Installation, usage and maintenance manual

FRIGOBOAT FRIGOMATIC SYSTEMS

Rev. 010624

frigoboat®
MARINE REFRIGERATION

Table of Contents

1. Introduction 4
1.1. General information 4
1.2. System features 4
1.3. Installation 4
1.4. Transport and handling 4
1.5. Unpacking 4
1.6. Disposal 5
1.7. Directives 5
1.8. General safety 5
2. Installation 6
2.1. Frigoboat Frigomatic system positioning and installation 6
2.1.1. Condensing unit 6
2.1.1.1. Air cooled models 6
2.1.1.2. Water cooled models 6
2.1.1.3. Keel cooled models 7
2.1.2. Evaporator plate 7
2.1.3. Evaporator plate bending (F type only) 8
2.1.4. Keel Cooler (for K models) 9
2.1.5. Sea water pump (for W models) 10
2.1.6. Extension pipes (optional) 11
2.1.7. Mechanical Thermostat 12
2.1.8. Spill-over mechanical Thermostat (optional) 13
2.1.9. Digital Thermostat (optional) 13
2.1.10. Refrigerant connections – Quick connect fittings 13
2.2. Grounding 19
2.3. Electrical connections 20
2.4. Merlin smart speed controller E52152 (optional) 23
2.5. Installation checks 23
3. Operating instructions 25
3.1. Spill-over thermostat option 25
3.2. Compressor speed regulation (E51045) 25
4. Maintenance and cleaning 26
4.1. Defrosting 26
4.2. Condenser cleaning (for Air cooled units only) 26
4.3. Sea water pump filter cleaning (for water cooled units only) 26
4.4. Winterization (for water cooled units only) 26
4.5. What not to do 26
5. Warnings, alarms and troubleshooting 27
5.1. Electronic controller troubleshooting 27

5.2. System troubleshooting 27

1. Introduction

1.1. General information

Thank you for purchasing a Frigoboat system!

This manual will provide necessary information for the proper installation, operation, and maintenance of your Frigoboat system.

All Frigoboat products are designed and produced to the highest standards and they are all tested in the factory. If your Frigoboat system is used according to the guidelines in this manual, it will guarantee you trouble free operation for many years.

If you require assistance, please contact one of our many authorized service centers. To find the service center please check our website www.veco.net or write us at customerservice@veco.net.

WARNING

This unit should only be used for the purposes for which it was designed. The manufacturer declines all responsibility for any damage caused by incorrect or unreasonable use, such as:

- improper use by untrained persons;
- technical modifications or operations not suited to specific models;
- use of non-original or non-specific spare parts;

1.2. System features

The Frigomatic system consists of the following parts:

1. The condensing unit – A variable speed compressor running with R134a refrigerant gas, pre-charged, and already connected to an electronic device; unit comes with unique Frigoboat self-sealing coupling to easily connect it to the other part of the system.
2. The thermostat
3. The evaporator
4. The water pump (only for water cooled W models, water cooled with pump)
5. The keep cooler heat exchanger (only for keel cooled K models, with keel cooler)
6. (optional) extension pipes
7. (optional) additional air-cooled condenser for W and K models

The Frigoboat Frigomatic system is designed for capillary refrigeration systems with evaporating temperature between -25°C and +10°C, for AC or DC power supply, depending on the model.

1.3. Installation

The unit must be installed by an authorized Frigoboat service center and in compliance with the instructions given in this manual.

1.4. Transport and handling

When loading or unloading the parts, take every precaution to prevent damage, when handling the unit or components keeping in compliance with the information given on the packaging material.

1.5. Unpacking

Each Frigoboat Frigomatic system component is packed in separate box.

Remove parts from the box, removing all cardboard and other protective materials, then set the unit or components into position.

Once all packing material has been removed, check that the unit has not been damaged in any way.

WARNING: Wear protective gloves when handling any packing materials. Dispose of all packaging materials appropriately in accordance to local codes.

1.6. Disposal

This appliance should not be disposed of with household waste. Please dispose of the device or its individual components in accordance with local regulations at an authorized collection center.

1.7. Directives

Frigoboat Frigomatic respect the following directives.

- CE
- 2014/35/UE – LVD
- 2014/30/UE - EMC
- 2006/42/CEE – MSD - Machinery Directive
- 2014/68/UE - PED (97/23/CE)

1.8. General safety

Injuries or accidents caused by failure to comply with the recommendations of this manual are solely the responsibility of the unit operator.

Basic Rules for Safe Operation:

- do not touch the unit with moist or wet hands or feet;
- never operate the unit while barefoot;
- before installation and maintenance operations, disconnect the unit from the power supply. failure to comply may result in injury or death;
- installation and maintenance of this system can be hazardous due to system working pressure and electrical components. Only a Frigoboat certified service center should install and maintain the system;
- to minimize the hazard of electrical shock and personal injury, this component must be effectively grounded;
- during installation and maintenance follow safety codes, wear safety glasses and work gloves;

2. Installation

WARNING

- Failure to follow all the instructions in this manual can cause property damage, injury or death.
- Improper installation, adjustment or alteration can cause property damage, injury or death.
- Electrical connections should be performed only by a certified professional.
- Electrical and grounding connections must comply with the National Electric Code and local electric codes. Failure to comply with this procedure can cause property damage, injury or death.
- Before connecting the unit to the electrical supply, verify that the electrical connection agrees with the specifications on the data plate, placed on the main electrical box of the unit. Failure to comply with this procedure can cause property damage, injury or death.
- This appliance must be connected to a grounded, metal, permanent wiring system. Failure to comply with this procedure can cause property damage, injury or death.

2.1. Frigoboat Frigomatic system positioning and installation

The Frigoboat Frigomatic systems are designed for marine usage and installation.

All system components must be accessible for service and properly secured.

2.1.1. Condensing unit

Condensing unit needs to be installed with the compressor right way up, on a horizontal surface, as compressor can work with a maximum heel of 30° for a limited amount of time.

Condensing unit needs to be installed in areas where they will not be susceptible to physical or water damage, but accessible for service.

Condensing unit needs to be securely fixed to the surface; a mounting kit is supplied that includes rubber mounts and stainless-steel inserts. The unit may be screwed or bolted down using the supplied white, plastic washers, if desired.

If a Frigoboat mounting bracket (part E52135) is used, remove the stainless-steel mounts from the compressor and use the plastic mounts provided with the mounting bracket.

2.1.1.1. Air cooled models

All air-cooled models do require good ventilation, preferably expelling the heated air to another location.

In case of air-cooled condensing units with a duct ring installed, a flexible duct has to be connected, no longer then 1mt (3ft).

There should always be adequate ventilation to allow cool air to enter the condenser, and precautions made to prevent the heated expelled air from being drawn back in. The temperature of the air entering the condenser determines the efficiency of the system.

Re-circulating the heated air back into the condenser in a sealed or poorly ventilated cabinet will result in poor system performance. Poor system performance will also result from air being drawn in from a heated space, i.e. an engine room.

If the hole and therefore the finned condenser is in a position exposed to physical damage it should be protected by a grill having at least the same cross-section of the condenser.

Do not add any filtering material anywhere in the air flow.

2.1.1.2. Water cooled models

Water cooled condensing units are designed to work with sea water only and they do not require ventilation. They are not designed to use water from other sources, i.e. water tanks, skin tanks, or coolant pumped through secondary heat exchangers.

Serious health risks and/or performance issues can occur if any form of liquid coolant delivery is used other than sea water being pumped directly into the system and then expelled back overboard.

2.1.1.3. Keel cooled models

Keel cooled condensing units do not require ventilation.

The compressor must be mounted within 1,5mt (5') of the Keel Cooler.

This dimension cannot and must not be extended.

2.1.2. Evaporator plate

Before installing the evaporator, make sure that the ice box insulation is effective (i.e.50mm for fridge an 100mm for freezer when polyurethane is used).

All types of Frigoboat evaporator need to be located as high as possible in the icebox to maintain the correct temperatures, with consideration being given to access to the interior freezing section in the H and B type.

Special attention must be given to the fact that air flow must be allowed to circulate to and from the rear of the evaporator plate. This necessitates leaving a gap of approximately 2,5cm (1”) between the top of the evaporator and the roof of the box, and similar spacing at the lower edge. It is also important that the 2cm (¾”) spacers provided be used to offset the evaporator on all points from the icebox wall.

The H and B types may be mounted in any position. The F type must be mounted with the indicator arrows pointing upwards, on a vertical wall, and with the refrigerant channels running in a horizontal orientation.

Do not alter the orientation of the tubing and/or tubing components secured to the end of the evaporator plate. Do not remove any securing zip ties, or attempt to straighten the tubing.

All evaporators have approximately 2,5mt (8') of copper tubing attached, with dust-plugs in the end fittings that must remain installed until the very last moment when the connections are ready to be made.

A 4cm (1,5") hole needs be drilled in the wall of the icebox, as high as possible, and through successive bulkheads, as required. Carefully unroll the tubing, feeding it through the holes to the area where the compressor/condenser is located. Any bends that need to be fashioned in the tubing must be made carefully with as large a radius as possible to avoid kinking.

Excess tubing should be carefully coiled up outside of the box and fastened out of the way in a horizontal orientation. One tube is made intentionally longer than the other to enable as small a hole as possible to be made in the box wall, bulkheads, etc. and this allows the couplings to be fed through one after the other.

When the tubing run is complete, carefully fashion the longer tube so that the two halves of the coupling can be easily connected. Some evaporators have fragile sections of aluminum tubing close to the body of the evaporator that must be handled very carefully. Warnings to that effect are attached to the evaporators.

The section of foam insulation that is free to slide on the tubing should be positioned starting at the point where the tubing exits the icebox and leads back to the compressor. It is neither necessary nor desirable to add more insulation to the tubing, as any sweating or ice formation

seen on the exposed section of tubing indicates an overcharged condition which will require remedial action.

Once the evaporator is installed, the exit hole in the box must be sealed with expanding foam, refrigeration putty, or other suitable insulation material that will inhibit air flow.

Make sure that any drains are plugged and that there are no other holes or gaps through which cold air can escape, and through which warm, moist air can enter.

If the tubing is too short to reach the compressor/condensing unit, pre-charged extensions are available.

To mount the H type horizontally, drill four mounting holes in the roof of the icebox. Start two screws in the rear holes. Slide the mounting slots of the evaporator over the screws, then insert and tighten the two front screws. Finish by tightening the two rear screws.

The B- type can be mounted by using the row of holes along the top rear face of the evaporator. There are Lid Kits available for the 340B and 250B evaporators to facilitate horizontal mounting.

The F type has numerous mounting holes along the top and bottom edges, but only some need be used.

Do not attempt to cut, trim, or drill holes in any evaporator for any purpose. Holes may be drilled in the base that has been added to B type evaporators, as this is a separate piece of aluminum.

2.1.3. Evaporator plate bending (F type only)

The Frigoboat F type flat evaporators may be carefully bent on a minimum 25mm (1") radius to follow the shape of the icebox.

This is best done by holding a section of suitably padded PVC pipe firmly down on the plate, and then carefully bending the section upwards with the palm of your hand.

The stainless-steel plates need more force to bend and may require the assistance of a second person.

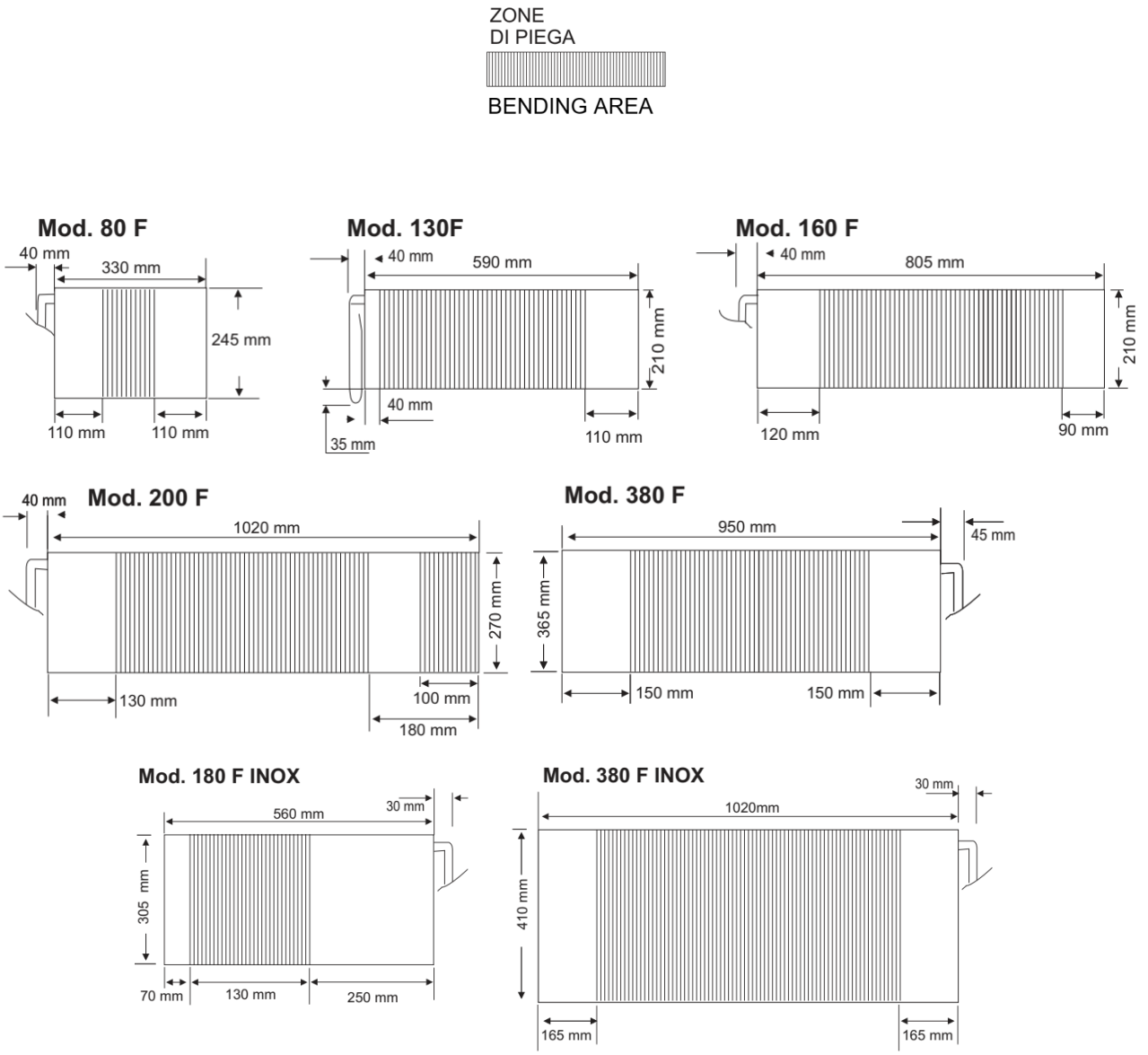
This must be done slowly and with great care to avoid excessive kinking of the channels in the evaporator.

Never attempt to bend a plate downwards over a pipe, as damage may result.

The area to be bent should be warmed with a hair dryer or heat gun to approximately 90°C (200 °F) before bending, in order to prevent the paint from cracking.

There are sections of the evaporator that must not be bent, and these are indicated on the Bending Sheet included with the evaporator. If the Bending Sheet has been misplaced, contact Veco to get more information on the bending points.

All F-type evaporators can be mounted with either side facing inwards, including the 380F which has one smooth side and one with channels. F-type plates with a stainless-steel cover must be mounted with the stainless side facing inwards.



2.1.4. Keel Cooler (for K models)

The Frigoboat Keel Cooler must be mounted through the hull by drilling a 40mm (1 9/16") smaller hole may be used, carefully enlarging it, if necessary.

Make a dry run(s) without the rubber O-ring and sealant installed, making sure that the Keel Cooler fits up flush with the hull, chamfering the hole if necessary. The rubber O-ring must then be installed and properly seated in the groove provided.

Do not install the Frigoboat Keel Cooler without the rubber O-ring.

Adequate sealant of the correct type must be used, and a bead applied to the area between the O-ring and the shaft of the Keel Cooler is all that is normally required.

The compressing of the rubber O-ring will serve to force sealant into any voids around the shaft as the fitting is tightened.

Consult a marine store if you are uncertain of which sealant to use.

With the sintered “Ground Plate” models, a dab of sealant should also be applied to the fore and aft ends of the Keel Cooler where it meets the hull to secure its orientation. If installing the “Bare

Bones" model, an adequate amount of sealer should be applied under the end fairing cap before the cap is secured to the hull with screws.

When installing the thread-type Keel Cooler you will need someone to hold the Keel Cooler outside the boat while you tighten the nut inside. The mounting location should be carefully chosen. Select a location with a flat exterior surface, as a concave area will damage the sintering on the Keel Cooler when it is tightened. Also, avoid areas where lifting slings may be applied or where other damage may occur.

On the boat's interior, the Keel Cooler should be installed in a location that is normally dry, and not where it is likely to be submerged or be subjected to frequent and/or heavy dousing.

Consideration should be given to the fact that the Keel Cooler must be below the water-line, and the compressor unit must be mounted within 1,5mt (5') of the Keel Cooler location.

On power boats it may be possible to mount the Keel Cooler in a vertical orientation on a section of the transom that is below the waterline. Keep the two tubes from the Keel Cooler separate from each other, and do not insulate them.

It is extremely important to orientate the cylindrical Filter/Drier fitted to the Keel Cooler discharge tube in a vertical manner, with the arrow pointing downwards. Failure to do so will lead to poor system performance.

Special constraints and working practices apply when installing the Keel Cooler on a vessel with a cored, metal, or carbon fiber hull. For these applications we suggest you consult a marine professional who is conversant in that particular field.

WARNING: Never operate a Keel Cooled system while the boat is out of the water without having first rigged some form of temporary water cooling on the Keel Cooler. If an additional air-cooled condenser is installed together with a Keel Cooler, ensure that the fan is operated only when the boat is out of the water, and then switched off when the boat is launched.

The sintered "Ground Plate" Keel Cooler should not be painted.

Clean occasionally with a brush, never with a metal scraper. All models of Keel Cooler must be inspected periodically for corrosion.

2.1.5. Sea water pump (for W models)

Frigomatic systems with water cooling are designed to use sea water to cool down the condensing unit, and condensing unit needs to be connected to a sea water pump.

These models are designed to work with sea water only. They are not designed to use water from other sources, i.e. water tanks, skin tanks, or coolant pumped through secondary heat exchangers. Serious health risks and/or performance issues can occur if any form of liquid coolant delivery is used other than sea water being pumped directly into the system and then expelled back overboard.

Usage of chilled water from the chilled water loop might be used prior to Veco authorization, and with a regulation valve installed to avoid damaging the unit.

The sea water circuit must always have an uphill incline from the sea water inlet to the chiller condenser to prevent the system to run properly. All hoses should be installed as straight as possible with no loops and bends.

All metal components of the sea water circuit must be properly grounded.

Sea water intake has to be installed as far below the water line to ensure always that no air enters the sea water circuit.

Sea water strainer (around 120 Mesh) has to be installed between the sea water intake and the sea water pump and it must be accessible for cleaning operations. The strainer has to be cleaned periodically.

WARNING: Sea water strainer is mandatory in the seawater circuit. Failure to install the sea water strainer will void the warranty.

The sea water outlet has to be installed above the sea water line, but as close as possible to it to reduce noises.

The standard pump supplied by Frigoboat is self-priming pump (code A092819C) and requires a good intake strainer. Other pumps of similar performance may be used.

After pump installation, check for leaks and a water flow of at least 4 lit/min (1 gal/min).

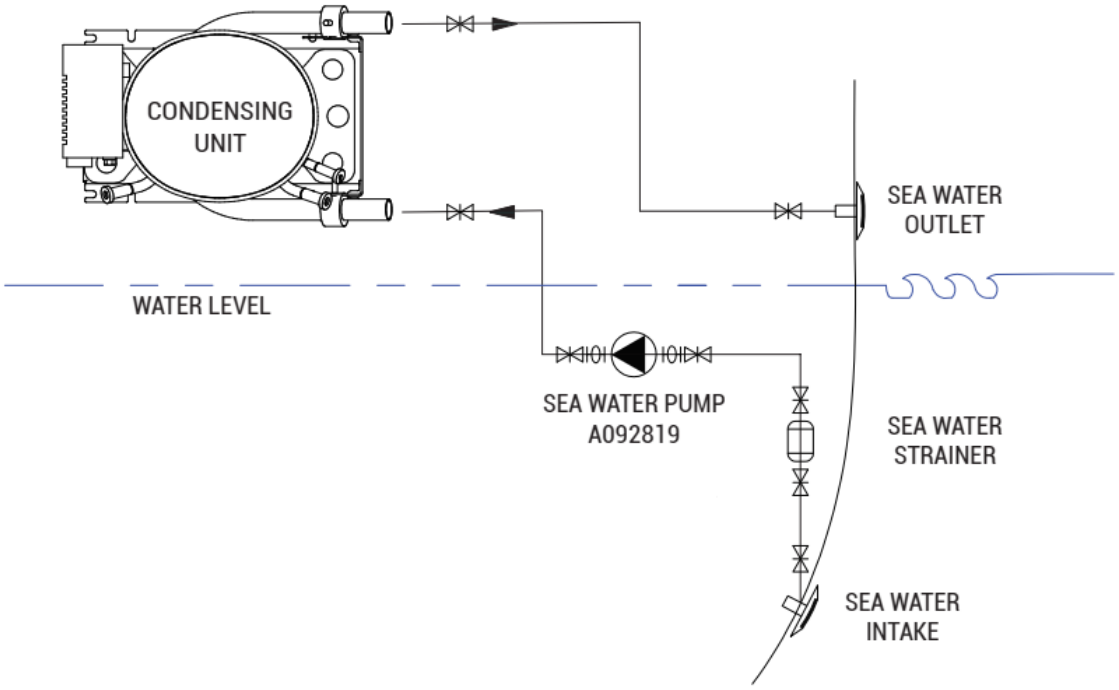
The pump power must be supplied through a 12V relay whose coil is connected to the fan terminals. The fan terminals on the module are limited to a current draw of 0.7 amps and will deliver 12V even if the system is connected to a 24V supply.

If more than one Water Cooled condensing unit is sharing a single water pump, they must be plumbed in a parallel configuration so that the pump output is split equally to each unit, and each unit receives water direct from the pump. The water discharges from each unit can then be combined into one single overboard discharge.

Multiple Water-Cooled condensing units must not be plumbed in a series string (i.e. pump output into unit 1; output from unit 1 to inlet of unit 2, etc., etc.).

The positive (+) lead to the pump can be wired in parallel to the individual 12V relays so that any unit can operate the water pump independent of the other(s).

WATER CONNECTIONS (only W models)



2.1.6. Extension pipes (optional)

When the compressor has to be placed further than the standard distance allowed by the refrigerant pipes, you might use an extension pipe.

Handle the extension pipe with care, as recommended for the evaporator pipes.

NOTE: the use of long extensions might slightly affect unit efficiency.

2.1.7. Mechanical Thermostat

There are two different Frigoboat mechanical thermostats for different applications. The refrigerator version, mounted in a white housing, is designed to be used where the evaporator is mounted in an icebox that is intended to be kept at refrigerator temperatures.

If the evaporator is of the H or B type and is correctly sized, a refrigerator mechanical thermostat is used and this ensures that the interior portion of these evaporators will be kept at freezer temperatures.

The freezer version, mounted in a blue housing, must be used where the evaporator is mounted in a space that is intended to be all at freezer temperatures.

If an existing icebox is divided with an insulated barrier, a spillover system can be employed whereby the evaporator is mounted in the freezer compartment, and a thermostatically controlled fan, mounted on the refrigerator side of the barrier, draws air from the freezer to keep the refrigerator section at the desired temperature. A gap or holes at the top of the barrier allow air to return to the freezer.

The mechanical thermostat can be mounted either inside the icebox, or in an alternative location that is within the scope of the sensing tube. If the thermostat is mounted inside the box make sure that liquids or condensation cannot flow down the shaft and into the mechanism by positioning the housing so that the shaft exits either on the bottom or the side. The Frigoboat logo will be the right way up if the thermostat is mounted correctly.

Do not mount on the ceiling of the box.

The sensing tube controls the thermostat by the pressure of the gas it contains and must not be kinked, broken, or cut.

Any excess tubing may be carefully coiled up and secured out of the way to avoid damage.

When securing the sensing tube, make sure contact is made only with the evaporator at the point where it is attached under the plastic mounting plate and that it does not touch any part of the aluminum or copper tubing.

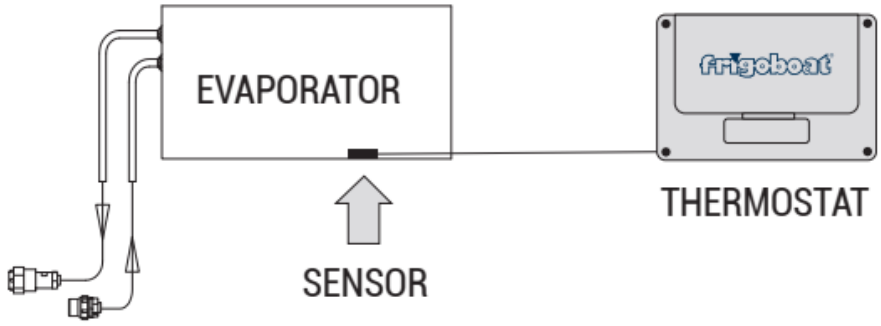
If necessary, the tube can be protected with small-bore plastic tubing, either by sliding it on prior to attaching to the evaporator or by slitting it along its length and feeding it over the sensing tube.

Run the cable together with the copper lines to the compressor /condensing unit. Care must be taken to ensure that the sensing tube does not come into contact with any electrical component either inside or outside the icebox. There is an insulating cover over the most exposed wire terminal and connector inside the plastic thermostat housing.

An inspection must be made before mounting, to ensure that the entire terminal and connector is covered and that no metal parts are exposed.

Confirm, before mounting the thermostat, that the capillary tube is not in contact with any wire terminal, connector, or bare wire.

If the sensing tube needs to be bent within the confines of the plastic thermostat housing, it must be done with great care, heeding the warnings above.



Mechanical thermostat sensor positioning.

2.1.8. Spill-over mechanical Thermostat (optional)

The Frigoboat Spillover Kit (with integrated mechanical thermostat) should be installed on the barrier dividing the freezer and refrigerator sections, on the refrigerator side, and no lower than at mid-height.
Screws may be used after drilling holes in the plastic flange.

A 6 cm (2.25”) diameter hole needs to be cut through the barrier to allow air to flow to the fan. The hole may be directly behind the evaporator in the freezer section, and this will not be detrimental to performance.

A return air path must be established at the top of the barrier to allow air back into the freezer. This can either be in the form of a gap at the top of the barrier (2,5cm - 1” should be sufficient) or 3 or more holes of the same size as the one behind the spillover fan. All other holes, gaps, etc, in the barrier must be completely sealed, including drains.

The Spillover thermostat must be powered by an independent 12V supply. This may be from a breaker on the electrical panel or via an in-line 2-amp fuse from the same supply that is feeding the refrigeration system. Do not power the Spillover Kit from the fan terminals on the controller.

2.1.9. Digital Thermostat (optional)

The Frigoboat Frigomatic system might be used with a digital thermostat, please see the dedicated digital thermostat instructions.

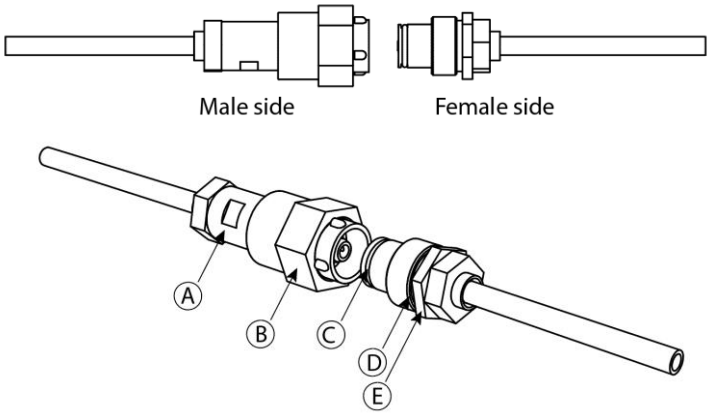
2.1.10. Refrigerant connections – Quick connect fittings

Once all Frigomatic system components are positioned, the refrigeration circuit can be connected together.

The condensing unit, the evaporator and (if present) air-cooled condenser, Keel Cooler and extension pipes, are all factory pre-charged with the correct refrigerant amount; connecting parts together will immediately allow gas to pass among components, so gas charges will change.

If you need to disconnect/change parts, it’s necessary to contact a Frigoboat service center.

Frigoboat Quick Connect fittings must be connected carefully. Leave the dust plugs installed until the very last moment when you are ready to connect the system together. Once the dust caps have been removed, it is imperative that the exposed components and surfaces be kept free of dust, dirt, construction debris, etc. After you have removed the plugs, keep them in a safe place in case you need to remove or replace a component later.



To connect them, the male side of the fitting needs to be connected with the female side, as per the image above.

Do not use any thread sealant or tape.

Center the two parts precisely and push them together until the nut (B) can be manually screwed into the male side (D); do not tight too much.

To tight them together use two monkey wrenches 20mm (13/16") and 24mm (15/16"). Using the wrench, keep steady the male connection and do not let the male side turn; then tight using the other wrench the female side, until the nut (B) completely covers the male thread (D).

It is most important not to let the male end rotate at all during this whole process.

NOTE: Excessive tightening is not required, as the O-ring (C) makes the seal and making up the threads simply open the internal valves and allows refrigerant to flow. If resistance is felt before the threads are covered, back off the collar and ensure that the shaft in the female coupling has not been mis-aligned. If it has, straighten it and re-make the coupling.

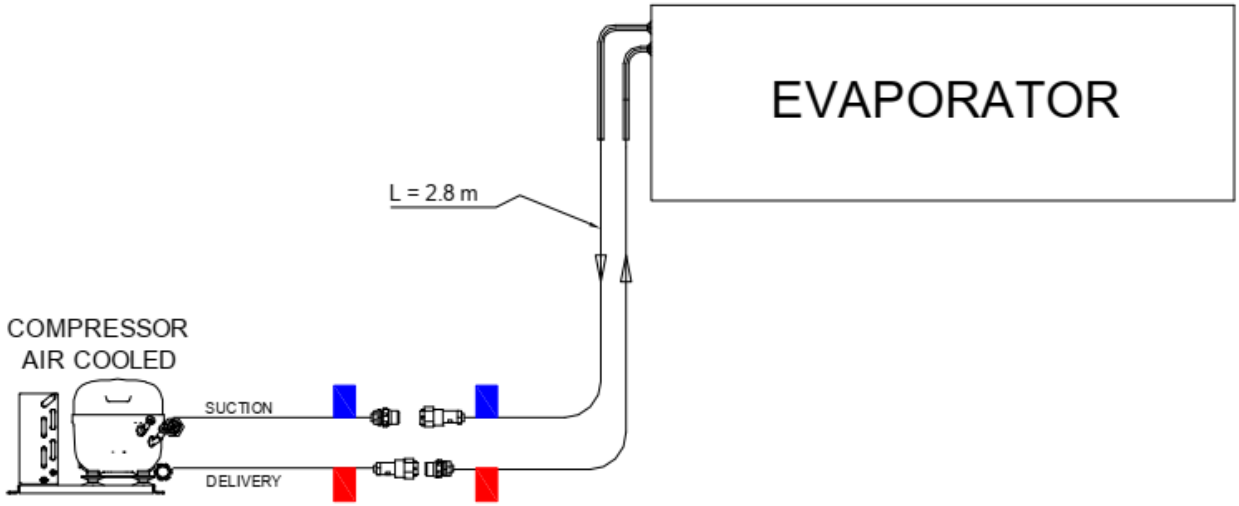
If there is a continuous hiss after the connection has been completed, quickly disconnect the fitting and check that the O-ring has not been damaged or unseated. If it has, carefully re-seat it or replace it with one of the spares provided that are taped to the compressor, and then re-make the fitting.

Take care not to bend or twist the two pipes during the above operation and always use two wrenches.

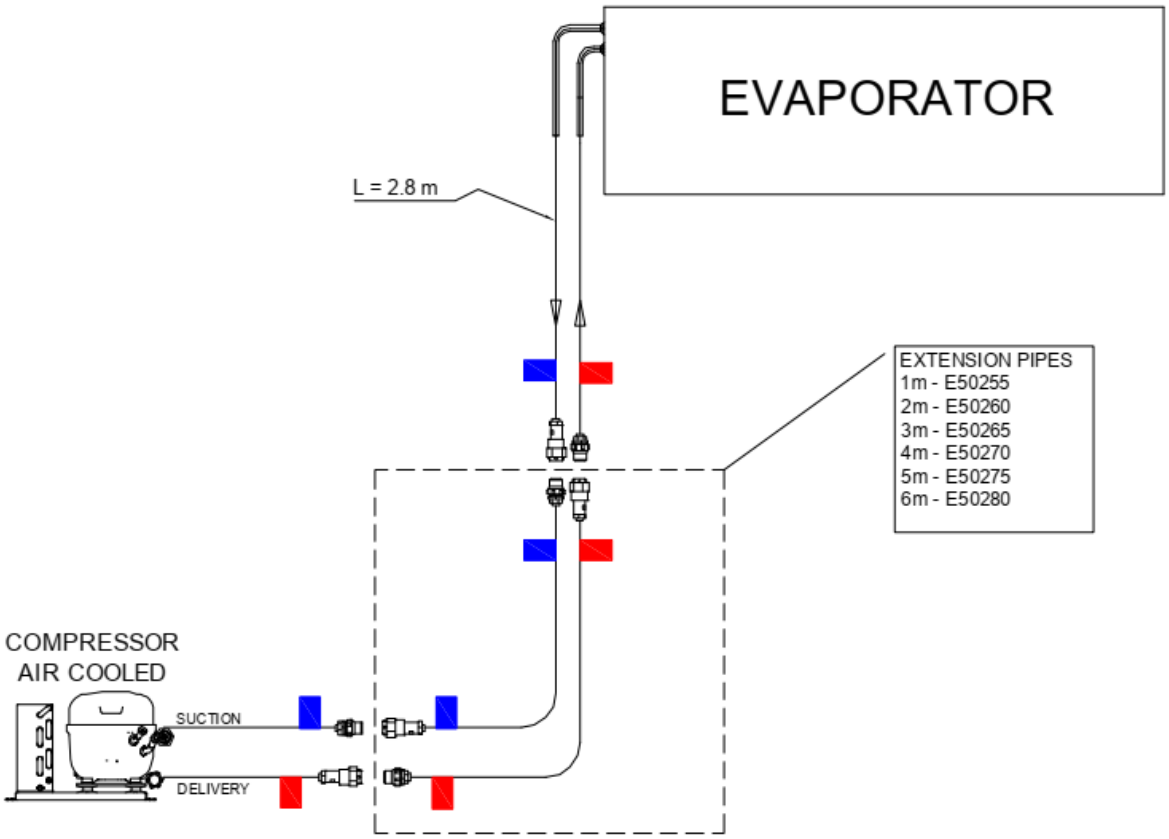
NOTE: The spare O-rings is provided as a convenience for use if any get damaged during system installation. They are NOT provided for use as routine replacements, and the original O-rings should never require replacement if the systems are installed and operated as designed.

Follow the schematics below to properly connect system components via self-sealing couplings.

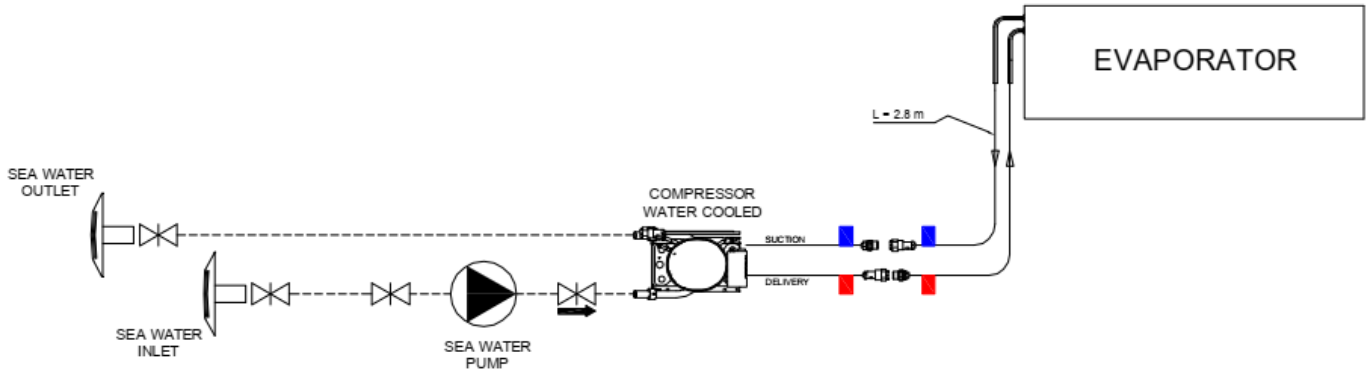
(A) STANDARD AIR COOLED SYSTEM:



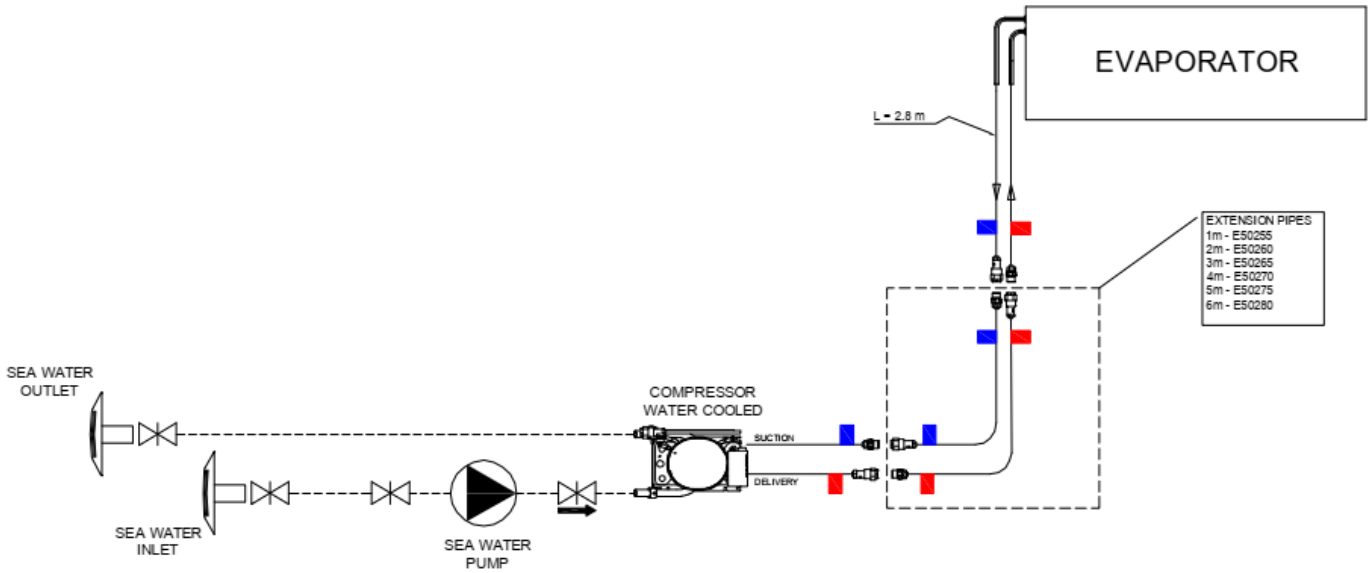
(B) AIR COOLED SYSTEM WITH EXTENSION PIPES:



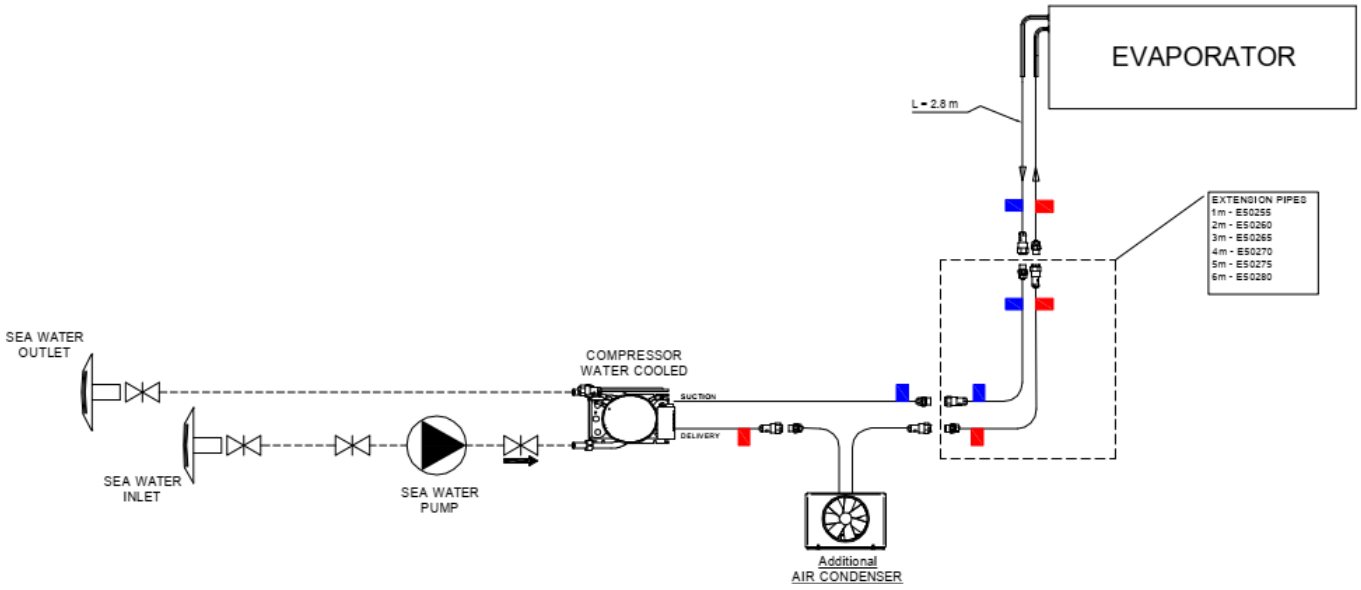
(C) STANDARD WATER COOLED SYSTEM:



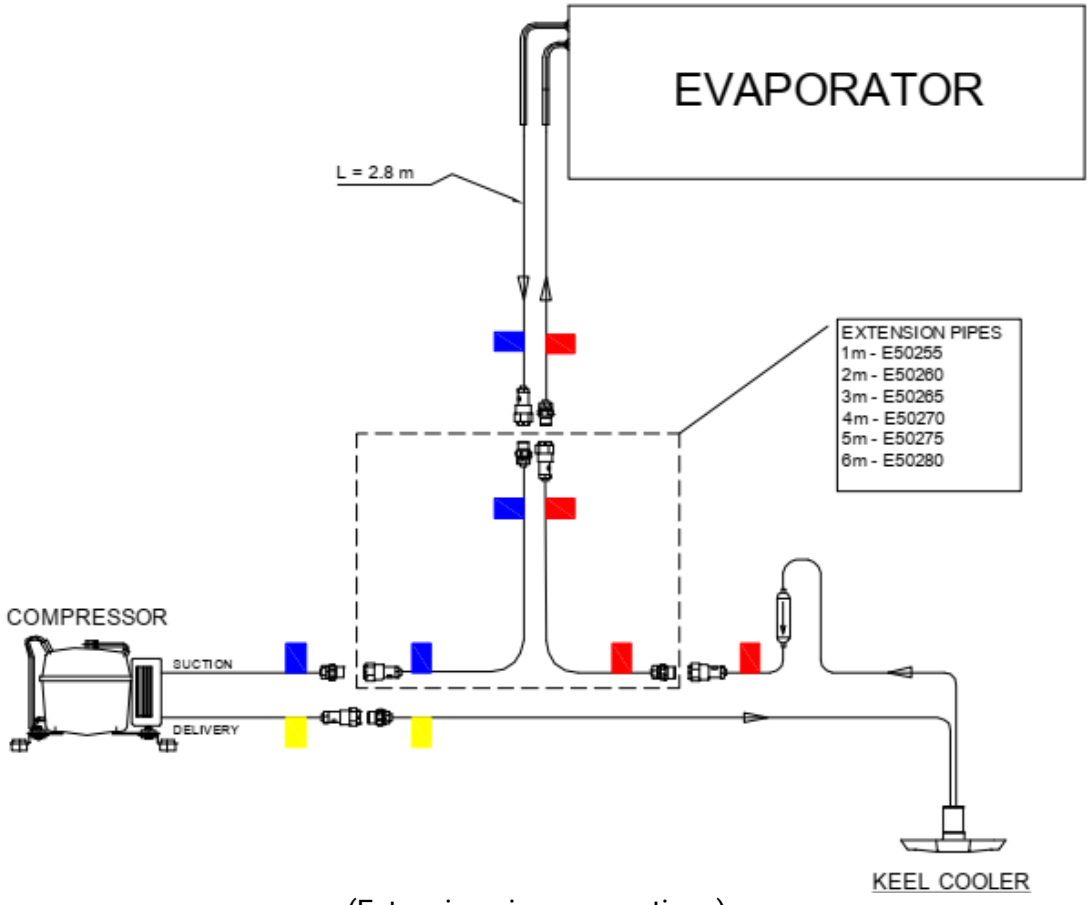
(D) WATER COOLED SYSTEM WITH EXTENSION PIPES:



(E) WATER COOLED SYSTEM WITH EXTENSION PIPES AND ADDITIONAL AIR-COOLED CONDENSER KIT:

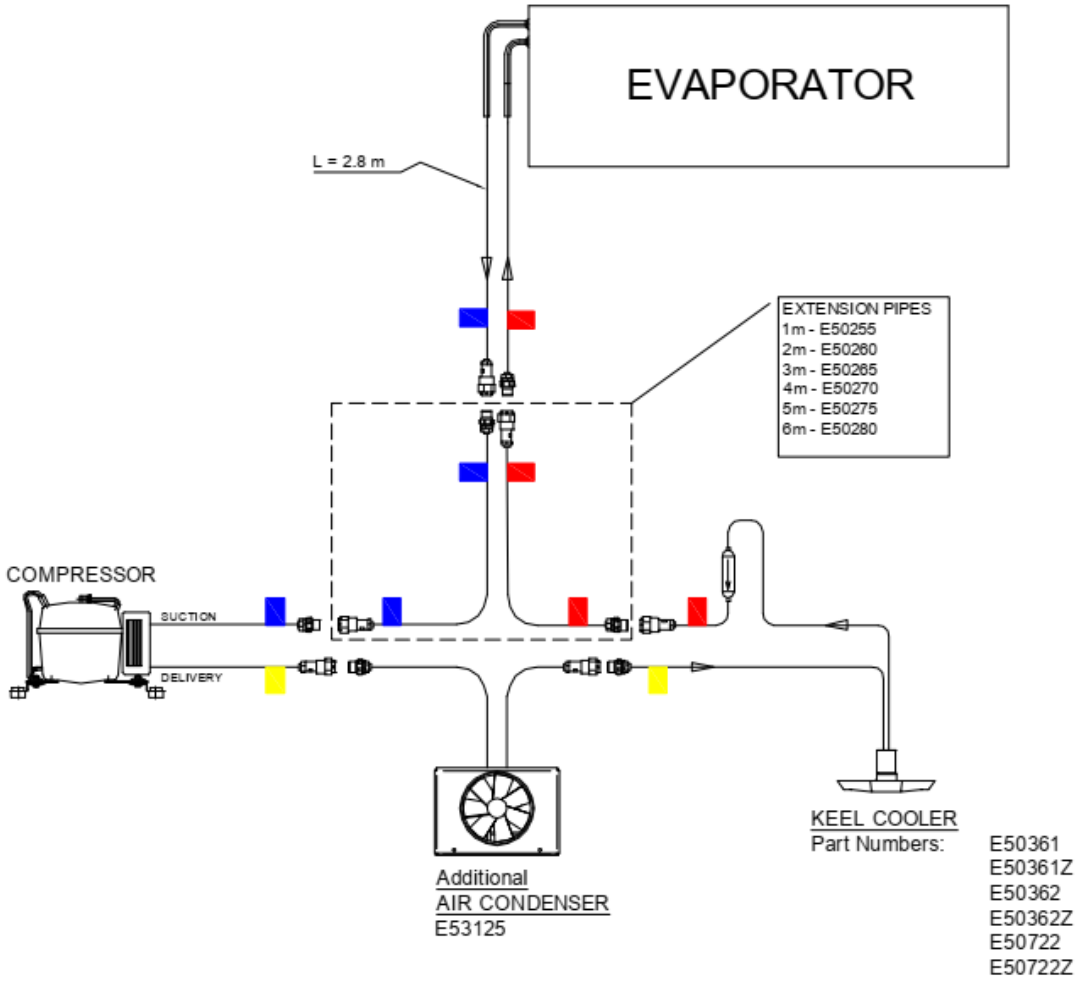


(F) KEEL COOLED SYSTEM WITH EXTENSION PIPES:

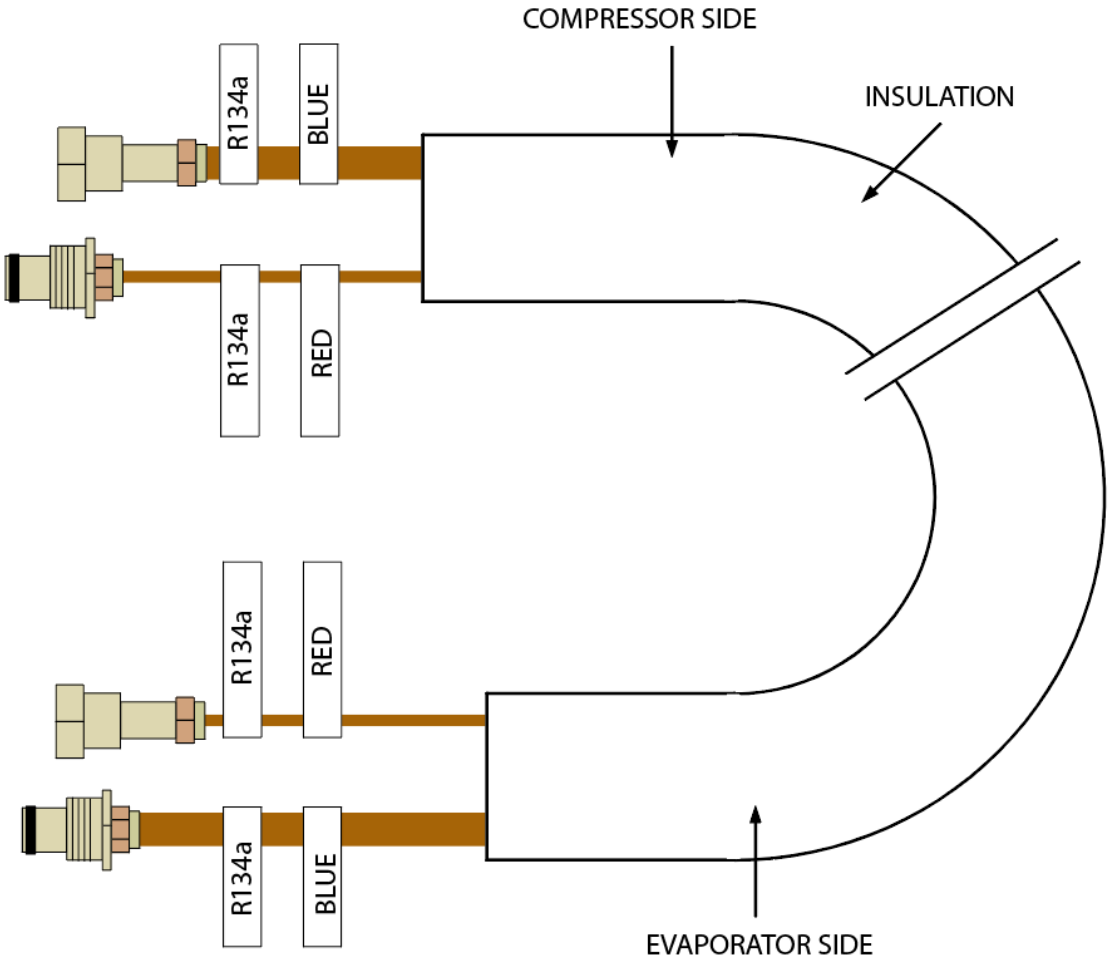


(Extension pipes are options)

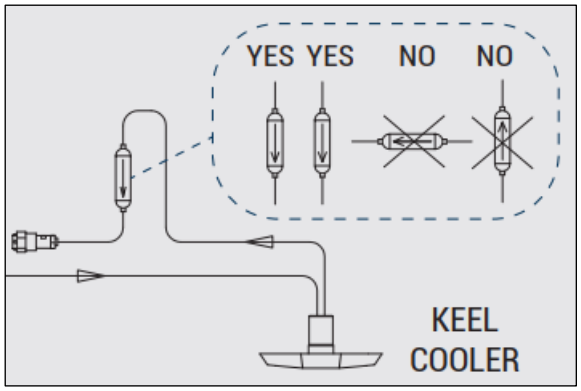
(G) KEEL COOLED SYSTEM WITH EXTENSION PIPES AND ADDITIONAL AIR-COOLED CONDENSER KIT:



(H) EXTENSION PIPE DETAILS:



WARNING: For keel cooled models, make sure the filter is installed vertically following the arrow as in the below image:



2.2. Grounding

Provision is provided for a grounding/bonding wire to be attached.

It is very important that the Keel Cooler is electrically connected to a point that is at the same potential as the boat's battery negative, with no switch in the circuit between the Keel Cooler connection and the battery negative.

If the Keel Cooler being installed is the type without zincs, it must be connected to the vessel's bonding system and also to a sacrificial zinc anode. This is an important safety precaution and does not alter the fact that a connection must be made between the Keel Cooler and a point that is at the same potential as the boat's battery negative, whether the Keel Cooler has zincs or not.

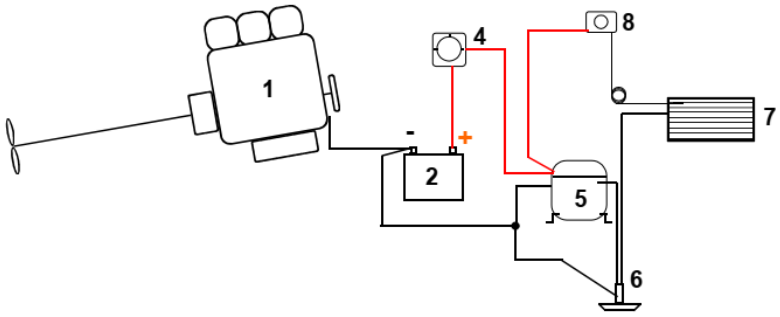
Bonding wire should respect local regulations.

If the installer is in any doubt as to how to make the grounding/bonding connections, a marine electrical technician should be consulted.

The connections must be checked with a multi-meter after installation to ensure that Keel Cooler and the battery negative post are at the same potential.

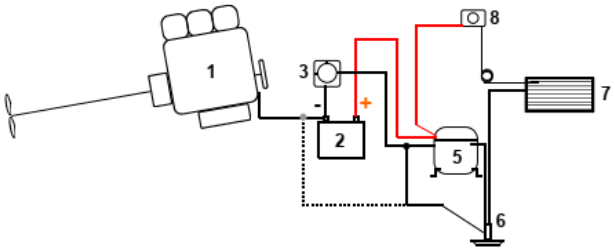
Never disconnect negative pole of the battery from the appliance and the keel cooler; in case when the boat is not used, if you want disconnect the battery, only disconnect the positive pole.

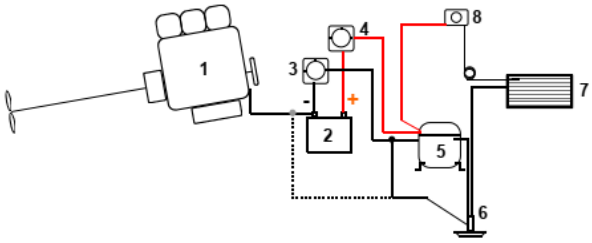
CORRECT INSTALLATION:



Ref	Description
1	Engine
2	Battery
4	Positive Battery Switch
5	Frigomatic Compressor
6	Keel Cooler
7	Evaporator
8	Thermostat

WRONG INSTALLATIONS:





2.3. Electrical connections

WARNING:

- The use of electrical grease and other anti-corrosion products is strongly discouraged. Do not attempt to make wiring connections or alterations with power supplied to system.
- Always disconnect the power supply by removing the fuse or turning off the breaker before working on electrical components and/or connections.

The unit must be installed on a dedicated circuit with a rated thermal-magnetic circuit breaker. The circuit breaker and electric cables (power supply) must be rated for the unit and comply with all local and national codes.

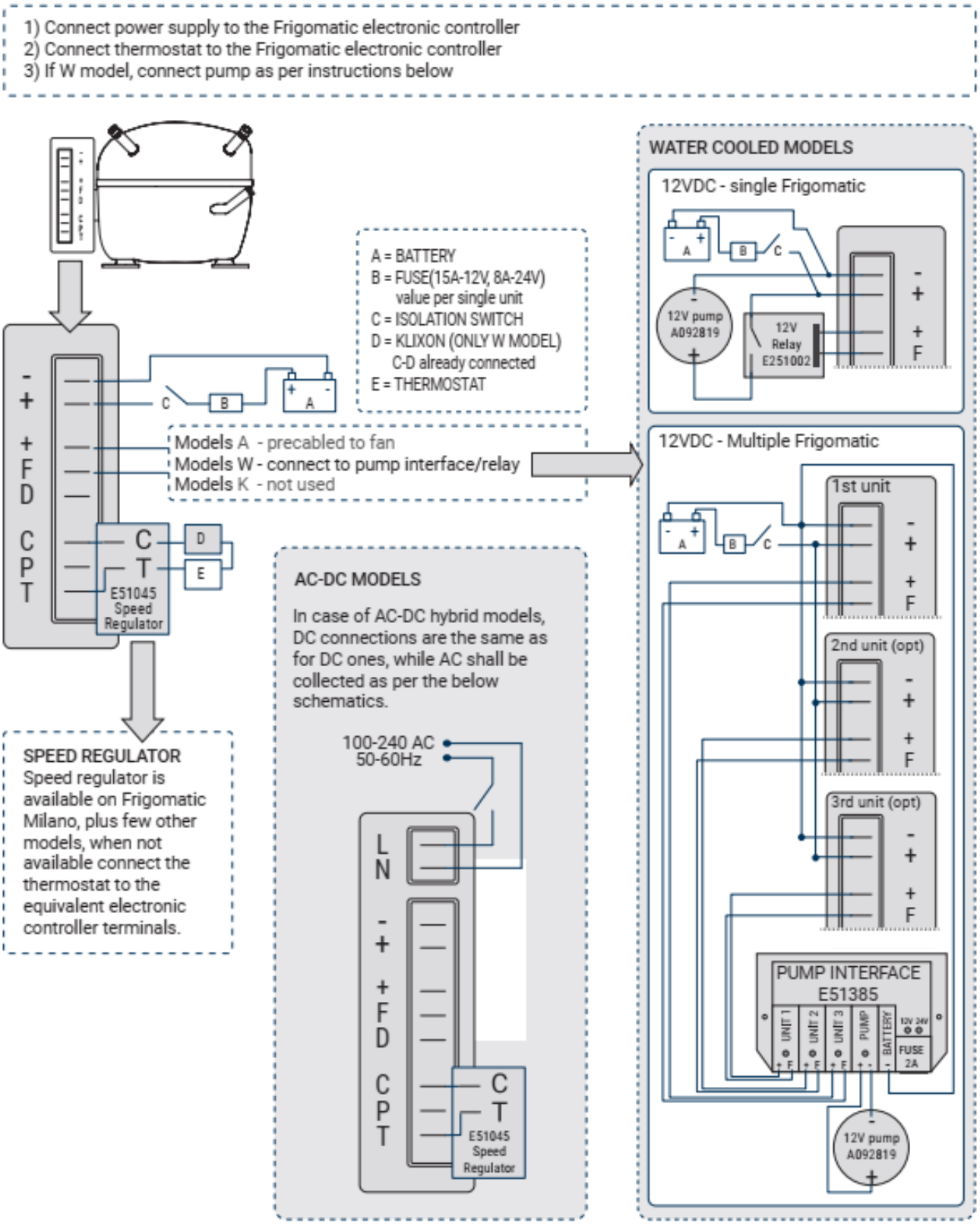
The manufacturer will not be held responsible for damage or injuries due to improper installation.

Incorrect installation will void the Manufacturer's warranty.

Please follow the below table or cable size, and check local regulations in case of longer cables.

Sezione Size		Max distanza – Max distance			
		12 V		24 V	
mm^2	Awg	m.	ft.	m.	ft.
2.5	14	2.5	8.5	5	16.4
4	12	4	13	8	26.2
6	10	6	19.6	12	39.4
10	8	10	33	20	65.6

Please follow below electric schematics for electrical connections.



2.4. Merlin smart speed controller E52152 (optional)

Merlin is a printed circuit board, designed to be mounted on to the C, T, and D terminals of the standard compressor controller.

Two power wires are supplied with “piggy-back” terminals to facilitate connection with the existing power feed wires on the + and - terminals of the controller.
Thermostat wires connect to the C and T terminals on Merlin. A green LED is also provided to show compressor speed and thermostat status; a red LED shows alarm codes.

Merlin is designed to mount directly on to the compressor controller, but may be mounted remotely if desired using connecting wires (not supplied).

If there is a Speed Board already installed on a Frigoboat compressor unit, this must be removed before the Merlin is installed. If the Merlin II is to be mounted remotely, care must be taken to ensure that the location chosen will not subject the panel or its components to splashing or running water, steam, corrosive gasses, excessive vibration, or physical damage.

When installed as designed, Merlin II simply plugs directly on to the C, T, and D terminals of the controller using the female connectors on the rear (component) side of the board. Care must be taken to ensure that no components are damaged during handling, that the connectors are properly mated, female over male, and that connection is correctly made to the terminals. Push on the center of the board to install. Do not push on the edges, sides or top and bottom of the board, or damage my result.

Two wires from the system’s thermostat plug on to the C and T terminals provided on the front of Merlin, and color and/or polarity is not an issue.

A 12VDC diode negative lead can be connected to the D terminal for remote alarm indication.

Merlin cannot be installed on the Danfoss/Secop 101N0500 AC/DC controller, and will need to be connected remotely.

Merlin automatic operation

Merlin controls compressor speed; protects electronics from overload at start-up using a warm-start ramp-up routine, and it selects the slowest possible compressor speed, from the six available, for maximum system efficiency, but it also ensures that maximum speed is utilized when required. Merlin also gives visual indication of thermostat status, compressor speed, and compressor fault alarms.

To avoid dangerous and potentially damaging high current draw when the system is first powered up in high ambient conditions, Merlin will start the compressor in medium speed and ramp up one speed every 5 minutes until maximum speed is engaged after 15 minutes. This is the warm-start ramp-up routine.

The green LED labeled “Speed” indicates the speed at which the compressor is operating by flashing in groups of 1 through 6 corresponding to the speed. A steady glow will indicate that the thermostat contacts are open, and that the compressor is idle.

If warm goods are loaded into the box, or a door/lid is not closed properly, Merlin II will, after a suitable delay, increase compressor speed to ensure maximum cooling. The speed will be reduced again after the issue is resolved.

The red LED marked “Alarm” is for compressor fault diagnostics, and will flash a code for one of five compressor alarms: 1-Low Voltage; 2-Fan/Pump Fault; 3-Compressor Non-Start; 4-Compressor Minimum Speed Alert; and 5-Electronics Overload.

2.5. Installation checks

The following checks MUST be made during the initial field start-up:

- Check all refrigeration connections

- Check all the wire connections
- Check electrical input

Note: If the condensing unit were not transported in an upright position, or has been overturned during the installation process, allow them to stand, in an upright position, at least 4 hours before starting the unit.

3. Operating instructions

The unit can be controlled by the Frigoboat mechanical thermostat.

Example of external electrical box.

The thermostat knob is marked from 0 to 7 with 7 being the coldest setting. From this position the knob can be rotated counter-clockwise to setting 1, which is the warmest. On initial system start-up, it is recommended that you set the thermostat to number 4, letting the system run through a few cycles while monitoring box temperature before any adjustments are made. Once the right setting is found for your application there should be no need for the thermostat to be adjusted again. If it is not possible to see the numbers on the dial, it is recommended to reproduce them on the perimeter.

Setting the knob to the 0 position will turn the system off.

It is recommended that the system not be turned off and on from the thermostat. To turn the system off and on, use a panel-mounted breaker or install a switch in line with the power supply.

3.1. Spill-over thermostat option

The temperature dial of the Spillover Thermostat must be set to the desired temperature in the refrigerator compartment.

This may take some trial and error before the ideal temperature is achieved. A period of at least one day is suggested between changes in settings. The temperature dial is in degrees Celsius and the setting is read against an indent in the plastic housing at the six o-clock position, above the Frigoboat sticker.

A setting of +5 is suggested initially and then adjusted accordingly as desired.

3.2. Compressor speed regulation (E51045)

The compressor speed regulator is installed in most of the Frigoboat condensing units, and it is used to vary the compressor speed from 2000 RPM to 3500 RPM, therefore regulating compressor power.

NOTE: With no compressor speed control installed, the compressor will run at the slowest speed and with the lowest capacity.

Compressor speed regulator E51045.

4. Maintenance and cleaning

Frigoboat systems require some basic maintenance that has to be done frequently and some extended maintenance to be done at longer intervals.

4.1. Defrosting

Defrost system by interrupting power supply at the breaker panel.

Restore power when evaporator is free of frost.

Never use any hard or sharp implement in an attempt to loosen the frost on the aluminum evaporator.

Check that all drains are blocked and there are no other openings or gaps that will allow air to enter or leak from the box.

4.2. Condenser cleaning (for Air cooled units only)

Clean the air condenser at least once a year. A condenser clogged with dust means waste of power.

(Please make sure not to bend the condenser fins)

4.3. Sea water pump filter cleaning (for water cooled units only)

Inspect and clean the sea water filter periodically.

4.4. Winterization (for water cooled units only)

When winterizing water cooled units, rinse the sea water circuit with fresh water before draining it out.

4.5. What not to do

- Load warm food into the fridge.
  Scrape the ice in the evaporator using a metal scraper. knife or similar
- Put food directly in contact with the evaporator
- Clean the fridge with solvents or other aggressive chemicals

5. Warnings, alarms and troubleshooting

5.1. Electronic controller troubleshooting

A 12v LED may be installed across the "+" and "D" (or “D/I”) terminals of the electronic compressor controller to indicate a failure condition.

Under a fault condition, the compressor will be stopped and an attempted restart will be made approximately every 45 -90 seconds.

Under this condition, when LED is connected, the LED will blink between 1 and five times every 5 seconds, as follows:

- 1 Blink: Supply voltage low, below 10.4v on a 12v system, 22.8v on a 24v system
- 2 Blinks: Excessive load on fan terminals, above 0.7 amps
- 3 Blinks: Compressor non-start (Common occurrence, and normal when compressor stopped and started again too quickly)
- 4 Blinks: Compressor speed below 1900 RPM
- 5 Blinks: Controller electronics temp too high. Re-sets on cool-down

NOTE

After power is applied to the controller there may be a delay of up to 30 seconds before the compressor starts.

If initial power is applied that is above the low-voltage threshold but below the cut-in voltage value, the compressor will not start and there will be no fault indication on the LED. System will start when voltage is increased above the cut-in value.

The electronic controller, although designed for harsh and marine applications, can be damaged by either direct or incidental contact with water and by water flowing down wires attached to the terminals. When attaching wires to the terminals on the controller, make sure that all wires approach from below the terminal, and endeavor to mount the compressor and controller combination in a location that is clear of existing and potential water leaks.

The electronic controller is secured to the compressor by a single screw and a push-on three-pin plug. The hole in the controller housing is larger than the screw head, and it is permissible to lever the casing over the screw for easier removal if access is limited.

5.2. System troubleshooting

NOTES

- Do not inject anything but unadulterated pure refrigerant R134a into any Frigoboat system. The addition of even a small amount of leak detecting fluid, leak sealer, extra refrigerant oil, flushing fluid, glycol, or other substances may cause irreversible damage.
- Always disconnect power supply by turning off the breaker or removing the fuse before working on electrical components or connections.
- Never operate a Keel Cooled or pumped-water cooled compressor when the boat is out of the water without having rigged temporary water cooling or installing an Air Add-On air cooled condenser. Failure to do so may cause irreversible damage.
- Voltage must be checked at the power terminals on the controller, with the supply wires attached.
- Always apply a suitable load when testing the output of electronic components such as a Voltage Divider, as open-terminal conditions will vary greatly from the designed output.
- Start-up may occur up to one minute after power is supplied and thermostat is on. This will also occur after a fault condition has been cleared.

- Run all applicable tests before assuming controller or compressor to be faulty. Controller can be removed by unscrewing the retaining screw or by levering the plastic case over the screw head.

(A) Compressor does not start

	Probable cause	Action
1	Power supply not available	Check that the power supply is correctly connected to the unit and that the circuit breaker is on.
2	Supply voltage too low	Check voltage with a multi-meter at the terminals on the controller. This must be 11.7v or more for a 12v supply, (24.2v at 24v) for compressor to start. Inspect power supply, ground connections and components for integrity. Check wire sizing. Charge batteries, if necessary.
3	Supply voltage too high	If a 12v supply is faulty and delivers over 17v, the compressor will not run. If it is over 24v, it will assume that it is a 24v supply and act accordingly.
4	Polarity incorrect	Check that the polarity is correct at the controller.
5	Faulty thermostat	Remove the thermostat wires and bridge the “C” and “T” terminals. If the system then runs, make the connection permanent and control the system manually from the breaker on your supply panel. Replace thermostat as soon as possible
6	Thermostat wired incorrectly, or faulty connections	Refer to the installation instructions to confirm that connections are as they should be. Ensure that the thermostat connectors are pushed firmly on to the terminals on the Controller. Pull wires to confirm integrity.
7	Speed board or Merlin II incorrectly installed	Check to make sure that the connectors at the rear of the Speed Board or Merlin are mated correctly to the C, P, T and D (or D/I) terminals of the controller.
8	Faulty Speed Board or Merlin II (if fitted)	Remove board and jumper terminals C and T on the controller. Note: When thermostat wires are connected directly to C and T on the controller, the compressor will run only at its slowest speed. Speed Board must not be installed with Merlin II
9	Compressor plug not connected	Disconnect the controller by removing the retaining screw. Then ensure that the 3-pin plug is seated firmly on the pins of the compressor.
10	Faulty compressor (Highly unlikely)	Remove the controller as above, unplug from the compressor. Check that ohm readings are the same across all terminals of the compressor and there is no continuity to ground. Do not attempt to connect power directly to compressor.
11	Heat sink overheated	Allow components to cool down before attempting re-start.
12	Compressor too cold	If compressor is below freezing temperature, allow to warm up before attempting re-start.

(B) Compressor attempts to start, or starts then stops soon after

	Probable cause	Action
1	Faulty or inadequate power supply (Most likely)	Monitor the supply voltage at the power terminals on the controller before, during, and after start attempts to ensure that it does not fall below threshold levels. If it does, check power supply, ground connections, and components for integrity. Check for correct wire sizing. Charge batteries, if necessary.
2	Faulty fan or pump relay or unauthorized component installed	Remove connectors from F and + terminals on controller and attempt re-start. Maximum current draw on these terminals is limited to 0.7 amps at 12v.
3	Quick Connect fittings not made	Check that all refrigerant couplings are properly made

(C) System runs, box temperature too high

	Probable cause	Action
1	Thermostat setting	Rotate mechanical thermostat knob clockwise to a higher number, or adjust the digital thermostat to a lower temperature.
2	Speed setting	Check that the speed setting is the one recommended for the installed evaporator and for its intended use, i.e. refrigerator or freezer. If needed, adjust the speed setting.
3	Thermostat type	Check that you are using a refrigerator thermostat (white housing) for a refrigerator application, and a freezer thermostat (blue housing) for a freezer application.
4	Evaporator type and size	If the evaporator has an even coating of frost, thermostat set on 7, and system is not cycling, evaporator may be too small. Either replace evaporator with a larger model, add insulation to the bottom of the box to reduce volume, or re-locate evaporator lower in box. The latter may cause the temperature at top of the box to be above acceptable levels.
5	Excessive frost build-up	If an excessive layer of frost is allowed to build up on the evaporator it will act as an insulator and adversely affect box temperatures. Defrost system by interrupting power supply at the breaker panel. Restore power when evaporator is free of frost. Never use any hard or sharp implement in an attempt to loosen the frost on the aluminum evaporator. Check that all drains are blocked and there are no other openings or gaps that will allow air to enter or leak from the box.
6	Incorrect refrigerant charge	If, after the compressor has been running for an appreciable length of time, the evaporator surface does not have an even coating of frost or it is only cold and sweating to the touch in some areas and frosting in others, the system may be low on refrigerant or overcharged. Get in contact with a Veco service center to check the system.
7	Drain left unplugged	If your icebox is equipped with a drain in the bottom of the box, this must be blocked off to prevent loss of cold air. The drain should only be used if you revert to melting ice, or after a major clean-up.
8	Tubing hole left unplugged	The hole that was drilled to allow the evaporator's copper tubes to pass through the box's side during installation must be sealed, as well as all other openings or gaps.

(D) System runs, box temperature too low

	Probable cause	Action
1	Thermostat setting	Rotate mechanical thermostat knob counter clockwise to a lower number, or adjust the digital thermostat to a higher temperature.
2	Thermostat type	Check that you are using a refrigerator thermostat (white housing) for a refrigerator application, and a freezer thermostat (blue housing) for a freezer application.
3	Faulty thermostat	If system is running continuously and box temperatures are too low with thermostat set on the lowest number, first check for correct thermostat connections at the controller, then remove one connection. If compressor stops, turn off breaker, replace connection, and then control system manually from the breaker until the thermostat can be replaced.
4	Sensor of Mechanical Thermostat not in good thermal contact with evaporator at designed location	The free end of the Mechanical Thermostat sensor must be in good thermal contact with the evaporator at the point where the black plastic clamp is situated. Not attaching the sensor, or attaching at somewhere other than the designed location will result in undesirable box temperatures.

5	Poor spillover system construction	If you are running the evaporator as a freezer and cooling an adjoining refrigerator compartment with spillover air, there must be an adequate thermal barrier between the two. It also must be completely sealed down the sides and along the bottom to prevent unwanted air-flow. Temperatures in the refrigerator side should be controlled either with trial-anderror convection holes, or a thermostatically controlled fan. Two apertures are necessary, one high and one mid-height for adequate air circulation.

(E) Excessive frost build-up

This is the result of moist air being allowed to enter the box. Problems are compounded when cold, dense air leaks from the lower area of the box through an open drain or weak door seal and is replaced by warm, humid air being drawn in elsewhere.

	Probable cause	**Action**
1	Drains and holes not plugged	Make sure all drains and holes in the floor and walls of the box are sealed.
2	Circulating fan	If a small fan is used to circulate air in the box, make sure that it is not too powerful, and that cold air is not escaping from a door/lid seal. This could force cold air out of the refrigerator box, and the freezer then has to draw air in from a weak seal to replace it.
3	Poor or damaged door/lid seals	Check seals and replace if necessary. A good seal will grip a piace of paper when inserted between the seal and door/lid when closed. A front opening door/top opening lid combination with poor seals is likely to result in excessive frost build-up on the evaporator and cause extended run times.

(F) Pump does not start

	Probable cause	**Action**
1	Pump power supply	Check the power to the pump (check the connection from the electrical control box to the pump). Note: pumps are working only when the compressor is running
2	Excessive power consumption of the E51385 (pump interface)	When a Pump Interface E51385 is installed to handle multiple Frigomatic, or a 24V power suppy, if the light is blinking it means that inner overload protection had cut of, due to excessive pump power consumption. Please check the pump.