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INSTALLATION & MAINTENANCE MANUAL FOR THE

CoolBlue Marine Refrigeration System

Keeping Beer Cold and Ice Cream Hard for Cruisers since 1968!

Rev 01/05/15

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Introduction

For over 45 years Technautics has been manufacturing the most energy efficient marine refrigeration systems available on the market, known as “CoolBlue Refrigeration Systems” or **CoolBlue** for short. CoolBlues are not mass produced in China, but rather built with pride and attention to detail at our production facility in Escondido, California. Every CoolBlue system undergoes multiple quality control and assurance procedures during the fabrication process cumulating in a full system hook-up and bench test run to assure system performance prior to shipping. There’s a reason we can offer a full 5 year warranty while competing systems all have much shorter warranty periods: Quality Design, Quality Build, and Quality Assurance.

The CoolBlue comes entirely pre-charged with the required 24oz of R-134a refrigerant and with the use of Aeroquip self-sealing refrigeration connectors; installation is a simple plug-n-play process. The CoolBlue system is designed so that no refrigeration technical experience is necessary for the installation, start-up, on-going maintenance, or even trouble shooting.

This manual covers the installation of the CoolBlue and we can’t stress this enough, even if we do put it in Bold Red.

Please read all instructions in this manual before beginning the installation process and if you have any questions at all, please contact us 7 days a week for technical support. An easy phone call, email, text, or even Skype can save you time and headache and we are here to help you!

A CoolBlue refrigeration system is comprised of four major components. We will list these below and then follow-up for each component in greater detail later in the manual.

CoolBlue Supplied components:

1. Compressor/Condensing Unit
2. Fin/Tube Holding Plate with Expansion Valve and Mounting Brackets
3. Thermostat with Mounting Bracket
4. High and Low Pressure Copper Tube Set:
    - 1/4” High Pressure Liquid Refrigerant Supply Line (Red Caps)
    - 3/8” Low Pressure Gas Refrigerant Return Line (Blue Caps)

Theory of Operation

You certainly don't need to fully understand the detailed thermodynamics that make the CoolBlue system work so efficiently, but a basic overview of the system that will keep your beer cold and ice cream hard is always worth going over. Perhaps the most basic point about refrigeration which is commonly misunderstood is that a refrigeration system does not put cold inside your freezer or refrigerator box. A refrigeration system removes heat, which then leaves cold. Cold is simply the absence of heat, in much the same way that darkness is the absence of light. To darken a room, you remove the light from the room but you can't add darkness. Understanding that the condition of cold is the absence of heat helps illustrate the importance of good insulation and hatch seals, because heat energy wants to flow towards cold. If the insulation and hatch seals can't efficiently keep heat from re-entering the box, then even the best refrigeration system won't be able to keep the beer cold.

Figure 1 represents the CoolBlue refrigeration system. Starting with the pressurized liquid refrigerant ahead of the fin/tube holding plate evaporator at Point A, the introduction of liquid refrigerant is regulated by a thermally adjusting expansion valve (TXV) that is controlled by temperature and pressure. The pressurized refrigerant is reduced in pressure across the expansion valve from high pressure (Point A) to the fin/tube evaporator holding plate pressure (Point B). The expansion valve acts as a boundary between the high and low-pressure sides of the system and uses the holding plate exit refrigerant gas temperature to throttle in more or less liquid refrigerant.

Once inside the holding plate, the low-pressure refrigerant begins to boil off, absorbs heat from the eutectic solution, and begins to evaporate. The refrigerant liquid and vapor passing through the fin/tube holding plate evaporator coil continues to absorb heat until it is completely evaporated and turns into gas (Point C). The now heated gas is drawn through the suction line to the compressor suction (Point D). The increased pressure produced in the compressor causes the gas to compress and heat and flow into the condenser (Point E). In the condenser, heat is removed causing the refrigerant gas to condense back to a liquid refrigerant form. The liquid refrigerant is collected and stored in the filter/drier (Point F) and is available to begin the cycle again. The thermostat (G) is monitoring the temperature of the holding plate and turning the compressor on/off to ensure that the eutectic solution is never allowed to defrost and undergo a phase change from solid back to liquid.

Theory of Operation

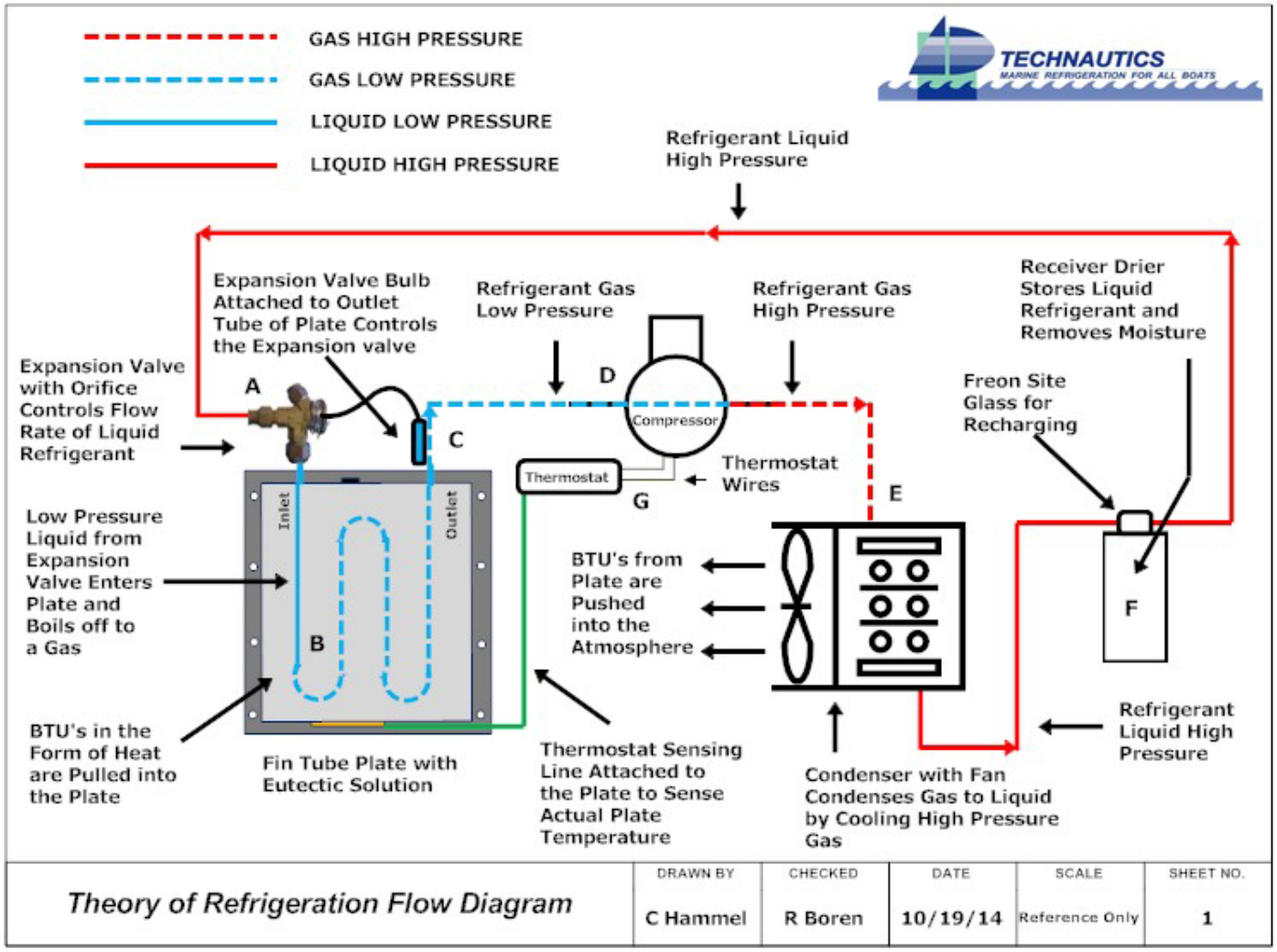


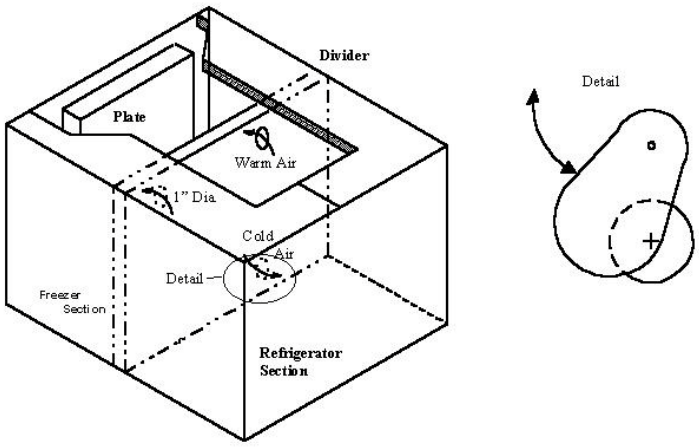
Figure 1: Theory of Operation

Typical Installation Instructions

The CoolBlue refrigeration system can be utilized for a dedicated refrigerator box, a dedicated freezer box, or a combination freezer and spill-over refrigerator box, with the addition of a thermal divider.

The spill-over combination box is a very common installation approach using the CoolBlue for boats with a single existing insulated box. Typical installations position the divider to form a ¼ or 1/3 freezer compartment with a larger ¾ or 2/3 refrigerator compartment. As shown below, the holding plate is mounted in the freezer section and the addition of a thermal divider regulates the amount of cold air that spills-over into the refrigerator. The thermal divider should be 1" of polyurethane foam covered with a water proof material, such as fiberglass, ABS plastic, or Formica. Air passages cut through in the divider can be lined with PVC or a similar tubing material, trimmed to length, and caulked. This will protect the insulating material from moisture penetration. The foam, water proof covering, and materials needed for construction of the thermal divider can all be purchased at your local Home Depot.

In most spill-over installations, the natural convection air movements will be sufficient to maintain adequate cooling in the refrigerator. The CoolBlue thermostat is cycling the compressor unit to keep the holding plate and freezer at the temperature set-point and the flapper valve in the thermal divider is used to maintain the refrigerator temperatures. In some cases, a thermostat mounted in the refrigeration box can be used to pull cold air from the freezer into the refrigerator box if the natural convection current is not sufficient to maintain adequate refrigerator box temperatures.



Single Box with Thermal Divider

Divider Hole Layout

- A 1" gap should be left between the top of the box & the top of the divider or two (2) one inch holes can be placed at the top (as pictured)
- Place a 2.5" hole on center up 1.5" from the bottom of the box. Install a piece of plastic over the hole that can be moved to control the air flow

Figure 2: Freezer/Refrigerator Box with Divider

Cool Blue Refrigeration System Specifications

CoolBlue Compressor/Condensing Unit Dimensions and weight:	10” Width x 12” Depth x 8.5” Height 22lbs
Standard Fin/Tube Holding Plate Size Options:	
Right and Left Hand	24” Height x 13” Width x 2.5” Thick 26lbs
Down Left and Right	22” Height x 15” Width x 2.5” Thick 26lbs
(Custom in all sizes)	
Length of copper line set:	Available from 2ft to 50ft. 12ft is Standard
Fin/Tube Holding Plate Evaporator Metering:	Thermally Adjusting Expansion Valve
Power Usage:	Variable 2.3 to 5.3 Amps at 12v depending on Compressor speed and box heat load.
Voltage Acceptance:	Autosensing for 12v, 24v, or 48v
Variable Compressor Speed RPMs:	1500, 2167, 2833, and 3500 RPM
Type and Volume of Refrigerant:	24oz of R-134a (Do Not use additives, dyes or any type of Leak stoppers)
Steady State High and Low Pressure Ranges Taken ONLY with a frozen plate:	Low Side 1-5 PSI High Side 90-130PSI
Ambient Operational Temperature Range:	Minimum of 14°F (-10°C) Maximum of 131°F (55°C)
Condenser Temperature Range of Operation: (Air Only Water Not Needed Even in the Tropics)	Stable Load Conditions 140°F (60°C) Peak Load Conditions 158° F (70°C)
Compressor Storage Temperature:	Down to -31°F (-35°C)

VELOCITY SELECTION

RPM	kCal/h	SW1	SW2
1500	28	OFF	OFF
2167	43	ON	OFF
2833	55	OFF	ON
3500	64	ON	ON

Evap. T = -23.3°C; Cond. T = 55°C

BATTERY PROTECTION SETTINGS

	12V	24V	42V
Cut-out	10	22	36
Cut-in	11,5	24,5	38,5

Installation General Overview

The CoolBlue refrigeration system has been designed and the manual written so that the average cruiser can not only install the system himself, but trouble shoot and make most needed repairs without having to hire an expensive (and sometimes questionably trained) refrigeration technician.

As seems to be the case with the majority of equipment installation projects on a boat, the most challenging part of the install is the layout. Where do you mount the individual pieces and what is the best way to connect them together without having to run through every locker on the boat? As live aboard cruisers ourselves, we know how these projects go. Taking some time to think through your installation can often save lots of headache and an installation project retreat and re-do. Mounting and operational considerations for the individual system components are given in greater detail in the following manual sections, and we are available 7 days a week to assist you with the installation.

After mounting the components, the CoolBlue is designed to be Plug-n-Play:

1. Two color coded refrigeration copper lines to connect on the Holding Plate.
2. Two color coded refrigeration copper lines to connect on the Compressor/condensing unit
3. Four electrical connections to make on the compressor/condensing unit electronic controller module and 2 on the Thermostat.

Once these connections are made, the CoolBlue is ready to be turned on.

A common question we receive is, “What can I do wrong during the installation that breaks something” and our standard answers are pretty short and easy, so once you get these out of the way the rest of the installation project is pretty easy.

1. Pay attention when hooking up the positive and negative DC power to the electronic control module. If you reverse the polarity you can fry the controller.
2. Work slowly with the copper tube sets to not kink them while running them through the boat and into the box. If you kink one, it will need to be replaced.
3. When connecting the male and female Aeroquip refrigeration couplings, be sure to use a backing wrench as shown in the instructions. If you don’t, you risk damaging the fittings or transferring the force past the fitting and breaking the coupling/tubing weld.
4. Work slowly with the thermostat capillary sensing bulb, this is a hollow tube filled with refrigerant gas. If it gets kinked, it will need to be replaced.
5. Last, but certainly not least, the electronic control module is VERY sensitive to voltage drop and spike issues. So skimping on the correct wire size (#10 GA

Minimum) or making messy multiple wire connections on marginal breakers isn't worth the heartache they can cause.

Avoid these 5 installation mistakes and please contact us with any questions!

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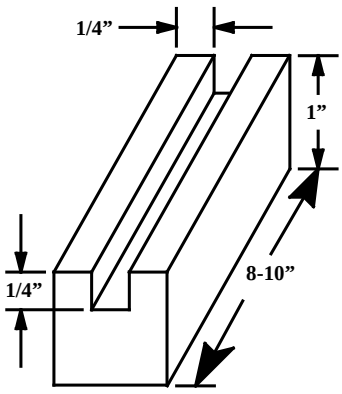
Installation of the Fin/Tube Holding Plate

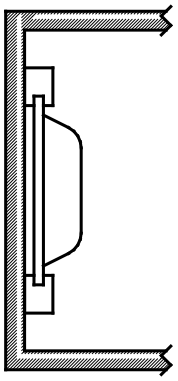
Caution: Do not drill through the flange of stainless steel fin/tube holding plate.

The fin/tube holding plate is filled with a eutectic solution that freezes at a specific temperature controlled by the thermostat. The varying holding plate configurations (Right Hand, Left Hand, Down Right, and Down Left) are offered to make the copper tube set connections and run from the holding plate through a hole in the box to the compressor/condensing unit as easy and clean as possible. Consider the following points and take the following steps for mounting the holding plate inside your box.

1. Determine the plate position in box to allow for air circulation around the holding plate. The holding plate may be mounted vertically or horizontally, there is no top or bottom to the plate.
2. The plate needs to be mounted as high in the box as possible to help set-up a natural convection air current of cold air sinking and warm air rising.
3. Position the plate so that it fits into the box with clearance for the lid, insulation, etc.
4. When selecting your plate mounting location, plan on where you will be able to drill a hole in the upper-most section inside the box, taking into account the path of the copper lines connecting the holding plate to the compressor/condensing unit.
5. The CoolBlue system is supplied with three (3) holding plate mounting brackets for the sides and bottom of the plate.
6. First install the bottom mounting channel with self-tapping screws to support the plate while the side mounting channels are installed.



Mounting Channel



Mounting Channel Cold Plate

Figure 3: Cold Plate Mounting Blocks

Installation of Thermostat

Warning: Do not kink small thermostat sensing capillary tubing.

The thermostat can be mounted in a convenient location inside the cooling box to allow easy temperature adjustment and close enough to the holding plate so that the capillary sensing tube can be inserted into the copper tube soldered to the side of the holding plate. The thermostat measures the temperature of the holding plate (Not the Box) to keep the eutectic solution frozen for an efficiently running system. Therefore, the tip of the thermostat sensing bulb needs to be inserted ¾ of the way into to copper tube attached to the holding plate.

Different thermostat temperature ranges are used for a freezer or refrigerator holding plate, so if you are replacing a thermostat be sure that your thermostat temperature range matches the eutectic solution in your holding plate. This is an important detail because using a thermostat temperature range that is not matched to the concentration of the holding plate eutectic solution can cause your CoolBlue system to lose efficiency.

The thermostat will control the compressor by sending a signal through two small gage wires to the electronic control unit on the CoolBlue condensing/compressor unit. In selecting a thermostat mounting location, plan ahead for the wire run along with the capillary sensing bulb. If you would like to monitor and display the actual box temperature, we can provide a 12v digital temperature display. Consider the following points and take the following steps for mounting the holding plate inside your box.

1. Using two-sided tape or screws, mount the thermostat on a convenient surface inside the cooling box. You don't want the frost that can build up on the plate to "grow over" the thermostat, so don't mount the thermostat right up against the holding plate.
2. Insert the capillary sensing tube ¾ of the way into the copper tube soldered to the side of the holding plate.
3. Coil and secure excess thermostat capillary sensing tubing to prevent damage.
4. Use #16 AWG wire to connect the two thermostat electrical connections to the electronic control module located on the compressor/condensing unit.
5. Since the thermostat acts only as a switch, there is no polarity for the thermostat wire connections and small AWG wire will be fine.
6. The thermostat dial settings range from 1 - 7, with 1 being the warmest and 7 being the coldest. 3-4 is the typical set point. Turning counter clockwise past the #1 position until you feel the indent and "click", will turn the CoolBlue system off.

Thermostat Photos

Figure 4: Thermostat Sensing Line Location

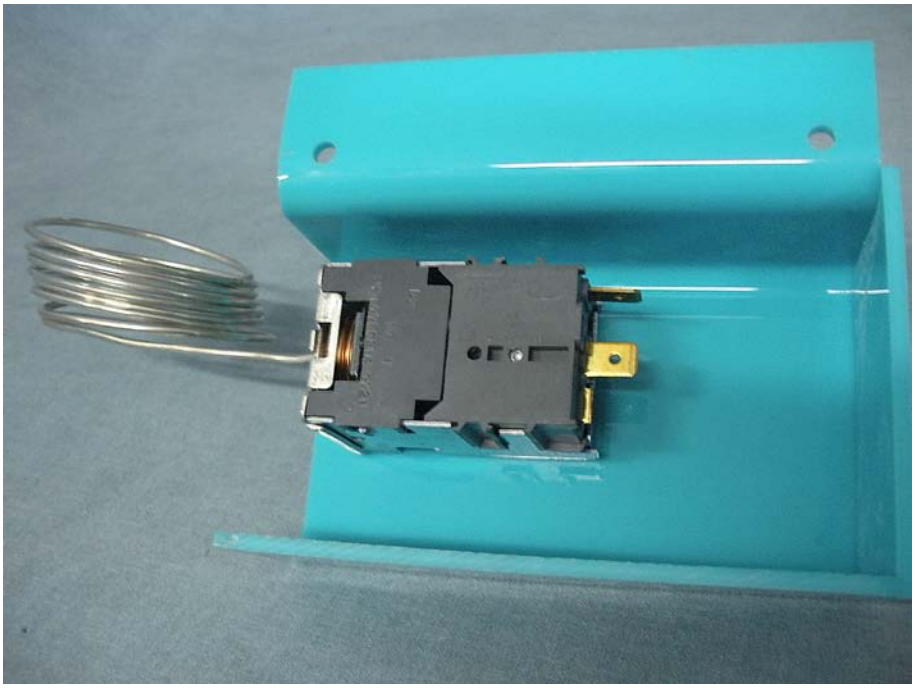


Figure 5: Thermostat Mounted Inside Housing Bracket

Installation of Compressor/Condensing Unit

Two Important notes:

To prevent contamination, do not remove Red and Blue protective caps from Aeroquip coupling fittings until final connection is ready to be made.

The compressor/condensing unit MUST be mounted on a level surface and in the upright position.

Any convenient location that has sufficient air circulation over the condensing coils. Installations in an engine room are OK if that is your most convenient space. Allow at least 3" of clearance around the condensing coils for free air circulation. If installed in a restrictive compartment like under a bunk or setae, air vents can be installed to allow for additional air circulation. You also have an option to install a 12v cooling van that will turn on and off with the compressor to assist in venting the compartment where natural air movement isn't adequate. Consider the following points and take the following steps for mounting the compressor/condensing unit.

1. Mount the DC compressor/condensing unit on a level platform and secure it to the platform through the mounting holes in each corner of the condensing unit.
2. The CoolBlue comes standard with a 12ft copper tube set, but longer copper tube sets of up to 50ft can be provided.
3. Do not install the compressor/condensing unit higher than 5 feet above the top of the stainless steel fin/tube holding plate.
4. You will want to be able to observe the sight glass on the top of the dryer/receiver to check the refrigerant charge level, so keep that in mind for your installation.
5. The compressor can operate continually at a heal angle of 30° but must be mounted on a level secure platform.
6. The compressor/condenser unit is hermetically sealed, but the electronic control module is susceptible to water splash or spray damage, so chose a mounting location well protected from the elements.

Condenser/Compressor Photos

Figure 6: Front View of Compressor Assembly

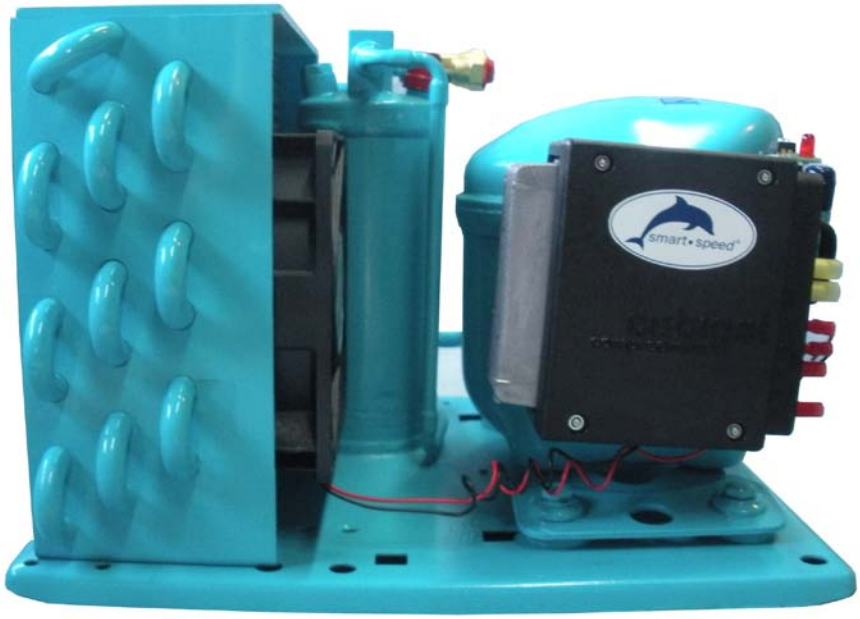


Figure 7: Left Side of Compressor Assembly

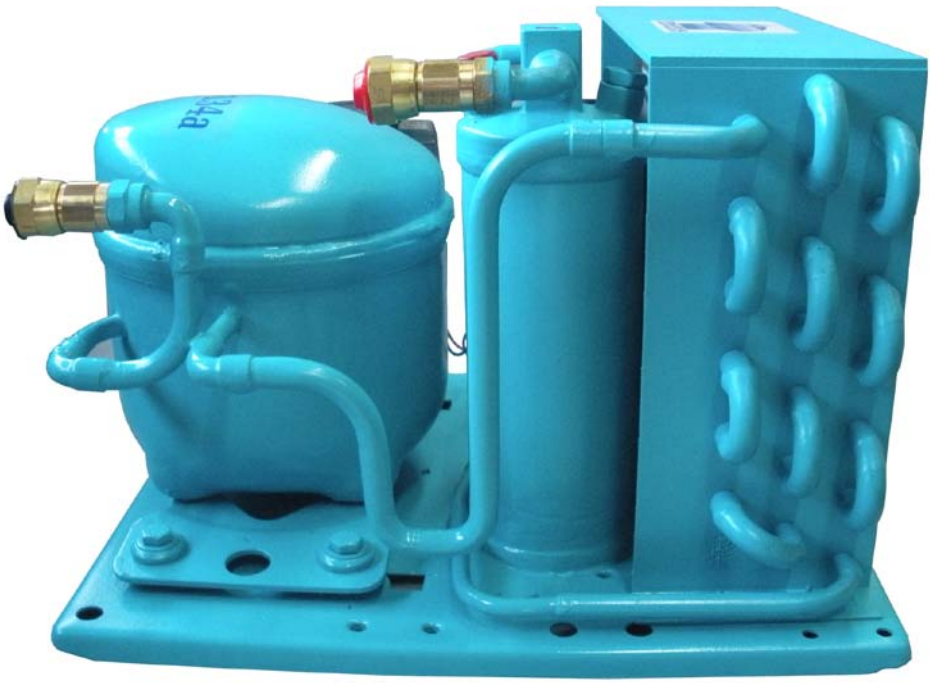


Figure 8: Rightside of Compressor Assembly

Figure 9: Back or Condenser Side of Assembly

Figure 10: Top View of Condenser Assembly

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How to Connect Aeroquip Refrigeration Couplings

Two Important notes:

To prevent contamination and damaging the O-rings in the ends of the Aeroquip refrigeration coupling fittings, do not remove the protective color coded caps until you are ready to make the final connections.

Always use a backing wrench when tightening the Aeroquip refrigeration couplings.

1. The Female refrigeration coupling has a Nut that will spin to allow the Female and Male fittings to be joined together. (Matching the color-coded caps)
2. Start the connection by hand, turning ONLY the Female nut. A ¾" wrench needs to be placed on the Female nut while a 5/8" backing wrench is placed on the Male refrigeration coupling to firmly hold it in place.
3. The connection is tightened to 10ft-lbs.
4. How much is 10ft-lbs? Just snug together the fittings by turning ONLY the Female nut on the left in the photo below while holding the Male fitting in place which is on the right side. You don't want to over tighten the fittings and warp their shape or tweak the sealing O-ring. So a firm snug connection with just one finger on each wrench is fine. You don't need more than two fingers of pressure on the wrenches to make a good seal; keep the breaker bar in the tool box!
5. It is common to hear the refrigerant start to flow as the Male and Female fittings are joined together and a small amount of refrigerant gas escaping during this process isn't something to panic about.
6. The Aeroquip fittings are multiple use self-sealing type fittings and can be disconnected without losing refrigerant.

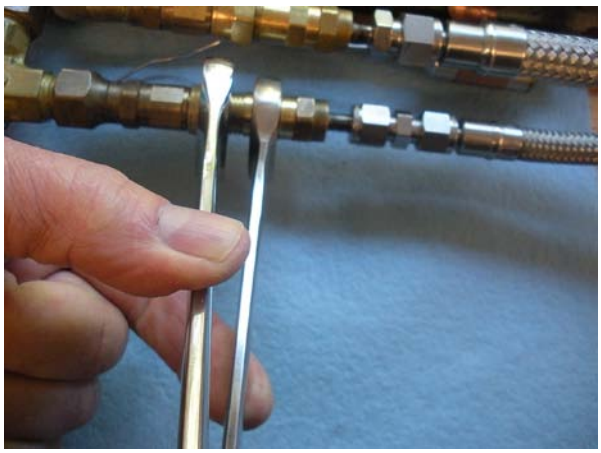

Figure 11: Tightening Aeroqip Fittings with 3/4" and 5/8" Wrenches

Installation of High and Low Pressure Lines to the Holding Plate

Two Important notes:

To prevent contamination and damaging the O-rings in the ends of the Aeroquip coupling fittings, do not remove the protective color coded caps until you are ready to make the final connections.

Work slowly and gently with the copper lines to avoid kinking them.

Because you want any extra copper tube length to be coiled at the compressor and not in your refrigeration box, we recommend making the connections on the holding plate first. Then work your way back to the compressor forming the lines and strapping them cleanly along the way. The copper lines do not require insulation for the function of the unit; however, we recommend covering the copper tubes with protective insulation commonly used for hot water lines (available at Home Depot) as a way to protect them from chafe and impact damage.

The two Female Aeroquip refrigeration fittings on the holding plate are identified by color coded caps.

1. The Red Cap identifies the high pressure inlet for the refrigerant liquid entering the expansion valve.
2. The Blue Cap identifies the suction low pressure holding plate outlet for the refrigerant gas returning to the compressor.

The two copper lines with Male Aeroquip fittings connect the holding plate to the compressor unit and in addition to their size difference; they also have the Red and Blue color coded caps which match up to the corresponding Female attachment points.

1. The Red Cap identifies the ¼” high pressure line that will connect to the Red Cap on the holding plate expansion valve inlet.
2. A Blue Cap identifies the 3/8” suction low pressure line that will connect to the Blue Cap suction low pressure holding plate fitting.

Holding Plate Photos

Figure 12: Holding Plate in Custom Foam Lined Box

Figure 13: Cold Plate Refrigerant Connection Lines

Connecting the Refrigerant Lines to the Condensing Assembly

Two Important notes:

To prevent contamination and damaging the O-rings in the ends of the Aeroquip coupling fittings, do not remove the protective color coded caps until you are ready to make the final connections.

Work slowly and gently with the copper lines to avoid kinking them.

The two Female Aeroquip fittings on the compressor/condensing unit are identified by color coded caps.

1. The Red Cap identifies the high pressure outlet fitting for the refrigerant liquid exiting the filter/dryer.

2. The Blue Cap identifies the suction low pressure compressor inlet fitting for the refrigerant gas returning to the compressor.

The two copper lines with Male Aeroquip fittings connect the holding plate to the compressor unit and in addition to their size difference; they also have the Red and Blue color coded caps which match up to the corresponding Female attachment points.

1. The Red Cap identifies the ¼" high pressure line that will connect to the Red Cap on the outlet of the filter/dryer.

2. The Blue Cap identifies the 3/8" suction low pressure line that will connect to the Blue Cap suction low pressure port on the compressor inlet.

Figure 14: High and Low Side Refrigerant Lines

Wiring Instructions

Three Important notes:

Reversing the Polarity of the positive and negative power connections WILL DAMAGE the electronic module. Pay close attention when making the connections and be sure to have the breaker turned off while making the connections.

The CoolBlue should have a dedicated 15A DC breaker not shared with another device to minimize voltage spikes and losses.

You purchased the most energy efficient refrigeration system on the market, so don't jeopardize the system performance by going cheap and skimping out on using the correct wire size! A large portion of our troubleshooting calls are voltage related.

Selecting the Correct Wire Size

Use the below wiring size table to select the correct sized wire based on the distance of the compressor/condensing unit to your ships DC power distribution source. Remember that an electrical load 10 ft. away is really 20 ft. away for wire size calculations because you have to count both directions of the electrical run. We recommend at minimum at #10 size wire.

AWG Wire Sizes for 12v System Based on a 3% Voltage Drop
(Recommended for Voltage Sensitive Components/Motors)

Total Current on Circuit in Amps	Total Length of wire run in Feet										
	20	30	40	50	60	70	80	90	100	110	120
5	10	10	10	10	10	8	8	8	8	8	6
10	10	10	8	8	6	6	6	5	5	5	4
15	**10**	**8**	**6**	**6**	**6**	**5**	**4**	**4**	**3**	**3**	**2**
20	8	6	6	4	4	2	2	2	2	2	1
25	8	6	4	4	2	2	2	1	1	1	0
30	6	4	4	2	2	-	-	-	-	-	-
40	6	4	2	2	1	-	-	-	-	-	-
50	4	2	2	1	1/0	-	-	-	-	-	-

12v/24v/48v Wiring Options

The CoolBlue is capable of running from a 12v, 24v, or 48v DC power source. The electronic control module will automatically sense the incoming voltage.

General Wiring Overview

Figure 15 on the next page represents the generalized wiring diagram for the CoolBlue refrigeration system. During a warm holding plate start-up, the compressor can momentarily use up to 10A, so it is important that a dedicated 15A breaker be installed on the positive (+) DC power supply wire coming from either the ships battery or ships power distribution panel. It is also important that the negative wire (-) is brought back to the battery negative and not a common grounding buss or engine ground.

The electronic control module is sensitive to voltage spikes and drops, so it is strongly recommended that power be supplied to the unit directly from your house battery bank. Your ships battery will act as a sink and dampen out voltage spikes from charging and load sources to protect the unit from fault or damage. It is not recommended to connect your DC power to a shared buss of charge and load sources. It is also not recommended to connect the negative (-) DC power wire to a common grounding buss or ships engine.

System Wiring Schematic

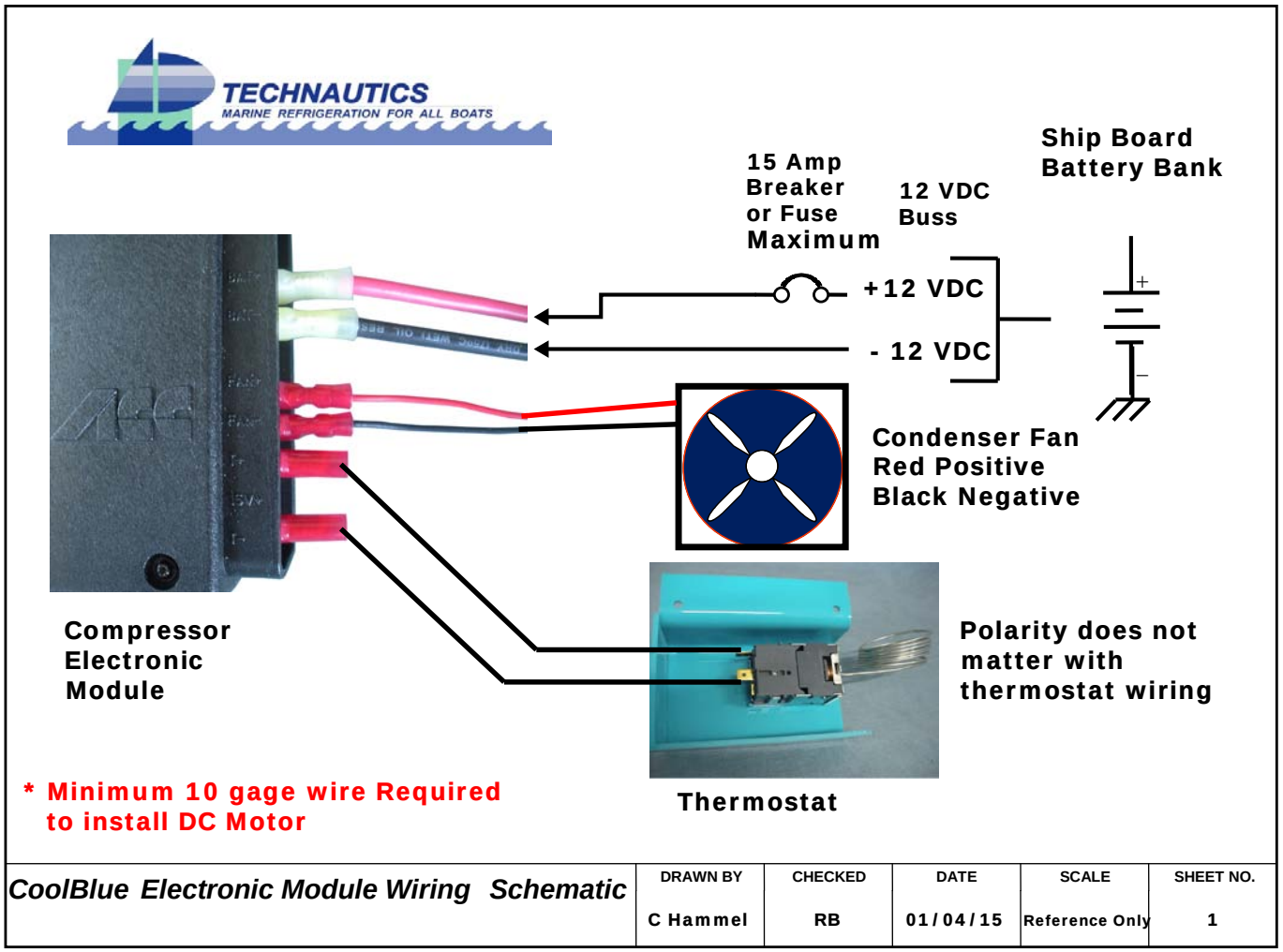

Figure 15: Electrical System Wiring Schematic

Electronic Control Module Connections

Important Note: Older models of CoolBlue systems use a different compressor and electronic module. The Positive (+) and Negative (-) DC power supply positions on the older unit's electronic control module are in opposite locations, so be careful if you have an older unit but have downloaded this newer manual!

The electronic control module connections on the unit are male spade connectors. We have provided two yellow female spade connectors for the DC power supply and two red spade connectors for the thermostat wires. It is very important that the correct DC power supply polarity is connected. To avoid a mistake which can damage the electronic controller, note closely that the top spade connector is for the DC power positive (+) and the second spade connector is for DC power negative (-). There is no polarity for the thermostat, which simply functions as an open/closed switch.

The electrical connections for the 12v condenser cooling fan have been completed for you and these should not be removed or spliced into another devise such as an hour meter or relay for a remote fan. There is a blank/unused auxiliary spade connector between the two thermostat leads. This positive output can be used to trip a low current draw relay to turn on remote devices such as an hour meter or auxiliary cooling fans if necessary.

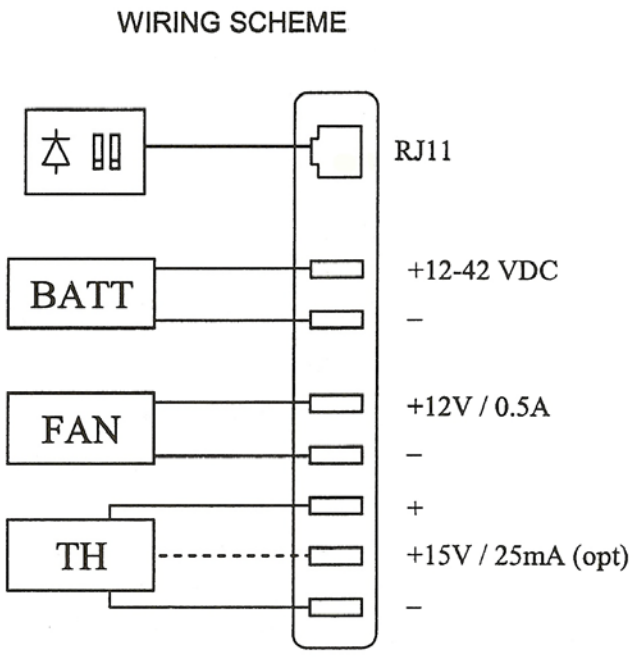

Figure 16: Compressor Electronic Control Module Wiring

Initial Start-up and Starting System with a Warm Plate

Starting the CoolBlue with a warm holding plate should be done with the compressor speed setting at low speed. This will minimize the start-up Amp draw and will keep the electronic control module from shutting down the unit due to an over-Amp fault, and showing the 3-Flash LED error code. Once the holding plate starts to develop frost, the compressor speed can then be returned to the normal operating speed of ¾.

The speed control dip switches are located on a small circuit board with the error indicator LED attached to the top of the electronic control module. For low speed, both dip switches are in the OFF position. For ¾ speed dip switch No 1 is OFF and No 2 is ON. The speed setting in the below photo has both dip switches in the off position for the low speed. The Arrow is pointing to the On switch position.

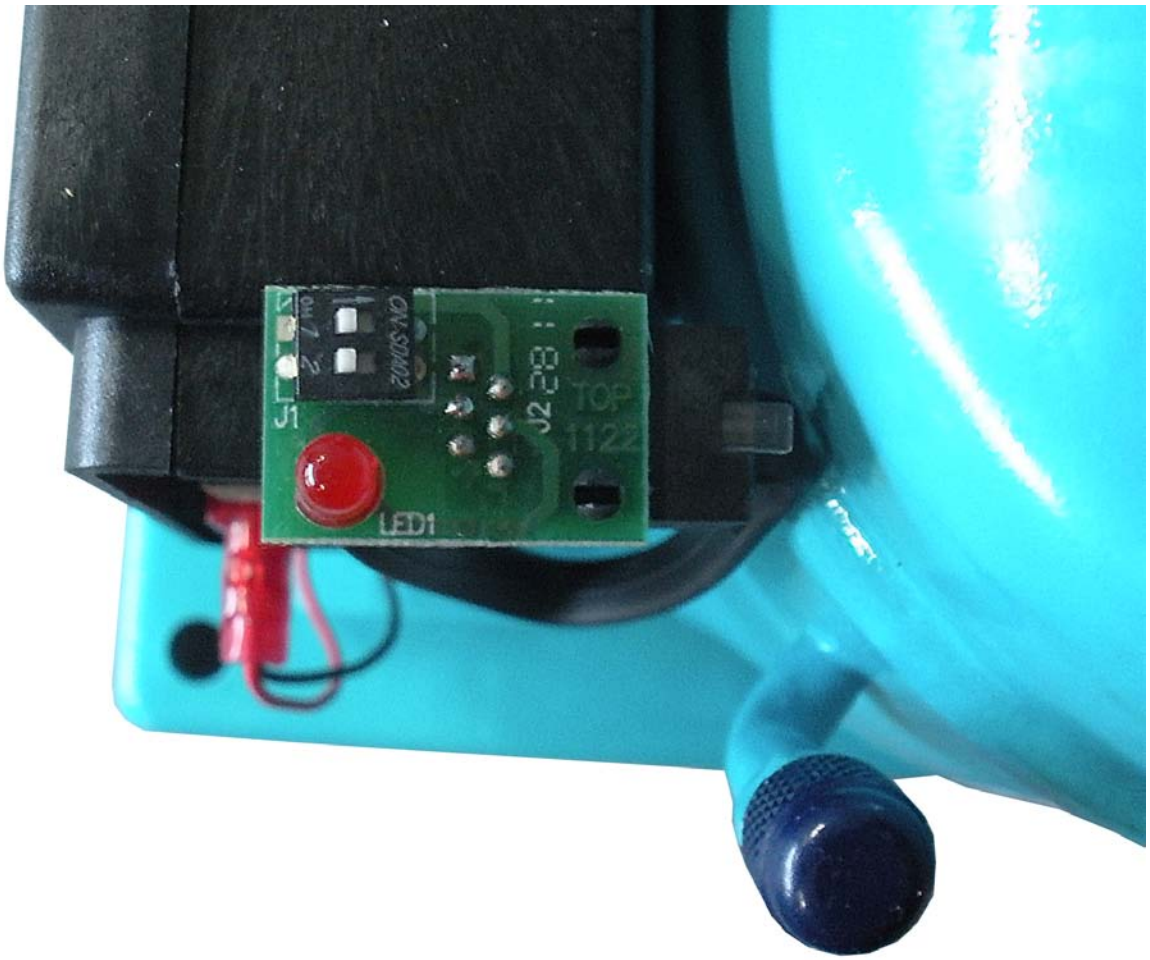

Figure 17: Compressor Electronic Module Speed Setting Board

To start the CoolBlue, first turn the thermostat dial in the box to the off position, turned passed the No1 setting. Next turn on the 15A DC power supply breaker. DC power should now be supplied to the electronic control module but until it sees a completed circuit from the thermostat it will remain in standby mode. Turn on the thermostat and set it to the normal starting temperature of between 3 and 4 on the dial indicator. You should now hear the 12v condensing unit fan start along with the near silent compressor and within a few minutes you should start to feel the expansion valve on the holding plate starting to get cold. Once the holding plate starts to develop frost, the compressor speed can then be returned to the normal operating speed of ¾.

It typically takes from 8-15 hours to initially freeze down the holding plate and bring the box down to equilibrium temperatures before the compressor will begin the normal on/off cycling.

If you are running a spill-over freezer/refrigerator box, once the compressor starts cycling, you can then start adjusting the valve placed in the thermal divide to dial in your refrigerator temperature.

Compressor Speed Set-point and Explanation

The CoolBlue compressor controller has 4 manual speed settings set by the position of the dip switches located on the circuit board atop the electronic control module.

Low-1500RPM, Med-2167RPM, Normal-3/4-2833RPM, and High-3500RPM

Unlike a critical orifice thin rolled aluminum evaporation plate type refrigeration units that have no hold over capacity that benefit from matching the compressor speed to the heat uptake of the evaporator, holding plate systems are designed for the compressor to pull out more heat than can absorbed by the holding plate. So on holding plate systems, the intent is to “store cold” in the holding plate eutectic solution to allow for longer compressor off periods and less compressor cycling. In fact, where thin rolled evaporators would cycle on and off up to 177 times in a 24 hour period, a holding plate system would only need the compressor to cycle on and off from 4-8 times!

From an efficiency standpoint, you would like to run the compressor at the slowest speed setting that will still allow for about a 50% compressor duty cycle. From experience we have found that the compressor speed of 3/4 works well for most installations, but larger boxes, boxes with poor insulation, or while cruising in tropical climates a compressor speed of full could be needed for good cycle time intervals and proper box temps.

In terms of power usage relating to speed and run time for example, a compressor on full speed will use 5A DC while running and for example will cycle on for 1 hour to freeze

down the holding plate. If the speed of the compressor is cut to 1/2 speed, then the compressor will use approximately 2.5A DC but will need to run for 2 hours to freeze down the holding plate. There is a small efficiency advantage of running at the lower speeds, but in general the daily power used in terms of Total Amp hours will be close to the same in the example above: 2.5A * 2hrs = 5AH or 5A * 1hr = 5AH.

The advantage of the higher compressor speeds are that the system will have a faster response time in pulling down the box temperature when stocking up the freezer/refrigerator with lots of provisions. If you just landed a big Dorado and want to put the filets in the freezer, the higher compressor speed will help freeze the fish faster. The disadvantage is that the instantaneous power Amp draw will be greater at the higher speeds, so life's a balancing act and you can decide for yourself how you would like to operate your system.

Fault Errors and Troubleshooting

The CoolBlue electronic control module incorporates a diagnostic LED that will flash from 1 to 5 times to indicate the error fault cause. The flashing errors codes will repeat every 5 seconds until the controller automatically tries to restart the compressor at about 1 minute intervals. After 10 failed attempts, the controller will shut down and wait for a reset. Turning power off and back on from the DC power supply will clear the error fault and the electronic module will attempt to start the compressor again. The LED is mounted on a small circuit board fitted to the top of the black electronic control module.

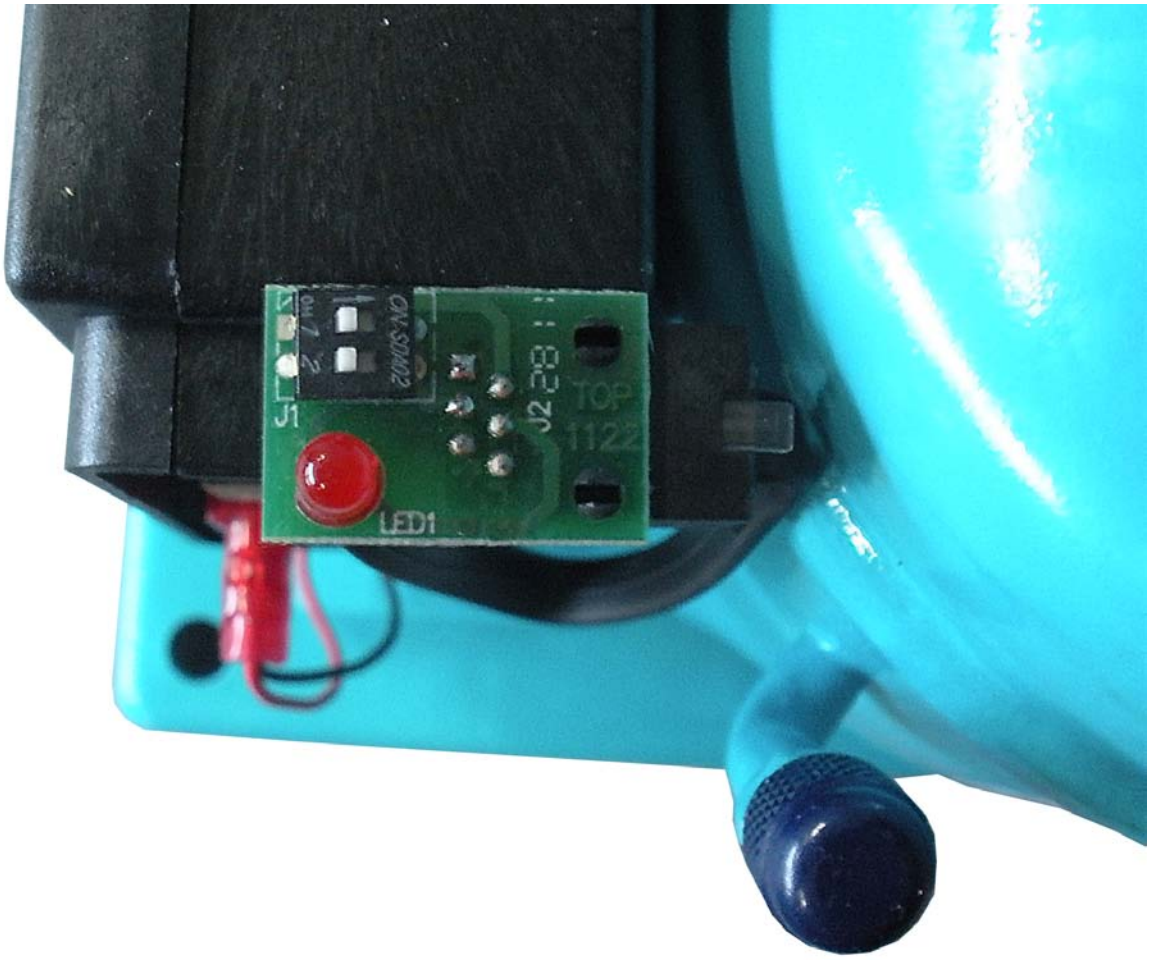

Figure 18: Fault Light Emitting Diode Mounted on Speed Control Board

1 Flash – Low Voltage Start Error

The electronic controller did not see the DC power supply voltage stay above the minimum during the starting sequence. It will abort the start attempt until proper voltage is detected. To correct the problem, check your DC power connections and turn on a battery charger or ships alternator to increase battery voltage. Just because your ships electrical panel is showing 13v doesn't mean the 13v is getting to the CoolBlue, so check the voltage at the CoolBlue power terminals to verify the voltage actually getting to the CoolBlue. Voltage drop on boats is very common from undersized wires, poorly made or corroded connections and voltage loss due to passing through too many connectors.

2 Flashes – Condensing Fan Over-Current

The electronic controller sees more than a 0.50A 12v draw from the condensing unit fan. The fan typically draws 0.29A but could fault if blocked or if the bearings in the fan are beginning to fail. Can also indicate an auxiliary load has been added to the fan circuit that exceeds the maximum amperage for the channel. The compressor cannot be operated without the cooling fan except for brief trouble shooting tests with the fan removed to determine if the Fault error will clear.

3 Flashes – Compressor Starting Failure

If the compressor running speed is not achieved during the start-up sequence, the fault condition occurs. The electronic module will attempt to restart in approximately 1 minute. This fault condition is typically not a compressor problem, but rather, a voltage spike/drop, or an over-Amp situation during the start-up sequence. Two easy trouble shooting techniques can be used to identify the actual cause of the Fault.

Over-Amp Condition

This Fault Error commonly occurs if starting the CoolBlue system with a warm holding plate with the compressor not set for low speed. To remedy, turn both dip switches mounted on the circuit board located on top of the electronic control module near the LED to the OFF position. The compressor should be left on low speed for the initial start-up until frost starts to appear on the holding plate. Then the DIP switches can be set back to either the ¾ (No1 OFF and No2 ON) or the full speed condition (Both 1 and 2 ON).

Voltage Spikes/Drops

The electronic control module is much more sensitive to voltage issues than you can see with a typical hand held volt meter or a ships voltage display. So just because you see 13.2v on your ships voltage panel, you can't assume that the controller is seeing adequate voltage during the compressor start-up sequence. An easy trouble shooting technique to rule out a wiring or voltage drop problem is to run a temporary DC power wire directly from the ships battery positive and negative terminal to the power supply leads on the electronic control module. This will eliminate all of your ships wiring and possible lose connections.

If the electronic controller is still giving the 3-Flash error fault after trying both the compressor speed reduction and wiring directly to the ships battery, it could be that the electronic controller has failed and needs to be replaced. Unfortunately there is no way to field test the electronic module except to test it on a known working compressor and power supply system. Electronic control module death is determined by a process of elimination by ruling out the other possibilities.

There is an extremely rare chance that a failed compressor is giving you the 3-Flash fault, but quite honestly, it is so rare for these compressors to fail within their 100,000 hour service life span that we don't start the trouble shooting process with that assumption. We have thousands of these systems sailing the seas with 15yr old compressors. So if you have an island refrigeration service tech telling you that your compressor has failed and he hasn't conducted the above tests, call us immediately 7 days a week (or skype) and get his hands off the unit ASAP before he does more harm than good!

4 Flashes – Compressor Overload

This Fault condition occurs when the compressor speed drops below a minimum speed, indicating an overload condition. Common causes can be due to a system overcharge or excessive heat loads.

5 Flashes – Electronic Controller Overheat

This Fault condition occurs if the temperature of the electronic control module gets too hot as a way to protect the electronic control module from burn-out. The controller will shut itself down to allow time for the electronic control module to cool down. This is a relatively rare Fault since the CoolBlue has been designed with the 12v condensing cooling fan blowing directly on the heat dissipation fins on the back of the electronic control module.

Troubleshooting the Thermostat

The thermostat acts as an Open/Closed circuit that the electronic control module senses to turn the compressor on and off. If the thermostat fails in the open position the compressor unit will not turn on. If the thermostat fails in the closed position, the compressor will not turn off. If your compressor will not turn on and you have verified you have good voltage at the electronic controller connections you can put in a jumper around the thermostat. If the compressor starts with the thermostat jumped, then you know the thermostat has failed and can be replaced. If on passage with a failed thermostat, you can run the system by leaving the thermostat jumped and manually turning off and on the system several times a day to keep the holding plate frozen.

Excessive Frost on Holding Plate (Defrosting and Hatch Seal Leaks)

It is common for humidity in the air to condense and form frost on the holding plate surface. Once the frost starts turning to ice and grows to over ¼" thick, the frost/ice starts acting as an insulator making it more difficult for heat to be absorbed from the box into the holding plate. This can significantly affect the overall efficiency of the refrigeration system and your box temperatures. It is recommended that an ice scraper or spatula is used on the holding plate to keep frost/ice down to a minimum. The 316 stainless steel construction of the holding plate makes it safe to scrape the frost/ice regularly from the holding plate.

Rapid frost build-up on the holding plate is a sign of an air leak. Since hot flows to cold, warm moist air is being drawn into the box most likely through poor hatch or door seals. A trouble shooting approach to see if your box seals are doing their job is to use blue painter's tape to seal your box hatch for a few days. If you notice a slowing of the frost formation, then it is time to do some work on your box hatch seals.

Bubbles in the Sight Glass

The CoolBlue system holds 24Oz of R-134a refrigerant and when the system is low on refrigerant you will see bubbles appearing in the sight glass. Along with the bubbles, you will notice the system running for longer periods of time and not getting as cold, which is a classic sign of a unit low on refrigerant. A few small "bb" type of bubbles are ok, but the presence of larger bubbles or if your sight glass looks like an old fashioned "coffee percolator" then it's time to add some refrigerant to the system. For a detailed description of the recharge process see page 31.

Recharge Instructions

Caution: Wear appropriate hand and eye protection when charging the system. The Liquid refrigerant will freeze what it comes in contact with: skin, eyes, and moles!!

Important Notes:

Charging a holding plate system utilizing a thermally adjusting expansion valve and dryer/receiver is NOT like charging a critical charge system utilizing a fixed critical orifice. So put your Refrigeration Gauges away. Charge the system by volume (24Oz is a full charge) or by using the sight glass to determine the proper state of charge.

ONLY use pure R-134a refrigerant gas. Do not use refrigerant with leak stopper, performance boosters, or dyes. These additives will foul the system.

The CoolBlue refrigeration system is designed to be easily rechargeable if it is determined to be low on refrigerant. The following steps can be used to top off the system with the correct 24Oz of R-134a refrigerant by observing the sight glass. Refrigerant isn't like garlic and you can add too much, so before adding refrigerant, make sure your system is indeed undercharged. Bubbles in the sight glass can help and if you have any questions at all, just call or text the Technautics technical support line 7 days a week at 619-609-3432.

Figure 19: Freon System Recharge Connection

1. Locate and identify the following:
   A. Sight Glass – the 3/8” diameter glass window on top of the receiver/drier by the compressor unit.
   B. Suction Low Pressure Service Valve – the blue painted cap located on the compressor.
2. Adjust the thermostat as needed to make the compressor run.
3. After 10 minutes of operation, observe the sight glass. If bubbles are present, the system needs to be charged.
4. Completely open the valve on the charging hose by turning the valve counter clockwise, which retracts the refrigerant can piercing needle.
5. Tightly connect the charging hose to the refrigerant can.
6. Completely close the valve on the charging hose, which will deploy the can piercing needle so that when you next open the valve refrigerant gas will flow.
7. Remove the blue cap from the suction low pressure service valve and **very loosely** attach the charging hose.
8. Open the refrigerant can valve slightly and purge air from the charging hose for 2 to 5 seconds, then **firmly tighten** the charging hose to suction valve connection.

   Caution: Hold the refrigeration can in the upright position. The compressor is designed to pull in refrigerant gas, not liquid. By turning the can upside down, a slug of liquid refrigerant will flow into the compressor and float out the compressor oil.
9. Open the refrigerant valve fully to feed refrigerant into the system until the large bubbles are no longer visible in the sight glass. Then close the valve on the charge hose.
10. Continue running the system for 5 more minutes and monitor the sight glass. If large bubbles are still present, repeat step 9.
11. Repeat steps 9 and 10 until no large bubbles are visible.
12. The system is now fully charged. Reset the thermostat to its previous position.
13. Close the refrigerant can valve, disconnect the charging hose, and replace the blue cap.

Helpful Recharge Charge Hint:

Shining a flash light into the sight glass can help illuminate the refrigerant flow stream. If you see nothing at all in the sight glass, it could be that your system is too low on refrigerant to even make bubbles.

There is no visual difference in the sight glass between a correct full charge and an over charged condition, so the key to successfully recharging is taking your time. Because once you overshoot the system charge, you have no visual way to know. Add smaller amounts of refrigerant in 5 to 15 second bursts, letting the system stabilize and then check the sight glass.

If you are having trouble determining your systems state of charge based on the appearance of the sight glass sometimes it is easier to simply start over. Meaning you can remove the refrigerant from the system and simply add two full 12oz refrigerant cans. This way, you know with absolute certainty that your system is charged correctly. The “catch” is that you will need to have a room temperature holding plate to remove the refrigerant from the holding plate and get to what is known in the technical refrigeration world as a “vapor charge” condition. This is useful in system troubleshooting because it rules out a charge problem. Charge problems and voltage drop/spike problems are the most common reasons for a CoolBlue refrigeration system to not function properly.

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Technical Data for Compressor and Electronic Controller

Compressor					
Model		GD30FDC			
Displacement	cm^3	3			
Diameter	mm	18			
Stroke	mm	12.1			
Net weight	kg	5.4			
Oil Type		ISO VG 22 Ester			
Oil Volume	mls	240			
Refrigerant type		R134a			
Evap Temp Range	°C	-30 to +10			
Expansion System		Expansion Valve or Capillary			
Voltage	V DC	12 to 42			
Voltage Range	V DC	10 to 42.4			
Motor type		Brushless, Sensorless, PMM			
Phase number		3			
Pole number		6			
Locked rotor current (12, 24, 42v)	A	11,6,4			
Resistance at 25°C (R-S/R-T/S-T)	Ohms	0.8			
Electronic Driver					
Model	FDC1				
Type	Digital and programable				
Supported devices	12v/0.5A fan				
	Compressor speed and battery protection switch				
	Alarm LED				
	15v/25mA electronic thermostat				
	5V/25mA electronic manager				
Communication port	Serial Port Interface (SPI)				
Communication capabilities	RS-232 serial port				
	2-digit, 4-level switcher				
	Alarm LED				
Protections	Battery protection				
	Fan over current				
	Stating failure				
	Compressor overload				
	Electronic Controler overheat				
Default setup	Speed selection: external switcher				
	Low/Med/Normal/High				
	(1500/2167/2833/3500 RPM)				
	Cut-out (12/24/42 V systems): 11.5/24.5/38.5 V				
	Cut-in (12/24/42 V systems): 10.0/22.0/36.0 V				
	3 minute thermostat delay: on				

Nominal performance at	RPM	1500	2000	2500	3000	3500
Cooling capacity	W	32	46	58	67	74
Cooling capacity	kCal/Hr	28	40	50	58	64
Input powr	W	26	36	46	54	61
EER	kCal/Hr	1.07	1.11	1.09	1.07	1.05
COP	W/W	1.24	1.28	1.26	1.24	1.22
Current	Amp	2.19	3.03	3.85	4.53	5.08
Test Conditions						
Evaporating temperature		°C		-23.3		
Condensing temperature		°C		55		
Liquid temp entering expansion		°C		32		
Ambient return temp		°C		32		
Voltage		V DC		12		
Approvals GD30FDC is in compliance with the following directives and approvals:						
* Low Voltage Directive 73/23/EEC (CE-marking)						
* Electromagnetic Compatibility Directive for Automotive Industry 95/54/EC (e-marking: e9 6013)						
* VDE approval						
* CCC approval						
* UL approval						
* Cubigel compressors declares that production is in RoHS compliance						
Reliability GD30FDC passed the follwing reliability tests:						
* High Temperaure: according with CECOMAF GT-4002 standard						
* Wear: according with CECOMAF GT-4003 standard						
* ON/OFF: according to CECOMAF GT-4004 standard						
* Vibrations: according to ASTM 5728 Level I standard						

RPM	-30	-25	-23.3	-20	-15	-10	-5	0	5	10
Cooling Capacity ASHRE (kCal/Hr)										
1500	19	25	28	33	43	60	78	100	126	160
2000	26	36	40	49	64	87	112	142	179	223
2500	32	45	50	62	82	110	142	180	227	281
3000	37	52	58	72	97	129	168	214	270	-
3500	41	57	64	79	109	144	190	244	-	-
Cooling Capacity CECOMAF (W)										
1500	18	24	26	31	41	57	73	94	119	150
2000	25	34	38	46	60	82	106	134	169	210
2500	30	42	47	58	77	104	134	170	214	264
3000	35	49	55	68	91	122	158	202	254	-
3500	39	54	60	74	103	136	179	230	-	-
Input Power (W)										
1500	23	25	26	29	34	41	47	52	57	63
2000	30	35	36	40	47	56	64	71	78	86
2500	38	44	46	53	63	73	83	92	101	110
3000	44	52	54	63	77	88	100	112	122	-
3500	50	58	61	71	89	102	116	130	-	-
C.O.P ASHRAE (W/W)										
1500	0.97	1.17	1.24	1.33	1.47	1.70	1.95	2.23	2.58	2.94
2000	1.01	1.21	1.28	1.41	1.57	1.82	2.05	2.33	2.66	3.02
2500	0.99	1.19	1.26	1.37	1.52	1.76	2.00	2.28	2.62	2.98
3000	0.97	1.17	1.24	1.33	1.47	1.70	1.95	2.23	2.58	-
3500	0.95	1.15	1.22	1.29	1.42	1.64	1.90	2.18	-	-
C.O.P CECOMAF (W/W)										
1500	0.79	0.97	1.03	1.07	1.21	1.39	1.57	1.80	2.10	2.37
2000	0.84	0.98	1.05	1.14	1.27	1.48	1.67	1.89	2.16	2.45
2500	0.80	0.96	1.02	1.12	1.23	1.43	1.62	1.85	2.12	2.41
3000	0.79	0.95	1.01	1.08	1.19	1.38	1.59	1.81	2.09	-
3500	0.78	0.94	0.98	1.04	1.15	1.33	1.54	1.77	-	-
Current (A)										
1500	1.90	2.07	2.19	2.40	2.83	3.42	3.88	4.35	4.73	5.27
2000	2.49	2.88	3.03	3.37	3.95	4.63	5.29	5.91	6.52	7.16
2500	3.13	3.66	3.85	4.39	5.23	6.06	6.88	7.65	8.40	9.10
3000	3.70	4.31	4.53	5.25	6.39	7.35	8.35	9.30	10.10	-
3500	4.18	4.80	5.08	5.93	7.44	8.51	9.70	10.80	-	-

	ASHRAE	CECOMAF
Condensation temp	55°C	55°C
Liquid temp entering expansion	32°C	55°C
Ambient and return temp	32°C	32°C
Voltage 12 VDC		

TECHNAUTICS COOLBLUE LIMITED WARRANTY

BORAMEL INC DBA TECHNAUTICS WARRANTS NEW EQUIPMENT TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP FOR FIVE YEARS FROM PURCHASE DATE, EXCLUDING THE ELECTRONIC CONTROLER. THE ELECTRONIC CONTROLER HAS A LIMITED ONE YEAR WARRANTY FROM THE DATE OF PURCHASE. THIS WARRANTY DOES NOT COVER ANY MERCHANDISE OR COMPONENT THEREOF WHICH, IN THE OPINION OF THE COMPANY, HAS BEEN SUBJECTED TO NEGLIGENT HANDLING, MISUSE, ALTERATION, AN ACCIDENT, OR IF REPAIRS HAVE BEEN MADE WITH PARTS OTHER THAN THOSE OBTAINABLE THROUGH TECHNAUTICS.

PARTS OF COMPONENTS BEING CLAIMED FOR WARRANTY MUST NOT BE DISASSEMBLED OR ANY ATTEMPT MADE TO REPAIR THEM UNLESS APPROVAL IS GIVEN BY TECHNAUTICS. BREAKAGE OR DAMAGE RESULTING FROM INSTALLATION OR OPERATION NOT IN ACCORDANCE WITH TECHNAUTICS' PUBLISHED INSTALLATION AND OPERATING INSTRUCTION ARE NOT COVERED BY THE WARRANTY.

TECHNAUTICS DOES NOT WARRANT EQUIPMENT AND ACCESSORIES NOT OF OUR MANUFACTURE, WHICH ARE WARRANTED BY THEIR RESPECTIVE MANUFACTURES, WHICH ARE EXTENDED TO THE PURCHASER THROUGH TECHNAUTICS.

ANY TECHNAUTICS PART OR COMPONENT COVERED BY THIS WARRANTY THAT IN OUR JUDGEMENT SHALL SHOW EVIDENCE OF A VALID DEFECT SHALL BE RETURNED TO TECHNAUTICS, FREIGHT CHARGES PREPAID.

IN NO EVENT SHALL THE COMPANY BE LIABLE FOR CONTINGENT OR CONSEQUENTIAL DAMAGES. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES AND IS LIMITED TO THE REPLACEMENT OF PARTS RETURNED TO THE FACTORY AND DETERMINED DEFECTIVE ON INSPECTION. FEES INCURRED BY UNATHOUTHORED REPAIRS WILL NOT BE PAID/REIMBURSED.

WARNING

DO NOT ADJUST THE EXPANSION VALVE

The expansion valve is factory set to the correct setting. If it is re-adjusted the warranty will be void, but more importantly you could screw up the system!