Honeywell Genetron® Refrigerants

HCFCs Refrigeration Retrofit Guidelines

R-12 to: MP39/R-401A
MP66/R-401B
R-409A

R-502 to: HP80/R-402A
R-408A

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Safety Tips

1. Never mix refrigerants in a refrigeration system or recovery cylinder. Any refrigerant mixing creates a non-reclaimable mixture that will cost you or your customer more money to dispose of.
2. Never leak test a system using air, oxygen or other oxidizing materials. When combined with HFCs and HCFCs under pressure, these mixtures can become combustible.
3. Always read the label and Material Safety Data Sheet (MSDS) before working with the refrigerant(s).
4. Never “top-off” a system with a refrigerant other than what is already in that system. If you aren’t sure what’s in a system, either recover the full charge or have the refrigerant tested.
5. Always make sure systems you work on are properly labeled with the refrigerant and oil when you leave.
6. Do not store refrigerant cylinders in direct sunlight or in areas where temperatures could exceed 125° F or 51.7° C.
7. Keep smaller cylinders from becoming a rolling hazard by keeping them in their cartons while storing or transporting them.
8. Always recover the contents of non-refillable refrigerant cylinders to 0 psig or less before disposing of them. Whenever possible, recycle non-refillable cylinders at a local metal recycling center or scrapyard.

HCFC Retrofit Guidelines

Although HCFCs (hydrochlorofluorocarbons) will be phased out over the next several decades in many countries, retrofitting existing CFC equipment to refrigerant blends that contain HCFCs may still remain a cost-effective alternative to complete equipment replacement. By following equipment manufacturers’ recommendations and the guidelines in this publication, service technicians can readily retrofit many existing CFC-12 refrigeration systems to use Genetron MP39 or Genetron 409A. Likewise, many R-502 systems can be retrofit to use Genetron HP80 or Genetron 408A.

When possible, refrigeration systems should be retrofit to use non-ozone depleting HFC (hydrofluorocarbon) refrigerants in order to reduce the environmental impact in the case of accidental discharge. Also, there are no current plans to phase out HFCs in the United States or most other countries, and so HFCs are considered a long-term refrigerant solution. These HCFC guidelines are meant to provide guidance in those situations where an HFC retrofit is not possible or economical.

Although the information in this booklet can be helpful as a general guide, it should not be used as a substitute for the equipment manufacturer’s specific recommendations. For this reason, Honeywell strongly recommends contacting the equipment manufacturer for detailed information on retrofitting the specific model under consideration. Also, refer to the Material Safety Data Sheet (MSDS) for safety information on the specific Genetron Refrigerant you will use.

How to Use These Guidelines

The HCFC guidelines begin with a General Procedures section that provides general guidelines for working with any Genetron HCFC refrigerant. See table below for recommended retrofit fluid. In the pages following each General Procedures section, you will find guidelines specific to the refrigerant you intend to retrofit into the system. In the back pages are tables of Pressure and Temperature data for R-12 replacements and R-502 replacements. Both Pressure-Temperature and Temperature-Pressure tables are provided to help you to work faster.

Recommended Retrofit Refrigerants	HFC-Based	HCFC-Based
R-12 Retrofits	134a	MP39 (401A) MP66 (401B) 409A
R-502 Retrofits	AZ-50 (507) 404A	HP80 (402A) 408A

Genetron HCFC Refrigerants

Genetron® MP39, Genetron MP66, and Genetron 409A are alternative refrigerants to replace CFC-12 in many medium temperature refrigeration systems. Genetron HP80 and Genetron 408A are alternative refrigerants designed to replace R-502 in low- and medium-temperature commercial refrigeration applications. These blends contain ozone-depleting hydrochlorofluorocarbons (HCFCs), chemicals subject to phaseout in the United States and other countries. The constituents of the refrigerant mixtures, ASHRAE numbers, refrigerant type, and applications are given below.

Applications

Genetron Refrigerant	Type	Replaces	Applications	Comments
MP39 (R-401A)	Blend	CFC-12	Supermarket display cases, walk-in coolers, beverage dispensers, vending machines, water coolers, home refrigerators.	Applications limited to evaporator temperatures > -10°F (-23°C).
MP 66 (R-401B)	Blend	CFC-12	Transport refrigeration, domestic and commercial freezers.	Consult equipment mfg'r where high compression ratios exist, may be excessive discharge temperature and capacity reduction.
409A (R-409A)	Blend	CFC-12	Supermarket display cases, walk-in coolers, beverage dispensers, vending machines, water coolers, domestic/ commercial refrigerators/ freezers, transport refrigeration.	
HP80 (R-402A)	Blend	R-502	Supermarket freezer cases, reach-in coolers, display cases, ice machines.	
408A (R-408A)	Blend	R-502	Same as for HP80 above.	To avoid high discharge temperature, use when evaporator temperature > -30°F and superheat not exceeding 10°F.

Service technicians should keep in mind that future regulations may restrict the use of HCFC refrigerants and dictate the ultimate use of an HFC refrigerant. Where feasible, the preferred replacement for CFC-12 is Genetron 134a. Likewise, the preferred replacement for R-502 is an HFC such as Genetron AZ-50. Although these non-ozone-depleting HFC refrigerants are being used in many OEM applications, there are instances where retrofitting to an HFC may be difficult because nearly all of the mineral oil in the system must be removed. In these situations, an interim service fluid such as a Genetron MP Blend or Genetron 409A may be preferred as an R-12 replacement. Similarly, an interim service fluid such as a Genetron HP80 or Genetron 408A may be preferred as a replacement for R-502.

HCFC Refrigerants are not "Drop-in" Replacements

The HCFC refrigerants are not "drop-in" replacements for the CFC refrigerants. Genetron MP39, Genetron MP66, Genetron HP80, Genetron 408A, and Genetron 409A, are blends and can segregate. As a result, service technicians must acquaint themselves with modified service procedures to perform each retrofit effectively. The retrofit procedures listed here have been developed by Honeywell to address these issues and to help technicians perform successful retrofits of R-12 and R-502 systems utilizing positive-displacement (reciprocating, rotary, scroll, or screw) compressors.

General HCFC Retrofit Procedures

A word about system preparation: In retrofitting an existing refrigeration system, the condition of the existing seals and gaskets must be taken into account. Heat set, compression set, and seal shrinkage can all impact the condition of an existing seal or gasket. When the system is put under vacuum, the sealing device can be displaced, creating the potential for leakage. Whenever possible, gaskets and seals should be replaced in order to minimize the chances of an old seal or gasket becoming a source of a leak.

1. Record Baseline Data

Before making any hardware changes, compare current system operating data with normal operating data. Correct any deficiencies and record final data as a performance baseline. Data should include temperature and pressure measurements throughout the system including the evaporator, compressor suction and discharge, condenser and expansion device. These measurements will be useful when adjusting the system with an alternative Genetron Refrigerant.

2. Recover CFC Refrigerant Charge

The CFC refrigerant charge should be isolated from the system by pumping it down into the receiver. If no receiver is present, the refrigerant must be removed from the system using a recovery machine capable of meeting or exceeding the required levels of evacuation.

The charge must be collected in a recovery cylinder dedicated to that refrigerant (e.g., CFC-12 or CFC-502). Do not mix the recovered material with other refrigerants in a recovery tank, as this will result in a mixture that cannot be reclaimed. Do not vent the refrigerant to the atmosphere.

Knowing the recommended CFC refrigerant charge size for the system is helpful. If it is not known, weigh the entire amount of refrigerant removed. This amount can be used as a guide for the initial quantity of alternative Genetron Refrigerant to be charged to the system.

3. Drain the Lubricant

Genetron 409A has sufficient mineral oil solubility for most applications, however, at evaporating temperatures below -20°F (-29°C), at least 50% of the mineral oil should be replaced with alkylbenzene lubricant. Genetron MP39 and Genetron MP66 have sufficient mineral oil solubility for most medium temperature (20°F or higher evaporating) applications where piping runs are not exceedingly long. If piping runs are lengthy or for low-temperature evaporating conditions with MP blends, at least 50% of the mineral oil should be replaced with alkylbenzene lubricant. Recall that for evaporating temperatures below -10°F (-7°C), Genetron MP66 is recommended in favor of Genetron MP39. When retrofitting low temperature R-502 systems to Genetron HP80 or Genetron 408A, at least 50% of the mineral oil should be replaced with alkylbenzene lubricant.

If the system being retrofitted requires removal of the existing mineral oil, continue with Step 3. If operating conditions permit the use of mineral oil, and the existing oil is in acceptable condition, proceed to step 7.

Many small hermetic compressors do not have oil drains, making it necessary to remove the compressor from the system to drain the lubricant. In this case, the best point in the system to drain the lubricant is the suction line of the compressor. Small hand-operated pumps are available which permit insertion of a tube into the compressor suction line. For compressors with an access port, the same hand-operated pump can be used to remove lubricant without removing the compressor from the system.

For larger systems, the mineral oil should be drained from multiple points in the system. Particular attention should be paid to low spots around the evaporator where lubricant often collects. The mineral oil should also be drained from oil separators and/or suction accumulators.

4. Measure Existing Lubricant

Measure and record the volume of the lubricant removed from the system. Compare this amount with the amount recommended by the manufacturer to ensure that the majority of lubricant has been removed. This volume also will be used as a guide to determine the amount of alkylbenzene lubricant to add in the next step.

5. Recharge Compressor with Alkylbenzene Lubricant

Add to the compressor the same volume of alkylbenzene lubricant as the volume of mineral oil drained in Step 4. Honeywell recommends using a commercially available alkylbenzene lubricant of the same viscosity as the mineral oil. Check with the compressor manufacturer for the correct viscosity grade.

6. Reinstall the Compressor

If the compressor was removed to drain the oil, reinstall the compressor following standard service practices recommended by the manufacturer.

7. Evaluate the Expansion Device

Most R-502 and R-12 systems with thermostatic expansion valves will operate satisfactorily with the appropriate interim HCFC blend, however, it may be necessary to adjust the superheat.

In most cases, an existing R-502 capillary tube can be expected to operate satisfactorily with HP80. In the case of Genetron 408A, the mass flow is about 75% of that for R-502. The mass flow of the R-12 replacements are measurably lower than R-12. Hence for R-408A and likewise, for the R-12 replacements, a more restrictive capillary is required to achieve satisfactory performance over the entire range of design conditions.

Honeywell recommends consulting with the equipment manufacturer before replacing the capillary tube. If the manufacturer's information is not available, consult the following table to determine capillary tube length at the same diameter. These figures are based on ASHRAE method for capillary tube sizing.

When considering the R-12 replacements or R-408A (for replacement of R-502), if operation of the original capillary tube is expected over a wide range of condensing temperatures, unsatisfactory performance may result at both high and low condensing temperatures. The potential problems would include liquid floodback and motor overload at high condensing temperatures and loss of liquid seal entering the capillary tube at low condensing temperatures. Only in a situation where ambient conditions are expected to be relatively constant can using the original capillary tube and undercharging the unit be considered.

Capillary Tube Sizing- Relative Length

Evaporating Temperature		R-502 = 100%		R-12 = 100%		
°F	(°C)	HP80[1]	408A[1]	MP39[2]	MP66[2]	409A[2]
-25	(-32)	115%	205%	–	–	–
-10	(-23)	115%	205%	215%	250%	190%
0	(-18)	110%	200%	205%	230%	170%
20	(-7)	110%	200%	190%	200%	150%
40	(4)	–	–	180%	195%	150%

[1] 110°F (43°C) condensing temperature, no significant difference at 130°F (54°C) condensing.

[2] 110°F (43°C) condensing temperature, 10-30% increase in length required at 130°F (54°C) condensing.

8. Replace the Filter Drier

Following system maintenance, a recommended service practice is to replace the filter drier. There are two types of filter driers commonly used in refrigeration equipment; loose-fill and solid-core.

Many, but not all, of the standard loose-fill and solid-core driers used with CFC refrigerants are compatible with the corresponding alternative Genetron Refrigerants. Check with your wholesaler to make sure the replacement filter drier is compatible with the Genetron Refrigerant being used.

9. Reconnect the System and Evacuate

Use normal service practices to reconnect and evacuate the system. To remove air and other non-condensables, Honeywell recommends evacuating the system to a full vacuum of 1,000 microns or less from both sides of the system. However, attempting to evacuate a system with the pump connected only to the low-side of the system will not adequately remove moisture and non-condensables such as air. Use a good electronic gauge to measure the vacuum. An accurate reading cannot be made with a refrigeration gauge.

10. Check the System for Leaks

Check the system for leaks using normal service practices.

11. Charge System with Alternative Genetron Refrigerant Blend

When charging an R-12 system with either Genetron MP39, Genetron MP66, or Genetron 409A or when charging an R-502 system with Genetron HP80 or Genetron 408A, it is important to remember that these products are blends and not azeotropes. This means the composition of the vapor is not the same as the composition of the liquid. It is essential that these refrigerants be liquid-charged by removing only liquid from the cylinder. Never charge the system with vapor from a refrigerant blend cylinder. Doing so will result in the wrong refrigerant composition and may lead to a loss of system performance. Cylinders for the refrigerant blends that are equipped with a dip tube should be kept upright for liquid removal. Cylinders for the refrigerant blends that do not contain a dip tube should be inverted in order to withdraw liquid. A throttling valve should be used to control the flow of refrigerant to the suction side to ensure that a liquid slug cannot enter the compressor. NOTE: To prevent compressor damage, do not directly charge liquid into the suction line of the unit.

12. Use Correct Charge Size

Systems being charged with Genetron® MP blends or Genetron 409A will require a smaller charge size than those using R-12. Genetron HP80 and Genetron 408A charge sizes are smaller than the R-502 charge size being replaced. For expansion valves or optimized capillary tube systems, the typical charge size relative to the CFC being replaced appears below.

Relative Charge Size

Genetron Refrigerant	R-12 Replacement	R-502 Replacement
MP39, MP66	90%	not applicable
409A	93%	not applicable
HP80	not applicable	95%
408A	not applicable	85%

Where MP39, MP66, or 409A has replaced CFC-12 or when 408A has replaced R-502 and the original capillary tube is used, it will generally be necessary to undercharge the system to prevent liquid floodback to the compressor. As part of general procedure, Honeywell recommends initially charging the system with 75 percent by weight of the original CFC charge. For example, if the original CFC charge was 100 pounds (45 kg), initially charge 75 pounds (35 kg) of the appropriate replacement blend. If, for example, the original CFC charge was 300 grams, initially charge 225 grams of the replacement blend.

13. Check System Operation

Start the system and allow conditions to stabilize. If the system is undercharged, add refrigerant in increments of 5 percent by weight of the original CFC charge. For example, if the original charge was 100 pounds (45 kg), charge increments of 5 pounds (2.5 kg). Continue until desired operating conditions have been achieved.

Compressor suction and discharge pressures for the HCFC refrigerants relative to the CFC refrigerants they replace is given below.

Comparative Suction and Discharge Pressure

Versus R-12

	Suction	Discharge
MP39	Within 1 psi (5-10 kPa)	10-20 psi (70-150 kPa) higher
MP66	Comparable at -20°F (-29°C) Evaporator 8-9 psi higher at 25°F (-4°C) evaporator	Up to 70 psi (450-500 kPa) higher with extreme ambient conditions
409A	4 psi (25-30 kPa) higher	15-20 psi (100-175 kPa) higher

Versus R-502

	Suction	Discharge
HP80	5 psi (35 kPa) higher	40-50 psi (275-350 kPa) higher
408A	1-2 psi (7-14 kPa) higher	1-10 psi (7-70 kPa) higher

It may be necessary to reset the high-pressure cutout to compensate for the higher discharge pressures of the replacement refrigerant. This procedure should be done carefully to avoid exceeding the recommended operating limits of the compressor and other system components. The use of the original capillary tube will make the system more sensitive to charge and/or operating conditions. As a result, system performance will change more quickly if the system is overcharged or undercharged. To avoid overcharging, it is best to charge the system by first measuring the operating conditions (including discharge and suction pressures, suction line temperature, compressor amps, superheat) instead of using the liquid line sight glass as a guide.

14. Label Components and System

After retrofitting the system with the appropriate HCFC-based Genetron Refrigerant, label the system components to identify the type of refrigerant (for example, Genetron MP39) and specify the type of alkylbenzene lubricant (by brand name) in the system. This will help ensure that the proper refrigerant and lubricant will be used to service the equipment in the future.

Retrofit Checklist for HCFC-based Genetron Refrigerants

1. Record baseline data on original system performance. _____
2. Recover CFC refrigerant charge using appropriate recovery equipment. _____
   * Record the identity (e.g., R-502) and amount of CFC removed. _____
3. Drain most of the lubricant from the compressor. _____
4. Measure the amount of lubricant removed. _____
5. Recharge compressor with alkylbenzene lubricant. _____
   * Use the same amount that was removed from existing system. _____
6. Reinstall compressor. _____
7. Check expansion device. _____
   * Adjust the setting of the valve as necessary. _____
8. Replace filter drier with new filter drier approved for use with the newly charged alternative Genetron® Refrigerant. _____
9. Reconnect system and evacuate. _____
10. Check system for leaks. _____
11. Recharge system with the alternative Genetron Refrigerant. _____
    * Remove liquid only from cylinder. Charge using a throttling device. _____
12. Use correct charge size. _____
    * Initial charge 75 percent by weight of the original CFC refrigerant charge. _____
    * Record amount of refrigerant charged. _____
13. Check system operation. _____
    * Adjust charge to achieve desired operating conditions. _____
    * If low, remove liquid only from cylinder in increments of 5 percent of original CFC refrigerant charge. _____
    * Record the amount of refrigerant added. _____
14. Label components and systems for refrigerant and lubricant by brand name. _____

Convenient Pressure-Temperature tables can be found at the end of these guidelines

Genetron® MP39 Retrofit Specifics

(To be used in conjunction with the General HCFC Retrofit Procedures)

Applications

Genetron Refrigerant	Type	Replaces	Applications	Comments
MP39 (R-401A)	Blend	CFC-12	Supermarket display cases, walk-in coolers, beverage dispensers, vending machines, water coolers, home refrigerators.	Applications limited to evaporator temperatures > -10°F (-23°C).

Lubricant

Mineral oil may have sufficient miscibility with Genetron MP39 to achieve adequate oil return to the compressor at medium temperature conditions (above 20°F or -7°C evaporator) unless extremely long lines exist. Otherwise, Alkylbenzene lubricant is required with Genetron MP39.

Expansion Device

Most R-12 systems with thermostatic expansion valves will work satisfactorily with Genetron MP39. A capillary tube will need to be replaced with one of greater restriction to achieve satisfactory performance over the complete range of design conditions. Using the original capillary tube may result in liquid floodback and motor overload at high-condensing temperatures and loss of liquid seal at low-condensing temperatures. Where ambient conditions are relatively constant, R-12 systems equipped with the original capillary tube, can, in most cases, be operated satisfactorily by undercharging the unit with MP39.

Honeywell recommends consulting with the equipment manufacturer before replacing the capillary tube. If the manufacturer's information is not available, consult the table below to determine capillary tube length at the same diameter. These figures are based on the ASHRAE method for capillary tube sizing.

Capillary Tube Sizing — Relative Length

R-12 = 100%

Evaporating Temperature °F (°C)	MP39[1]
-10 (-23)	215%
0 (-18)	205%
20 (-7)	190%
40 (4)	180%

[1]110°F (43°C) condensing temperature, 10-30% increase in length required at 130°F (54°C) condensing.

Charge Size

Genetron MP39 charge size is typically about 90% of the CFC-12 charge for systems with expansion valves or optimized capillary tubes. Initially charge the system with MP39 at 75% by weight of the original CFC charge. (Refer to General HCFC Retrofit procedures for more information.) Genetron MP39 must be liquid-charged. A throttling valve should be used to control the flow of refrigerant to the suction side to ensure that a liquid slug cannot enter the compressor. NOTE: To prevent compressor damage, do not directly charge liquid into the suction line of the unit.

Comparative Suction and Discharge Pressure Versus R-12

	Suction	Discharge
MP39	Within 1 psi (5-10 kPa)	10-20 psi (70-150 kPa) higher

If necessary, reset high-pressure cutout to compensate for higher discharge pressures.

Example: For a box temperature of 35°F (and a 15°F leaving difference), the suction pressure would be about 23 psig and the average evaporating temperature 20°F. This corresponds to a saturated suction temperature of 25°F. If the measured temperature of the suction-line is 35°F, there is a 10°F superheat (the difference between measured suction-line temperature and saturated suction temperature).

To determine superheat for different conditions than above, first note the measured suction pressure. Using the temperature-pressure chart for Genetron MP39, locate the measured suction pressure in the "dew" pressure column. Find the corresponding saturated temperature on the chart. Subtract the saturated temperature from the measured suction-line temperature to determine the superheat.

The average evaporating temperature is the average of the temperatures corresponding to the suction pressure from both the "bubble" and "dew" pressure columns in the MP39 temperature-pressure chart.

The expected box temperature can be found by adding the leaving difference (usually 15-20°F) to the average evaporating temperature.

For a head pressure of 157 psig, the average condensing temperature is about 110°F. To determine the average condensing temperature at a different head pressure, average the temperatures corresponding to the head pressure from both the "bubble" and "dew" pressure columns of the Genetron MP39 temperature-pressure chart.

Convenient Pressure-Temperature tables can be found at the end of these guidelines.

Genetron® MP66 Retrofit Specifics

(To be used in conjunction with the General HCFC Retrofit Procedures)

Applications

Genetron Refrigerant	Type	Replaces	Applications	Comments
MP66 (R-401B)	Blend	CFC-12	Transport refrigeration, domestic and commercial freezers.	Consult equipment mfg'r. where high compression (Evaporator < -10°F) ratios exist, may be excessive discharge temperature and capacity reduction.

Lubricant

Alkylbenzene lubricant is required with Genetron MP66.

Expansion Device

Most R-12 systems with thermostatic expansion valves will work satisfactorily with Genetron MP66. A capillary tube will need to be replaced with one of greater restriction to achieve satisfactory performance over the complete range of design conditions. Using the original capillary tube may result in liquid floodback and motor overload at high-condensing temperatures and loss of liquid seal at low-condensing temperatures. Where ambient conditions are relatively constant, R-12 systems equipped with the original capillary tube, can, in most cases, be operated satisfactorily by undercharging the unit with MP66.

Honeywell recommends consulting with the equipment manufacturer before replacing the capillary tube. If the manufacturer's information is not available, consult the table below to determine capillary tube length at the same diameter. These figures are based on the ASHRAE method for capillary tube sizing.

Capillary Tube Sizing – Relative Length

R-12 = 100%

Evaporating Temperature °F (°C)	MP66[1]
-25 (-32)	–
-10 (-23)	250%
0 (-18)	230%
20 (-7)	200%
40 (4)	195%

[1] 110°F (43°C) condensing temperature, 10-30% increase in length required at 130°F (54°C) condensing.

Charge Size

Genetron MP66 charge size is typically about 90% of the CFC-12 charge for systems with expansion valves or optimized capillary tubes. Initially charge the system with MP66 at 75% by weight of the original CFC charge. (Refer to General HCFC Retrofit Procedures for more information.) Genetron MP66 must be liquid-charged. A throttling valve should be used to control the flow of refrigerant to the suction side to ensure that a liquid slug cannot enter the compressor. NOTE: To prevent compressor damage, do not directly charge liquid into the suction line of the unit.

Comparative Suction and Discharge Pressure

Versus R-12

	Suction	Discharge
MP66	Comparable at -20°F (-29°C) Evaporator 8-9 psi higher at 25°F (-4°C) evaporator.	Up to 70 psi (450-500 kPa) higher with extreme ambient conditions.

If necessary, reset high pressure cutout to compsensate for higher discharge pressures.

Example: For a box temperature of -5°F (and a 15°F leaving difference), the suction pressure would be about 2.0 psig and the average evaporating temperature -20°F. This corresponds to a saturated suction temperature of -15°F. If the measured temperature of the suction-line is -5°F, there is a 10°F superheat (the difference between measured suction-line temperature and saturated suction temperature).

To determine superheat for a different box temperature, first note the measured suction pressure. Using the temperature-pressure chart for MP66, locate the measured suction pressure in the "dew" pressure column. Find the corresponding saturated temperature on the chart. Subtract the saturated temperature from the measured suction-line temperature to determine the superheat.

The average evaporating temperature is the average of the temperatures corresponding to the suction pressure from both the "bubble" and "dew" pressure columns in the MP66 temperature-pressure chart.

The expected box temperature can be found by adding the leaving difference (usually15-20°F) to the average evaporating temperature.

For a head pressure of 168 psig, the average condensing temperature is about 110°F. To determine the average condensing temperature at a different head pressure, average the temperatures corresponding to the head pressure from both the "bubble" and "dew" pressure columns in the MP66 temperature-pressure chart.

Convenient Pressure-Temperature tables can be found at the end of these guidelines.

Genetron® 409A Retrofit Specifics

(To be used in conjunction with the General HCFC Retrofit Procedures.)

Applications

Genetron Refrigerant	Type	Replaces	Applications
409A (R-409A)	Blend	CFC-12	Supermarket display cases, walk-in coolers, beverage dispensers, vending machines, water coolers, domestic/commercial transport refrigeration.

Lubricant

Mineral oil may have sufficient miscibility with Genetron 409A to achieve adequate oil return to the compressor down to evaporating temperatures of -20°F (-29°C) unless piping is extremely long. For systems operating with Genetron 409A at evaporating temperatures below -20°F (-29°C), at least 50% of the mineral oil should be replaced with alklybenzene lubricant. Likewise, if piping runs are extremely long, at least 50% of the mineral oil should be replaced with alkylbenzene lubricant.

Expansion Device

Most R-12 systems with thermostatic expansion valves will work satisfactorily with Genetron® 409A. A capillary tube will need to be replaced with one of greater restriction to achieve satisfactory performance over the complete range of design conditions. Using the original capillary tube may result in liquid floodback and motor overload at high-condensing temperatures and loss of liquid seal at low-condensing temperatures. Where ambient conditions are relatively constant, R-12 systems equipped with the original capillary tube, can, in most cases, be operated satisfactorily by undercharging the unit with Genetron 409A.

Honeywell recommends consulting with the equipment manufacturer before replacing the capillary tube. If the manufacturer's information is not available, consult the table below to determine capillary tube length at the same diameter. These figures are based on the ASHRAE method for capillary tube sizing.

Capillary Tube Sizing – Relative Length

R-12 = 100%

Evaporating Temperature °F (°C)	R-409A[1]
-25 (-32)	–
-10 (-23)	190%
0 (-18)	170%
20 (-7)	150%
40 (4)	150%

[1] 110°F (43°C) condensing temperature, 10-30% increase in length required at 130°F (54°C) condensing.

Charge Size

Genetron 409A charge size is typically about 93% of the CFC-12 charge for systems with expansion valves or optimized capillary tubes. Initially charge the system with Genetron 409A at 75% by weight of the original CFC charge. (Refer to General HCFC Retrofit Procedures for more information.) Genetron 409A must be liquid-charged. A throttling valve should be used to control the flow of refrigerant to the suction side to ensure that a liquid slug cannot enter the compressor. NOTE: To prevent compressor damage, do not directly charge liquid into the suction line of the unit.

Comparative Suction and Discharge Pressure

Versus R-12

	Suction	Discharge
409A	4 psi higher. (25-30 kPa) higher.	15-20 psi higher. (100-175 kPa) higher.

If necessary, reset high pressure cutout to compsensate for higher discharge pressures.

Example: For a box temperature of 35°F (and a 15°F leaving difference), the suction pressure would be about 23 psig and the average evaporating temperature 20°F. This corresponds to a saturated suction temperature of 27°F. If the measured temperature of the suction-line is 37°F, there is a 10°F superheat (the difference between measured suction-line temperature and saturated suction temperature).

To determine superheat for a different box temperature, first note the measured suction pressure. Using the temperature-pressure chart for Genetron 409A, locate the measured suction pressure in the "dew" pressure column. Find the corresponding saturated temperature on the chart. Subtract the saturated temperature from the measured suction-line temperature to determine the superheat.

The average evaporating temperature is the average of the temperatures corresponding to the suction pressure from both the "bubble" and "dew" pressure columns in the Genetron 409A temperature-pressure chart. The expected box temperature can be found by adding the leaving difference (usually15-20°F) to the average evaporating temperature.

For a head pressure of 156 psig, the average condensing temperature is about 110°F. To determine the average condensing temperature at a different head pressure, average the temperatures corresponding to the head pressure from both the "bubble" and "dew" pressure columns of the Genetron 409A temperature-pressure chart.

Convenient Pressure-Temperature tables can be found at the end of these guidelines.

Genetron® HP80 Retrofit Specifics

(To be used in conjunction with the General HCFC Retrofit Procedures.)

Applications

Genetron Refrigerant	Type	Replaces	Applications
HP80 (R-402A)	Blend	R-502	Supermarket, freezer cases, reach-in coolers, display cases, ice machines.

Lubricant

Alkylbenzene lubricant is required with Genetron HP80.

Expansion Device

Most R-502 systems with thermostatic expansion valves will operate satisfactorily with Genetron HP80, however, it may be necessary to adjust the superheat. In most cases, an existing R-502 capillary tube can be expected to operate satisfactorily with HP80. Although the need to change an R-502 capillary is unlikely, comparative tube length information for Genetron HP80 is given below.

Capillary Tube Sizing – Relative Length

R-502 = 100%

Evaporating Temperature °F (°C)	HP80[1]
-25(-32)	115%
-10 (-23)	115%
0 (-18)	110%
20 (-7)	110%

[1] 110°F (43°C) condensing temperature, no significant difference at 130°F (54°C) condensing.

Charge Size

Genetron HP80 charge size is typically about 95% of the R-502 charge for systems with expansion valves or optimized capillary tubes. Initially charge the system with HP80 at 75% by weight of the original CFC charge. (Refer to General HCFC Retrofit Procedures for more information.) Genetron HP80 must be liquid-charged. A throttling valve should be used to control the flow of refrigerant to the suction side to ensure that a liquid slug cannot enter the compressor. NOTE: To prevent compressor damage, do not directly charge liquid into the suction line of the unit.

Comparative Suction and Discharge Pressure Versus R-502

	Suction	Discharge
HP80	5 psi higher. (35 kPa) higher.	40-50 psi higher. (275-350 kPa) higher.

If necessary, reset high pressure cutout to compsensate for higher discharge pressures.

Example: For a box temperature of -15°F (and a 15°F leaving difference), the suction pressure would be about 11 psig and the average evaporating temperature -32°F. This corresponds to a saturated suction temperature of -31°F. If the measured temperature of the suction-line is -16°F, there is a 15°F superheat (the difference between measured suction-line temperature and saturated suction temperature).

To determine superheat for a different box temperature, first note the measured suction pressure. Using the temperature-pressure chart for Genetron HP80, locate the measured suction pressure in the “dew” pressure column. Find the corresponding saturated temperature on the chart. The difference between the saturated temperature and the measured suction-line temperature is the superheat.

The average evaporating temperature is the average of the temperatures corresponding to the suction pressure from both the “bubble” and “dew” pressure columns in the Genetron HP80 temperature-pressure chart. The expected box temperature can be found by adding the leaving difference (usually15-20°F) to the average evaporator temperature.

For a head pressure of 288 psig, the average condensing temperature is about 110°F. To determine the average condensing temperature at a different head pressure, average the temperatures corresponding to the head pressure from both the “bubble” and “dew” pressure columns of the Genetron HP80 temperature-pressure chart.

Convenient Pressure-Temperature tables can be found at the end of these guidelines.

Genetron® 408A Retrofit Specifics

(To be used in conjunction with the General HCFC Retrofit Procedures.)

Applications

Genetron Refrigerant	Type	Replaces	Applications
408A (R-402A)	Blend	R-502	Supermarket freezer cases, reach-in coolers, display cases, ice machines.

Lubricant

Alkylbenzene lubricant is required with Genetron 408A.

Expansion Device

The capacity of an existing R-502 thermostatic expansion valve (TXV) will be oversized but may be acceptable when using R-408A. However, the superheat setting should be checked and may have to be readjusted after the system is put back into operation. If hunting of the TXV cannot be minimized by adjustment, the valve should be replaced with a smaller one. Honeywell recommends consulting with the TXV manufacturer for correct sizing and superheat setting.

An existing capillary tube will be unsatisfactory with R-408A. If operation of the original capillary tube is expected over a wide range of condensing temperatures, unsatisfactory performance may result at both high and low condensing temperatures. The potential problems would include liquid floodback and motor overload at high condensing temperatures and loss of liquid seal entering the capillary tube at low condensing temperatures. Only in a situation where ambient conditions are expected to be relatively constant can using the original capillary tube and undercharging the unit be considered.

The mass flow rate of R-408A is about 75% of that for R-502. R-408A will require a more restrictive capillary tube in order to achieve satisfactory performance over the entire range of design conditions. Honeywell recommends consulting with the equipment manufacturer before replacing the capillary tube. If the manufacturer's information is unavailable, it is recommended that a new capillary tube of the same diameter but twice the length of the original be used.

Capillary Tube Sizing – Relative Length

R-502 = 100%

Evaporating Temperature °F (°C)	R-408A[1]
-25(-32)	205%
-10 (-23)	205%
0 (-18)	205%
20 (-7)	205%

[1] 110°F (43 °C) condensing temperature, no significant difference at 130°F (54°C) condensing.

Charge Size

Genetron 408A charge size is typically about 85% of the R-502 charge for systems with expansion valves or optimized capillary tubes. Initially charge the system with R-408A at 75% by weight of the original CFC charge. (Refer to General HCFC Retrofit Procedures for more information.) Genetron 408A must be liquid-charged. A throttling valve should be used to control the flow of refrigerant to the suction side to ensure that a liquid slug cannot enter the compressor. NOTE: To prevent compressor damage, do not directly charge liquid into the suction line of the unit.

Comparative Suction and Discharge Pressure

- **Versus R-502**

	Suction	Discharge
R-408A	1-2 psi (7-14 kPa) higher	1-10 psi higher (10-70 kPa) higher

It may be necessary to reset the high-pressure cutout to compensate for higher discharge pressures.

Example: For a box temperature of -15°F (and a 15°F leaving difference), the suction pressure would be about 8 psig and the average evaporating temperature -30°F. This corresponds to a saturated suction temperature of -30°F. If the measured temperature of the suction-line is -15°F, there is a 15°F superheat (the difference between measured suction-line temperature and saturated suction temperature).

To determine superheat for a different box temperature, first note the measured suction pressure. Using the temperature-pressure chart for Genetron 408A, locate the measured suction pressure in the "dew" pressure column. Find the corresponding saturated temperature on the chart. The difference between the saturated temperature and the measured suction-line temperature is the superheat.

The average evaporating temperature is the average of the temperatures corresponding to the suction pressure from both the "bubble" and "dew" pressure columns in the Genetron 408A temperature-pressure chart. The expected box temperature can be found by adding the leaving difference (usually 15-20°F) to the average evaporating temperature.

For a head pressure of 252 psig, the average condensing temperature is about 110°F. To determine the average condensing temperature at a different head pressure, average the temperatures corresponding to the head pressure from both the "bubble" and "dew" pressure columns of the Genetron 408A pressure-temperature table.

Convenient Pressure-Temperature tables can be found at the end of these guidelines.

R-12 Retrofit

Pressure-Temperature Table (English units)

Units are in Pounds Per Square Inch Gauge vs. Degrees Fahrenheit

Pressure (psig)	Temperature (°F) 12	134a	MP39 Bubble (liquid)	MP39 Dew (vapor)	MP66 Bubble (liquid)	MP66 Dew (vapor)	409A Bubble (liquid)	409A Dew (vapor)
0	-22	-15	-27	-17	-30	-20	-30	-15
2	-16	-10	-22	-12	-25	-15	-25	-10
4	-11	-5	-17	-7	-20	-10	-20	-5
6	-7	-1	-13	-3	-16	-6	-16	-1
8	-2	3	-9	1	-12	-2	-12	3
10	2	7	-5	5	-8	1	-8	7
12	5	10	-2	8	-5	5	-4	11
14	9	13	2	12	-1	8	-1	14
16	12	16	5	15	2	11	2	17
18	16	19	8	18	5	14	5	20
20	19	22	11	21	8	17	8	23
22	21	25	13	23	10	20	11	26
24	24	27	16	26	13	22	14	28
26	27	30	19	28	15	25	16	31
28	30	32	21	31	18	27	19	33
30	32	35	23	33	20	29	21	35
32	34	37	26	35	22	32	23	38
34	37	39	28	37	25	34	25	40
36	39	41	30	39	27	36	28	42
38	41	43	32	42	29	38	30	44
40	43	45	34	44	31	40	32	46
42	45	47	36	45	33	42	34	48
44	47	49	38	47	35	44	36	50
46	49	51	40	49	36	45	37	52
48	51	52	42	51	38	47	39	53
50	53	54	43	53	40	49	41	55
52	55	56	45	54	42	51	43	57
54	57	57	47	56	43	52	44	58
56	59	59	48	58	45	54	46	60
58	60	60	50	59	47	55	48	62
60	62	62	52	61	48	57	49	63
65	66	66	55	65	52	61	53	67
70	70	69	59	68	56	64	57	71
75	74	73	63	72	59	68	60	74
80	77	76	66	75	62	71	64	77
85	81	79	69	78	66	74	67	80
90	84	82	72	81	69	77	70	84
95	87	85	75	84	72	80	73	86
100	90	88	78	87	74	83	76	89
105	93	90	81	89	77	85	79	92
110	96	93	84	92	80	88	82	95
115	99	96	86	95	83	91	84	97
120	102	98	89	97	85	93	87	100
125	104	100	91	100	88	96	89	102
130	107	103	94	102	90	98	92	105
135	109	105	96	104	92	100	94	107
140	112	107	98	107	95	102	97	109
145	114	109	101	109	97	105	99	111
150	117	112	103	111	99	107	101	114
155	119	114	105	113	101	109	103	116
160	121	116	107	115	103	111	105	118

Pressure (psig)	Temperature (°F) 12	134a	MP39 Bubble (liquid)	MP39 Dew (vapor)	MP66 Bubble (liquid)	MP66 Dew (vapor)	409A Bubble (liquid)	409A Dew (vapor)
170	126	120	111	119	107	115	110	122
175	128	121	113	121	109	117	112	124
180	130	123	115	123	111	119	113	126
185	132	125	117	125	113	120	115	127
190	134	127	119	127	115	122	117	129
195	136	129	121	128	117	124	119	131
200	138	130	123	130	119	126	121	133
205	140	132	124	132	120	127	123	134
210	141	134	126	134	122	129	125	136
215	143	135	128	135	124	131	126	138
220	145	137	130	137	125	132	128	140
225	147	139	131	138	127	134	130	141
230	149	140	133	140	129	136	131	143
235	150	142	135	142	130	137	133	144
240	152	143	136	143	132	139	135	146
245	154	145	138	145	133	140	136	147
250	155	146	139	146	135	142	138	149
255	157	148	141	148	137	143	139	150
260	159	149	142	149	138	145	141	152
265	160	151	144	151	139	146	142	153
270	162	152	145	152	141	147	144	155
275	163	153	147	153	142	149	145	156
280	165	155	148	155	144	150	147	157
285	166	156	150	156	145	152	148	159
290	168	157	151	157	147	153	150	160
295	169	159	152	159	148	154	151	161
300	171	160	154	160	149	156	152	163
305	172	161	155	161	151	157	154	164
310	174	163	156	163	152	158	155	165
315	175	164	158	164	153	159	157	167
320	176	165	159	165	155	161	158	168
325	178	166	160	166	156	162	159	169
330	179	167	161	168	157	163	160	170
335	180	169	163	169	158	164	162	172
340	182	170	164	170	160	165	163	173
345	183	171	165	171	161	167	164	174
350	184	172	166	172	162	168	165	175
355	186	173	168	174	163	169	167	176
360	187	174	169	175	164	170	168	177
365	188	176	170	176	166	171	169	178
370	189	177	171	177	167	172	170	180
375	191	178	172	178	168	173	172	181
380	192	179	174	179	169	174	173	182
385	193	180	175	180	170	176	174	183
390	194	181	176	181	171	177	175	184
395	196	182	177	182	172	178	176	185
400	197	183	178	183	174	179	177	186

R-12 Retrofit

Temperature-Pressure Table (English units)

Units are in Degrees Fahrenheit vs Pounds Per Square Inch Gauge

* = Inches of Mercury Vacuum

Temperature	Pressure (psig)							
			Bubble (liquid)	Dew (vapor)	Bubble (liquid)	Dew (vapor)	Bubble (liquid)	Dew (vapor)
-40	11.0 *	14.8 *	8.4 *	13.8 *	6.7 *	12.4 *	6.7 *	14.8 *
-38	10.0 *	13.9 *	7.2 *	12.9 *	5.4 *	11.3 *	5.5 *	13.9 *
-36	8.9 *	12.9 *	6.0 *	11.9 *	4.1 *	10.3 *	4.2 *	13.0 *
-34	7.8 *	12.0 *	4.7 *	10.9 *	2.8 *	9.2 *	2.9 *	12.0 *
-32	6.7 *	10.9 *	3.4 *	9.8 *	1.3 *	8.0 *	1.5 *	10.9 *
-30	5.5 *	9.8 *	2.0 *	8.7 *	0	6.8 *	0	9.9 *
-28	4.3 *	8.7 *	0.5 *	7.5 *	1	5.5 *	1	8.8 *
-26	3.0 *	7.5 *	1	6.2 *	2	4.2 *	2	7.6 *
-24	1.7 *	6.3 *	1	5.0 *	2	2.8 *	2	6.4 *
-22	0.3 *	5.0 *	2	3.6 *	3	1.4 *	3	5.1 *
-20	1	3.7 *	3	2.2 *	4	0	4	3.8 *
-18	1	2.3 *	4	0.8 *	5	1	5	2.4 *
-16	2	0.8 *	5	0	6	2	6	1.0 *
-14	3	0	6	1	7	3	7	0
-12	4	1	7	2	8	3	8	1
-10	5	2	8	3	9	4	9	2
-8	5	3	9	4	10	5	10	3
-6	6	4	10	5	11	6	11	4
-4	7	5	11	6	12	7	12	4
-2	8	6	12	6	14	8	13	5
0	9	7	13	7	15	9	15	6
2	10	8	14	9	16	10	16	7
4	11	9	15	10	18	12	17	8
6	12	10	17	11	19	13	19	9
8	13	11	18	12	20	14	20	11
10	15	12	20	13	22	15	21	12
12	16	13	21	14	23	17	23	13
14	17	14	22	16	25	18	24	14
16	18	16	24	17	27	19	26	15
18	20	17	26	18	28	21	28	17
20	21	18	27	20	30	22	29	18
22	22	20	29	21	32	24	31	19
24	24	21	31	23	34	25	33	21
26	25	23	32	24	35	27	35	22
28	27	25	34	26	37	29	36	24
30	28	26	36	27	39	31	38	26
32	30	28	38	29	41	32	40	27
34	32	30	40	31	43	34	42	29
36	33	31	42	33	46	36	45	31
38	35	33	44	35	48	38	47	32
40	37	35	46	37	50	40	49	34
42	39	37	48	39	52	42	51	36
44	41	39	51	41	55	45	54	38
46	43	41	53	43	57	47	56	40
48	45	43	55	45	60	49	58	42
50	47	45	58	47	62	51	61	44
52	49	48	60	49	65	54	63	47
54	51	50	63	52	68	56	66	49
56	53	52	66	54	71	59	69	51
58	55	55	68	57	74	61	72	53
60	58	57	71	59	77	64	75	56

Temperature	Pressure (psig)							
			Bubble (liquid)	Dew (vapor)	Bubble (liquid)	Dew (vapor)	Bubble (liquid)	Dew (vapor)
(°F)	12	134a	MP39		MP66		409A	
62	60	60	74	62	80	67	77	58
64	62	63	77	64	83	70	80	61
66	65	65	80	67	86	73	84	64
68	68	68	83	70	89	76	87	66
70	70	71	86	73	92	79	90	69
72	73	74	90	76	96	82	93	72
74	76	77	93	79	99	85	97	75
76	78	80	96	82	103	88	100	78
78	81	83	100	85	106	92	103	81
80	84	87	103	88	110	95	107	84
82	87	90	107	92	114	99	111	88
84	90	94	111	95	118	102	115	91
86	93	97	114	99	122	106	118	94
88	96	101	118	102	126	110	122	98
90	100	104	122	106	130	114	126	101
92	103	108	126	110	134	118	130	105
94	106	112	130	114	139	122	135	109
96	110	116	135	118	143	126	139	113
98	113	120	139	122	148	130	143	116
100	117	124	143	126	152	135	148	120
102	121	128	148	130	157	139	152	125
104	124	133	152	134	162	144	157	129
106	128	137	157	139	167	148	162	133
108	132	142	162	143	172	153	166	137
110	136	146	167	148	177	158	171	142
112	140	151	172	153	182	163	176	146
114	144	156	177	157	187	168	181	151
116	149	161	182	162	193	173	187	156
118	153	166	187	167	198	179	192	161
120	157	171	193	172	204	184	197	166
122	162	177	198	178	210	189	203	171
124	166	182	204	183	216	195	208	176
126	171	187	210	189	222	201	214	181
128	176	193	215	194	228	207	220	187
130	181	199	221	200	234	213	226	192
132	186	205	227	206	240	219	232	198
134	191	211	233	211	247	225	238	204
136	196	217	240	218	253	231	244	209
138	201	223	246	224	260	238	251	215
140	206	229	253	230	267	244	257	222
142	211	236	259	236	274	251	264	228
144	217	242	266	243	281	258	270	234
146	223	249	273	250	288	265	277	241
148	228	256	280	256	295	272	284	247
150	234	263	287	263	303	279	291	254

R-502 Retrofit

Pressure-Temperature Table (English units)

Units are in Pounds Per Square Inch Gauge vs. Degrees Fahrenheit

Pressure (psig)	Temperature (°F) 502	AZ-50 507	404A Bubble (liquid)	404A Dew (vapor)	HP80 Bubble (liquid)	HP80 Dew (vapor)	408A Bubble (liquid)	408A Dew (vapor)
0	-49	-52	-51	-50	-56	-53	-48	-47
2	-44	-47	-46	-45	-51	-48	-43	-43
4	-39	-43	-42	-41	-47	-43	-39	-38
6	-35	-39	-38	-37	-43	-39	-35	-34
8	-31	-35	-34	-33	-39	-36	-31	-30
10	-28	-32	-31	-29	-35	-32	-27	-27
12	-24	-28	-27	-26	-32	-29	-24	-23
14	-21	-25	-24	-23	-29	-26	-21	-20
16	-18	-22	-21	-20	-26	-23	-18	-17
18	-15	-19	-18	-17	-23	-20	-15	-14
20	-12	-17	-16	-15	-21	-18	-12	-11
22	-10	-14	-13	-12	-18	-15	-10	-9
24	-7	-12	-11	-10	-16	-13	-7	-6
26	-5	-9	-8	-7	-13	-10	-5	-4
28	-3	-7	-6	-5	-11	-8	-2	-2
30	0	-5	-4	-3	-9	-6	0	1
32	2	-3	-2	-1	-7	-4	2	3
34	4	-1	0	1	-5	-2	4	5
36	6	1	2	3	-3	0	6	7
38	8	3	4	5	-1	2	8	9
40	10	5	6	7	1	4	10	11
42	12	7	8	9	3	6	12	13
44	14	9	10	11	5	8	14	14
46	16	10	11	13	7	9	15	16
48	17	12	13	14	8	11	17	18
50	19	14	15	16	10	13	19	19
52	21	15	16	17	11	14	20	21
54	22	17	18	19	13	16	22	23
56	24	18	20	21	15	17	24	24
58	25	20	21	22	16	19	25	26
60	27	21	23	24	18	20	27	27
65	31	25	26	27	21	24	30	31
70	34	28	30	30	25	27	34	34
75	37	31	33	34	28	30	37	38
80	41	35	36	37	31	33	40	41
85	44	38	39	40	34	36	43	44
90	47	40	42	43	37	39	46	47
95	50	43	45	45	40	42	49	50
100	52	46	47	48	42	45	52	52
105	55	49	50	51	45	47	54	55
110	58	51	52	53	47	50	57	58
115	60	53	55	56	50	52	59	60
120	63	56	57	58	52	54	62	62
125	65	58	60	60	55	57	64	65
130	67	60	62	63	57	59	67	67
135	70	63	64	65	59	61	69	69
140	72	65	66	67	61	63	71	71

Pressure (psig)	Temperature (°F) 502	AZ-50 507	404A Bubble (liquid)	404A Dew (vapor)	HP80 Bubble (liquid)	HP80 Dew (vapor)	408A Bubble (liquid)	408A Dew (vapor)
145	74	67	68	69	63	65	73	74
150	76	69	70	71	65	67	75	76
155	78	71	72	73	67	69	77	78
160	80	73	74	75	69	71	79	80
165	82	75	76	77	71	73	81	82
170	84	77	78	79	73	75	83	84
175	86	78	80	81	75	77	85	85
180	88	80	82	82	77	79	87	87
185	90	82	83	84	78	80	89	89
190	92	84	85	86	80	82	90	91
195	93	85	87	88	82	84	92	93
200	95	87	89	89	84	85	94	94
205	97	89	90	91	85	87	95	96
210	99	90	92	92	87	89	97	98
215	100	92	93	94	88	90	99	99
220	102	93	95	96	90	92	100	101
225	103	95	96	97	91	93	102	102
230	105	96	98	99	93	95	103	104
235	107	98	99	100	94	96	105	105
240	108	99	101	102	96	98	106	107
245	110	101	102	103	97	99	108	108
250	111	102	104	104	99	100	109	110
255	113	104	105	106	100	102	111	111
260	114	105	107	107	102	103	112	113
265	115	106	108	109	103	105	114	114
270	117	108	109	110	104	106	115	115
275	118	109	111	111	106	107	116	117
280	120	110	112	113	107	109	118	118
285	121	112	113	114	108	110	119	119
290	122	113	115	115	110	111	120	121
295	124	114	116	116	111	112	122	122
300	125	115	117	118	112	114	123	123
310	127	118	120	120	115	116	125	126
320	130	120	122	122	117	118	128	128
330	132	123	124	125	119	121	130	131
340	135	125	127	127	122	123	133	133
350	137	127	129	129	124	125	135	135
360	139	129	131	131	126	127	137	137
370	142	131	133	134	128	130	139	140
380	144	133	135	136	130	132	141	142
390	146	136	137	138	132	134	144	144
400	148	138	139	140	135	136	146	146
410	150	139	141	142	137	138	148	148
420	152	141	143	144	138	140	150	150
430	154	143	145	145	140	142	152	152
440	156	145	147	147	142	143	154	154
450	158	147	149	149	144	144	145	155

R-502 Retrofit

Temperature-Pressure Table (English units)

Units are in Degrees Fahrenheit vs. Pounds Per Square Inch Gauge

* = Inches of Mercury Vacuum

Temperature		Pressure (psig)							
			Bubble	Dew	Bubble	Dew	Bubble	Dew	
		AZ-50	(liquid)	(vapor)	(liquid)	(vapor)	(liquid)	(vapor)	
(°F)	502	507	404A		HP80		408A		
-40	4	5	5	4	7	6	4	3	
-38	5	6	6	5	9	7	4	4	
-36	6	8	7	6	10	8	5	5	
-34	7	9	8	7	11	9	6	6	
-32	8	10	9	9	12	10	7	7	
-30	9	11	10	10	13	11	9	8	
-28	10	12	12	11	15	13	10	9	
-26	11	14	13	12	16	14	11	10	
-24	12	15	14	13	18	15	12	12	
-22	14	16	15	15	19	17	13	13	
-20	15	18	17	16	20	18	15	14	
-18	16	19	18	17	22	20	16	15	
-16	17	21	20	19	24	21	17	17	
-14	19	22	21	20	25	23	19	18	
-12	20	24	23	22	27	25	20	20	
-10	22	26	25	24	29	26	22	21	
-8	23	27	26	25	31	28	23	23	
-6	25	29	28	27	33	30	25	24	
-4	27	31	30	29	35	32	27	26	
-2	29	33	32	31	37	34	28	28	
0	30	35	34	33	39	36	30	30	
2	32	37	36	35	41	38	32	31	
4	34	39	38	37	43	40	34	33	
6	36	41	40	39	45	42	36	35	
8	38	43	42	41	48	45	38	37	
10	40	46	44	43	50	47	40	39	
12	42	48	47	45	53	49	42	41	
14	44	51	49	48	55	52	44	44	
16	47	53	52	50	58	54	47	46	
18	49	56	54	53	61	57	49	48	
20	51	58	57	55	63	60	52	51	
22	54	61	59	58	66	63	54	53	
24	56	64	62	61	69	66	57	56	
26	59	67	65	64	72	69	59	58	
28	62	70	68	66	75	72	62	61	
30	64	73	71	69	79	75	65	64	
32	67	76	74	72	82	78	68	67	
34	70	79	77	76	85	81	70	70	
36	73	82	80	79	89	85	73	73	
38	76	86	84	82	92	88	77	76	
40	79	89	87	85	96	92	80	79	
42	82	93	90	89	100	95	83	82	
44	85	96	94	92	103	99	86	85	
46	89	100	98	96	107	103	90	89	
48	92	104	101	100	111	107	93	92	
50	96	108	105	104	115	111	97	96	
52	99	112	109	108	120	115	101	99	
54	103	116	113	112	124	119	104	103	

Temperature		Temperature (°F)							
			Bubble	Dew	Bubble	Dew	Bubble	Dew	
		AZ-50	(liquid)	(vapor)	(liquid)	(vapor)	(liquid)	(vapor)	
(°F)	502	507	404A		HP80		408A		
56	107	120	117	116	128	124	108	107	
58	111	125	122	120	133	128	112	111	
60	114	129	126	124	137	133	116	115	
62	119	134	131	129	142	137	120	119	
64	123	138	135	133	147	142	125	123	
66	127	143	140	138	152	147	129	128	
68	131	148	144	143	157	152	133	132	
70	136	153	149	147	162	157	138	137	
72	140	158	154	152	167	162	143	141	
74	145	163	159	158	173	168	147	146	
76	149	169	165	163	178	173	152	151	
78	154	174	170	168	184	179	157	156	
80	159	180	175	173	190	184	162	161	
82	164	185	181	179	196	190	167	166	
84	169	191	187	185	202	196	173	171	
86	175	197	193	190	208	202	178	177	
88	180	203	198	196	214	208	184	182	
90	185	209	205	202	220	215	189	188	
92	191	215	211	209	227	221	195	194	
94	197	222	217	215	233	228	201	199	
96	202	229	223	221	240	234	207	205	
98	208	235	230	228	247	241	213	211	
100	214	242	237	235	254	248	219	218	
102	220	249	244	242	261	256	226	224	
104	227	256	251	249	269	263	232	231	
106	233	264	258	256	276	270	239	237	
108	240	271	265	263	284	278	245	244	
110	246	279	273	270	292	286	252	251	
112	253	286	280	278	300	294	259	258	
114	260	294	288	286	308	302	267	265	
116	267	302	296	294	316	310	274	272	
118	274	311	304	302	324	318	281	280	
120	282	319	312	310	333	327	289	287	
122	289	328	320	318	342	336	297	295	
124	297	336	329	327	350	344	305	303	
126	304	345	338	336	360	353	313	311	
128	312	354	347	344	369	363	321	319	
130	320	364	356	354	378	372	329	327	
132	328	373	365	363	388	382	338	336	
134	337	383	374	372	397	391	346	345	
136	345	392	384	382	407	401	355	353	
138	354	402	394	392	418	412	364	362	
140	363	413	404	402	428	422	373	372	
142	372	423	414	412	438	433	383	381	
144	381	434	424	422	449	443	392	390	
146	390	445	435	433	460	454	402	400	
148	399	456	446	444	471	465	412	410	
150	409	467	457	455	482	477	422	420	

R-12 Retrofit

Pressure-Temperature Table (International System of Units)
Units are kiloPascals vs. Degrees Celsius

			Temperature (°C)					
			Bubble	Dew	Bubble	Dew	Bubble	Dew
Pressure			(liquid)	(vapor)	(liquid)	(vapor)	(liquid)	(vapor)
(kPa)	12	134a	MP39		MP66		409A	
100	-30.1	-26.4	-33.2	-27.5	-34.8	-29.3	-34.7	-26.2
110	-27.8	-24.3	-31.1	-25.4	-32.7	-27.2	-32.6	-24.1
120	-25.7	-22.3	-29.1	-23.4	-30.7	-25.2	-30.6	-22.2
130	-23.7	-20.5	-27.2	-21.6	-28.9	-23.4	-28.7	-20.3
140	-21.9	-18.8	-25.5	-19.8	-27.1	-21.7	-27.0	-18.6
150	-20.1	-17.1	-23.8	-18.2	-25.5	-20.0	-25.3	-16.9
160	-18.5	-15.6	-22.2	-16.6	-23.9	-18.5	-23.7	-15.4
170	-16.9	-14.1	-20.7	-15.1	-22.4	-17.0	-22.2	-13.9
180	-15.3	-12.7	-19.3	-13.7	-21.0	-15.6	-20.7	-12.4
190	-13.9	-11.4	-17.9	-12.4	-19.6	-14.3	-19.4	-11.1
200	-12.5	-10.1	-16.6	-11.1	-18.3	-13.0	-18.0	-9.8
210	-11.1	-8.8	-15.3	-9.8	-17.0	-11.7	-16.7	-8.5
220	-9.8	-7.6	-14.1	-8.6	-15.8	-10.5	-15.5	-7.3
230	-8.6	-6.5	-12.9	-7.4	-14.7	-9.4	-14.3	-6.1
240	-7.4	-5.4	-11.7	-6.3	-13.5	-8.3	-13.2	-5.0
250	-6.2	-4.3	-10.6	-5.2	-12.4	-7.2	-12.1	-3.9
260	-5.1	-3.2	-9.5	-4.2	-11.3	-6.1	-11.0	-2.8
270	-4.0	-2.2	-8.5	-3.1	-10.3	-5.1	-9.9	-1.8
280	-2.9	-1.2	-7.5	-2.1	-9.3	-4.1	-8.9	-0.8
290	-1.8	-0.3	-6.5	-1.2	-8.3	-3.2	-7.9	0.2
300	-0.8	0.7	-5.5	-0.2	-7.4	-2.2	-6.9	1.1
310	0.2	1.6	-4.6	0.7	-6.4	-1.3	-6.0	2.1
320	1.2	2.5	-3.7	1.6	-5.5	-0.4	-5.1	3.0
330	2.1	3.4	-2.8	2.5	-4.6	0.5	-4.2	3.8
340	3.0	4.2	-1.9	3.4	-3.8	1.3	-3.3	4.7
350	3.9	5.0	-1.1	4.2	-2.9	2.2	-2.4	5.5
360	4.8	5.8	-0.2	5.0	-2.1	3.0	-1.6	6.4
380	6.5	7.4	1.4	6.6	-0.5	4.6	0.0	8.0
400	8.2	8.9	3.0	8.2	1.1	6.1	1.6	9.5
420	9.8	10.4	4.5	9.6	2.6	7.5	3.1	11.0
440	11.3	11.8	5.9	11.0	4.0	9.0	4.6	12.4
460	12.8	13.2	7.3	12.4	5.4	10.3	6.0	13.8
480	14.3	14.5	8.7	13.7	6.7	11.6	7.3	15.1
500	15.7	15.7	10.0	15.0	8.0	12.9	8.7	16.4
520	17.0	17.0	11.2	16.3	9.3	14.1	9.9	17.7
540	18.3	18.2	12.5	17.5	10.5	15.4	11.2	18.9
560	19.6	19.3	13.7	18.7	11.7	16.5	12.4	20.1
580	20.8	20.5	14.9	19.8	12.9	17.7	13.6	21.2
600	22.1	21.6	16.0	20.9	14.0	18.8	14.7	22.3
620	23.2	22.7	17.1	22.0	15.1	19.9	15.9	23.4
640	24.4	23.7	18.2	23.1	16.2	20.9	16.9	24.5
660	25.5	24.7	19.3	24.1	17.2	21.9	18.0	25.5
680	26.6	25.7	20.3	25.2	18.3	23.0	19.1	26.6
700	27.7	26.7	21.3	26.1	19.3	23.9	20.1	27.6
720	28.8	27.7	22.3	27.1	20.3	24.9	21.1	28.5
740	29.8	28.6	23.3	28.1	21.2	25.8	22.1	29.5
760	30.8	29.5	24.2	29.0	22.2	26.8	23.0	30.4
780	31.8	30.4	25.2	29.9	23.1	27.7	24.0	31.3
800	32.8	31.3	26.1	30.8	24.0	28.6	24.9	32.2
820	33.8	32.2	27.0	31.7	24.9	29.5	25.8	33.1
840	34.7	33.1	27.9	32.6	25.8	30.3	26.7	34.0

			Temperature (°C)					
			Bubble	Dew	Bubble	Dew	Bubble	Dew
Pressure			(liquid)	(vapor)	(liquid)	(vapor)	(liquid)	(vapor)
(kPa)	12	134a	MP39		MP66		409A	
860	35.6	33.9	28.7	33.4	26.6	31.2	27.6	34.9
880	36.6	34.7	29.6	34.3	27.5	32.0	28.4	35.7
900	37.5	35.5	30.4	35.1	28.3	32.8	29.3	36.5
920	38.3	36.3	31.3	35.9	29.1	33.6	30.1	37.3
940	39.2	37.1	32.1	36.7	29.9	34.4	31.0	38.1
960	40.1	37.9	32.9	37.5	30.7	35.2	31.8	38.9
980	40.9	38.6	33.7	38.2	31.5	35.9	32.6	39.7
1000	41.7	39.4	34.4	39.0	32.3	36.7	33.3	40.4
1050	43.7	41.2	36.3	40.8	34.2	38.5	35.3	42.3
1100	45.7	43.0	38.2	42.6	36.0	40.3	37.1	44.1
1150	47.6	44.7	39.9	44.3	37.7	42.0	38.9	45.8
1200	49.4	46.3	41.6	46.0	39.4	43.7	40.6	47.5
1250	51.2	47.9	43.3	47.6	41.1	45.3	42.3	49.1
1300	52.9	49.5	44.9	49.2	42.7	46.8	43.9	50.7
1350	54.6	51.0	46.5	50.7	44.2	48.3	45.5	52.2
1400	56.2	52.4	48.0	52.2	45.8	49.8	47.1	53.7
1450	57.8	53.9	49.5	53.6	47.2	51.2	48.6	55.1
1500	59.3	55.2	50.9	55.1	48.7	52.6	50.0	56.5
1550	60.8	56.6	52.3	56.4	50.1	54.0	51.5	57.9
1600	62.3	57.9	53.7	57.8	51.4	55.3	52.9	59.3
1650	63.8	59.2	55.1	59.1	52.8	56.6	54.2	60.6
1700	65.2	60.5	56.4	60.3	54.1	57.9	55.6	61.8
1750	66.5	61.7	57.7	61.6	55.4	59.1	56.9	63.1
1800	67.9	62.9	59.0	62.8	56.6	60.3	58.2	64.3
1850	69.2	64.1	60.2	64.0	57.8	61.5	59.4	65.5
1900	70.5	65.2	61.4	65.2	59.0	62.7	60.6	66.7
1950	71.8	66.4	62.6	66.3	60.2	63.8	61.9	67.8
2000	73.0	67.5	63.8	67.5	61.4	65.0	63.0	69.0

Gauge Pressure = Absolute Pressure - 101.3 kPa
1 Bar = 101.3 kPa

R-12 Retrofit

Temperature-Pressure Table (International System of Units)
Units are in Degrees Celsius vs kiloPascals

Temperature			Pressure (kPa)					
			Bubble (liquid)	Dew (vapor)	Bubble (liquid)	Dew (vapor)	Bubble (liquid)	Dew (vapor)
(°C)	12	134a	MP39		MP66		409A	
-40	64	51	73	55	79	59	79	51
-39	67	54	77	57	83	63	82	54
-38	70	57	80	60	86	66	86	57
-37	74	60	84	63	91	69	90	60
-36	77	63	88	67	95	73	94	63
-35	81	66	92	70	99	76	99	66
-34	84	70	97	74	104	80	103	69
-33	88	73	101	77	109	84	108	73
-32	92	77	106	81	114	88	113	76
-31	96	80	110	85	119	92	118	80
-30	100	84	115	89	124	97	123	84
-29	105	88	120	93	129	101	128	88
-28	109	93	126	98	135	106	134	92
-27	114	97	131	102	141	111	140	97
-26	119	102	137	107	147	116	146	101
-25	123	106	143	112	153	121	152	106
-24	129	111	149	117	159	127	158	111
-23	134	116	155	122	166	132	164	116
-22	139	122	161	128	173	138	171	121
-21	145	127	168	133	180	144	178	126
-20	151	133	175	139	187	150	185	132
-19	157	139	182	145	195	157	193	137
-18	163	145	189	151	202	163	200	143
-17	169	151	197	158	210	170	208	149
-16	176	157	204	164	219	177	216	156
-15	182	164	212	171	227	185	224	162
-14	189	171	220	178	236	192	233	169
-13	196	178	229	185	245	200	241	176
-12	204	185	238	193	254	208	250	183
-11	211	193	247	200	263	216	260	191
-10	219	201	256	208	273	225	269	198
-9	227	209	265	217	283	233	279	206
-8	235	217	275	225	293	242	289	214
-7	243	225	285	234	304	252	299	222
-6	252	234	295	243	315	261	310	231
-5	261	243	306	252	326	271	321	240
-4	270	253	316	261	337	281	332	249
-3	279	262	328	271	349	292	343	258
-2	288	272	339	281	361	302	355	268
-1	298	282	351	292	373	313	367	278
0	308	293	363	302	386	325	380	288
1	318	304	375	313	399	336	392	299
2	329	315	388	324	413	348	405	309
3	340	326	401	336	426	360	418	320
4	351	338	414	348	440	373	432	332
5	362	350	427	360	455	386	446	344
6	374	362	441	372	469	399	460	356
7	385	375	456	385	484	413	475	368
8	398	388	470	398	500	427	490	380
9	410	401	485	411	516	441	505	393
10	423	415	500	425	532	455	521	407
11	436	429	516	439	548	470	537	420

Temperature			Pressure (kPa)					
			Bubble (liquid)	Dew (vapor)	Bubble (liquid)	Dew (vapor)	Bubble (liquid)	Dew (vapor)
(°C)	12	134a	MP39		MP66		409A	
12	449	443	532	454	565	486	553	434
13	463	458	549	469	582	502	570	449
14	476	473	565	484	600	518	587	463
15	491	488	583	500	618	534	605	478
16	505	504	600	515	637	551	623	494
17	520	521	618	532	656	568	641	509
18	535	537	636	549	675	586	660	526
19	551	554	655	566	695	604	679	542
20	566	572	674	583	715	623	698	559
21	583	590	694	601	736	642	718	576
22	599	608	714	619	757	661	739	594
23	616	627	734	638	778	681	759	612
24	633	646	755	657	800	701	781	631
25	651	665	777	677	822	722	802	650
26	668	685	798	697	845	743	824	669
27	687	706	820	718	869	765	847	689
28	705	727	843	739	892	787	870	709
29	724	748	866	760	917	810	893	730
30	744	770	890	782	941	833	917	751
31	763	793	914	804	967	856	941	772
32	784	815	938	827	992	881	966	795
33	804	839	963	850	1019	905	991	817
34	825	863	989	874	1045	930	1017	840
35	846	887	1015	898	1073	956	1043	864
36	868	912	1041	923	1101	982	1070	888
37	890	937	1068	948	1129	1009	1097	912
38	913	963	1096	974	1158	1036	1125	937
39	935	990	1124	1000	1187	1064	1153	963
40	959	1017	1152	1027	1217	1092	1182	989
41	983	1044	1181	1055	1248	1121	1211	1015
42	1007	1072	1211	1083	1279	1150	1241	1042
43	1031	1101	1241	1111	1310	1180	1271	1070
44	1057	1130	1272	1140	1342	1211	1302	1098
45	1082	1160	1303	1170	1375	1242	1334	1127
46	1108	1190	1335	1200	1409	1274	1366	1156
47	1135	1221	1367	1231	1442	1306	1398	1186
48	1161	1253	1400	1262	1477	1339	1431	1216
49	1189	1285	1434	1294	1512	1373	1465	1247
50	1217	1318	1468	1326	1548	1407	1499	1279
51	1245	1351	1502	1360	1584	1442	1534	1311
52	1274	1385	1538	1393	1621	1477	1569	1344
53	1303	1420	1574	1428	1659	1514	1605	1377
54	1333	1455	1610	1463	1697	1550	1642	1411
55	1363	1492	1647	1498	1736	1588	1679	1446
56	1394	1528	1685	1535	1776	1626	1717	1481
57	1425	1566	1723	1572	1816	1665	1755	1517
58	1457	1604	1762	1609	1857	1705	1794	1553
59	1489	1642	1802	1648	1898	1745	1834	1591
60	1522	1682	1842	1687	1940	1786	1874	1629
61	1555	1722	1883	1726	1983	1828	1915	1667
62	1589	1763	1925	1767	2027	1870	1956	1706
63	1624	1804	1967	1808	2071	1913	1998	1746
64	1659	1847	2010	1849	2116	1957	2041	1787
65	1694	1890	2054	1892	2162	2002	2085	1829

Gauge Pressure = Absolute Pressure - 101.3 kPa
1 Bar = 101.3 kPa

R-502 Retrofit

Pressure-Temperature Table (International System of Units)
Units are in kiloPascals vs. Degrees Celsius

Pressure			Temperature (°C) Bubble	Dew	Bubble	Dew	Bubble	Dew
		AZ-50	(liquid)	(vapor)	(liquid)	(vapor)	(liquid)	(vapor)
(kPa)	502	507	404A		HP80		408A	
100	-45.2	-47.0	-46.5	-45.7	-49.2	-47.3	-44.9	-44.4
110	-43.2	-45.0	-44.5	-43.8	-47.2	-45.3	-42.8	-42.4
120	-41.3	-43.2	-42.6	-41.9	-45.3	-43.5	-40.9	-40.5
130	-39.5	-41.4	-40.9	-40.2	-43.6	-41.7	-39.2	-38.7
140	-37.8	-39.8	-39.2	-38.5	-41.9	-40.1	-37.5	-37.1
150	-36.2	-38.2	-37.7	-37.0	-40.4	-38.6	-35.9	-35.5
160	-34.7	-36.8	-36.2	-35.5	-38.9	-37.1	-34.4	-34.0
170	-33.2	-35.4	-34.8	-34.1	-37.5	-35.7	-33.0	-32.6
180	-31.9	-34.0	-33.5	-32.8	-36.2	-34.4	-31.6	-31.2
190	-30.5	-32.7	-32.2	-31.5	-34.9	-33.1	-30.3	-29.9
200	-29.3	-31.5	-30.9	-30.3	-33.6	-31.9	-29.1	-28.6
210	-28.0	-30.3	-29.7	-29.1	-32.4	-30.7	-27.8	-27.4
220	-26.9	-29.2	-28.6	-27.9	-31.3	-29.6	-26.7	-26.3
230	-25.7	-28.1	-27.5	-26.8	-30.2	-28.5	-25.6	-25.1
240	-24.6	-27.0	-26.4	-25.8	-29.1	-27.5	-24.5	-24.1
250	-23.6	-26.0	-25.4	-24.8	-28.1	-26.4	-23.4	-23.0
260	-22.5	-25.0	-24.4	-23.8	-27.1	-25.5	-22.4	-22.0
270	-21.5	-24.0	-23.4	-22.8	-26.1	-24.5	-21.4	-21.0
280	-20.5	-23.1	-22.5	-21.8	-25.2	-23.6	-20.4	-20.0
290	-19.6	-22.2	-21.5	-20.9	-24.2	-22.6	-19.5	-19.1
300	-18.7	-21.3	-20.6	-20.0	-23.4	-21.8	-18.6	-18.2
310	-17.8	-20.4	-19.8	-19.1	-22.5	-20.9	-17.7	-17.3
320	-16.9	-19.5	-18.9	-18.3	-21.6	-20.1	-16.8	-16.4
330	-16.0	-18.7	-18.1	-17.5	-20.8	-19.2	-16.0	-15.6
340	-15.2	-17.9	-17.2	-16.7	-20.0	-18.4	-15.2	-14.8
350	-14.4	-17.1	-16.4	-15.9	-19.2	-17.6	-14.3	-14.0
375	-12.4	-15.2	-14.5	-13.9	-17.3	-15.7	-12.4	-12.0
400	-10.5	-13.4	-12.7	-12.1	-15.4	-13.9	-10.5	-10.2
425	-8.7	-11.6	-11.0	-10.4	-13.7	-12.2	-8.8	-8.4
450	-7.0	-10.0	-9.3	-8.7	-12.0	-10.6	-7.1	-6.7
475	-5.3	-8.4	-7.7	-7.1	-10.4	-9.0	-5.5	-5.1
500	-3.8	-6.8	-6.2	-5.6	-8.9	-7.5	-3.9	-3.5
525	-2.2	-5.4	-4.7	-4.1	-7.4	-6.0	-2.4	-2.0
550	-0.8	-3.9	-3.2	-2.7	-6.0	-4.6	-0.9	-0.6
575	0.7	-2.6	-1.9	-1.4	-4.6	-3.3	0.5	0.8
600	2.1	-1.2	-0.5	0.0	-3.3	-1.9	1.8	2.2
625	3.4	0.1	0.8	1.3	-2.0	-0.7	3.1	3.5
650	4.7	1.3	2.0	2.5	-0.8	0.6	4.4	4.8
675	5.9	2.5	3.2	3.7	0.5	1.8	5.6	6.0
700	7.2	3.7	4.4	4.9	1.6	3.0	6.9	7.2
725	8.4	4.9	5.6	6.1	2.8	4.1	8.0	8.4
750	9.5	6.0	6.7	7.2	3.9	5.2	9.2	9.5
775	10.7	7.1	7.8	8.3	5.0	6.3	10.3	10.6
800	11.8	8.1	8.9	9.3	6.1	7.3	11.4	11.7
825	12.8	9.2	9.9	10.4	7.1	8.4	12.4	12.8
850	13.9	10.2	10.9	11.4	8.2	9.4	13.5	13.8
875	14.9	11.2	11.9	12.4	9.1	10.4	14.5	14.8
900	16.0	12.2	12.9	13.4	10.1	11.3	15.5	15.8
925	16.9	13.1	13.9	14.3	11.1	12.3	16.5	16.8
950	17.9	14.1	14.8	15.3	12.0	13.2	17.4	17.7
975	18.9	15.0	15.7	16.2	12.9	14.1	18.4	18.7
1000	19.8	15.9	16.6	17.1	13.8	15.0	19.3	19.6

Pressure			Temperature (°C) Bubble	Dew	Bubble	Dew	Bubble	Dew
		AZ-50	(liquid)	(vapor)	(liquid)	(vapor)	(liquid)	(vapor)
(kPa)	502	507	404A		HP80		408A	
1050	21.6	17.6	18.4	18.8	15.6	16.8	21.1	21.4
1100	23.4	19.3	20.1	20.5	17.3	18.4	22.8	23.1
1150	25.1	20.9	21.7	22.2	18.9	20.1	24.5	24.8
1200	26.7	22.5	23.3	23.7	20.5	21.6	26.1	26.4
1250	28.3	24.1	24.9	25.3	22.1	23.2	27.6	27.9
1300	29.9	25.6	26.4	26.8	23.6	24.6	29.2	29.4
1350	31.4	27.0	27.8	28.2	25.0	26.1	30.6	30.9
1400	32.8	28.4	29.2	29.6	26.4	27.5	32.1	32.4
1450	34.3	29.8	30.6	31.0	27.8	28.8	33.5	33.7
1500	35.7	31.1	31.9	32.3	29.1	30.1	34.8	35.1
1550	37.0	32.4	33.2	33.6	30.4	31.4	36.2	36.4
1600	38.3	33.7	34.5	34.9	31.7	32.7	37.5	37.7
1650	39.6	34.9	35.8	36.1	33.0	33.9	38.7	39.0
1700	40.9	36.1	37.0	37.3	34.2	35.1	40.0	40.2
1750	42.1	37.3	38.2	38.5	35.4	36.3	41.2	41.5
1800	43.4	38.5	39.3	39.7	36.6	37.5	42.4	42.6
1850	44.5	39.6	40.5	40.8	37.7	38.6	43.5	43.8
1900	45.7	40.7	41.6	41.9	38.8	39.7	44.7	44.9
1950	46.8	41.8	42.7	43.0	39.9	40.8	45.8	46.1
2000	48.0	42.9	43.8	44.1	41.0	41.9	46.9	47.1
2050	49.1	43.9	44.8	45.1	42.1	42.9	48.0	48.2
2100	50.1	45.0	45.8	46.2	43.1	43.9	49.0	49.3
2150	51.2	46.0	46.9	47.2	44.1	45.0	50.1	50.3
2200	52.2	47.0	47.9	48.2	45.1	45.9	51.1	51.3
2250	53.3	47.9	48.8	49.1	46.1	46.9	52.1	52.3
2300	54.3	48.9	49.8	50.1	47.1	47.9	53.1	53.3
2350	55.3	49.8	50.7	51.0	48.0	48.8	54.1	54.3
2400	56.2	50.8	51.7	52.0	49.0	49.7	55.0	55.2
2450	57.2	51.7	52.6	52.9	49.9	50.7	55.9	56.2
2500	58.1	52.6	53.5	53.8	50.8	51.6	56.9	57.1
2550	59.1	53.5	54.4	54.6	51.7	52.4	57.8	58.0
2600	60.0	54.3	55.3	55.5	52.6	53.3	58.7	58.9
2650	60.9	55.2	56.1	56.4	53.4	54.2	59.6	59.8
2700	61.8	56.0	57.0	57.2	54.3	55.0	60.4	60.6
2750	62.6	56.9	57.8	58.0	55.2	55.8	61.3	61.5
2800	63.5	57.7	58.6	58.9	56.0	56.7	62.1	62.3
2850	64.4	58.5	59.4	59.7	56.8	57.5	63.0	63.2
2900	65.2	59.3	60.2	60.5	57.6	58.3	63.8	64.0
2950	66.0	60.1	61.0	61.2	58.4	59.1	64.6	64.8
3000	66.8	60.8	61.8	62.0	59.2	59.8	65.4	65.6
3050	67.7	61.6	62.6	62.8	60.0	60.6	66.2	66.4
3100	68.4	62.3	63.3	63.5	60.8	61.4	67.0	67.2
3150	69.2	63.1	64.1	64.3	61.5	62.1	67.8	68.0
3200	70.0	63.8	64.8	65.0	62.3	62.9	68.5	68.7
3250	70.8	64.5	65.5	65.7	63.0	63.6	69.3	69.5
3300	71.5	65.2	66.3	66.4	63.7	64.3	70.0	70.2
3350	72.3	65.9	67.0	67.1	64.5	65.0	70.8	70.9
3400	73.0	66.6	67.7	67.8	65.2	65.7	71.5	71.7

Gauge Pressure = Absolute Pressure - 101.3 kPa
1 Bar = 101.3 kPa

R-502 Retrofit

Temperature-Pressure Table (International System of Units)

Units are in Degrees Celsius vs. kiloPascals

Temperature			Pressure (kPa)					
			Bubble	Dew	Bubble	Dew	Bubble	Dew
	AZ-50		(liquid)	(vapor)	(liquid)	(vapor)	(liquid)	(vapor)
(°C)	502	507	404A		HP80		408A	
-40	127	139	135	131	153	141	125	123
-39	133	145	141	137	159	147	131	128
-38	139	152	148	143	166	154	137	134
-37	145	158	155	150	174	161	143	140
-36	151	165	161	157	181	168	149	147
-35	158	173	169	164	189	175	156	153
-34	165	180	176	171	197	183	163	160
-33	172	188	183	178	205	191	170	167
-32	179	196	191	186	214	199	177	174
-31	186	204	199	194	223	208	185	181
-30	194	213	208	202	232	217	192	189
-29	202	222	216	211	241	226	200	197
-28	210	231	225	220	251	235	209	205
-27	219	240	235	229	261	245	217	214
-26	227	250	244	238	271	254	226	222
-25	236	260	254	248	282	265	235	231
-24	246	270	264	257	293	275	244	241
-23	255	281	274	268	304	286	254	250
-22	265	292	285	278	315	297	264	260
-21	275	303	296	289	327	309	274	270
-20	286	314	307	300	340	321	285	280
-19	296	326	319	312	352	333	295	291
-18	307	339	331	324	365	345	307	302
-17	319	351	343	336	378	358	318	313
-16	330	364	356	348	392	371	330	325
-15	342	377	369	361	406	385	342	337
-14	354	391	382	374	421	399	354	349
-13	367	405	396	388	435	413	367	362
-12	380	419	410	402	450	428	380	375
-11	393	434	424	416	466	443	394	388
-10	407	449	439	431	482	459	407	402
-9	421	465	454	446	498	475	422	416
-8	435	481	470	461	515	491	436	431
-7	450	497	486	477	532	508	451	446
-6	465	514	502	494	550	525	466	461
-5	480	531	519	510	568	543	482	476
-4	496	549	537	527	587	561	498	492
-3	512	567	554	545	606	580	515	509
-2	529	586	573	563	625	599	532	526
-1	546	605	591	581	645	618	549	543
0	563	624	610	600	665	638	567	560
1	581	644	630	620	686	659	585	578
2	599	664	650	640	708	680	603	597
3	618	685	670	660	730	701	622	616
4	637	706	691	681	752	723	642	635
5	656	728	712	702	775	745	662	655
6	676	751	734	724	798	768	682	675
7	697	774	757	746	822	792	703	696
8	718	797	780	769	846	816	725	717
9	739	821	803	792	871	840	746	739
10	761	845	827	816	897	866	769	761
11	783	870	852	840	923	891	792	784
12	806	896	877	865	949	917	815	807

Temperature			Pressure (kPa)					
			Bubble	Dew	Bubble	Dew	Bubble	Dew
	AZ-50		(liquid)	(vapor)	(liquid)	(vapor)	(liquid)	(vapor)
(°C)	502	507	404A		HP80		408A	
13	829	922	902	890	977	944	839	831
14	852	949	928	916	1004	972	863	855
15	877	976	955	943	1033	1000	888	880
16	901	1004	982	970	1062	1028	913	905
17	927	1032	1010	998	1091	1057	939	931
18	952	1061	1039	1026	1121	1087	966	957
19	979	1091	1068	1055	1152	1117	993	984
20	1005	1121	1097	1084	1183	1148	1020	1012
21	1033	1152	1127	1115	1215	1180	1048	1040
22	1061	1183	1158	1145	1248	1212	1077	1068
23	1089	1215	1190	1177	1281	1245	1106	1098
24	1118	1248	1222	1209	1315	1279	1136	1127
25	1148	1281	1255	1241	1350	1313	1167	1158
26	1178	1316	1288	1274	1385	1348	1198	1189
27	1208	1350	1322	1308	1421	1384	1230	1220
28	1240	1386	1357	1343	1458	1420	1262	1253
29	1272	1422	1392	1378	1495	1457	1295	1285
30	1304	1459	1428	1414	1533	1495	1329	1319
31	1337	1496	1465	1451	1572	1533	1363	1353
32	1371	1535	1503	1489	1611	1572	1398	1388
33	1405	1574	1541	1527	1651	1612	1433	1423
34	1440	1613	1580	1566	1692	1653	1469	1459
35	1476	1654	1620	1605	1734	1694	1506	1496
36	1512	1695	1660	1645	1776	1736	1544	1534
37	1549	1737	1701	1687	1820	1779	1582	1572
38	1587	1780	1743	1728	1864	1823	1621	1611
39	1625	1824	1786	1771	1908	1868	1661	1650
40	1664	1868	1829	1815	1954	1913	1701	1690
41	1704	1913	1874	1859	2000	1959	1742	1731
42	1744	1959	1919	1904	2048	2006	1784	1773
43	1785	2006	1965	1950	2096	2054	1827	1816
44	1827	2054	2012	1997	2145	2103	1870	1859
45	1870	2103	2059	2044	2194	2153	1914	1903
46	1913	2152	2108	2093	2245	2203	1959	1948
47	1957	2203	2157	2142	2296	2255	2005	1993
48	2002	2254	2207	2192	2349	2307	2051	2040
49	2047	2306	2259	2244	2402	2360	2099	2087
50	2093	2359	2311	2296	2456	2414	2147	2135
51	2141	2413	2364	2349	2511	2469	2196	2184
52	2188	2469	2418	2403	2567	2525	2245	2234
53	2237	2525	2472	2458	2624	2582	2296	2284
54	2287	2582	2528	2514	2682	2640	2348	2336
55	2337	2640	2585	2571	2741	2699	2400	2388
56	2388	2699	2643	2629	2801	2759	2453	2441
57	2440	2759	2702	2688	2862	2821	2507	2495
58	2493	2821	2762	2748	2924	2883	2562	2550
59	2547	2883	2823	2809	2987	2946	2618	2606
60	2601	2947	2885	2871	3051	3010	2675	2663
61	2657	3011	2948	2934	3116	3076	2733	2721
62	2713	3077	3012	2999	3182	3142	2792	2780
63	2771	3145	3078	3065	3250	3210	2852	2839
64	2829	3213	3145	3132	3318	3279	2912	2900
65	2888	3283	3213	3200	3388	3350	2974	2962

Gauge Pressure = Absolute Pressure - 101.3 kPa

1 Bar = 101.3 kPa

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