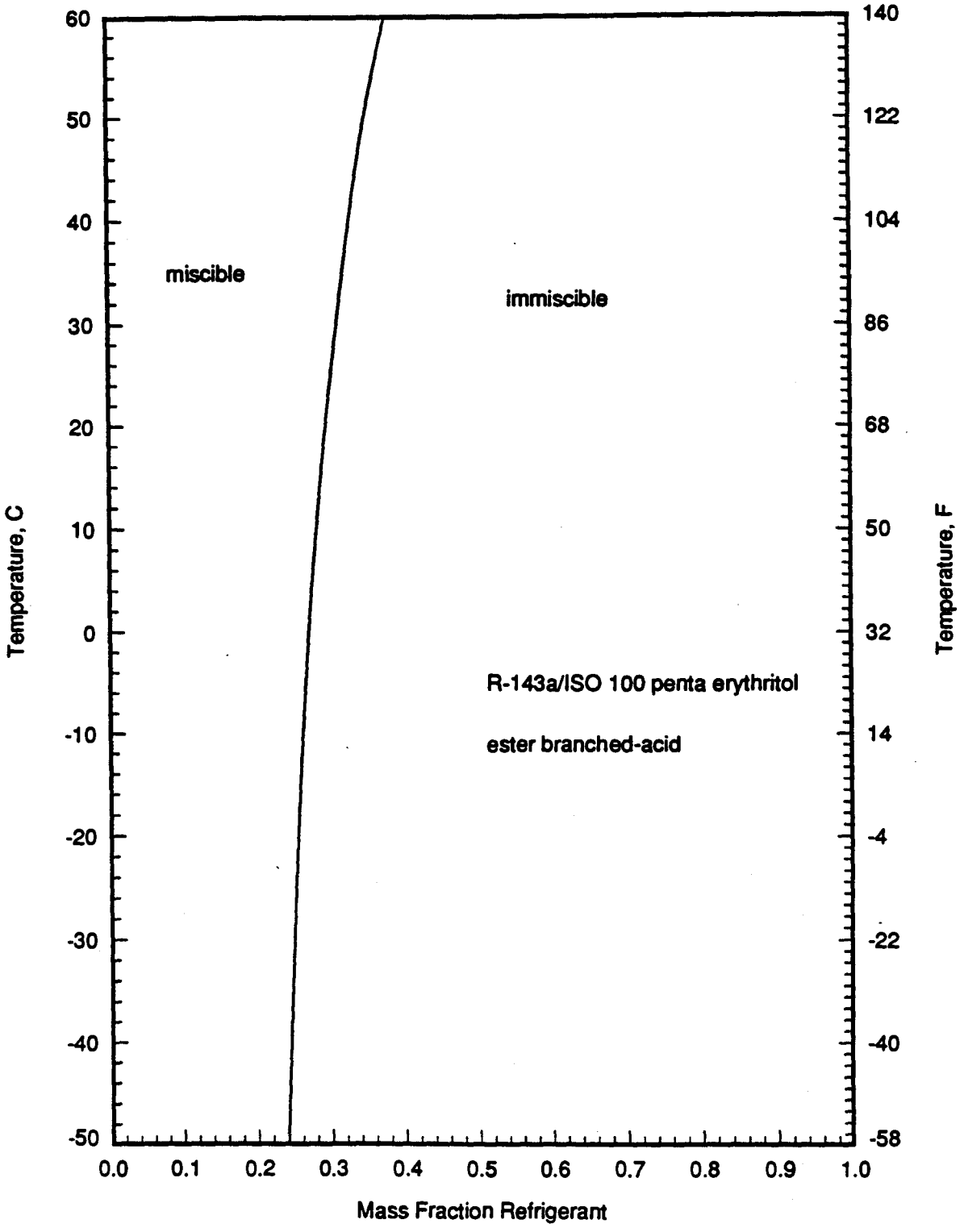

Figure 66 Miscibility plot for R-143a/ISO 100 penta erythritol ester branched-acid mixtures.

R-152a

R-152a was found to be completely miscible over the temperature range -50°C to 90°C with the following lubricants:

- polypropylene glycol butyl monoether (ISO 32)
- polypropylene glycol diol (ISO 32)
- modified polyglycol (ISO 32)
- penta erythritol ester mixed-acid (ISO 22)
- penta erythritol ester mixed-acid (ISO 32)
- penta erythritol ester branched-acid (ISO 32)
- penta erythritol ester mixed-acid (ISO 100)

Figure 67 shows a miscibility plot for R-152a and the ISO 32 naphthenic mineral oil. Figure 68 shows a miscibility plot for R-152a and the ISO 32 alkylbenzene. Figure 69 shows a miscibility plot for R-152a and the ISO 68 naphthenic mineral oil. Figure 70 shows a miscibility plot for R-152a and the ISO 68 alkylbenzene. Figure 71 shows a miscibility plot for R-152a and the ISO 58 polypropylene glycol butyl monoether. Figure 72 shows a miscibility plot for R-152a and the ISO 100 polypropylene glycol diol. Figure 73 shows a miscibility plot for R-152a and the ISO 100 penta erythritol ester branched-acid.

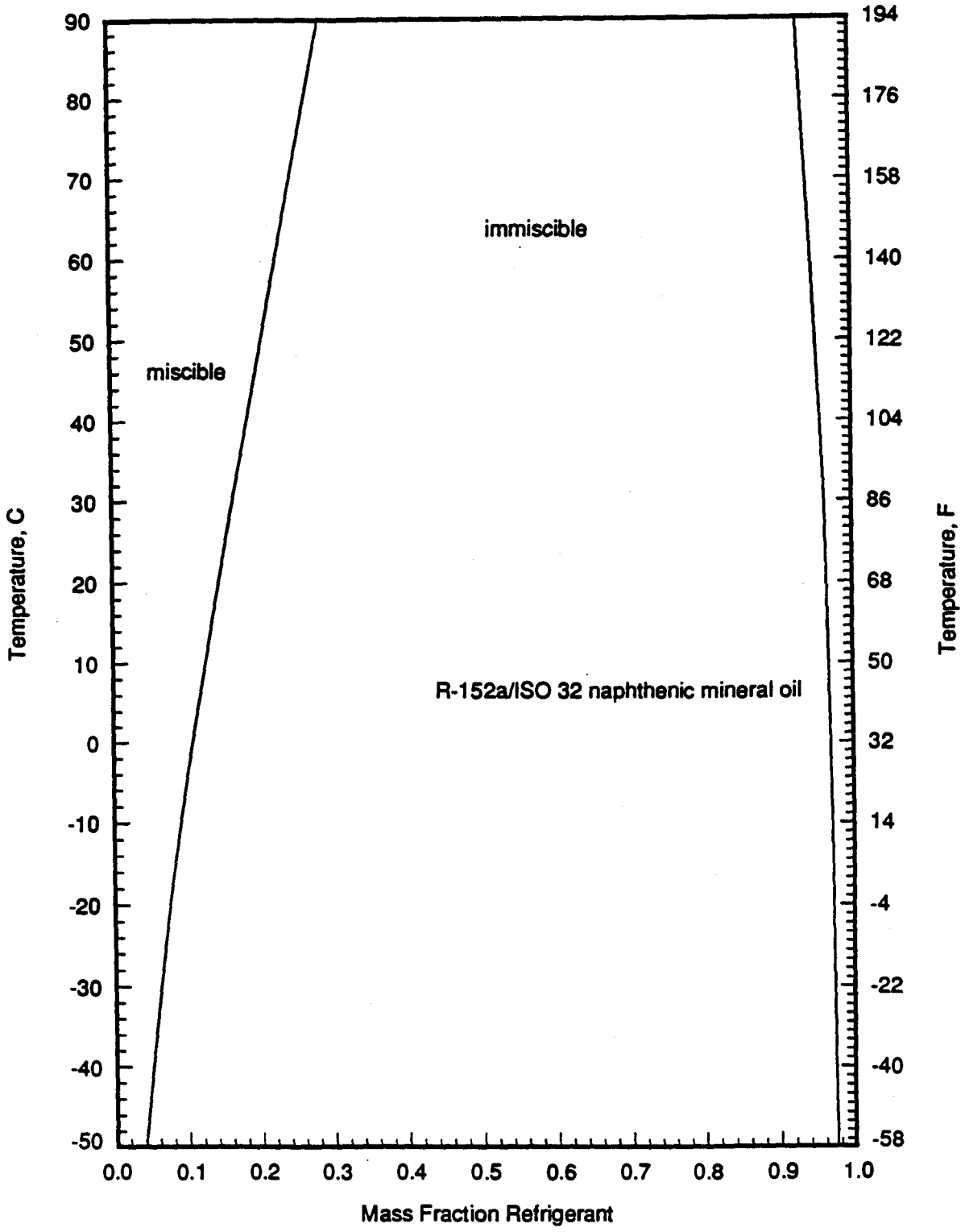

Figure 67 Miscibility plot for R-152a/ISO 32 naphthenic mineral oil mixtures.

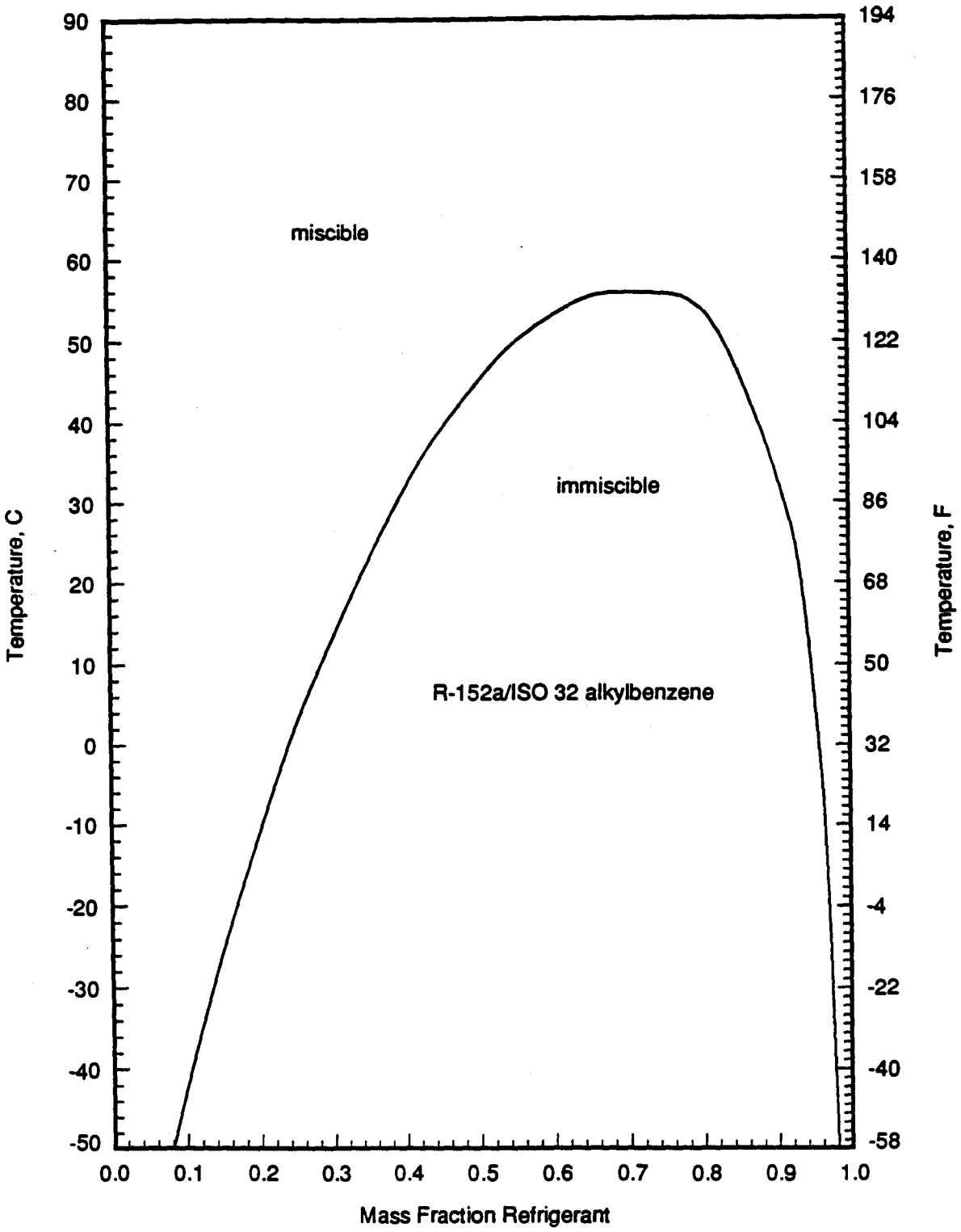

Figure 68 Miscibility plot for R-152a/ISO 32 alkylbenzene mixtures.

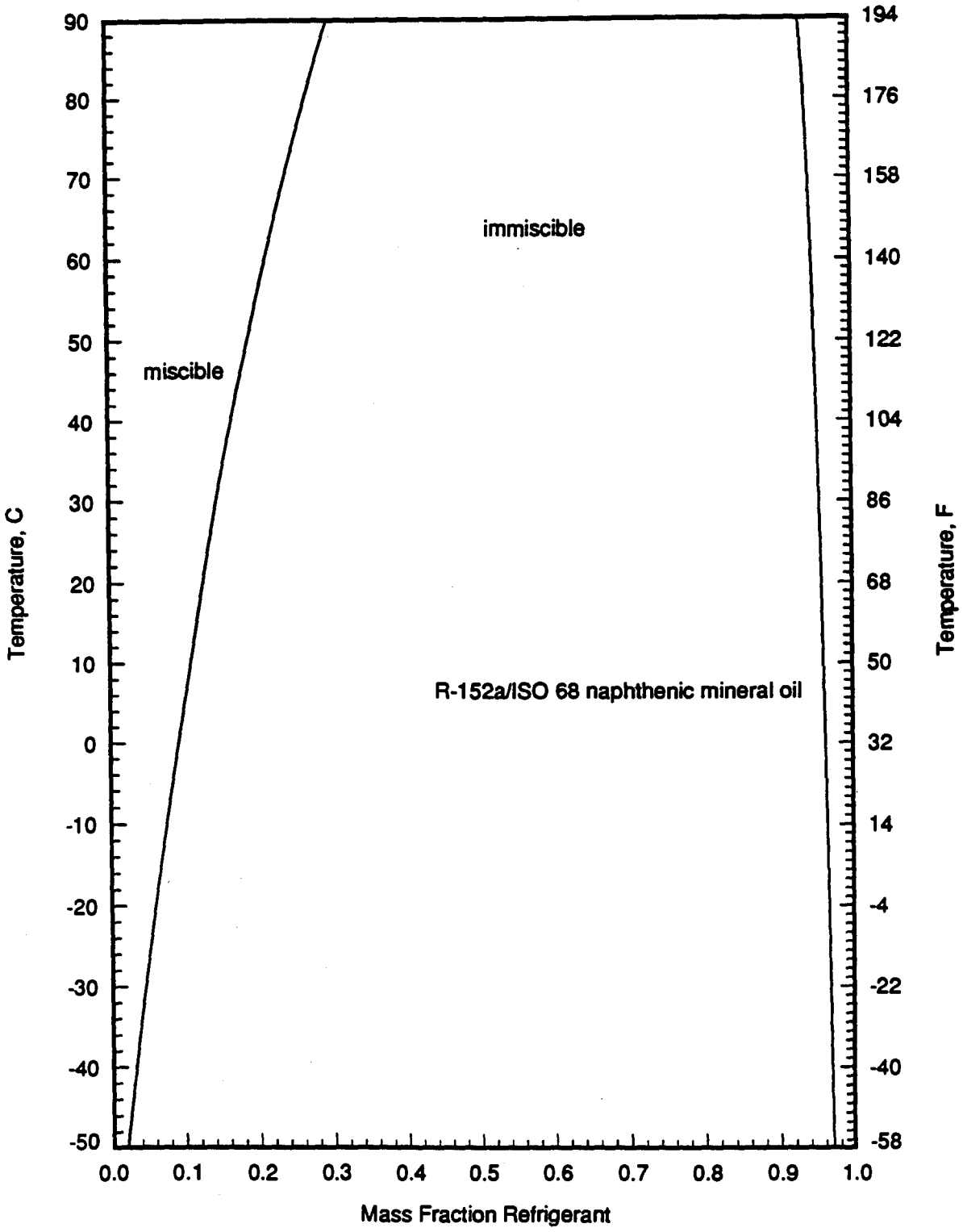

Figure 69 Miscibility plot for R-152a/ISO 68 naphthenic mineral oil mixtures.

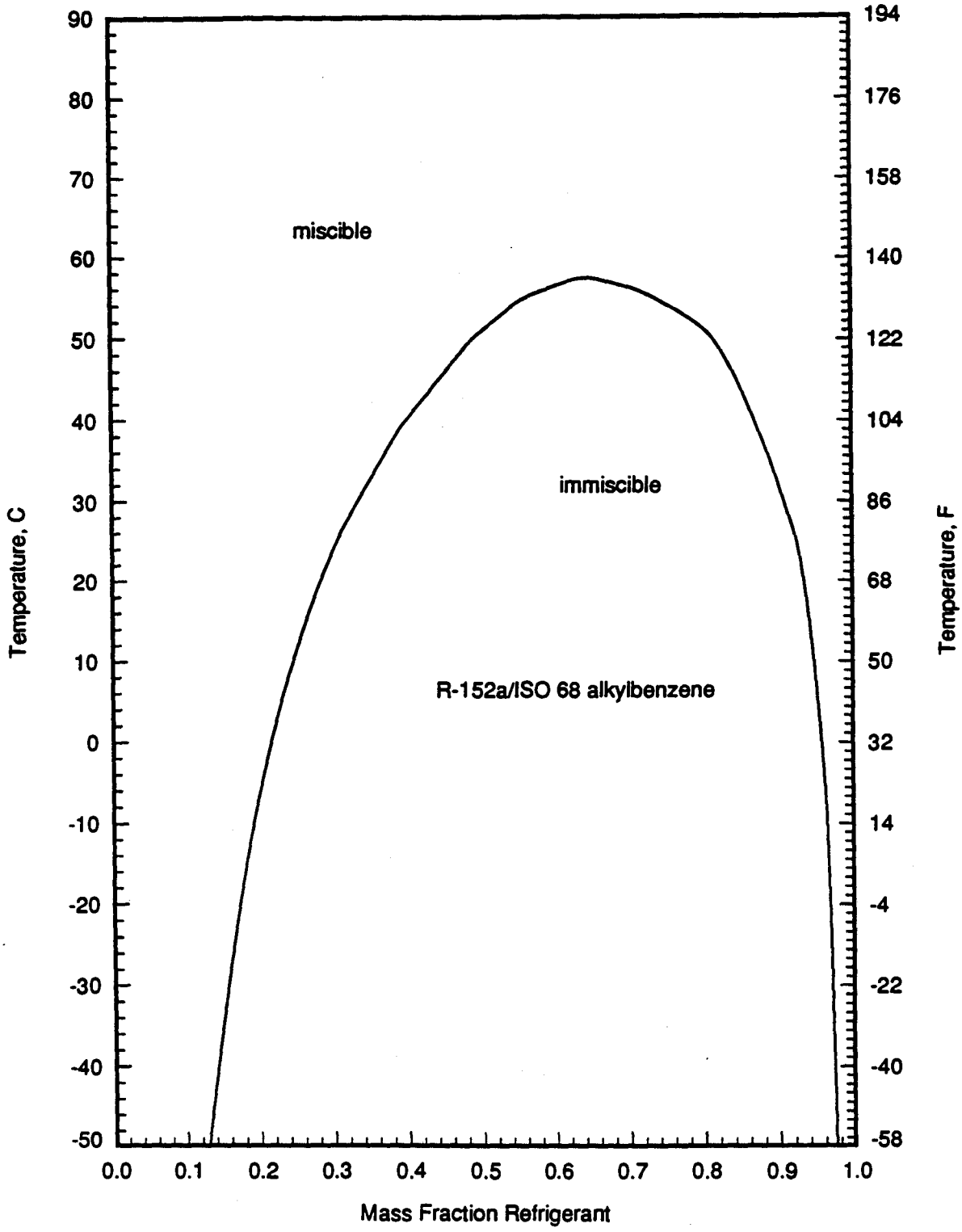

Figure 70 Miscibility plot for R-152a/ISO 68 alkylbenzene mixtures.

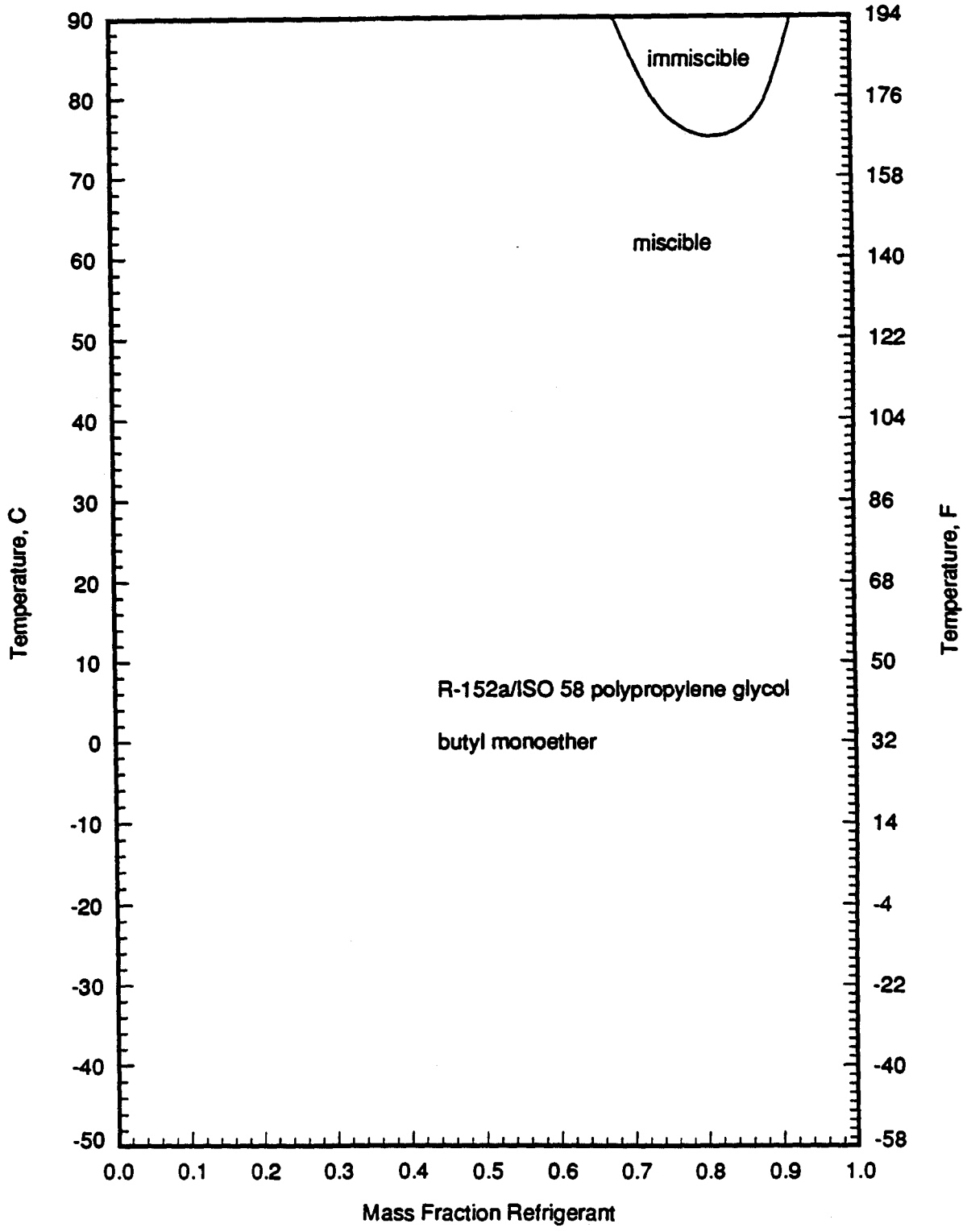

Figure 71 Miscibility plot for R-152a/ISO 58 polypropylene glycol butyl monoether mixtures.

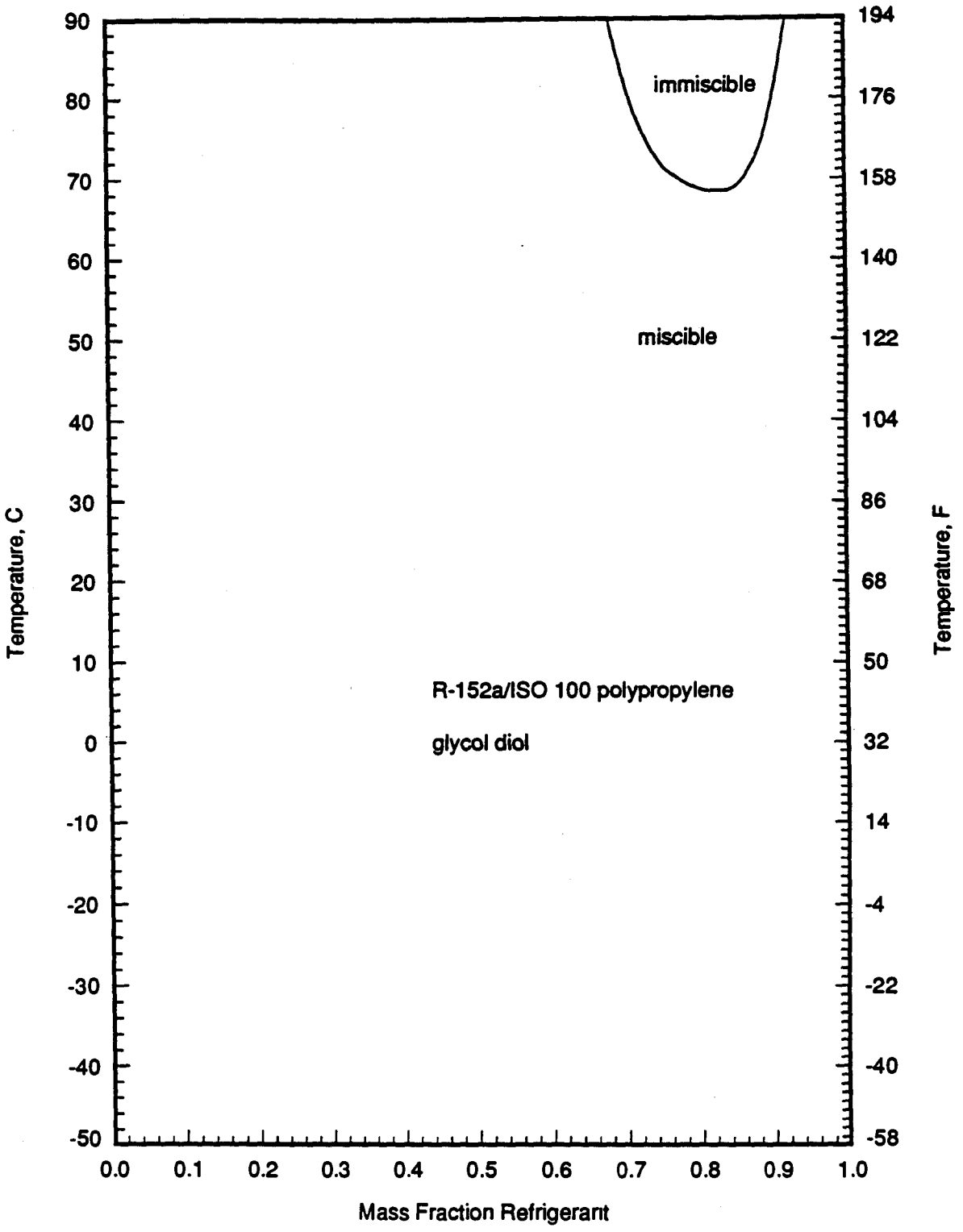

Figure 72 Miscibility plot for R-152a/ISO 100 polypropylene glycol diol mixtures.

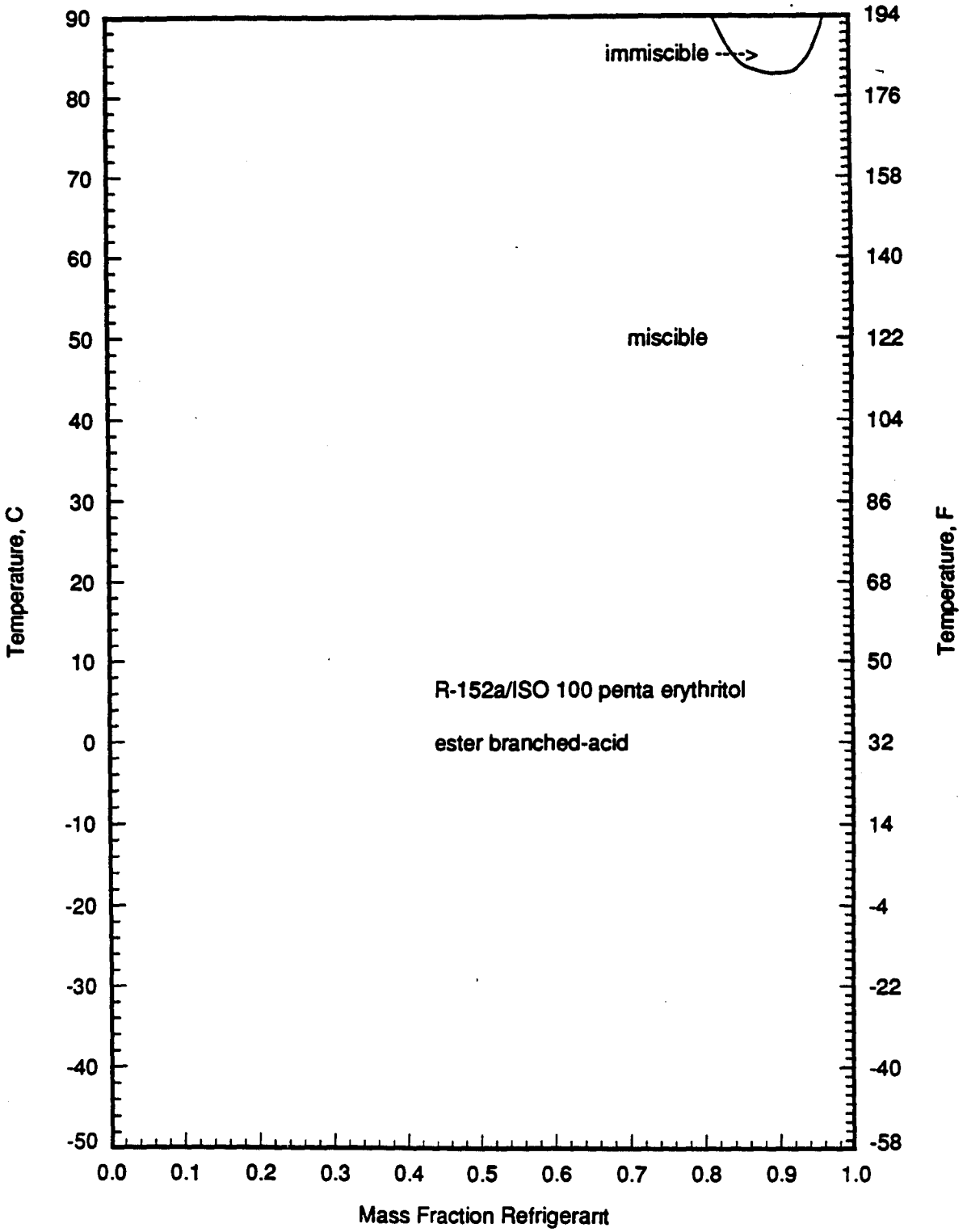

Figure 73 Miscibility plot for R-152a/ISO 100 penta erythritol ester branched-acid mixtures.

Additional Testing

Due to the possibility of errors during cleaning, charging, or data taking, some additional tests were performed to verify the results. When the eight concentrations of a refrigerant/lubricant combination were completed, a broad picture of the miscibility characteristics could be visualized. If any individual concentration was not consistent with the other seven concentrations for the refrigerant/lubricant combination, then that concentration was retested. This retesting accounts for any differences in the reported miscibility characteristics between Phase I and Phase II.

REFRIGERANT AND LUBRICANT PURITY

The lubricants used in this testing were to meet certain moisture content, acid number, iron content, and copper content requirements. These tests were conducted according to the standards recommended in the Work Statement, and the results are shown in Table 11. Prior to testing, each lubricant was heated and evacuated to remove dissolved air or water. This technique was also used prior to all miscibility testing. The refrigerants were used as delivered from the manufacturer.

Table 11 Characteristics of the test lubricants.

Lubricant	Moisture (ppm)	Iron Content (microgram/gram)	Copper Content (microgram/gram)	Acid Number
penta erythritol ester mixed-acid (ISO 22)	33	<1	<1	0.018
polypropylene glycol diol (ISO 32)	68	<1	<1	0.007
penta erythritol ester mixed-acid (ISO 32)	59	<1	<1	0.229
polypropylene glycol butyl monoether (ISO 32)	62	<1	<1	0.002
naphthenic mineral oil (ISO 32)	31	<1	<1	0.004
alkylbenzene (ISO 32)	28	<1	<1	0.006
modified polyglycol (ISO 32)	67	<1	<1	0.015
penta erythritol ester branched-acid (ISO 32)	43	<0.5	<0.5	0.025
naphthenic mineral oil (ISO 68)	14	<0.5	<0.5	0.043
alkylbenzene (ISO 68)	25	<0.5	<0.5	0.014
polypropylene glycol butyl monoether (ISO 58)	73	<0.5	<0.5	0.052
polypropylene glycol diol (ISO 100)	63	<0.5	<0.5	0.056
penta erythritol ester mixed-acid (ISO 100)	67	<0.5	<0.5	0.097
penta erythritol ester branched-acid (ISO 100)	99	<0.5	<0.5	0.056

CONCLUSIONS

Phase I and Phase II of the Miscibility of Lubricants With Refrigerants project is complete. Miscibility data have been obtained for a variety of non-CFC refrigerants and their potential lubricants. Ten (10) different refrigerants and fourteen (14) different lubricants were investigated. A test facility has been described and experimental procedures have been documented. Eight concentrations (10, 20, 35, 50, 65, 80, 90, and 95% refrigerant) of each refrigerant/lubricant combination were tested. The data have been summarized as well as presented in detail in the appendices. Each of the refrigerants tested are miscible with at least one of the lubricants, with the exception of R-143a, which exhibits partial miscibility with each of the lubricants.

COMPLIANCE WITH AGREEMENT

The work statement designated temperatures ranging from 90°C to -50°C in ten degree increments. The exact temperatures (e.g., 90, 80, ..., -50) are not necessarily being achieved. However, steady state temperatures near these temperatures at approximately 10°C increments are being achieved and recorded. Any immiscibility that occurs will certainly be observable by using this approach. The work statement also specified lubricant concentrations of 10%, 20%, 35%, 50%, 65%, 80%, 90%, and 95% refrigerant. For the data presented herein, the refrigerant concentrations are within ±4% from the above stated values. Exact refrigerant concentrations for each test are given, along with other data, in Appendix A. Also, the work statement stated that the lubricants meet certain purity requirements as previously discussed. In particular, it was stated that the moisture content of the ester and glycol based lubricants were not to exceed 50 ppm. These lubricants were found to contain slightly higher moisture levels as shown in Table 11. Also, the penta erythritol ester mixed-acid (ISO 32), the polypropylene glycol butyl monoether (ISO 58), the polypropylene glycol diol (ISO 100), the penta erythritol ester mixed-acid (ISO 68), and the penta erythritol ester branched-acid (ISO 100) were tested to have an acid number of 0.229, 0.052, 0.056, 0.097, and 0.056, respectively, whereas the required acid numbers were to be less than 0.05.

Appendix A - Tabulation of Experimental Data

Tables A1 through A140 provide a summary of the test data for each lubricant and refrigerant pair. In the following tables, if the mixture was separated into two liquid phases, it is designated as "2 phase". If the mixtures exhibited no evidence of immiscibility whatsoever, then it is designated as "clear". If the mixture was slightly hazy, it is designated as "slt hazy". If the mixture was hazy, it is noted as "hazy".

Table A1. Observations for R-22/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.20	.36	.47	.68	.81	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	2 phase	clear	clear
-20	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
-30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
Temp. Set	A	B	B	D	B	B	C	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.2	49.6	39.6	30.4	20.1	10.2	-0.3	-9.5	-19.6	-30.1	-40.1	-49.4
	B	XX	XX	XX	59.9	50.2	39.7	30.1	19.8	9.6	-0.1	-9.7	-20.5	-30.1	-40.3	-49.0
	C	XX	XX	XX	59.8	49.9	40.4	29.8	19.7	9.8	0.3	-9.7	-19.6	-30.2	-40.9	-49.8
	D	XX	XX	XX	60.1	50.0	39.9	30.1	20.0	10.0	-0.1	-9.9	-20.1	-30.1	-40.0	-47.6

Table A2. Observations for R-22/alkylbenzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.22	.37	.51	.65	.80	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.2	49.6	39.6	30.4	20.1	10.2	-0.3	-9.5	-19.6	-30.1	-40.1	-49.4
	B	XX	XX	XX	59.8	49.9	40.4	29.8	19.7	9.8	0.3	-9.7	-19.6	-30.2	-40.9	-49.8
	C															
	D															

Table A3. Observations for R-22/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °3C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.21	.33	.52	.68	.80	.91	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.4	50.3	40.3	30.3	20.2	10.3	0.3	-9.9	-20.0	-30.4	-40.3	-49.6
	B	XX	XX	XX	59.9	50.2	39.7	30.1	19.8	9.6	-0.1	-9.7	-20.5	-30.1	-40.3	-49.0
	C															
	D															

Table A4. Observations for R-22/polypropylene glycol diol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.23	.36	.53	.66	.80	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.4	50.3	40.3	30.3	20.2	10.3	0.3	-9.9	-20.0	-30.4	-40.2	-49.6
	B	XX	XX	XX	60.2	49.6	40.4	29.9	20.0	9.8	0.1	-9.6	-20.4	-29.9	-40.2	-48.3
	C															
	D															

Table A5. Observations for R-22/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.23	.39	.50	.68	.81	.91	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	very slt haze	very slt haze	clear	clear	clear	clear	clear
-30	clear	very slt haze	very slt haze	slt haze	clear	clear	clear	clear
-40	clear	very slt haze	slt haze	hazy	clear	clear	clear	clear
-50	clear	very slt haze	hazy	hazy	clear	clear	clear	clear
Temp. Set	C	B	B	D	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.9	50.2	39.5	29.8	19.6	10.4	0	-10.0	-19.8	-29.8	-39.6	-49.6
	B	XX	XX	XX	59.8	49.9	40.4	29.8	19.7	9.8	0.3	-9.7	-19.6	-30.2	-40.9	-49.8
	C	XX	XX	XX	60.1	50.0	39.9	30.1	20.0	10.0	-0.1	-9.9	-20.1	-30.1	-40.0	-47.6
	D	XX	XX	XX	60.0	49.9	40.1	30.4	20.0	10.0	-0.2	-9.8	-20.3	-30.2	-39.8	-48.9

Table A6. Observations for R-22/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.20	.32	.49	.64	.78	.90	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.4	50.3	40.3	30.3	20.2	10.3	-0.3	-9.9	-20.2	-30.4	-40.3	-49.6
	B	XX	XX	XX	60.2	49.6	40.4	29.9	20.0	9.8	0.1	-9.6	-20.4	-29.9	-40.2	-48.3
	C															
	D															

Table A7. Observations for R-22/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.24	.38	.48	.67	.82	.91	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	C	C	C	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.4	50.3	40.3	30.3	20.2	10.3	0.3	-9.9	-20.0	-30.4	-40.3	-49.6
	B	XX	XX	XX	60.2	49.6	40.4	29.9	20.0	9.8	0.1	-9.6	-20.4	-29.9	-40.2	-48.3
	C	XX	XX	XX	59.9	50.2	39.7	30.1	19.8	9.6	-0.1	-9.7	-20.5	-30.1	-40.3	-49.0
	D															

Table A8. Observations for R-22/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.17	.38	.51	.66	.79	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	50.0	39.9	29.9	19.8	10.0	-0.4	-10.3	-20.0	-29.9	-40.0	-47.6
	B															
	C															
	D															

Table A9. Observations for R-22/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.22	.36	.51	.64	.80	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	hazy	clear	clear
0	clear	clear	clear	clear	2 phase	2 phase	clear	clear
-10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.4	50.4	39.9	29.9	19.9	10.9	0.0	-10.5	-19.7	-29.9	-40.3	-48.2
	B															
	C															
	D															

Table A10. Observations for R-22/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.22	.35	.48	.63	.79	.91	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	C	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.4	50.4	39.9	29.9	19.9	10.9	0.0	-10.5	-19.7	-29.9	40.3	48.2
	B	XX	XX	XX	60.7	50.0	39.8	30.2	19.8	10.4	0.0	-9.9	-19.9	-29.7	-39.5	-48.5
	C	XX	XX	XX	60.1	50.0	39.9	30.1	20.0	10.0	-0.1	-9.9	-20.1	-30.1	-40.0	-47.6
	D															

Table A11. Observations for R-22/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.24	.37	.48	.65	.80	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	49.9	39.9	30.0	20.1	10.3	-0.2	-10.3	-20.0	-30.0	-40.2	-48.6
	B	XX	XX	XX	60.0	49.9	40.1	30.2	20.1	10.2	0.4	-9.8	-19.7	-29.6	-40.0	-47.0
	C															
	D															

Table A12. Observations for R-22/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.23	.38	.50	.61	.80	.90	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	50.0	39.9	29.9	19.8	10.0	-0.4	-10.3	-20.0	-29.9	-40.0	-47.6
	B	XX	XX	XX	60.0	50.1	40.0	30.1	20.0	10.0	-0.5	-10.3	-20.3	-30.0	-40.4	-48.1
	C															
	D															

Table A13. Observations for R-22/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.37	.52	.65	.78	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.7	50.0	39.8	30.2	19.8	10.4	0.0	-9.9	-19.9	-29.7	-39.5	-48.5
	B															
	C															
	D															

Table A14. Observations for R-22/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.20	.37	.50	.66	.78	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	50.1	40.0	30.1	20.0	10.0	-0.5	-10.3	-20.3	-30.0	-40.4	-48.1
	B															
	C															
	D															

Table A15. Observations for R-32/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.20	.34	.53	.65	.79	.89	.94
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	C	C	B	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.5	30.3	20.5	10.0	-0.2	-10.3	-20.3	-29.8	-40.1	-46.0
	B	XX	XX	XX	57.0	50.0	40.2	29.7	19.8	11.0	-0.2	-9.8	-19.6	-30.3	-40.4	-48.0
	C	XX	XX	XX	60.0	49.7	40.1	30.4	20.5	9.7	0.2	-9.8	-19.9	-30.2	-40.3	-48.9
	D															

Table A16. Observations for R-32/alkylbenzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.21	.35	.49	.64	.80	.89	.94
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	C	C	B	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.5	30.3	20.5	10.0	-0.2	-10.3	-20.3	-29.8	-40.1	-46.0
	B	XX	XX	XX	57.0	50.0	40.2	29.7	19.8	11.0	-0.2	-9.8	-19.6	-30.3	-40.4	-48.0
	C	XX	XX	XX	60.0	49.7	40.1	30.4	20.5	9.7	0.2	-9.8	-19.9	-30.2	-40.3	-48.9
	D															

Table A17. Observations for R-32/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.20	.34	.53	.63	.80	.89	.94
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
20	clear	clear	clear	clear	clear	2 phase	2 phase	clear
10	clear	clear	clear	clear	clear	2 phase	2 phase	clear
0	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
-10	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
-20	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	55.4	49.9	38.7	30.2	20.3	11.3	0.3	-9.6	-19.6	-30.4	-40.4	-48.3
	B	XX	XX	XX	60.4	50.0	40.2	30.0	20.4	10.0	-0.1	-10.0	-19.6	-29.7	-40.1	-48.0
	C															
	D															

Table A18. Observations for R-32/polypropylene glycol diol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.21	.35	.50	.63	.78	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	A	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.5	30.3	20.5	10.0	-0.2	-10.3	-20.3	-29.8	-40.1	-46.0
	B	XX	XX	XX	55.4	49.9	38.7	30.2	20.3	11.3	-0.3	-9.6	-19.6	-30.4	-40.4	-48.3
	C	XX	XX	XX	60.3	49.9	40.1	30.3	20.5	9.9	-0.3	-10.5	-19.7	-30.0	-40.1	-49.3
	D															

Table A19. Observations for R-32/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.34	.48	.65	.80	.90	.94
60	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	slt haze	clear	clear	clear	clear
0	clear	clear	slt haze	slt haze	slt haze	clear	clear	clear
-10	clear	clear	slt haze	slt haze	hazy	clear	clear	clear
-20	clear	clear	slt haze	slt haze	hazy	clear	clear	clear
-30	clear	clear	hazy	hazy	hazy	clear	clear	clear
-40	clear	hazy	hazy	hazy	hazy	clear	clear	clear
-50	clear	hazy	hazy	hazy	hazy	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.9	50.2	39.5	29.8	19.6	10.4	-0.3	-10.0	-19.8	-29.8	-39.6	-49.6
	B	XX	XX	XX	60.4	50.0	40.2	30.0	20.4	10.0	-0.1	-10.0	-19.6	-29.7	-40.1	-48.0
	C															
	D															

Table A20. Observations for R-32/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.20	.35	.49	.65	.79	.90	.95
60	clear	clear	clear	clear	2 phase	2 phase	clear	clear
50	clear	clear	clear	clear	2 phase	2 phase	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	2 phase	2 phase	clear	clear
-10	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
-20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	55.4	49.9	38.7	30.2	20.3	11.3	-0.3	-9.6	-19.6	-30.4	-40.4	-48.3
	B	XX	XX	XX	60.3	49.9	40.1	30.3	20.5	9.9	-0.3	-10.5	-19.7	-30.0	-40.1	-49.3
	C															
	D															

Table A21. Observations for R-32/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.21	.34	.48	.61	.79	.90	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	hazy	slt haze	slt haze
-30	clear	clear	clear	clear	2 phase	hazy	2 phase	hazy
-40	clear	clear	clear	hazy	2 phase	hazy	2 phase	2 phase
-50	clear	clear	clear	2 phase	2 phase	hazy	2 phase	2 phase
Temp. Set	A	D	D	A	C	C	D	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.5	30.3	20.5	10.0	-0.2	-10.3	-20.3	-29.8	-40.1	-46.0
	B	XX	XX	XX	55.4	49.9	38.7	30.2	20.3	11.3	-0.3	-9.6	-19.6	-30.4	-40.4	-48.3
	C	XX	XX	XX	60.4	50.0	40.2	30.0	20.4	10.0	-0.1	-10.0	-19.6	-29.7	-40.1	-48.0
	D	XX	XX	XX	60.0	49.7	40.1	30.4	20.5	9.7	0.2	-9.8	-19.9	-30.2	-40.3	-48.9

Table A22. Observations for R-32/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.20	.36	.51	.65	.79	.90	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	hazy	hazy	clear	clear
-30	clear	clear	clear	2 phase	2 phase	2 phase	hazy	clear
-40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.3	49.8	40.2	29.8	20.1	9.9	-0.4	-9.5	-19.9	-30.0	-40.5	-48.5
	B															
	C															
	D															

Table A23. Observations for R-32/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.20	.36	.48	.64	.79	.89	.95
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.0	39.8	30.0	19.8	9.7	-0.4	-9.9	-19.6	-29.9	-40.0	-48.1
	B															
	C															
	D															

Table A24. Observations for R-32/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.22	.33	.48	.65	.80	.89	.95
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	B	B	B	B	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.3	49.8	40.2	29.8	20.1	9.9	-0.4	-9.5	-19.9	-30.0	-40.5	-48.5
	B	XX	XX	XX	60.1	50.0	39.8	30.0	19.8	9.7	-0.4	-9.9	-19.6	-29.9	-40.0	-48.1
	C															
	D															

Table A25. Observations for R-32/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.32	.47	.64	.80	.89	.94
60	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
20	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
10	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
0	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	B	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.0	39.9	30.1	20.0	10.0	-0.1	-9.9	-20.1	-30.1	-40.0	-47.6
	B	XX	XX	XX	60.0	49.9	40.2	30.0	20.3	10.0	-0.4	-9.6	-19.8	-29.6	-40.2	-49.3
	C															
	D															

Table A26. Observations for R-32/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.36	.49	.64	.78	.90	.94
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
20	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
10	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
0	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	49.8	39.9	30.2	20.3	10.4	0.0	-10.0	-20.1	-30.5	-40.3	-46.7
	B	XX	XX	XX	60.4	50.0	40.3	30.2	20.4	9.9	-0.3	-10.0	-20.1	-30.1	-40.1	-47.5
	C															
	D															

Table A27. Observations for R-32/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.35	.51	.65	.78	.89	.94
60	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
50	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
40	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
30	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
20	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
0	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.4	50.0	40.3	30.2	20.4	9.9	-0.3	-10.0	-20.1	-30.1	-40.1	-47.5
	B															
	C															
	D															

Table A28. Observations for R-32/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.35	.51	.65	.80	.90	.95
60	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
30	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
20	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
10	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
0	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
-10	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
-20	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	49.8	39.9	30.2	20.3	10.4	0.0	-10.0	-20.1	-30.5	-40.3	-46.7
	B															
	C															
	D															

Table A29. Observations for R-123/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.23	.34	.53	.62	.80	.90	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	D	B	C	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.2	49.6	39.6	30.4	20.1	10.2	-0.3	-9.5	-19.6	-30.1	-40.1	-49.4
	B	XX	XX	XX	59.6	50.4	39.3	30.0	19.7	10.7	-0.4	-9.6	-19.5	-29.7	-40.2	-47.4
	C	XX	XX	XX	59.5	49.7	40.1	30.0	19.9	10.6	0.1	-9.9	-19.7	-30.3	-39.9	-49.0
	D	XX	XX	XX	60.3	49.6	40.4	30.2	19.9	10.1	-0.2	-9.9	-19.9	-29.8	-39.9	-47.4

Table A30. Observations for R-123/alkylbenzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.19	.31	.50	.64	.78	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.2	49.6	39.6	30.4	20.1	10.2	-0.3	-9.5	-19.6	-30.1	-40.1	-49.4
	B	XX	XX	XX	59.9	49.7	40.1	30.0	19.9	10.6	0.5	-9.9	-19.7	-30.3	-39.9	-49.0
	C															
	D															

Table A31. Observations for R-123/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °3C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.21	.36	.48	.65	.80	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.8	50.7	40.7	30.2	19.9	10.1	-0.4	-9.6	-19.7	-30.5	-40.3	-49.0
	B	XX	XX	XX	59.6	50.4	39.8	30.0	19.7	10.7	-0.4	-9.6	-19.5	-29.7	-40.2	-47.4
	C															
	D															

Table A32. Observations for R-123/polypropylene glycol diol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.17	.33	.50	.68	.76	.89	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.8	50.7	40.7	30.2	19.9	10.1	-0.4	-9.6	-19.7	-30.5	-40.3	-49.0
	B	XX	XX	XX	60.0	50.3	39.8	30.2	20.5	11.4	0.5	-9.5	-19.6	-30.4	-40.2	-47.1
	C															
	D															

Table A33. Observations for R-123/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.22	.39	.49	.69	.81	.91	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	slt haze	clear	clear	clear	clear	clear
-50	clear	clear	slt haze	clear	clear	clear	clear	clear
Temp. Set	B	C	D	C	A	A	A	C

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.5	49.7	40.1	30.0	19.9	10.6	0.5	-9.9	-19.7	-30.3	-39.9	-49.0
	B	XX	XX	XX	59.9	50.2	39.5	29.8	19.6	10.4	0.0	-10.0	-19.8	-29.8	-39.6	-49.6
	C	XX	XX	XX	60.0	49.9	40.1	30.4	20.0	10.0	-0.2	-9.7	-20.3	-30.2	-39.8	-48.9
	D	XX	XX	XX	60.3	49.6	40.4	30.2	19.9	10.1	-0.2	-9.9	-19.9	-29.8	-39.9	-47.4

Table A34. Observations for R-123/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.16	.38	.52	.67	.81	.89	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.8	50.7	40.7	30.2	19.9	10.1	-0.4	-9.6	-19.7	-30.5	-40.3	-49.0
	B	XX	XX	XX	60.0	50.3	39.8	30.2	20.5	11.4	0.5	-9.5	-19.6	-30.4	-40.2	-47.1
	C															
	D															

Table A35. Observations for R-123/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.18	.36	.51	.66	.81	.91	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	C	C	C	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.8	50.7	40.7	30.2	19.9	10.1	-0.4	-9.6	-19.7	-30.5	-40.3	-49.0
	B	XX	XX	XX	60.0	50.3	39.8	30.2	20.5	11.4	0.5	-9.5	-19.6	-30.4	-40.2	-47.1
	C	XX	XX	XX	59.6	50.4	39.8	30.0	19.7	10.7	-0.4	-9.6	-19.5	-29.7	-40.2	-47.4
	D															

Table A36. Observations for R-123/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.23	.38	.47	.64	.79	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.7	50.4	39.9	30.3	20.3	10.0	0.1	-10.0	-19.8	-29.7	-39.7	-48.4
	B															
	C															
	D															

Table A37. Observations for R-123/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.21	.38	.47	.63	.80	.89	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	slt haze	clear	clear
-50	clear	clear	clear	hazy	hazy	2 phase	2 phase	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.8	49.6	40.0	30.5	20.3	9.6	0.1	-10.3	-19.6	-29.7	-40.3	-47.7
	B															
	C															
	D															

Table A38. Observations for R-123/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.07	.23	.37	.52	.65	.80	.89	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	B	B	C	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.3	49.5	40.2	30.0	20.1	9.0	0.1	-10.2	-20.1	-29.9	-39.8	-49.2
	B	XX	XX	XX	59.8	49.6	40.0	30.5	20.3	9.6	0.1	-10.3	-19.6	-29.7	-40.3	-47.7
	C	XX	XX	XX	60.0	49.9	40.1	30.4	20.0	10.0	-0.2	-9.7	20.3	-30.2	-39.8	-48.9
	D															

Table A39. Observations for R-123/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.21	.38	.48	.64	.78	.90	.95
60	2 phase	2 phase	clear	clear	clear	clear	clear	clear
50	2 phase	2 phase	clear	clear	clear	clear	clear	clear
40	clear	2 phase	clear	clear	clear	clear	clear	clear
30	clear	2 phase	clear	clear	clear	clear	clear	clear
20	clear	2 phase	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	49.9	39.9	30.0	20.1	10.3	-0.4	-10.3	-20.0	-30.0	-40.2	-48.6
	B															
	C															
	D															

Table A40. Observations for R-123/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.22	.35	.51	.61	.79	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	B	B	B	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.0	40.0	30.0	20.0	10.0	-0.2	-10.1	-20.0	-30.0	-40.0	-47.7
	B	XX	XX	XX	59.7	50.4	39.9	30.3	20.3	10.0	0.1	-10.0	-19.8	-29.7	-39.7	-48.4
	C															
	D															

Table A41. Observations for R-123/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.21	.34	.51	.64	.79	.88	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.3	49.5	40.2	30.0	20.1	9.0	0.1	-10.2	-20.1	-29.9	-39.8	-49.2
	B															
	C															
	D															

Table A42. Observations for R-123/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.23	.38	.53	.66	.80	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.0	40.0	30.0	20.0	10.0	-0.2	-10.1	-20.0	-30.0	-40.0	-47.7
	B															
	C															
	D															

Table A43. Observations for R-124/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.23	.36	.52	.66	.81	.90	.96
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
10	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
0	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	slt haze	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	C	A	A	C	A	A	B	C

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.8	79.8	70.2	59.8	49.9	39.8	30.1	19.7	10.4	0.2	-9.8	-20.3	-30.4	-40.2	-46.6
	B	89.8	79.8	70.2	60.0	50.0	39.9	30.3	20.5	10.9	-0.4	-10.2	-20.3	-30.2	-39.9	-47.4
	C	88.5	80.1	70.1	60.2	50.0	40.5	30.4	20.1	10.3	-0.1	-9.7	-19.8	-30.0	-40.2	-49.5
	D															

Table A44. Observations for R-124/alkylbenzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.21	.32	.51	.63	.78	.90	.96
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	88.5	80.1	70.1	60.2	50.0	40.5	30.4	20.1	10.3	-0.1	-9.7	-19.8	-30.0	-39.9	-49.5
	B	89.8	79.8	70.2	60.2	50.0	39.9	30.3	20.5	10.9	-0.4	-10.2	-20.3	-30.2	-39.9	-47.4
	C															
	D															

Table A45. Observations for R-124/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °3C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.23	.37	.51	.65	.81	.91	.96
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.7	79.6	69.8	60.0	50.3	40.2	30.1	19.9	10.1	-0.3	-9.5	-20.4	-30.0	-40.5	-49.7
	B	89.8	79.8	70.2	59.8	49.9	39.8	30.1	19.7	10.4	0.2	-9.8	-20.3	-30.4	-40.2	-46.6
	C															
	D															

Table A46. Observations for R-124/polypropylene glycol diol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.24	.34	.52	.66	.79	.90	.96
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	C	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.7	79.6	69.8	60.0	50.3	40.2	30.1	19.9	10.1	-0.3	-9.5	-20.4	-30.0	-40.5	-49.7
	B	89.6	80.0	70.2	60.2	49.9	40.0	29.8	19.9	9.9	0.2	-9.8	-19.5	-30.2	-40.1	-50.0
	C	90.0	80.0	70.0	60.0	49.9	40.0	30.0	20.0	9.8	0.1	-10.1	-19.6	-29.7	-39.8	-49.2
	D															

Table A47. Observations for R-124/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.19	.37	.50	.67	.81	.90	.94
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	slt haze	clear	clear	clear
-20	clear	clear	slt haze	clear	slt haze	slt haze	clear	clear
-30	clear	clear	slt haze	slt haze	slt haze	slt haze	clear	clear
-40	clear	clear	slt haze	slt haze	slt haze	slt haze	clear	clear
-50	clear	clear	slt haze	slt haze	slt haze	slt haze	clear	clear
Temp. Set	C	A	A	B	A	A	A	C

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.8	79.8	70.2	60.2	50.0	39.9	30.3	20.5	10.9	-0.4	-10.2	-20.3	-30.2	-39.9	-47.4
	B	89.7	79.6	69.7	59.9	50.2	40.5	30.1	19.7	10.3	-0.4	-9.7	-19.6	-30.1	-40.5	-49.6
	C	87.6	79.6	69.7	59.6	49.8	39.6	29.6	19.8	9.5	0.1	-9.7	-20.3	-30.2	-40.3	-50.0
	D															

Table A48. Observations for R-124/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.23	.34	.54	.66	.79	.91	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.7	79.6	69.8	60.0	50.3	40.2	30.1	19.9	10.1	-0.3	-9.5	-20.4	-30.0	-40.5	-49.7
	B	89.6	80.0	70.2	60.2	49.9	40.0	29.8	19.9	9.9	0.2	-9.8	-19.5	-30.2	-40.1	-50.0
	C															
	D															

Table A49. Observations for R-124/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.24	.39	.46	.63	.79	.91	.94
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	C	C	C	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.7	79.6	69.8	60.0	50.3	40.2	30.1	19.9	10.1	-0.3	-9.5	-20.4	-30.0	-40.5	-49.7
	B	89.6	80.0	70.2	60.2	49.9	40.0	29.8	19.9	9.9	0.2	-9.8	-19.5	-30.2	-40.1	-50.0
	C	89.8	79.8	70.2	59.8	49.9	39.8	30.1	19.7	10.4	0.2	-9.8	-20.3	-30.4	-40.2	-46.6
	D															

Table A50. Observations for R-124/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.16	.37	.51	.66	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.3	80.3	70.3	60.1	50.0	40.2	29.5	20.0	12.2	-0.2	-10.2	-19.8	-30.1	-40.4	-47.8
	B															
	C															
	D															

Table A51. Observations for R-124/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.22	.37	.50	.66	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	2 phase	clear	clear
40	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
30	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.7	79.7	69.6	60.0	49.8	39.5	30.0	20.1	9.7	0.0	-10.2	-19.9	-30.0	-40.2	-48.6
	B															
	C															
	D															

Table A52. Observations for R-124/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.16	.37	.51	.65	.78	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	B	B	B	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.8	80.0	69.8	60.0	50.2	40.3	30.4	20.4	10.4	-0.1	-10.1	-19.9	-30.1	-40.2	-48.2
	B	89.7	79.7	69.6	60.0	49.8	39.5	30.0	20.1	9.7	0.0	-10.2	-19.9	-30.0	-40.2	-48.6
	C															
	D															

Table A53. Observations for R-124/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.36	.51	.65	.79	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	79.9	69.4	60.2	50.0	39.9	30.0	20.3	10.0	0.0	-9.8	-20.0	-29.8	-39.7	-49.2
	B															
	C															
	D															

Table A54. Observations for R-124/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.19	.33	.51	.63	.77	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	B	B	B	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	80.1	70.0	60.0	50.0	39.9	29.7	20.0	10.2	0.0	-9.8	-19.9	-29.8	-40.4	-49.6
	B	90.3	80.3	70.3	60.1	50.0	40.2	29.5	20.0	12.2	-0.2	-10.2	-19.8	-30.1	-40.4	-47.8
	C															
	D															

Table A55. Observations for R-124/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.17	.38	.50	.64	.80	.89	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.8	80.0	69.8	60.0	50.2	40.3	30.4	20.4	10.4	-0.1	-10.1	-19.9	-30.1	-40.1	-48.2
	B															
	C															
	D															

Table A56. Observations for R-124/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.17	.38	.52	.66	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	80.1	70.0	60.0	50.0	39.9	29.7	20.0	10.2	0.0	-9.81	-19.9	-29.8	-40.4	-49.6
	B															
	C															
	D															

Table A57. Observations for R-125/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.23	.33	.52	.66	.80	.90	.95
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	C	A	A	C	A	A	B	C

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.6	48.8	39.8	29.6	19.7	10.8	-0.2	-9.8	-20.0	-30.3	-39.8	-49.5
	B	XX	XX	XX	58.6	50.2	39.7	29.9	19.7	10.6	0.2	-9.8	-19.9	-30.1	-40.3	-49.5
	C	XX	XX	XX	59.8	49.2	40.0	30.1	20.1	10.5	-0.6	-9.3	-19.7	-30.2	-39.8	-47.3
	D															

Table A58. Observations for R-125/alkyl benzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.22	.33	.53	.66	.81	.91	.95
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	B	A	A	B	A	A	A	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	58.6	50.2	39.7	29.9	19.7	10.6	0.2	-9.8	-19.9	-30.1	-40.3	-49.5
	B	XX	XX	XX	59.8	49.2	40.0	30.1	20.1	10.5	-0.6	-9.3	-19.7	-30.2	-39.8	-47.3
	C															
	D															

Table A59. Observations for R-125/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °3C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.23	.37	.52	.65	.82	.90	.96
60	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	A	D	C	D	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.5	49.9	40.3	30.1	20.1	9.9	0.3	-10.1	-20.4	-30.1	-40.0	-49.0
	B	XX	XX	XX	60.5	50.1	40.1	30.3	20.1	10.7	-0.1	-9.7	-20.2	-30.5	-39.8	-47.8
	C	XX	XX	XX	59.6	49.8	39.8	29.6	19.7	10.8	-0.2	-9.8	-20.0	-30.3	-39.8	-49.5
	D	XX	XX	XX	59.8	49.6	40.1	29.8	19.7	10.0	-0.4	-10.1	-20.2	-29.6	-40.0	-48.6

Table A60. Observations for R-125/polypropylene glycol diol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.18	.38	.48	.64	.82	.90	.96
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	A	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.5	49.9	40.1	30.1	20.1	9.9	0.3	-10.1	-20.4	-30.1	-40.0	-49.0
	B	XX	XX	XX	60.5	50.1	40.1	30.3	20.1	10.7	-0.1	-9.7	-20.2	-30.5	-39.8	-47.8
	C	XX	XX	XX	59.9	49.9	40.1	30.3	20.0	10.8	-0.2	-10.1	-19.9	-29.9	-40.0	-49.5
	D															

Table A61. Observations for R-125/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.20	.36	.49	.61	.82	.90	.95
60	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
40	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
30	clear	clear	clear	clear	clear	clear	2 phase	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	slt haze	slt haze	clear	clear	clear
-10	clear	clear	clear	hazy	slt haze	clear	clear	clear
-20	clear	clear	clear	hazy	hazy	clear	clear	clear
-30	clear	hazy	hazy	hazy	hazy	clear	clear	clear
-40	clear	hazy	hazy	hazy	hazy	clear	clear	clear
-50	clear	hazy	hazy	hazy	hazy	clear	clear	clear
Temp. Set	B	A	A	B	C	A	A	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	58.6	50.2	39.7	29.9	19.7	10.6	0.2	-9.8	-19.9	-30.1	-40.3	-49.5
	B	XX	XX	XX	59.9	50.2	40.5	30.1	19.7	10.3	-0.4	-9.7	-19.6	-30.1	-40.5	-49.6
	C	XX	XX	XX	59.8	49.6	40.1	29.8	19.7	10.0	-0.4	-10.0	-20.0	-29.6	-40.0	-48.6
	D															

Table A62. Observations for R-125/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.18	.32	.48	.65	.80	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	C	C	C	D

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.5	49.9	40.1	30.1	20.1	9.9	0.3	-10.1	-20.4	-30.1	-40.0	-49.0
	B	XX	XX	XX	60.5	50.1	40.1	30.3	20.1	10.7	-0.1	-9.7	-20.2	-30.5	-39.8	-47.8
	C	XX	XX	XX	59.9	49.9	40.1	30.3	20.0	10.8	-0.2	-10.1	-19.9	-29.9	-40.0	-49.5
	D	XX	XX	XX	59.8	49.6	40.1	29.8	19.7	10.0	-0.4	-10.0	-20.2	-29.6	-40.0	-48.6

Table A63. Observations for R-125/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.08	.22	.35	.50	.68	.81	.89	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	D	D	A	C	C	E	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.5	49.9	40.1	30.1	20.1	9.9	0.3	-10.1	-20.4	-30.1	-40.0	-49.0
	B	XX	XX	XX	60.5	50.1	40.1	30.3	20.1	10.7	-0.1	-9.7	-20.2	-30.5	-39.8	-47.8
	C	XX	XX	XX	59.6	49.8	39.8	39.6	19.7	10.8	-0.2	-9.8	-20.0	-30.3	-39.8	-49.5
	D	XX	XX	XX	59.9	49.9	40.1	30.3	20.0	10.8	-0.2	-10.1	-19.9	-29.9	-40.0	-49.5
	E	XX	XX	XX	59.8	49.6	40.1	29.8	19.7	10.0	-0.4	-10.0	-20.2	-29.6	-40.0	-48.6

Table A64. Observations for R-125/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.21	.36	.51	.65	.80	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.6	50.0	40.3	30.1	20.3	10.0	0.1	-9.8	-19.9	-30.3	-39.9	-49.3
	B															
	C															
	D															

Table A65. Observations for R-125/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.23	.31	.52	.67	.81	.90	.95
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	50.0	40.1	30.1	20.5	9.6	0.0	-10.0	-20.0	-30.0	-40.0	-47.2
	B															
	C															
	D															

Table A66. Observations for R-125/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.22	.36	.48	.64	.77	.90	.94
60	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	50.0	40.1	30.1	20.5	9.6	0.2	-10.0	-20.0	-30.0	-40.0	-47.2
	B	XX	XX	XX	59.4	50.1	40.0	30.0	20.1	10.0	0.0	-10.0	-20.0	-30.0	-40.3	-47.5
	C															
	D															

Table A67. Observations for R-125/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.21	.35	.50	.65	.80	.89	.95
60	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	49.9	40.1	30.2	20.1	10.2	0.4	-9.8	-19.7	-29.6	-40.0	-47.0
	B															
	C															
	D															

Table A68. Observations for R-125/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.23	.37	.51	.61	.80	.90	.94
60	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
40	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.6	50.0	40.3	30.1	20.3	10.0	0.1	-9.8	-19.9	-30.3	-39.9	-49.3
	B	XX	XX	XX	60.1	49.6	39.8	30.0	20.0	10.1	0.0	-10.1	-20.0	-30.0	-40.0	-46.6
	C															
	D															

Table A69. Observations for R-125/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.18	.36	.50	.66	.79	.89	.95
60	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.4	50.1	40.0	30.0	20.1	10.0	0.0	-10.0	-20.0	-30.0	-40.3	-47.5
	B															
	C															
	D															

Table A70. Observations for R-125/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.17	.36	.51	.64	.77	.89	.95
60	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	clear	clear	2 phase	2 phase
40	clear	clear	clear	clear	clear	clear	clear	2 phase
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	49.6	39.8	30.0	20.0	10.1	0.0	-10.1	-20.0	-30.0	-40.0	-46.6
	B															
	C															
	D															

Table A71. Observations for R-134/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.34	.48	.62	.77	.90	.95
60	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	B	B	A	B	B	C	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.8	49.2	40.0	30.1	20.1	10.5	-0.6	-9.3	-19.7	-30.2	-39.8	-47.3
	B	XX	XX	XX	60.2	49.8	40.5	30.1	20.0	10.2	0.0	-10.2	-19.7	-29.6	-39.9	-49.0
	C	XX	XX	XX	60.5	50.1	40.5	29.7	20.1	9.9	0.5	-9.8	-20.3	-29.7	-40.4	-47.3
	D															

Table A72. Observations for R-134/alkylbenzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.22	.35	.49	.67	.80	.90	.95
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.8	49.2	40.0	30.1	20.1	10.5	-0.6	-9.3	-19.7	-30.2	-39.8	-47.3
	B	XX	XX	XX	60.5	50.1	40.5	29.7	20.1	9.9	0.5	-9.8	-20.3	-29.7	-40.4	-47.3
	C															
	D															

Table A73. Observations for R-134/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °3C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.20	.32	.50	.67	.78	.88	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	hazy
-30	clear	clear	clear	clear	clear	clear	clear	hazy
-40	clear	clear	clear	clear	clear	clear	slt haze	hazy
-50	clear	clear	clear	clear	clear	clear	hazy	hazy
Temp. Set	A	C	C	B	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.5	30.3	20.5	10.0	-0.2	-10.3	-20.3	-29.8	-40.1	-46.0
	B	XX	XX	XX	59.6	50.3	40.3	30.0	20.1	10.9	-3.0	-10.1	-20.8	-29.7	-39.7	-47.6
	C	XX	XX	XX	60.2	49.8	40.5	30.1	20.0	10.2	0.2	-10.2	-19.7	-29.6	-39.9	-49.0
	D															

Table A74. Observations for R-134/polypropylene glycol diol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.23	.35	.49	.65	.81	.90	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	B	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.5	30.3	20.5	10.0	-0.2	-10.3	-20.3	-29.8	-40.1	-46.0
	B	XX	XX	XX	59.6	50.3	40.3	30.0	20.1	10.9	-3.0	-10.1	-20.8	-29.7	-39.7	-47.6
	C	XX	XX	XX	59.8	49.8	40.3	29.9	20.1	10.4	0.4	-10.0	-20.1	-29.9	-39.8	-49.0
	D															

Table A75. Observations for R-134/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.23	.37	.48	.64	.79	.89	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	hazy	clear	clear	clear	clear
-10	clear	clear	clear	hazy	clear	clear	clear	clear
-20	clear	slt haze	slt haze	hazy	hazy	clear	clear	clear
-30	clear	slt haze	hazy	hazy	hazy	clear	clear	clear
-40	clear	hazy	hazy	hazy	hazy	hazy	clear	clear
-50	clear	hazy	hazy	hazy	hazy	hazy	clear	clear
Temp. Set	A	B	B	A	C	C	C	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.9	50.2	40.5	30.1	19.73	10.3	-0.4	-9.7	-19.6	-30.1	-40.5	-49.6
	B	XX	XX	XX	60.5	50.1	40.5	29.7	20.1	9.9	0.5	-9.8	-20.3	-29.7	-40.4	-47.3
	C	XX	XX	XX	60.0	49.9	40.3	30.0	20.0	9.8	0.1	-10.0	-19.6	-29.6	-39.8	-49.1
	D															

Table A76. Observations for R-134/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.21	.38	.48	.66	.78	.88	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	B	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.5	30.3	20.5	10.0	-0.2	-10.3	-20.3	-29.8	-40.1	-46.0
	B	XX	XX	XX	59.6	50.3	40.3	30.0	20.1	10.9	-3.0	-10.1	-20.8	-29.7	-39.7	-47.6
	C	XX	XX	XX	59.8	49.8	40.3	29.9	20.1	10.4	0.4	-10.0	-20.1	-29.9	-39.8	-49.0
	D															

Table A77. Observations for R-134/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.20	.35	.47	.65	.78	.88	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	A	D	D	D	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.5	30.3	20.5	10.0	-0.2	-10.3	-20.3	-29.8	-40.1	-46.0
	B	XX	XX	XX	59.6	50.3	40.3	30.0	20.1	10.9	-3.0	-10.1	-20.8	-29.7	-39.7	-47.6
	C	XX	XX	XX	59.8	49.8	40.3	29.9	20.1	10.4	0.4	-10.0	-20.1	-29.9	-39.8	-49.0
	D	XX	XX	XX	60.2	49.8	40.5	30.1	20.0	10.2	0.2	-10.2	-19.7	-29.6	-39.9	-49.0

Table A78. Observations for R-134/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.19	.35	.46	.65	.77	.90	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.1	40.1	30.0	20.0	10.0	0.0	-10.1	-20.1	-30.0	-40.3	-47.8
	B															
	C															
	D															

Table A79. Observations for R-134/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.07	.19	.35	.50	.65	.80	.90	.95
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	hazy	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	hazy	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	hazy	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	hazy	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	hazy	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	hazy	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.9	49.6	39.6	30.1	20.2	10.4	0.2	-9.8	-20.3	-30.4	-40.4	-48.2
	B															
	C															
	D															

Table A80. Observations for R-134/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.20	.31	.50	. 64	.79	.90	.95
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	slt haze	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	hazy	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.3	49.8	40.4	30.4	20.3	10.3	-0.2	-10.1	-19.8	-29.6	-39.8	-49.2
	B															
	C															
	D															

Table A81. Observations for R-134/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.21	.36	.50	.65	.79	.90	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	49.9	40.0	30.0	20.0	9.8	0.1	-10.1	-19.6	-29.7	-39.8	-49.2
	B															
	C															
	D															

Table A82. Observations for R-134/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.35	.50	.64	.80	.89	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	B	B	B	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.3	49.8	40.4	30.4	20.3	10.3	-0.2	-10.1	-19.8	-29.6	-39.8	-49.2
	B	XX	XX	XX	59.9	49.6	39.6	30.1	20.2	10.4	0.2	-9.8	-20.3	-30.4	-40.4	-48.2
	C															
	D															

Table A83. Observations for R-134/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.18	.33	.50	.62	.77	.90	.94
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.1	40.1	30.0	20.0	10.0	0.0	-10.0	-20.1	-30.0	-40.3	-47.8
	B	XX	XX	XX	60.3	49.6	40.1	30.3	20.3	9.4	0.2	-10.1	-20.0	-29.8	-40.4	-47.8
	C															
	D															

Table A84. Observations for R-134/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.16	.37	.50	.66	.77	.89	.95
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.3	49.6	40.1	30.3	20.3	9.4	0.2	-10.0	-20.0	-29.8	-40.4	-47.8
	B															
	C															
	D															

Table A85. Observations for R-134a/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.21	.36	.49	.63	.80	.90	.95
90	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
80	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
70	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	B	C	C	A	C	C	D	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.1	60.3	50.2	40.5	30.2	20.5	10.1	0.4	-10.4	-20.2	-30.3	-40.4	-49.3
	B	89.4	80.3	70.2	60.2	50.4	40.2	30.1	20.2	10.2	-0.2	-10.0	-20.5	-30.2	-40.2	-48.3
	C	87.1	79.9	70.1	60.0	49.9	40.2	30.1	20.2	10.2	0.2	-9.7	-19.9	-30.4	-40.0	-50.4
	D	88.9	80.0	69.8	59.9	49.6	40.3	30.1	20.3	10.4	0.5	-9.9	-19.5	-29.9	-40.2	-49.3

Table A86. Observations for R-134a/alkylbenzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.18	.36	.52	.67	.78	.90	.95
90	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
80	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
70	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
60	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	B	C	C	A	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.1	60.3	50.2	40.5	30.2	20.5	10.1	0.4	-10.4	-20.2	-30.3	-40.4	-49.5
	B	89.4	80.3	70.2	60.2	50.4	40.2	30.4	19.9	10.2	-0.2	-10.0	-20.5	-30.2	-40.2	-48.3
	C	88.9	80.0	69.8	59.9	49.6	40.3	30.1	20.3	10.4	0.5	-9.9	-19.5	-29.9	-40.2	-49.3
	D															

Table A87. Observations for R-134a/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °3C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.21	.37	.51	.62	.81	.89	.95
90	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
80	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
70	clear	clear	clear	clear	clear	2 phase	2 phase	clear
60	clear	clear	clear	clear	clear	clear	2 phase	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	87.4	80.0	69.9	60.4	50.2	40.2	30.3	20.3	10.5	0.1	-10.1	-20.2	-30.1	-40.1	-49.4
	B	87.1	79.9	70.1	60.0	49.9	40.2	30.1	20.2	10.2	0.2	-9.7	-19.9	-30.4	-40.0	-50.4
	C															
	D															

Table A88. Observations for R-134a/polypropylene glycol diol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.23	.38	.53	.67	.80	.89	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	C

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	87.4	80.0	69.9	60.4	50.2	40.2	30.3	20.3	10.5	0.1	-10.1	-20.2	-30.1	-40.1	-49.4
	B	88.3	80.1	70.4	59.7	49.9	40.1	29.7	19.8	10.3	0.2	-10.0	-19.8	-29.7	-40.0	-49.5
	C	89.8	80.0	69.8	60.0	50.1	39.7	30.0	20.2	10.2	0.0	-10.2	-20.1	-30.2	-40.4	-49.2
	D															

Table A89. Observations for R-134a/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.22	.37	.52	.63	.81	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	slt haze	slt haze	clear	clear	clear	clear
-10	clear	clear	slt haze	hazy	clear	clear	clear	clear
-20	clear	slt haze	hazy	hazy	clear	clear	clear	clear
-30	clear	hazy	hazy	hazy	clear	clear	clear	clear
-40	clear	hazy	hazy	hazy	clear	clear	clear	clear
-50	clear	hazy	hazy	hazy	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	C

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	87.6	79.6	69.7	59.6	49.8	39.6	29.6	19.8	9.5	0.1	-9.7	-20.3	-30.2	-40.3	-50.0
	B	88.9	80.0	69.8	59.9	49.6	40.3	30.1	20.3	10.4	0.5	-9.9	-19.5	-29.9	-40.2	-49.3
	C	90.1	80.0	70.0	60.0	49.9	40.2	30.0	20.3	10.0	-0.4	-9.6	-19.8	-29.6	-40.2	-49.3
	D															

Table A90. Observations for R-134a/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.20	.36	.51	.69	.78	.91	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	2 phase	2 phase	hazy	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	87.4	80.0	69.9	60.4	50.2	40.2	30.3	20.3	10.5	0.1	-10.1	-20.2	-30.1	-40.1	-49.4
	B	88.3	80.1	70.4	59.7	49.9	40.1	29.7	19.8	10.3	0.2	-10.0	-19.8	-29.7	-40.0	-49.5
	C															
	D															

Table A91. Observations for R-134a/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.22	.36	.49	.64	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	E	D	C	C	C	D

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	87.4	80.0	69.9	60.4	50.2	40.2	30.3	20.3	10.5	0.1	-10.1	-20.2	-30.1	-40.1	-49.4
	B	88.3	80.1	70.4	59.7	49.9	40.1	29.7	19.8	10.3	0.2	-10.1	-19.8	-29.7	-40.0	-49.5
	C	90.0	80.2	69.9	60.3	49.6	40.4	30.2	19.9	10.1	-0.2	-9.9	-19.9	-29.8	-39.9	-47.4
	D	89.8	80.0	69.8	60.0	50.1	39.7	30.0	20.2	10.2	0.0	-10.2	-20.1	-30.2	-40.4	-49.2
	E	90.1	80.0	70.0	60.0	49.9	40.2	30.0	20.3	10.0	-0.4	-9.6	-19.8	-29.6	-40.2	-48.3

Table A92. Observations for R-134a/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.18	.37	.48	.66	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	80.4	70.0	60.3	50.4	40.1	29.9	20.0	10.3	0.5	-10.5	-20.2	-29.9	-40.5	-48.9
	B															
	C															
	D															

Table A93. Observations for R-134a/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.08	.20	.34	.51	.66	.81	.90	.95
90	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
80	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
70	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	85.2	79.6	70.2	60.2	50.1	40.3	30.0	20.0	11.1	0.1	-10.2	-19.5	-29.9	-39.9	-49.3
	B															
	C															
	D															

Table A94. Observations for R-134a/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.21	.34	.49	.67	.78	.90	.94
90	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
80	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
70	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	B	B	B	B	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	80.2	70.0	60.2	50.2	40.2	30.1	20.5	12.0	-0.4	-9.7	-19.6	-30.0	-39.6	-50.0
	B	85.2	79.6	70.2	60..2	50.1	40.3	30.0	20.0	11.1	0.1	-10.2	-19.5	-29.9	-39.9	-49.3
	C															
	D															

Table A95. Observations for R-134a/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.17	.32	.50	.64	.79	.90	.95
90	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
80	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
70	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
60	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
50	clear	clear	clear	clear	clear	2 phase	2 phase	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	79.9	69.4	60.2	50.0	39.9	30.0	20.3	10.0	0.0	-9.8	-20.0	-29.8	-39.7	-49.2
	B	90.0	80.2	70.1	59.9	49.9	40.2	29.9	20.4	9.6	0.2	-9.5	-19.7	-29.4	-40.1	-49.8
	C															
	D															

Table A96. Observations for R-134a/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.20	.37	.52	.66	.77	.90	.94
90	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
80	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
70	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
60	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	B	B	B	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.7	80.2	69.5	60.4	50.0	39.6	30.1	19.9	9.9	0.1	-10.0	-20.0	-29.9	-40.0	-48.4
	B	90.0	80.4	70.0	60.3	50.4	40.1	29.9	20.0	10.3	0.5	-10.5	-20.2	-29.9	-40.5	-48.9
	C															
	D															

Table A97. Observations for R-134a/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.18	.36	.52	.64	.81	.89	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	slt haze
-20	clear	clear	clear	clear	clear	clear	clear	slt haze
-30	clear	clear	clear	clear	clear	clear	slt haze	slt haze
-40	clear	clear	clear	clear	hazy	2 phase	hazy	slt haze
-50	clear	clear	clear	clear	2 phase	2 phase	2 phase	hazy
Temp. Set	B	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	80.2	70.0	60.2	50.2	40.2	30.1	20.5	12.0	-0.4	-9.7	-19.6	-30.0	-39.6	-50.0
	B	90.0	80.2	69.9	60.3	49.6	40.4	30.2	19.9	10.1	-0.2	-9.9	-19.9	-29.8	-39.9	-47.4
	C															
	D															

Table A98. Observations for R-134a/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.18	.34	.51	.64	.79	.90	.95
90	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
80	clear	clear	clear	clear	clear	2 phase	2 phase	2 phase
70	clear	clear	clear	clear	clear	clear	2 phase	2 phase
60	clear	clear	clear	clear	clear	clear	2 phase	2 phase
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.7	80.2	69.5	60.4	50.0	39.6	30.1	19.9	9.9	0.1	-10.0	-20.0	-29.9	-40.0	-48.4
	B															
	C															
	D															

Table A99. Observations for R-142b/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.24	.36	.50	.66	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	2 phase	2 phase	clear	clear
-50	clear	clear	clear	hazy	2 phase	2 phase	clear	clear
Temp. Set	D	B	B	A	B	B	C	D

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.1	60.3	50.2	40.5	30.2	20.5	10.1	0.4	-10.4	-20.2	-30.3	-40.4	-45.1
	B	89.8	79.6	69.9	60.2	50.3	39.9	30.1	19.6	11.0	-0.2	-9.6	-19.7	-30.3	-40.3	-49.5
	C	90.2	80.1	70.2	60.2	50.3	40.3	30.1	19.9	10.2	-0.4	-9.9	-19.7	-30.5	-39.9	-46.4
	D	89.4	80.3	70.2	60.2	50.4	40.2	30.4	19.9	10.2	-0.2	-10.0	-20.5	-30.2	-40.2	-48.3

Table A100. Observations for R-142b/alkylbenzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.20	.35	.53	.65	.77	.88	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	A	A	B	A	A	A	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.2	80.1	70.2	60.2	50.3	40.3	30.1	19.9	10.2	-0.4	-9.9	-19.7	-30.5	-39.9	-46.4
	B	89.4	80.3	70.2	50.2	50.4	40.2	30.4	19.9	10.2	-0.2	-10.0	-20.5	-30.2	-40.2	-48.3
	C															
	D															

Table A101. Observations for R-142b/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °3C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.20	.35	.47	.67	.82	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	A	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.1	60.3	50.2	40.5	30.2	20.5	10.1	0.4	-10.4	-20.2	-30.3	-40.4	-45.1
	B	86.9	80.6	67.8	60.6	50.7	40.3	30.0	20.5	9.7	-1.4	-9.8	-19.1	-31.5	-40.5	-48.7
	C	89.8	79.6	69.9	60.2	50.3	39.9	30.1	19.6	11.0	-0.2	-9.6	-19.7	-30.3	-40.3	-49.5
	D															

Table A102. Observations for R-142b/polypropylene glycol diol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.38	.47	.67	.81	.89	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	A	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.1	60.3	50.2	40.5	30.2	20.5	10.1	0.4	-10.4	-20.2	-30.3	-40.4	-45.1
	B	86.9	80.6	69.8	60.6	50.7	40.3	30.0	20.5	9.7	-1.4	-9.8	-19.1	-31.5	-40.5	-48.7
	C	90.0	79.9	69.6	60.0	50.3	40.1	29.6	19.6	10.3	-0.4	-9.9	-19.7	-29.7	-40.2	-46.7
	D															

Table A103. Observations for R-142b/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.23	.37	.53	.68	.80	.91	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	slt haze	slt haze	clear	clear	clear	clear	clear
-50	clear	slt haze	slt haze	clear	slt haze	clear	clear	clear
Temp. Set	B	A	A	B	A	A	A	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.2	80.1	70.2	60.2	50.3	40.3	30.1	19.9	10.2	-0.4	-9.9	-19.7	-30.5	39.9	-46.4
	B	87.6	79.6	69.7	59.9	49.8	39.6	29.6	19.8	9.5	0.1	-9.6	-20.3	-30.2	-40.3	-50.0
	C															
	D															

Table A104. Observations for R-142b/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.22	.31	.49	.62	.81	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	A	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.1	60.3	50.2	40.5	30.2	20.5	10.1	0.4	-10.4	-20.2	-30.3	-40.4	-45.1
	B	86.9	80.6	69.8	60.6	50.7	40.3	30.0	20.5	9.7	-1.4	-9.8	-19.1	-31.5	-40.5	-48.7
	C	90.0	79.9	69.6	60.0	50.3	40.1	29.6	19.6	10.3	-0.4	-9.9	-19.7	-29.7	-40.2	-46.7
	D															

Table A105. Observations for R-142b/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.23	.36	.46	.63	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	C	C	B	D	D	D	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.1	60.3	50.2	40.5	30.2	20.5	10.1	0.4	-10.4	-20.2	-30.3	-40.4	-45.1
	B	86.9	80.6	69.8	60.6	50.7	40.3	30.0	20.5	9.7	-1.4	-9.8	-19.1	-31.5	-40.5	-48.7
	C	90.0	79.9	69.6	60.0	50.3	40.1	29.6	19.6	10.3	-0.4	-9.9	-19.7	-29.7	-40.2	-46.7
	D	89.8	79.6	69.9	60.2	50.3	39.9	30.1	19.6	11.0	-0.2	-9.6	-19.7	-30.3	-40.3	-49.5

Table A106. Observations for R-142b/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.16	.37	.51	.63	.81	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	79.6	70.1	59.8	50.0	40.2	29.7	20.0	10.3	0.0	-10.0	-20.0	-30.0	-40.2	-49.8
	B															
	C															
	D															

Table A107. Observations for R-142b/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.21	.36	.48	.65	.79	.89	.94
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	slt haze	2 phase	2 phase	clear	clear
-40	clear	clear	slt haze	2 phase	2 phase	2 phase	2 phase	clear
-50	clear	slt haze	2 phase	2 phase	2 phase	2 phase	2 phase	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	79.6	70.1	60.0	50.2	40.1	30.1	20.1	10.8	0.0	-10.0	-20.0	-30.1	-40.3	-46.1
	B															
	C															
	D															

Table A108. Observations for R-142b/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.23	.32	.50	.64	.79	.89	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	79.6	70.1	60.0	50.2	40.1	30.1	20.1	10.8	0.0	-10.0	-20.0	-30.1	-40.3	-46.1
	B	90.2	80.0	70.1	60.0	50.0	39.6	30.0	20.7	10.1	-0.1	-10.0	-20.0	-29.9	-40.2	-48.3
	C															
	D															

Table A109. Observations for R-142b/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.22	.35	.47	.64	.77	.90	.94
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	80.0	70.0	60.0	49.9	40.2	30.0	20.3	10.0	-0.4	-9.6	-19.8	-29.6	-40.2	-49.3
	B															
	C															
	D															

Table A110. Observations for R-142b/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.17	.36	.49	.65	.78	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	79.6	70.1	59.8	50.0	40.2	29.7	20.0	10.3	0.0	-10.0	-20.0	-30.0	-40.2	-49.8
	B	90.0	80.0	69.9	59.7	50.0	39.9	30.0	20.0	10.2	-0.1	-10.3	-20.1	-30.0	-40.4	-49.0
	C															
	D															

Table A111. Observations for R-142b/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.18	.37	.50	.66	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.2	80.0	70.1	60.0	50.0	39.6	30.0	20.7	10.1	-0.1	-10.0	-20.0	-29.9	-40.3	-48.3
	B															
	C															
	D															

Table A112. Observations for R-142b/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.20	.35	.50	.66	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	80.0	69.9	59.7	50.0	39.9	30.0	20.0	10.2	-0.1	-10.3	-20.1	-30.0	-40.4	-49.0
	B															
	C															
	D															

Table A113. Observations for R-143a/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.16	.37	.54	.67	.80	.90	.95
60	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	2 phase	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	2 phase	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	2 phase	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	C	A	A	C	A	A	B	C

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	49.8	39.9	30.0	19.9	10.8	0.4	-9.7	-19.5	-30.5	-40.4	-49.8
	B	XX	XX	XX	60.0	49.9	40.2	30.4	20.2	11.2	-0.4	-10.0	-19.5	-30.1	-40.2	-49.9
	C	XX	XX	XX	57.0	50.0	40.2	29.7	19.8	11.0	-0.2	-9.8	-19.6	-30.3	-40.4	-48.0
	D															

Table A114. Observations for R-143a/alkylbenzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.21	.35	.52	.64	.79	.89	.95
60	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	B	C	A	B	A	A	A	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	49.9	40.2	30.4	20.2	11.2	-0.4	-10.0	-19.5	-30.1	-40.2	-49.9
	B	XX	XX	XX	57.0	50.0	40.2	29.7	19.8	11.0	-0.2	-9.8	-19.6	-30.3	-40.4	-48.0
	C	XX	XX	XX	60.0	49.9	40.1	30.4	20.0	10.0	-0.2	-9.7	-20.3	-30.2	-39.8	-48.9
	D															

Table A115. Observations for R-143a/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °3C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.23	.35	.47	.64	.81	.89	.95
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	C	C	B	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.5	49.9	40.1	30.1	20.1	9.9	0.3	-10.1	-20.4	-30.1	-40.0	-49.0
	B	XX	XX	XX	60.6	50.1	40.1	30.6	19.8	11.0	0.2	-9.5	-19.3	-31.0	-40.3	-48.0
	C	XX	XX	XX	60.0	49.8	39.9	30.0	19.9	10.8	0.4	-9.7	-19.5	-30.5	-40.4	-49.8
	D															

Table A116. Observations for R-143a/polypropylene glycol diol (IS0 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.23	.34	.51	.65	.79	.89	.95
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	C	C	B	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.5	49.9	40.1	30.1	20.1	9.9	0.3	-10.1	-20.4	-30.1	-40.0	-49.0
	B	XX	XX	XX	60.6	50.1	40.1	30.6	19.8	11.0	0.2	-9.5	-19.3	-31.0	-40.3	-48.0
	C	XX	XX	XX	60.4	49.9	40.0	30.3	20.0	11.0	0.1	-9.7	-19.5	-30.5	-40.0	-49.7
	D															

Table A117. Observations for R-143a/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.23	.37	.50	.64	.81	.90	.95
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
0	clear	clear	clear	slt haze	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	clear	slt haze	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	clear	hazy	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	clear	hazy	2 phase	2 phase	2 phase	2 phase
-40	slt haze	clear	slt haze	hazy	2 phase	2 phase	2 phase	2 phase
-50	slt haze	slt haze	slt haze	hazy	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	B	B	D	B	B	B	C

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	59.9	50.2	39.5	29.8	19.6	10.4	0.0	-10.0	-19.8	-29.8	-39.6	-49.6
	B	XX	XX	XX	60.0	49.9	40.2	30.4	20.2	11.2	-0.4	-10.0	-19.5	-30.1	-40.2	-49.9
	C	XX	XX	XX	60.0	49.9	40.0	30.4	20.0	10.0	0.2	-9.7	-20.3	-30.2	-39.8	-48.9
	D	XX	XX	XX	60.3	49.6	40.4	30.2	19.9	10.1	-0.2	-9.9	-19.9	-29.8	-29.9	-47.4

Table A118. Observations for R-143a/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.08	.20	.38	.50	.65	.79	.90	.95
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	C	C	B	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.5	49.9	40.1	30.1	20.1	9.9	0.3	-10.1	-20.4	-30.1	-40.0	-49.0
	B	XX	XX	XX	60.6	50.1	40.1	30.6	19.9	11.0	0.2	-9.5	-19.3	-31.0	-40.3	-48.0
	C	XX	XX	XX	60.4	49.9	40.0	30.3	20.0	11.0	0.1	-9.9	-19.5	-30.5	-40.0	-49.7
	D															

Table A119. Observations for R-143a/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.14	.22	.33	.49	.66	.79	.89	.95
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
0	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	B	B	A	C	C	C	D

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.6	50.1	40.1	30.6	19.9	11.0	0.2	-9.5	-19.3	-31.0	-40.3	-48.0
	B	XX	XX	XX	60.4	49.9	40.0	30.3	20.0	11.0	0.1	-9.9	-19.5	-30.5	-40.0	-49.7
	C	XX	XX	XX	60.0	49.8	39.9	30.0	19.9	10.8	0.4	-9.7	-19.5	-30.5	-40.4	-49.8
	D	XX	XX	XX	60.3	49.6	40.4	30.2	19.9	10.1	-0.2	-9.9	-19.9	-29.8	-39.9	-47.4

Table A120. Observations for R-143a/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.22	.38	.51	.66	.79	.90	.95
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
20	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
10	clear	clear	clear	clear	2 phase	2 phase	2 phase	clear
0	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
-50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.0	50.1	40.0	29.9	20.1	11.1	0.2	-10.0	-20.1	-30.3	-40.0	-47.5
	B	XX	XX	XX	59.8	49.6	40.1	29.8	19.7	10.0	-0.4	-10.0	-20.2	-29.6	-40.0	-48.6
	C															
	D															

Table A121. Observations for R-143a/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.06	.21	.38	.51	.66	.80	.90	.95
60	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.2	49.9	39.5	29.7	20.0	10.8	0.0	-10.1	-20.5	-30.0	-40.3	-49.0
	B															
	C															
	D															

Table A122. Observations for R-143a/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.22	.32	.52	.64	.80	.89	.94
60	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.2	49.9	39.5	29.7	20.0	10.8	0.0	-10.1	-20.5	-30.0	-40.3	-49.0
	B	XX	XX	XX	60.2	49.8	39.8	30.0	20.0	10.0	0.4	-9.6	-20.1	-30.1	-39.6	-47.1
	C															
	D															

Table A123. Observations for R-143a/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.23	.38	.51	.64	.80	.90	.94
60	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.2	49.8	39.8	30.0	20.0	10.0	0.4	-9.6	-20.1	-30.1	-39.6	-47.1
	B															
	C															
	D															

Table A124. Observations for R-143a/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.21	.35	.48	.62	.79	.89	.95
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
10	clear	clear	clear	clear	2 phase	2 phase	2 phase	2 phase
0	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	B	B	B	B	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.3	30.0	20.4	13.0	-0.6	-10.2	-20.0	-30.4	-40.3	-47.6
	B	XX	XX	XX	60.0	50.1	40.0	29.9	20.1	11.1	0.2	-10.0	-20.1	-30.0	-40.0	-47.5
	C															
	D															

Table A125. Observations for R-143a/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.20	.36	.47	.63	.78	.89	.93
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	B	B	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.2	40.3	30.1	19.7	10.1	-0.3	-10.1	-20.0	-30.5	-39.9	-47.8
	B	XX	XX	XX	60.0	49.9	40.1	30.4	20.0	10.0	-0.2	-9.7	-20.3	-30.2	-39.8	-48.9
	C															
	D															

Table A126. Observations for R-143a/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.07	.18	.34	.49	.64	.78	.90	.95
60	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	XX	XX	XX	60.1	50.3	40.3	30.0	20.4	13.0	-0.6	-10.2	-20.0	-30.4	-40.3	-47.6
	B															
	C															
	D															

Table A127. Observations for R-152a/naphthenic mineral oil (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.22	.34	.52	.64	.80	.90	.95
90	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
80	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
70	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
60	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	B	B	A	B	B	C	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	88.5	80.1	70.1	60.2	50.0	40.5	30.4	20.1	10.3	-0.1	-9.7	-19.8	-30.0	-40.2	-49.5
	B	89.7	79.8	70.2	60.1	50.2	40.2	30.3	20.0	10.3	0.3	-10.2	-20.7	-30.1	-39.9	-49.6
	C	90.2	80.2	70.4	60.3	50.3	40.2	30.4	20.3	10.0	-0.4	-10.1	-20.1	-30.3	-39.6	-45.7
	D															

Table A128. Observations for R-152a/alkylbenzene (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.21	.33	.47	.66	.79	.90	.96
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	2 phase	2 phase	clear	clear
40	clear	clear	clear	2 phase	2 phase	2 phase	clear	clear
30	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
20	clear	clear	clear	2 phase	2 phase	2 phase	2 phase	clear
10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
0	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
-10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	88.5	80.1	70.1	60.2	50.0	40.5	30.4	20.1	10.3	-0.1	-9.7	-19.8	-30.0	-40.2	-49.5
	B	90.2	80.2	70.4	60.3	50.3	40.2	30.4	20.3	10.0	-0.4	-10.1	-20.1	-30.3	-39.6	-45.7
	C															
	D															

Table A129. Observations for R-152a/polypropylene glycol butyl monoether (ISO 32) mixtures

Nominal Temp. °3C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.19	.32	.52	.63	.80	.89	.96
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.9	79.9	70.0	59.6	50.2	40.2	30.3	20.0	9.7	-0.5	-10.0	-20.1	-30.1	-40.2	-49.7
	B	89.7	79.8	70.2	60.1	50.2	40.2	30.3	20.0	10.3	0.3	-10.2	-20.7	-30.1	-39.9	-49.6
	C															
	D															

Table A130. Observations for R-152a/polypropylene glycol diol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.22	.34	.51	.64	.78	.89	.96
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	C	C	A	C	C	C	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.1	60.3	50.2	40.5	30.2	20.5	10.1	0.4	-10.4	-20.2	-30.3	-40.4	-45.1
	B	89.9	79.9	70.0	59.6	50.2	40.2	30.3	20.0	9.7	-0.5	-10.0	-20.1	-30.1	-40.2	-49.7
	C	89.9	79.7	69.9	60.3	50.0	40.1	30.3	20.3	11.3	-0.4	-10.5	-20.0	-29.7	-39.6	-49.8
	D															

Table A131. Observations for R-152a/modified polyglycol (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.21	.35	.48	.66	.81	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	A	A	B	A	A	A	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.2	80.2	70.4	60.3	50.3	40.2	30.4	20.3	10.0	-0.4	-10.1	-20.1	-30.3	-39.6	-45.7
	B	87.6	79.6	69.7	59.6	49.8	39.6	29.6	19.8	9.5	0.1	-9.7	-20.3	-30.2	-40.3	-50.0
	C															
	D															

Table A132. Observations for R-152a/penta erythritol ester mixed-acid (ISO 22) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.12	.19	.33	.53	.65	.81	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	B	B	A	B	B	B	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	89.9	79.9	70.0	59.6	50.2	40.2	30.3	20.0	9.7	-.05	-10.0	-20.1	-30.1	-40.2	-49.7
	B	89.9	79.7	69.9	60.3	50.0	40.1	30.3	20.3	11.3	-0.4	-10.5	-20.0	-29.7	-39.6	-49.8
	C															
	D															

Table A133. Observations for R-152a/mixed-acid poly ester (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.23	.36	.49	.66	.79	.89	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	B	C	C	A	D	D	D	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.1	60.3	50.2	40.5	30.2	20.5	10.1	0.4	-10.4	-20.2	-30.3	-40.4	-45.1
	B	89.9	79.9	70.0	59.6	50.2	40.2	30.3	20.0	9.7	-.05	-10.0	-20.1	-30.1	-40.2	-49.7
	C	89.9	79.7	69.9	60.3	50.0	40.1	30.3	20.3	11.3	-0.4	-10.5	-20.0	-29.7	-39.6	-49.8
	D	89.7	79.8	70.2	60.1	50.2	40.2	30.3	20.0	10.3	0.3	-10.2	-20.7	-30.1	-39.9	-49.6

Table A134. Observations for R-152a/penta erythritol ester branched-acid (ISO 32) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.11	.17	.32	.52	.66	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.2	80.0	69.7	60.2	49.6	40.3	29.9	20.1	11.0	0.2	-10.0	-20.1	-30.0	-40.3	-49.1
	B															
	C															
	D															

Table A135. Observations for R-152a/naphthenic mineral oil (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.16	.34	.52	.65	.81	.91	.95
90	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
80	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
70	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
60	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
50	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
40	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.0	60.0	49.9	39.9	30.1	19.8	9.6	0.0	-10.2	-19.9	-30.4	-39.9	-46.9
	B															
	C															
	D															

Table A136. Observations for R-152a/alkylbenzene (ISO 68) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.08	.20	.37	.51	.63	.80	.90	.94
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	2 phase	2 phase	2 phase	clear	clear
40	clear	clear	clear	2 phase	2 phase	2 phase	clear	clear
30	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
20	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	clear
10	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
0	clear	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-10	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-20	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-30	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-40	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
-50	clear	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase	2 phase
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.1	79.9	70.0	60.0	49.9	39.9	30.1	19.8	9.6	0.0	-10.2	-19.9	-30.4	-39.9	-46.9
	B	90.0	80.0	70.1	60.5	49.7	39.8	30.0	20.0	10.4	0.0	-10.0	-20.1	-30.2	-40.1	-47.2
	C															
	D															

Table A137. Observations for R-152a/polypropylene glycol butyl monoether (ISO 58) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.16	.36	.49	.65	.80	.90	.95
90	clear	clear	clear	clear	clear	2 phase	2 phase	clear
80	clear	clear	clear	clear	clear	2 phase	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	80.2	70.1	59.9	49.9	40.2	29.9	20.4	9.6	0.2	-9.5	-19.7	-29.4	-40.1	-49.8
	B															
	C															
	D															

Table A138. Observations for R-152a/polypropylene glycol diol (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.13	.22	.37	.51	.66	.81	.90	.94
90	clear	clear	clear	clear	clear	2 phase	2 phase	clear
80	clear	clear	clear	clear	clear	2 phase	clear	clear
70	clear	clear	clear	clear	clear	2 phase	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	B	B	B	B

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.2	80.0	69.7	60.2	49.6	40.3	29.9	20.1	11.0	0.0	-10.0	-20.1	-30.0	-40.3	-49.1
	B	88.9	80.5	69.7	59.9	50.0	40.2	29.9	20.0	13.3	0.2	-9.6	-19.7	-30.0	-40.0	-48.9
	C															
	D															

Table A139. Observations for R-152a/mixed-acid poly ester (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.09	.17	.36	.52	.66	.80	.90	.95
90	clear	clear	clear	clear	clear	clear	clear	clear
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	90.0	80.0	70.1	60.5	49.7	39.8	30.0	20.0	10.4	0.0	-10.0	-20.1	-30.2	-40.1	-47.2
	B															
	C															
	D															

Table A140. Observations for R-152a/penta erythritol ester branched-acid (ISO 100) mixtures

Nominal Temp. °C	Refrigerant Concentration (mass fraction refrigerant)							
	.10	.22	.37	.52	.65	.79	.90	.95
90	clear	clear	clear	clear	clear	clear	2 phase	2 phase
80	clear	clear	clear	clear	clear	clear	clear	clear
70	clear	clear	clear	clear	clear	clear	clear	clear
60	clear	clear	clear	clear	clear	clear	clear	clear
50	clear	clear	clear	clear	clear	clear	clear	clear
40	clear	clear	clear	clear	clear	clear	clear	clear
30	clear	clear	clear	clear	clear	clear	clear	clear
20	clear	clear	clear	clear	clear	clear	clear	clear
10	clear	clear	clear	clear	clear	clear	clear	clear
0	clear	clear	clear	clear	clear	clear	clear	clear
-10	clear	clear	clear	clear	clear	clear	clear	clear
-20	clear	clear	clear	clear	clear	clear	clear	clear
-30	clear	clear	clear	clear	clear	clear	clear	clear
-40	clear	clear	clear	clear	clear	clear	clear	clear
-50	clear	clear	clear	clear	clear	clear	clear	clear
Temp. Set	A	A	A	A	A	A	A	A

Nominal Temp., °C		90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50
Actual Temperature Set °C	A	88.9	80.5	69.7	59.9	50.0	40.2	29.9	20.0	13.3	0.2	-9.6	-19.7	-30.0	-40.0	-48.9
	B															
	C															
	D															

Appendix B - Actual Test Lubricants

The actual lubricants tested are commercially available and are listed as follows:

- naphthenic mineral oil (ISO 32): Witco Suniso® 3GS
- alkylbenzene (ISO 32): Shrieve Zerol® 150
- polypropylene glycol butyl monoether (ISO 32): ICI Emkarox™ VG32
- polypropylene glycol diol (ISO 32): Dow P425
- modified polyglycol (ISO 32): Allied-Signal BRL-150
- penta erythritol ester mixed-acid (ISO 22): ICI Emkarate™ RL244
- penta erythritol ester mixed-acid (ISO 32): Castrol Icematic™ SW32
- penta erythritol. ester branched-acid (ISO 32): Emery E2927
- naphthenic mineral oil (ISO 68): Witco Suniso® 4GS
- alkylbenzene (ISO 68): Shrieve Zerol® 300
- polypropylene glycol butyl monoether (ISO 58): ICI Emkarox™ VG58
- polypropylene glycol diol (ISO 100): Dow P1200
- penta erythritol ester mixed-acid (ISO 100): Castrol Icematic™ SW100
- penta erythritol ester branched-acid (ISO 100): Emery E2928