

# The Big Chill



## Timing is everything during *Lyra's* refrigeration installation

By Green Brett

I love my mother-in-law, I really do. But how were we to explain that her new grandchild would be snuggling up with our trusty steel Engel refrigerator box in the no-longer-spare quarter berth?

"Oh, don't worry, the baby will sleep with us for the first few weeks." Or, "We'll just get rid of the Engel and lug blocks of ice for the boat's icebox down the snowy dock," (along with our four-year-old daughter, new baby, groceries and stroller).

Or, "Sorry, you can't visit right now," (which was not a good option for *several* reasons). My mother-in-law might not even *like* me unless something was done immediately.

She was coming up from Florida to stay with us for the baby shower in less than a week and the Engel was still using the baby's (and for now our spare) bunk.

### SETTING THE SCENE

We have a nice icebox on *Lyra*, but the previous owner had pulled out the engine-driven Sea Frost refrigeration system. For the first month that we lived aboard, we lugged ice down to the boat twice a week, but the melt goop made a stinky mess in the bilge.

On our annual trip to see the family, we recovered our Engel refrigerator box from an attic. It worked well enough; the wind generator

and solar panel nearly kept up with its power draw. Unfortunately, its relatively small interior volume didn't make up for all the space it took up in the spare bunk. With a baby on the way, it would have to go. We needed refrigeration for *Lyra's* icebox.

## RESEARCHING OUR NEEDS

The first order of business was to figure out what we had to work with. According to the original owner of our boat, the icebox had four inches of insulating foam and required one hour of engine run time each day to keep the box cool and make two trays of ice cubes. From this, we inferred that the icebox was reasonably well insulated.

We would also need to account for the volume. Using this formula—length X height X width—and fudging a bit off for the turn of the hull, we came up with about 10 cubic feet of air space to cool.

Next, we had to choose the system that would work best for our needs. We live at anchor in the summers and on a dock with shore power in the winter. Our eventual plans include cruising in the tropics. We are trying to minimize our engine run time by using solar and our KISS wind generator to keep up with our needs.

If we reinstalled an engine-driven compressor, a second compressor would be needed if we wanted to keep the icebox cold with shore power. Our venerable diesel may be reliable and push the boat around effectively, but nobody would call it quiet. Why wake a sleeping baby to

keep the icebox cold? This was not a good option for us.

If we installed a 12-volt compressor, we would be able to use any green power that we could harvest. Certainly there would be days when there wasn't enough sun or wind to keep up the batteries, but at least we wouldn't be stuck running the engine for an hour every day. As long as we left the batteries with a full charge, a 12-volt system would also give us the freedom to leave the boat unattended for as long as our batteries could keep up with the

### MARINE REFRIGERATION COMPONENTS

Stated simply, marine refrigeration systems have the following parts:

- Compressor - This pressurizes the refrigerant gas returning from the evaporator and also raises its temperature.
- Condenser - This can be a radiator with a fan, a pipe with seawater pumped around it, or a Keel Cooler. It reduces the temperature of the gas and condenses it into a liquid.
- Metering device - Can be capillary tube or expansion valve. Separates the high and low pressure sides of the system and feeds liquid refrigerant into the evaporator.
- Thermostat—this sets the temperature and tells the compressor when to run
- Evaporator - Can be "Flat" evaporator or holding plate. A holding plate will "sink" heat (it stays cold) for long periods of time using a brine solution that has a low freezing point, but the compressor must run for extended periods. All evaporators get cold when the liquid refrigerant boils (evaporates) in the evaporator at very low temperatures when exposed to the low pressure side of the compressor.

refrigerator draw.

If we chose to go with an air-cooled system, we would need to locate the compressor/condenser in a location where there would be cool air let in and a place for hot air to exit. The nice thing about an air-cooled system is that it can be used even if the boat is hauled out of the water. They are, however, less efficient and slightly noisier than a keel-cooled system. A water-cooled system is more efficient than an air-cooled system, but it requires more electricity to run the required circulating pump. Keel coolers are

porous bronze heat sinks that are installed much like a through-hull. The refrigerant circulates through the keel cooler and bleeds the heat off into the water. Even in tropical waters, keel coolers remove heat more efficiently than an air-cooled unit will. More and more cruising boats are going to a hybrid system, where the air-cooler is turned on only when the boat is out of the water. This is the option that we chose.

As a direct result of choosing the less powerful, battery-driven compressor, we chose to install an

evaporator rather than a cold plate. Cold plates are designed around massive, engine-driven compressors. Their brine solution has a low freezing point and can "store" a great deal of cold, much like a battery. With a 12-volt system, it is much more efficient to run a smaller, lower power draw compressor. This matches up better with an evaporator than with cold plates. The aluminum body of an evaporator is better at transferring heat than the stainless steel of cold plates. An evaporator

is also typically configured as a rectangular container—the interior is an instant freezer. If more freezer space is desired, a vertical partition can be added in the icebox to create a "spill over," exactly as one would with a cold plate system. If we had a separate freezer box, the evaporator would still get cold enough to do the job.

There are two downsides to installing an evaporator versus a cold plate. The aluminum body of the evaporator is much less durable than the stainless steel of the cold plate. This results in a roughly 10-year life span and a "no ice pick" policy for



Top, the complete package; bottom, keel cooler and an old through hull. Opposite, fresh paint and a shiny icebox

the evaporator, while a cold plate will last indefinitely and is more likely to survive being repeatedly stabbed with sharp objects. We decided that \$300 now and again in 10 years was an acceptable price to pay for an evaporator. An appropriately-sized cold plate would cost much more and we would need to alter our icebox configuration to make the freezer space we desired.

We chose to go with a digital thermostat rather than the mechanical one, as the digital unit measures the temperature in the icebox itself rather than the temperature of the

evaporator. When coupled with a Smart Speed Control-capable compressor, we would have extremely stable temperatures in the icebox. The mechanical thermostat costs less than the digital version and can be used with the Smart Speed Control unit.

## FRIGOBOAT

After much research, we decided to use Frigoboat ([www.frigoboat.com](http://www.frigoboat.com)) as our source of refrigeration systems. Their website is clearly written and simple to navigate, their prices are competitive, and there is

excellent resource material to answer any questions that you have about designing your system.

Once we had an informed idea of what we wanted for our system, we picked up the telephone and called Frigoboat. They made a few suggestions to fine tune our system and shipped the order the same day. Customer service during the installation was immediate and well-informed. In fact, our entire experience with Frigoboat was top-notch. If you would like to see operational systems, the company has a booth at most boat shows.



**INSTALLATION**

The first order of business was to prepare the area. I had already put two coats of Sherwin-Williams Tile Clad epoxy paint on the interior of the icebox and replaced the original lid seal with two strips of window seal (available at your local hardware store).

Once we had the system components, we verified that the allocated space for each item was proper. The biggest change in the original plan was to convert the vertically-mounted evaporator to a horizontal mount. This would give us more usable space and leave the full aperture of the icebox lid available to us for loading large items. The conversion consists of adding a formed plastic door with a simple bungee that acts as a hinge.

Our icebox extends into the aft head as counter space, so we installed the Capri 50-SSC and the Smart Speed Controller under the aft head sink. This is four feet away from the through-hull location for the keel cooler (it must be less than six feet) and right next to the icebox wall. From there, it was a simple matter to install the 340H evaporator and run the copper tubing through

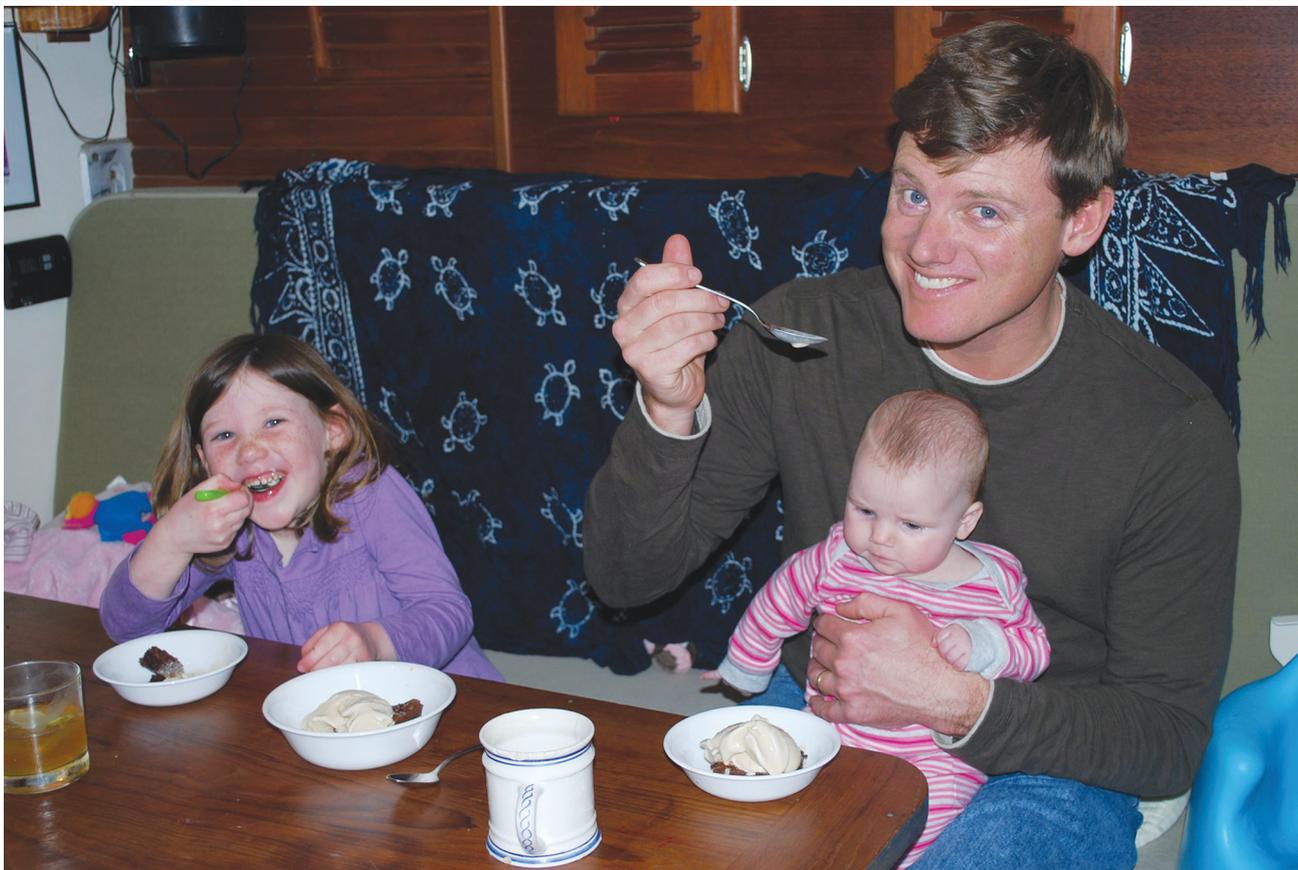


the icebox wall and down to the compressor. The only tools needed were a saber saw, drill, drill bits, a one-and-a-half-inch hole saw and screwdrivers. The one-and-a-half-inch hole allows the tubing and fittings to fit through a single hole in the icebox wall and is also the size of the keel cooler through-hull. The hole in the icebox is quickly resealed with a can of expanding foam, also available at your local hardware store. I also cut a hole through the bulkhead so that the thermometer could display in the galley. Within five hours, the system was up and running as an air-cooled unit.

Enter: MY MOTHER-IN-LAW.

Yes, I was attempting to complete the refrigeration installation in time for her visit (remember, she needed to sleep in the spare bunk that had been the home of our Engel). I am not sure if her first impression of the project was necessarily the one I was going for, as the interior looked remarkably like the boat had suffered a recent knockdown, with tools scattered across the entire living space and displaced items from the work areas in question likewise haphazardly stacked in every available nook and cranny. She was great about it and we did end up with cold food and space for her to sleep that

Unit	Frigoboat Description	Notes	Frigoboat Cost
Compressor	Capri 50-SSC with Smart Speed Control	The keel cooler can be added in line	\$1,271.00
Keel Cooler	Keel Cooler Stud-Mounted Condenser with Zinc	The puck can do double duty as an SSB ground plate	\$659.75
Evaporator	340H Evaporator - 15" w x 6" h x 11.5" d	Added lid kit so it could be installed horizontally	\$441.75
Thermostat	Coastal Digital Fahrenheit 12v	Necessary to operate the Smart Speed Controller	\$125.00



Big sis Caitlyn, the author and new addition Juliana enjoying the fruits of Green's labor; bottom, the finished product



night. She even got to help decorate the space for the coming baby.

We ran the system in the air-cooled configuration for two weeks before hauling the boat to install the keel cooler. Daily temperatures were typically around 85 degrees and the water temperature was 78. We estimate that our 10 cubic foot icebox used 22 amp hours each day. The cooling fan is audible, but not annoyingly so.

Adding the keel cooler was a relatively simple process. We hauled the boat at 9 a.m., and the puck was installed by 10:30 a.m. Since it was

bedded with 3M Fast Cure 5200, we let it set until just after lunch before relaunching. We had opted to get the stud-type keel cooler versus the threaded version, which allowed me to do the installation quickly and by myself. Since the quick connectors do not lose refrigerant when they are disconnected, it was a simple matter to connect the keel cooler inline with the air-cooled system.

With the air-cooling fan disconnected, we estimate that there was a 25 to 30 percent increase in efficiency. Also, the system became nearly silent in operation once we turned off the air-cooling fan. If power consumption is a concern, the keel cooler is a must.

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After five months of continuous live-aboard use, we remain completely happy with the entire refrigeration system. The only change that we have made is to apply some plastic foam with contact cement to the bottom of our evaporator. This makes the interior freezer area colder and keeps the rest of the box at 34 degrees. We routinely keep vegetables such as lettuce fresh for two weeks and have ice cream when we want it. We know that the system works great in both summer and winter conditions, and are confident that it will also function properly in a tropical climate. ≈

*Green Brett grew up living aboard a cruising sailboat. He and his wife, Jen, are currently based in Newport, R.I., and are raising their daughters aboard Lyra, their Reliance 44. You can wish them luck at [jen@bwsailing.com](mailto:jen@bwsailing.com)*

## *I'd just like to say that .....*

"I must say, this is a most efficient and very excellent refrigeration system. Quiet, light on amps, and very effective at cooling/freezing."

*Chris Goodfellow*

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"Well, I finally got the refer installed and it works great! I especially liked the way the gas connectors work. Obviously a great deal of work went into your instructions. They were very useful. Thank you so much for your great assistance throughout these birth pains. Great technical support is what makes or breaks many vendors, but unfortunately most don't realize that until it is too late."

*Mike Dietz*

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"It's probably not that often that good products gets the recognition they deserve but I wanted not to let good praise go by without passing it on. Our production and sales team here love your system and found it to be user friendly and an absolute winner for our production installation. From all of the Catalina team here "Thanks for sending good, easy to install units."

*Bob DeFilippo – Catalina Yachts*

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"Many thanks for your prompt and honest response. It's obvious to me that you care more with the reputation of your product than in doing a quick single sale."

*Oscar Ernst*

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"Almost every piece of equipment on the boat has needed some repair or attention over the last year except my Frigo boat system. It sure is nice to know that, at the end of the day when I'm tired and frustrated, I can depend on having a cold beer. Thanks."

*Bob Willmann - S/V Viva*

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"The Frigo unit is absolutely unbeatable and a nice piece of engineering on top of that."

*Alan Sugarman*

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"We thank you very much for all your support. It is helpful and comforting to know that there is someone there **after** the sale!"

*Nancy and Bob Bush*

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"I've had a Frigo boat keel cooler system installed on my Islander 36 for about three years now. It's been the single greatest upgrade I've made to the boat -- easy to install, quiet, efficient, just works flawlessly."

*Eric Lyons - s/v Pearl, Islander 36*