# A COOL WAY TO TRAVEL

As Prevost motor coach owners who found the "driver's air" option lacking in cooling capacity, we adapted our system to provide adequate over-the-road air conditioning. This article details those changes. Prevost has issued instructions for changing R-12 air-conditioning systems to R134a, and anyone who makes the decision to change to R134a may want to contemplate these additional changes.

As of July 13, 1995, the EPA, through its Significant New Alternatives Policy (SNAP), approved three substitutes for R-12 Freon. The three substitutes are R134a, HCFC Blend Beta (Intermagnetics General Corporation's FR-12 or FRIGC), and R401c (DuPont's MP52).

The R401c requires barrier hoses, because of the high rate at which it leaks through flexible hosing. FR-12 is considered a "drop-in" replacement and requires only new service ports and an identification label. FR-12 currently is available only for fleet sales, but it is expected to become available to the general public. Because R134a operates at a higher pressure, it usually involves several recommended component changes, so it can be comparatively more expensive.

Two types of heater/air-conditioning systems are available on Prevost motorhome shell. The "bus air" system heats and cools the entire coach, including the driver's area, and provides for windshield defrosting. It utilizes an engine-driven compressor. Typically, the condenser is located in the third bay on the passenger side, and the evaporator fan assembly is in the third bay on the driver's side. This system, rated at 80,000 BTUs, provides more than adequate heating and cooling for the entire coach. This large unit may be required to obtain adequate heating and cooling in coaches with expansive windows or in coaches that will be operated in extreme heat and high humidity. The disadvantage of this system is the complete occupation of two storage bays. In addition, vents and heat exchangers are immovable components within the coach that place restrictions on the interior floor plan.

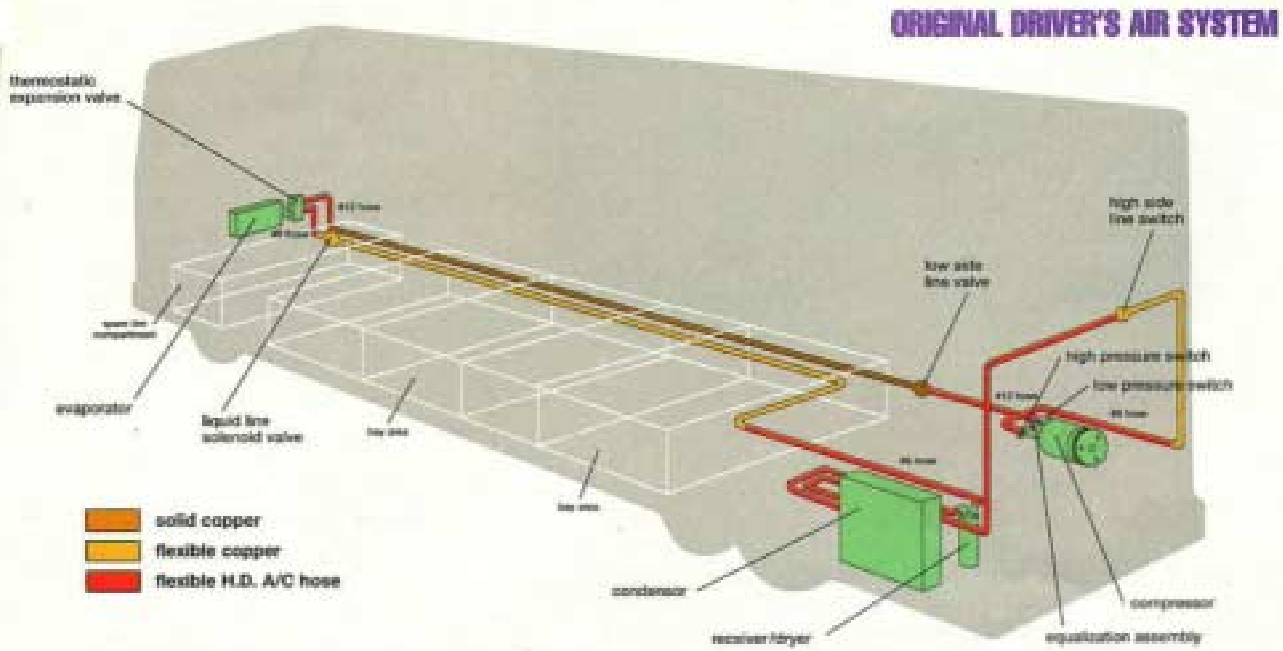
The second system usually is referred to as "driver's air." It supplies heating and cooling to the driver's area only, and also provides for windshield defrosting. This system utilizes an engine-mounted compressor. Before 1987 this compressor was commonly a Delco A6 unit; 1987 and later model Prevosts used a Tecumseh unit. The condenser is mounted outboard of the engine radiator, and the heater core and evaporator are in the dash area. This system does not impinge on the storage bays, does not impact the interior design, and is considerably less expensive than the "bus air" system. However, the heating and cooling capabilities are marginal. Historically, it has had problems with refrigerant leaks, especially in the earlier models, and there is the possibility of aggravating any engine overheating problems, because the condenser partially covers the engine radiator.

Coach converters sometimes order the "driver's air" option because the increase in the available space in the storage bays and the flexibility of interior design offset the heating and cooling limitations. If more heating or cooling is required, it can be provided by the motorhome systems, such as the Aqua-Hot or Webasto heaters, and Cruisair or rooftop central air conditioners. Three Cruisair units have a total capacity of approximately 42,000 BTUs and have provided adequate cooling in a 40-foot coach. Although it may be possible to run a single air conditioner with an inverter, usually alternating current supplied by an auxiliary generator will be required. Various coach converters have tried to increase the cooling capacity of the "driver's air" by adding a second evaporator or another complete system with its own compressor, evaporator, and condenser units.

Because of the space advantage, we were pleased that our coach was delivered with "driver's air." The coach also had an automotive-type heater in the bedroom. Since we planned to use the coach predominantly in temperate zones, we thought the over-the-road heat would be sufficient. We also thought episodes of inadequate cooling would be infrequent, and the central air units could be used if we needed additional cooling while traveling. Our major problem turned out to be trying to keep the system charged. It was quite difficult to determine whether diminished cooling was a result of low system capacity or low refrigerant charge.

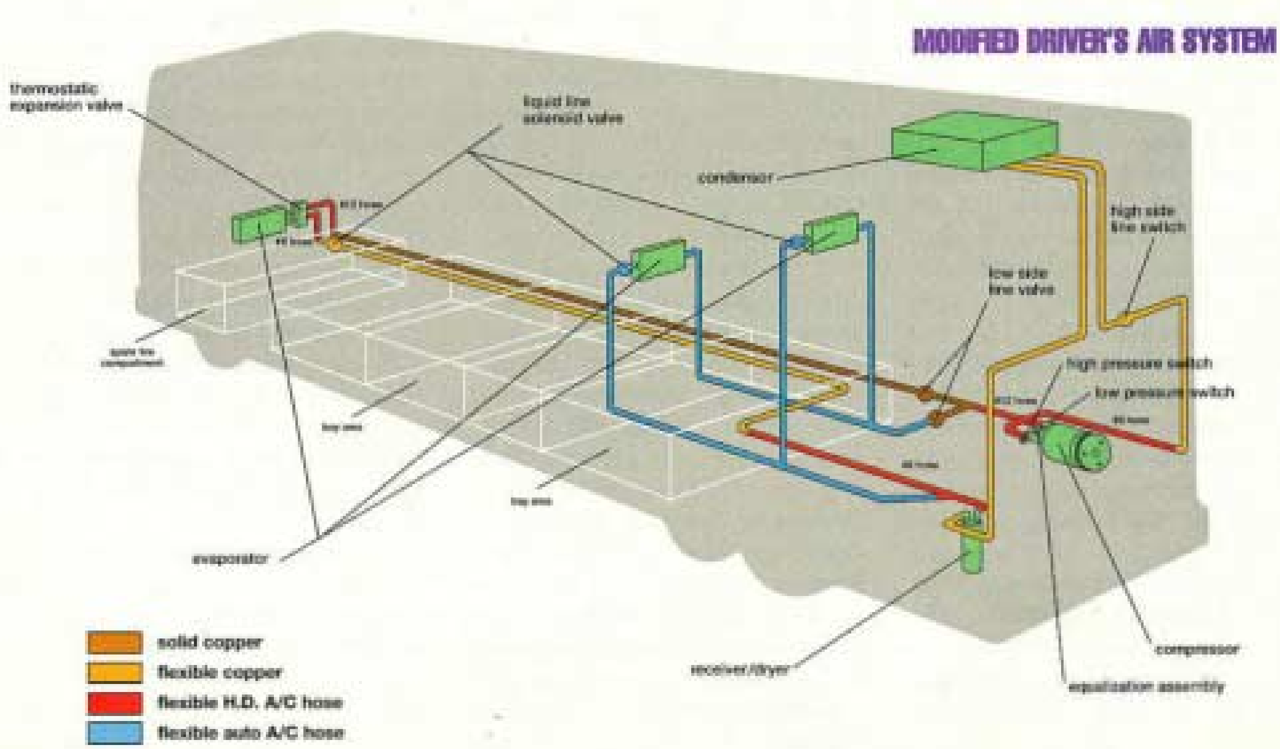
This project evolved over several years. We began by locating and deleting air drafts; inspecting closets and cupboards to add insulation to any outside walls we could reach; and selecting window treatments such as solar shades and mini-blinds for their insulating properties. In addition, Ed successfully completed training and has been certified by the International Mobile Air Conditioning Association (IMACA) in the proper use of mobile air-conditioning refrigerant recovery and recycling equipment. By purchasing recycling and hose-making equipment, we were able to make several interim adaptations and to eventually develop the complete system.

As you can see from the service record that accompanies this article, we




# These Prevost owners improved their driver's air cooling by troubleshooting and modifying the system.

*By CAROL MAXWELL & E.S. GURDJIAN, F76350*



added R-12 Freon to the system each spring or early summer. There were constant problems with low-pressure switches, which may have been caused by a partial loss of charge. There was a persistent slow leak. Each time we made a repair, we thought we time we made a repair, we thought we had identified the source, but after a few months, the problem recurred.

After owning the coach for five years, we discovered that the high-pressure compressor-to-condenser hose was a hydraulic hose and not suitable for R-12 Freon. In this case, porosity is the critical parameter rather than pressure. The hydraulic hose is too porous to contain R-12 Freon and allows low diffusion through the hose wall, which is not detectable by electronic sniffers. This was the major source of our slow leak. In Prevost applications, air-conditioning hoses are usually red, and hydraulic hoses are usually blue or black. These hoses also have imprinted part numbers that identify their intended applications. After noting this misapplication on our coach, we have observed this same blue hose on at least two other coaches.

By the summer of 1991, we had become frustrated with the overall performance of our road air-conditioning system and had begun to formulate possible solutions. We discussed converting to R134a but decided not to proceed at that time. Recommended procedures for changing over to R134a were in a state of flux, and the experts had not been able to develop a standardized policy.

Our goal was to use a single compressor, a single condenser, and three evaporators, which, if necessary, could be used sequentially. We took any opportunity to see how others had addressed the problem, such as those mentioned earlier. In December 1991, we were fortunate to meet J. R. Clements of Acme Radiator and Air Conditioning at the National RV Trade Show in Louisville, Kentucky. Acme had a number of components that were well suited to our project. These included special hose fittings, liquid line solenoid valves, an evaporator-only unit to combine with our rear automotive heater, and a combination heater-evaporator to be used as our third unit.

Mr. Clements pointed out that the Delco A6 compressor has a displacement of more than 12.5 cubic inches. Only one automotive-type unit is larger, the Zexel DK26, at 15.5 cubic inches. The Tecumseh has a displacement several cubic inches lower than the Delco. He was sure the Zexel could service three evaporators at one time and thought the Delco might also have adequate capacity.

What was missing was a suitable condenser. We wanted a rooftop condenser for two reasons. Removing the original condenser would improve air flow through the engine radiator. This also created the space needed to install a shutter on the radiator door to protect the engine from road salt as much as possible. The second reason was to distance the new condenser from salt spray and other road debris. The highest-capacity roof-mounted condenser from Acme was rated at 22,000 BTUs, significantly less than required. After diligently searching for six months, we finally found the model KC-110 from Kysor, rated at 45,000 BTUs.

In the summer of 1992, the original equipment condenser sprung a leak, probably because of corrosion. This incident was the final nudge to attempt a major performance upgrade, so we ordered the Kysor condenser and the various hose fittings Our plan was to install the Acme evaporator-only cooling unit alongside the automotive-type heater in the rear bedroom area. The combination heater-evaporator would fit in a midcoach bulkhead that currently housed a Cruisair air conditioner and a propane furnace with ducts to the galley, bath, and downward to the storage/plumbing bay. Since we were not sure any of these modifications were going to be successful; we wanted to keep the Prevost air-conditioning lines intact, in case we had to reconstruct the original system.

The Prevost system-from the high side line valve to the condenser and back to the receiver/dryer-was disassembled and removed intact. The Kysor condenser was installed on the roof with two "S" channel mounting brackets. It was positioned just forward of the rear cap and coach roof junction. With dimensions of 41 ¼ inches wide, 38 ½ inches front to rear, and less than 8 inches high as installed on the "S" channels, the condenser is no more

**Air Conditioning Service Record**

| | |
|---|---|
| June 1988 | Low charge — add R-12 |
| August 31, 1988 | Low pressure switch erratic — replace |
| | Recharge |
| March 1989 | Replace radiator |
| June 1989 | Condenser leaking — replace (may have been damaged during radiator replacement) |
| | Recharge |
| February 1990 | Replace A/C belt |
| June 1990 | Low pressure switch erratic — replace |
| | Recharge |
| May 1991 | Low charge — add R-12 (6 @ 14 ounces) |
| July 1991 | Thermostatic expansion valve leaking — replace |
| | Recharge |
| May 30, 1992 | Low charge; leak test did not find source; did not add R-12 |
| June 1992 | Bench test Delco A6; no apparent leak |
| | Replace shaft, seal, and worn clutch bearing |
| | System recharged |
| July 1992 | OE condenser leaking — remove |
| | Add Kysor roof condenser |
| Aug. and Sept. 1992 | Replace compressor-to-condenser high-pressure hose |
| | Install rear and center A/C evaporator and auxiliary wiring |
| | Replace receiver/dryer |
| | Recharge |
| April 30, 1993 | System check — top with 36 ounces R-12 |
| July 1, 1993 | Low charge — add R-12 |
| August 1993 | Noted oil on Delco A6; bench test |
| | Reseal — large "O" rings |
| | Recharge |
| April 1994 | System check — Okay |
| September 1994 | System check — Okay |
| March 1995 | System check - Okay |
| June 1995 | Installed Zexel DK 26 |
| | Installed new suction hose |

obtrusive than any of the other roof-mounted components. The refrigerant lines are ½-inch, refrigerant grade copper tubing with flare fittings at the attachment points. The new copper tubing runs from the Prevost high side line valve, along the back of the engine compartment and the rear end cap to the roof, where it exits and attaches to the condenser. The return line from the condenser follows the same path down to the engine compartment, where it is routed to the inlet of the receiver/dryer.

Acme part #460-1032 is a combination male "O" ring, female "O" ring, and push-on (⅜ inches by ⅜ inches by #6) "T" fitting. The female end was attached to the high-pressure outlet line of the receiver/dryer. The Prevost hose to the front evaporator was reattached to the male end. The push-on end was available for the high-pressure line to the rear and middle evaporators. The suction line was disconnected from the suction line valve, and an Aeroquip #12 Flare Running Swivel "T" was installed. Because the suction line hose does not flex, it had to be shortened about 2 inches in order to accommodate the insertion of the swivel "T." The terminal connector on the hose was disassembled and reused after the hose was shortened. The outlet of the "T" fitting was reduced to #10, and an auxiliary line valve was installed to accommodate the suction lines from the rear and middle evaporators.

Copper gaskets were used in all locations that had a hard metal-to-hard metal junction. This was particularly required on the Swivel "T," because this fitting was available only as 37 degrees. This is standard for hydraulic fittings, but air-conditioning fittings are 45 degrees. The gaskets achieved a leak-free connection.

The evaporator-only unit (Acme part #4210011) was fitted into its planned location in the bedroom. A #6 automotive-style barrier air-conditioning hose was installed from the "T" barb fitting on the receiver/dryer, with a liquid line solenoid valve (Acme part #4100162) between the receiver/dryer and the evaporator. The suction line, #10 automotive-style barrier air-conditioning hose, was installed between the evaporator and the auxiliary suction line valve. To this point, the only additional wiring required was the three-speed fan motor on the evaporator, the 12-volt liquid line solenoid, and the 24-volt dual fan motors on the condenser. We used a relay to prevent any back induction created by passively spinning the fan motors. The condenser fans were triggered whenever the compressor clutch was activated.

At this point, we were able to vacuum and leak test the system to determine whether the front evaporator performed satisfactorily. By activating the solenoid valve to the rear unit, it was possible to find out whether the front and rear components would work together. They did!

Since the interim testing indicated that the system was functioning well, we continued with the installation of the middle evaporator and heater unit. We fit the unit into its planned location in the midcoach bulkhead. We were able to use the existing air return and cold air outlet of the Cruisair for the new evaporator. The hot air outlets from the new heater were connected into the existing ductwork from the propane furnace, although we could have had individual ducts coming directly from this heat exchanger.

After the system was fully evacuated, high- and low-pressure lines from the middle evaporator were connected via a "T" to the existing high- and low-pressure lines of the rear evaporator. A liquid line solenoid valve was installed in the high-pressure line near the middle evaporator. The heat exchanger pipes were connected to the copper pipes from the driver's heating system using automotive heater hose. Shutoff valves were installed on both the inlet and outlet, so that the heat source could be turned off during warm weather. The fan motor, used for both the heating and cooling components of the unit, was wired for 12 volts DC. The liquid line solenoid valve was wired for 12-volt-DC operation when air conditioning was selected. Two Prevost control assemblies were used to control airflow and heater temperature (see parts list). Additional wiring was installed to allow activation of the middle and rear units from the dashboard.

The system was vacuumed, leak checked, charged, and checked for performance. All three units were able to run simultaneously and pressure gauge installed on the high-pressure line from the compressor did not show an over-pressure condition. The system was evacuated again, and a new receiver/dryer was installed. A final extended vacuum was placed on the system, followed by a full charge of R-12 Freon. We were now adequately cooling the entire coach when outdoor temperatures reached the mid-90s, accompanied by high humidity. Over the next several months, we noted that it was not unusual to maintain a temperature differential of 15 degrees.

Subsequent to the completion of the project, the Delco compressor developed a leak. Ultimately this leak was found to be in the large "O" rings at each end of the case. We replaced the "O" rings but were concerned that the failure might be the result of overstressing. We put it back into service, but we also ordered the Zexel DK 26 compressor. We fabricated mounting brackets that would use the base of the Delco A6 mounting bracket and gathered all of the parts to install the Zexel unit if the Delco failed. After two seasons, we had detected no increased pressure, so we removed the pressure gauge. We continued to use the Delco A6 until early summer of 1995, when we installed the Zexel.

The Zexel compressor was installed using the fabricated brackets. It required a new suction hose that was 2 inches longer. The pressure switches for the Zexel are wired in parallel and use a relay instead of being wired in series, as is the Delco. This resulted in significant wiring changes for the low-pressure and high-pressure protection circuit. The Zexel does not need an external pressure equalizing system. It was difficult to obtain a service manual, and special tools are needed to service the unit. I suspect that some repair facilities will not have these tools. The cost of the Zexel is nearly twice that of a Delco A6. There has been no noticeable change in the overall function of the entire system with the Zexel, but in view of the Zexel requirements, we would not hesitate to use a Delco A6 in the future. The Zexel, with its increased capacity, may outlast the Delco, which is running at near maximum capacity.

Most people have concerns regarding how solid copper tubing tolerates the vibration in a bus conversion. We, too, had those concerns. However, because of limited accessibility, using regular automotive air-conditioning hose would have been much more difficult, so we opted to try the copper tubing.

Our system has been in service since late summer 1992 and has been leak-free, except for the compressor "O" ring failure. It has never developed a low-pressure situation or insufficient cooling during this time. We believe it was critically important to utilize the copper gaskets as described. If leaks should develop in the copper tubing flare connections because of vibration, our intention is to install flexible rubber couplings.

Our experience over the past two years has convinced us of five things:

It is possible to get leak-free performance from a "driver's air" system.

This system can be modified to cool the entire bus.

Increasing the capacity of this system does not appear to decrease the component service life.

The Delco A6 compressor can provide reliable, leak-free performance.

We would not hesitate to order another conversion shell with a "driver's air" system with the intention of duplicating this modification.

Anyone who wants to upgrade their system as well as convert to R134a should be aware that all R-12 components mentioned in this article are available in R134a-compatible versions. Chuck Gosh and Mick Brady at Prevost EXPAR will be happy to provide the Prevost recommendations for changing your specific coach to R134a.

**If we knew then what we know now.**

We would have positioned the rear evaporator in a more ideal location if we had known how well the system was going to perform. We did not do this at the time, because it would have required significant changes to the bedroom cabinetry.

We would increase the cooling capabilities of the middle evaporator by using #12 instead of #10 suction hose. An alternative method would be to gain access to the Prevost front evaporator solid copper suction line located in the fourth bay by drilling a hole and attaching a fitting with silver solder. This would shorten the distance of the suction line from the middle evaporator, but we wanted to preserve the integrity of the original system.

## Component Parts List

**Compressors:**
- Tecumseh
- Delco A6
- Zexel, DK26

*Note: The Tecumseh and Zexel units are bi-directional; Delco A6 is unidirectional — must be reverse rotating (CCW) model for standard Prevost mount*

**Condenser:**
- Kysor, Model KC 110

**Evaporators:**
- Evaporator-only, Acme #4210011
- Evaporator-Heater Combination, Acme #4212001-IJ
  Requires bi-level chute #4570023

**Solenoid valves:**
- Acme #4100162

**Packless line valve:**
- Granger #1A-547

**Line adapter fittings:**
- High pressure, Acme #460-1032
- Suction line, flare union — Aeroquip #2215-12-10S
- Flare Swivel "T" — Aeroquip #203102-12-12S
- Female swivel flare ½ X ½ (generic)

**Prevost parts:**
- Receiver/dryer, #95-0048
- Delco A6 Compressor Brackets:
  Mounting Bracket, #45-0606
  Front Bracket, #45-0366
  Rear Bracket, #45-0365
  Tension Bracket, #45-0367
  Bolt, A/C compressor mount, #45-0610
- Bypass Valve Kit, #45-1279 **
- Pressure Switch Assembly, #45-1209 ***
- Control Assembly, #95-0063
  Control knob, #50-3318
  Cable — various lengths available
  Adapter "T," #50-1653
- High Pressure Tubing
  Low Pressure Tubing

**Generic parts:**
- Copper gaskets
- ½-inch refrigerant copper tubing
- #6, #10, or #12, barrier-type automotive A/C hose
  Hose fittings
- Electrical relays and switches

***The bypass valve kit, high-pressure switch, and low-pressure switch are usually present in original installation. These parts are readily adaptable to a new compressor. The Zexel DK26 requires special high- and low-pressure switches, which are supplied with the compressor. A bypass assembly is not required.*

****Included with bypass switch; required if bypass kit not used.*

### Manufacturers And Suppliers:

Following is a list of the companies that assisted in this project.

*Acme Radiator & Air Conditioning Co.*
*79 N. 10th St.*
*Kansas City, KS 66102*
*(800) 422-6322*

*Alma Products Company*
*2000 Michigan Ave.*
*Alma, MI 48801*
*Contact: Mark Swiercinski, ext. 289*
*(Manufactures Delco A6 Compressors)*

*Kysor/Westran*
*Air conditioning & Heating Products*
*P.O. Box 921*
*Byron, IL 61010-0921*
*(815) 234-2811*

*Prevost EXPAR*
*124 Joey Drive*
*Elk Grove Village, IL 60007*
*(800) 621-5519*

*Transport Specialists-Central Inc.*
*4300 Lyman Drive*
*Hilliard, OH 43026*
*(614) 876-8588 or (800) 589-3474*
*Contact: Mark Rupp*
*(Can supply roof condensers and compressors)*