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Thank you for purchasing C&R Racing's

PORTABLE ENGINE HEATER

61-00004

This guide is provided to make sure you have all the information needed to operate this unit correctly.

Please read all information carefully before using.

Failure to follow these instructions will VOID any and all warranty included with the heater.

Please contact us if you have any questions regarding the use of this product.

!! WARNING !!

This engine heater is equipped with a programmable timer that allows for remote start. Since the unit is self-contained, the potential exists for an unintentional start. The result of which could be property damage or injury. This can only happen if the unit is programmed improperly.

The following precautions must be followed in order to prevent this situation from happening.

1. Be aware of this potential situation. Read the included manual and understand all of the settings prior to use. DO NOT let unqualified users operate the heater.
2. **ALWAYS** keep the "Accessory" toggle switch in the "Off" position when not in use. This breaks the electrical connection to the heater. The heater cannot start if this switch is "Off".
3. **ALWAYS** install the exhaust "cap" when not in use. This will prevent the unit from carrying out the ignition process - no matter what the circumstances.
4. **ALWAYS** keep the preheat time set to the minimum of 10 minutes when not utilizing the remote start option.
5. **ALWAYS** be aware of the exhaust orientation. The exhaust emitted from the unit is extremely HOT. When utilizing the remote start option, special care MUST be taken to ensure safety and prevent property damage.

OTHER IMPORTANT RECOMMENDATIONS

Listed below are recommendations that will help to maximize heater life and keep the heater operating at its full potential. ***Failure to follow these recommendations will VOID any and all warranty included with the heater.***

ALWAYS drain the water from the unit if there is a chance the heater may see freezing temperatures during storage or transport. Observe the following steps to remove ALL water from the heater:

- Remove the water drain cap from the fitting under the unit.
- Loosen the radiator cap and crack the line fittings.
- Allow some water to drain, then remove the radiator cap and lines.
- Apply light air pressure to the "out" fitting. (Use caution as the air pressure will force water out of the open fittings.)
- Continue to apply air pressure to the fitting until minimal water is exiting the unit from all openings.
- Close the bleeder & install the drain cap, radiator cap, and lines.

The following steps should be applied for extended storage periods (1 month+):

- Drain fuel and water (follow above steps to drain water).
- Ensure battery has full charge (Charge minimum of 2.5 hours)
- Remove fuse and ensure charger switch is in the off position (Espar fuse is located in the main switch panel)
- If fuse remains installed, the unit must be charged on a bi-weekly basis to keep battery full charged and maintain battery life.

Ensure that the charger toggle switch is in the "OFF" position when the unit is not being charged:

- Charger switch must be "On" when charging the unit.
- LED lights are visible through sight glass when switch is "On"

BATTERY/CHARGER INFORMATION

This heater is equipped with a 12V Braille Battery and 10 amp Braille AGM Charger. Listed below are the general specs and information regarding the battery & charging system.

A small parasitic load exists within the Espar Heater, and applies a small Amp draw on the battery, even when the heater is not in use. Extended periods of storage will damage the battery if precautions are not taken.

CHARGE THE HEATER ON A BI-WEEKLY BASIS (Minimum of 2 hours) TO OPTIMIZE AND MAINTAIN BATTERY LIFE!

Braille Battery:

- Part #B2015 (21.0 amp-hr, AGM battery)
- USDOT classified as non-spillable, allowing for express shipping via air
- Maintain battery life by keeping the battery at full charge whenever possible by keeping the heater plugged in whenever its not in use.
- Heater will operate for approximately 3.5 hours on a complete charge.

Braille AGM Charger:

- Part #12310-10 (10 amp charger)
- Fully electronic & fully automatic 110V & 220V compatible
- Reduce sulphation during charging cycle, prolonging battery life
- Electronically measures battery voltage and shuts off when voltage reading indicates the batteries fully charged, and then switches to "true float mode" and maintains the fully charged battery
- When LED2 is red, the battery is charging
- When LED2 is green, the battery is fully charged
- CHG SWITCH OFF/PLUGGED IN - red and green light will appear
- CHG SWITCH ON/UNPLUGGED - one red light will appear
- CHG SWITCH ON/PLUGGED IN - red and green (or red) light will appear (Green - battery full charged/Red - battery is charging)

The battery charger applies a parasitic amp draw to the battery when not in use. To prevent this amp draw and damage to the battery, keep the charger toggle switch in the "OFF" position when the unit is not being charged. This will prevent damage to the battery and maintain battery life - switch must be "ON" when charging the battery.

GENERAL INFORMATION

Electrical:

- Self-contained 12V battery with "Smart" charger
- 110V plug to charge battery and/or operate unit (2.5 hours for complete charge)
- Unit will operation for approximately 4.0 hours on a complete charge (AF:11 = Low Battery)

This unit comes with an adapter that converts the 110v plug to a 220v plug.

Fuel:

- Operates on diesel fuel or kerosene ONLY! Always strain fuel to keep dirt out of system.
- Fuel consumption: 0.16 gal/hr (high) or 0.08 gal/hr (low)
- Tank capacity: .3 gal
- **NEVER** fill the heater or the race car with fuel while the heater is running!

Coolant:

- Recommended mix of water and NEO "Keep Cool" conditioner (minimizes heater corrosion)
- Water tank capacity: 1.0 gal
- Always keep the heater completely full of water to eliminate any air added to the engine system. (It is recommended that you check all fluid levels each time prior to using the unit).
- Always drain water if the unit will see freezing temperatures during storage. See instructions on page 2.

Exhaust:

- Exhaust exiting the unit at the exhaust pipe is extremely hot!
- Always be sure that the heater unit is oriented with the exhaust point to "open air" (this step is extremely important when utilizing the 7-day timer).
- Do not sit the heater on top of anything that may contact the exhaust pipe underneath the unit! (i.e., grass, a tire, plastic of any kind ...)

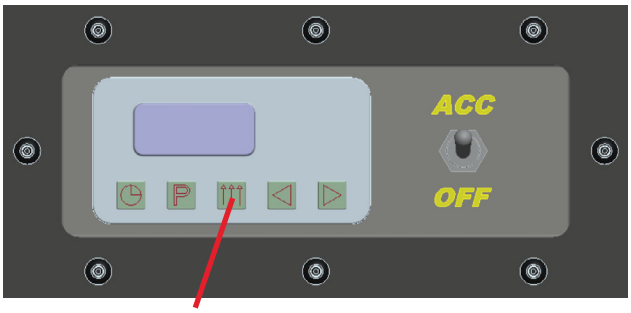
CONNECTING TO THE RACECAR

Prior to connecting to the race car, it is recommended that you fill the heater completely. This can be accomplished by plugging the hoses together and turning the heater on. Top the heater off by filling the water tank at the radiator cap. Keeping the heater full of water will eliminate any change in the water level of the race car. In certain applications, the water level of the cooling system (race car) can be checked once the heater is hooked up to the car. The fill on the car must be at the absolute highest point of the system for this situation to be applicable.

- Attach the "OUT" line of the heater to the "FLAPPER SIDE" of the checkvalve.
  - Water entering the cooling system from the heater will push against the flapper, thus pushing it shut.
- Attach the "IN" line of the heater to the checkvalve port opposite of the "FLAPPER"
- Flip the Accessory Toggle Switch to the "ON" (ACC) position.
- Press the Heater Button (center button on the timer). The heater will begin its startup cycle.
  - Control unit does a systems check (flame sensor, temp sensor, safety thermal sensor, etc.)
  - Water pump starts circulating fluid
  - Combustion air blower comes on
  - Glow pin begins to preheat (20-50 seconds)
  - NOTE: There will be a "puff" of smoke out the exhaust ... this is normal.
  - Metering pump starts and combustion air blower speeds up gradually
  - Once ignition takes place, the flame sensor alerts the control unit, which shuts off the glow pin

Total Startup Time - 1.5 –2 minutes

- Allow the heater to operate until your desired pre-heating temperature is reached. Check the system temperature by observing the water temp gauge inside the car.
  - NOTE: Once turned on, the heater will run continuously until the desired start-up temperature for the race car is achieved.
  - The heater will switch to "low heat" mode once the internal temp reaches 200°F. It will switch between "low heat" and "high heat" mode to maintain a temperature between 175°F-189°F. If the internal temp exceeds 185°F, the heater will shut off, but continue to circulate water. It will restart once the internal temp drops below 175°F.



"ON/OFF" BUTTON (illustrated with lines to represent heat waves - center button)

The "Accessory" toggle switch allows for continuous operation of the heater. Upon purchasing from C&R, the preheat time is set to 10 minutes as a safety feature for unintended startups. When utilizing the remote timer option, you must set the preheat time to your desired setting. See "ADJUSTING THE PREHEAT TIME PERMANENTLY" in the Timer Section.

When the switch is in the "OFF" position, the heater will NOT function. In order to utilize the remote start op- tion, the toggle switch must be positioned in the "ACC" position. Follow the directions for using pre-set start times in the Timer Section.

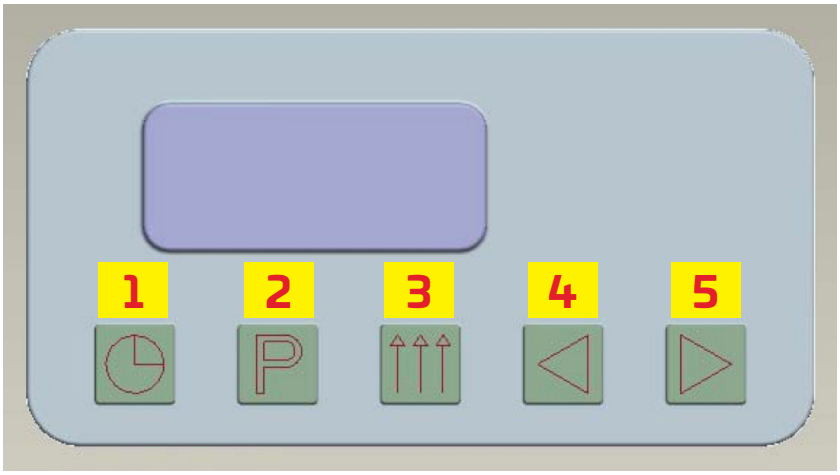
DISCONNECTING FROM THE RACECAR

- Push the "ON/OFF" Switch (the center button on the 7-day timer).
- Flip the Accessory Toggle Switch to the "OFF" position. The heater will begin its shutdown cycle.
  - The fuel pump stops delivery fuel and the flame is extinguished
  - The combustion air blower and water pump continue to run for 130 seconds to cool down
  - The heater shuts off
- Disconnect the heater from the car at the checkvalve (2 places).

NOTE: During shutdown, the heater continues to circulate water for approximately 2 minutes before it shuts off completely. If the heater is disconnected from the car within this 2 minute time period, it is recommended to hook the hoses together at the quick-connects to allow the water to keep circulating, preventing damage to the heater unit.

TIMER INFORMATION

The 7-Day Timer has been designed to provide a simple means to control the operation of the heater system and to include diagnostics capability. This timer connects to the diagnostic circuit of the heater. The timer then displays any heater fault codes in three-digit number form automaticlally. The timer allows for pre- selection of turn on time, up to 7 days in advance, as well as an option for run times up to 2 hours before automatically turning off. In addition, there is an on/off switch for manual operation. By default, the timer is pre-set to operate for two hours.



1. "CLOCK" button (used to set time of day, day of week, etc.)
2. "PREHEAT" button (used for setting pre-heat times, etc.)
3. "HEATER" or "ON/OFF" button (used to turn the heater ON and OFF in all modes)
4. "BACKWARD SCAN" button (used for navigating through control settings)
5. "FORWARD SCAN" button (used for navigating through control settings)

NOTE: When the accessory toggle switch is in the "ACC" (ON) position, the time of day and the day of the week will appear in the display. This will remain in the display as long as the switch is turned on.

TURNING ON THE ACCESSORY TOGGLE SWITCH DOES NOT START THE HEATER!!

SETTING TIME & WEEKDAY

Upon connection to power, the entire timer display will begin to flash. The heater will NOT function until the time is programmed. When the heater has been delivered by C&R Racing, the time of day and day of the week have already been set. This step will need to be completed if ever the battery becomes disconnected for one reason or another.

- Push the clock button once - 12:00 will begin to flash (this will occur upon initial hookup to power)
- Use the scan buttons to set the present time of day (24-hour clock)

When the time stops flashing, the time of day has been stored.
The weekday will now begin to flash.

- Use the scan buttons to set the present weekday.

When the weekday stops flashing the weekday has been stored.

When the "Accessory" toggle switch is in the "ACC" (or "ON") position, the time display will appear.
When the "Accessory" toggle switch is in the "OFF" position, the time display will go off after 15 seconds.

CHANGING THE TIME OR DAY

- Push and hold the clock button until the time display begins to flash
- Continue to set the time as listed in setting the time and weekday

ADJUSTING THE PREHEAT TIME PERMANENTLY

The maximum preheat time is 120 minutes.

- Press and hold the backward scan button for 3 seonds until the display lights up and flashes
- Release button
- Use the scan buttons to set the new fixed preheat time

When the display goes off the new preheat time is set.

TURNING HEATER "OFF" - ALL MODES

- Press the heater button once

The signal to the heater will be terminated. The heater will do a normal cool down and turn itself off.

SET PREHEAT TIMES INTO MEMORY

- Press the preheat button until the desired memory location is shown in the display (3 available)
- Use the scan buttons to set the desired preheat start time of day

When the time stops flashing, the time of day is set.

- Use the scan buttons to set the desired day of the week

When the day of the week stops flashing, the day of the week is set.

USING PRESET START TIMES

- Press the preheat button until the desired memory location appears in the display
- Flip the accessory toggle switch to the "ACC" (or "ON") position
- Remove the exhaust cap and ensure that the exhaust is exiting to open air.

Remove anything flammable from around the exhaust pipe (Allow minimum 6" of clearance)

The heater will start at the day and time displayed. The display will go off in 15 seconds. The memory location number will stay displayed (1,2, or 3). When a preset is chosen, the heater symbol will flash red. Once the heater starts, it will operate for the amount of time that has been permanently set as per the above instructions ... this time is set at 10 minutes upon purchase from C&R.

DIAGNOSTICS

This timer is equipped to display fault code numbers if the heater should shut down due to an operating fault. This fault code will show in the timer display next to the flashing heat wave symbol. Please see next page for fault codes and their corresponding descriptions.

A common fault code will be AF:11 for an "under voltage shutdown", which is caused by the battery not having enough charge. Common causes for overheating could be the unit being turned on without establishing a connection at the quick disconnects, lack of flow at the checkvalve, etc. Always check the fuel supply, battery charge, and water level when diagnosing a problem with your heater.

CONTROL UNIT LOCKING

The control unit may become locked due to one of the following conditions:

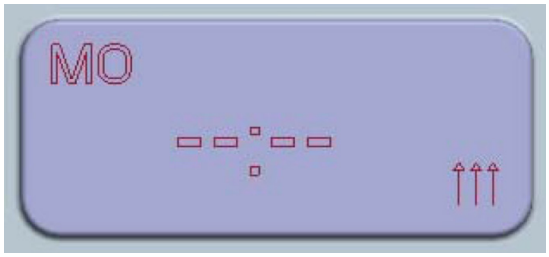
1. **OVERHEAT (F15)** - if the heater overheats 3 times in succession (i.e., fault 12/13, fault message F15 is displayed and the control unit is locked. (See page 11 for troubleshooting tips)
2. **TOO MANY FAILED START ATTEMPTS (F50)** - if the heater performs 10 start attempts in succession (i.e., Fault 52), fault message F50 is displayed and the control unit is locked. (See page 11)

UNLOCKING THE CONTROL UNIT & ERASING FAULT MEMORY

In the event that the control unit becomes locked due to the above conditions, you may unlock the unit by utilizing the 7-day timer along with the accessory toggle switch and following the following steps:

NOTE: Prior to following the steps of unlocking the control, the top of the unit must be removed, and the yellow wire must be disconnected from the "ACC" switch and joined together.

- Turn the accessory switch to the "ACC" (ON) postion to activate timer display
- Press the heater button - the current fault (i.e., F15 or F50) is now displayed
- Press the clock button and hold it down, pressing the preheat button within 2 seconds - the timer is now in retreival mode.
- Turn the accessory switch to the "OFF" position
- Press the clock button and hold it down and press the preheat button within 2 seconds and hold it down
- While holding down the clock & preheat buttons, turn the accessory switch to the "ON" position and wait until the following display appears (release all buttons once this display appears):



- Press the heater button to turn the heater off
- Press the heater button to turn the heater on
- Press the clock button and hold it down, pressing the preheat button within 2 seconds (the following display appears):

THE CONTROL UNIT LOCK IS CANCELLED AFTER 3 SECONDS AND THE HEATER STARTS

Fault Code	Fault Description	Causes/Repair
000	Normal Operation	
010	Overvoltage	Check voltage between terminals 1 (red) and 2 (brown) at connector (B1). This must be less than 16 volts. Check battery, electrical leads and vehicle charging system.
011	Under voltage shut down	Check voltage between terminals 1 (red) and 2 (brown) at connector (B1). This must be greater than 10.2 volts. Check battery, electrical leads and vehicle charging system.
012	Overheating	Check for possible causes of overheat (water circuit), Sensor. Check overheat switch resistance values. Temperature at temperature sensor or overheat sensor is greater than 125°C.
014	Possible overheating detected (difference evaluation)	Difference of measured values at temperature sensor >15°C (min. 70°C water temperature and metering pump in operation); Check temperature sensor and overheating sensor, replace if necessary. Check values from previous page.
015	Too many overheats	Remove cause of over heat. Reset control unit using 7 day timer or fault code retrieval device to unlock control unit. Permanent overheating counter reading exceeded. Heating enable only possible by means of diagnostics system (press both "LL" keys simultaneously).
017	Overheating detected	Temperature at temperature or overheating sensor >130°C, emergency OFF if Fault Code 012 or 014 not applicable; check water circuit, check temperature sensor and overheating sensor; replace if necessary. See graph on previous page.
020	Open circuit - glow pin	Check glow pin and electrical leads for continuity, replace if necessary.
021	Short circuit - glow pin	Check glow pin and electrical leads for continuity, replace if necessary.
030	Combustion air blower motor	Blower impeller or electric motor may be jammed (frozen solid, dirty, etc.) Fix jam, replace electric motor if necessary.
031	Combustion air blower motor	Check lead to combustion air motor for continuity, replace motor if necessary.
032	Combustion air blower motor short-circuit	Check combustion air blower motor (electric motor); replace if necessary. Check power supply (chafed, corroded, etc.)
038	Vehicle fan relay control break	Check electric lead to relay, fix break, replace relay if necessary. For wiring harness (P/N CA1 60 401) without relay, replace harness.
039	Vehicle fan relay control short circuit	Check electric lead to relay, fix break, replace relay if necessary. For wiring harness (P/N CA1 60 401) without relay, replace harness.
041	Water pump break	Check supply lead to water pump for continuity, remedy break, replace water pump if necessary.
042	Water pump short-circuit	Check supply lead to water pump for short circuit, check water pump, replace water pump if necessary.
047	Short circuit - fuel metering pump	Check wires for short to fuel metering pump. Test fuel metering pump. Replace if necessary.
048	Open circuit - fuel metering pump	Check supply lead to metering pump for continuity, remedy break, replace if necessary.
050	Too many no start attempts	Safety time counter reading exceeded. Reset control unit using 7 day timer or fault code retrieval device to unlock control unit.
051	Faulty flame recognition	At start, if flame sensor is above 70°C > 240 seconds; check exhaust gas and combustion air supply, check flame sensor, replace if necessary. For flame sensor values see graph on previous page.
052	No start safety time exceeded	No flame detected on start attempt. Check fuel delivery and fuel supply. Check exhaust gas and combustion air ducts.

Fault Code	Fault Description	Causes/Repair
053	Flame cutout in boost mode	Heater has started successfully the flame has extinguished. Check fuel supply. Check combustion air and exhaust flow. Check flame sensor resistance value. Replace flame sensor if necessary.
054	Flame cutout in high mode	Heater has started successfully the flame has extinguished. Check fuel supply. Check combustion air and exhaust flow.
056	Flame cutout in low mode	Check flame sensor resistance value.
060	Open circuit - temperature sensor	Temperature sensor detects a value beyond it's range. Check connections. Check sensor resistance values between 11 and 12 at connector B2 > 2 M W (if open circuit).
061	Short circuit - external temperature sensor	Check connections. Check sensor resistance values between 11 and 12 at connector B2 < 50 W (if short circuit). Temperature sensor values on previous pages.
064	Open circuit - flame sensor	Sensor is sensing value outside of range. Check connection leads. Resistance values between 13 and 14 at connector B2 > 3040 W (if open circuit).
065	Short circuit - flame sensor	Check connection leads. Resistance values between 13 and 14 at connector B2 > 780 W (if short circuit). Flame sensor values on page 17.
071	Open circuit - overheat sensor	Check connection leads. Resistance values between 9 and 10 at connector B2 > 2 M W (if open circuit).
072	Short circuit - overheat sensor	Check connection leads. Resistance values between 9 and 10 at connector B2 < 50 M W (if short circuit).
090 092 093	Control unit defect (internal fault) Control unit defective (ROM error) Control unit defective (RAM error)	Control unit malfunction due to interference voltage from vehicle electrical system; possible causes low batteries, charges, other sources of interference, eliminate interference voltages. Internal faults detected in microprocessor/memory detected. Replace control unit.
097	Control unit defective (power failure)	Internal failure. Replace control unit.

TROUBLESHOOTING

Listed below are a few of the more common Fault Codes and troubleshooting notes.

F11 - UNDER VOLTAGE SHUT DOWN

This code basically means that the battery is dead.

Portable Engine Heaters purchased before November, 2011

The original version utilized an 18 amp-hr Odyssey battery (#PC625) along with a 7amp Odyssey charger (#BCSC-7A). We saw issues with this setup if the unit sat for a long period of time (6 weeks+) without being charged. This was caused by a combination of the parasitic amp draw of the heater display and the charger. The amp draw from these items would cause the battery to go dead – when the battery sits in a "dead" state for a long period of time, it sulfates inside and will not take a charge.

We installed an externally removable fuse for the heater circuit that could be removed for periods of long term storage...that said, the problem still arose due to the amp draw from the charger.

These units were sold as either a 110v or 220v version - not universal. In addition, the older unit has only one switch on the battery.

The solution for this is to charge the unit on a bi-weekly basis (minimum) as noted in the instruction manual to prevent damage to the battery. Listed below are some notes on the F11 code for the earlier models:

- After charging the battery for a minimum of 2 hours, unhook the charger and check the voltage across the terminals. If this value is around 6-7 volts, the battery is defective and needs replaced.
- With the charger plugged in, check the voltage across the terminals to make sure that the charger is working properly. Though slowly, the voltage number should gradually be increasing. Replace the charger if it is defective.

Portable Engine Heaters purchased after November, 2011

Heater builds after November 2011 utilize a 21 amp/hr Braille battery (#B2015) along with a 10 amp billet aluminum Braille charger (#12310). At this point, a charger toggle switch was also added to the system. This allows for both the timer and the charger to be disconnected from the battery, thus preventing parasitic amp draw on the battery when the unit is not being used. In addition to the notes above, here are some notes for the later models:

- Check to see that the customer is turning the "charger" toggle switch to the "CHG" position when charging the battery.
- You can differentiate a "newer" unit from an "older" unit by looking for the "CHG" toggle switch (control panel has 2 switches). The older unit has only one switch.

F14 - POSSIBLE OVERHEATING DETECTED

This code is triggered by an excessive temperature split between the internal temperature sensor and the overheat sensor.

Internally, the Espar heater has temperature sensors that continually monitor the temperature in two different locations within the heater. In order to make the units achieve the desired pre-heat temps, a potentiometer/resistors had to be installed internally to these circuits to essentially "trick" the controls. Depending on the water fl ow restriction of the system, the difference between these two values can become too high (>15 deg C), and essentially trigger the F14 code. Listed below are some notes that correspond to this code:

- This code will repeatedly trip if the unit is pre-heated (unhooked from the car/lines hooked together). This is an unnecessary step and not recommended, as the capacity of the heater alone is very minimal. It trips the code when it tries to resume "high" heat mode.
- Check the potentiometer setting. It should be backed OUT 7 turns to start - turn the knob clockwise until closed, and then counter-clockwise 7 turns out. This can be accessed by removing the exhaust side skin.
- If the problem still exists, turn IN (clockwise) ½ turn at a time and cycle the unit when hooked up to the car...this value (# of turns) is system dependent per the water fl ow restriction that exists.
- Likewise, if the customer would like to see more performance (higher temp) out of the unit, this potentiometer setting can be backed OUT ½ turn at a time until the F14 code begins to trip.
- Open the brass bleeder on the side of the unit to ensure that water is flowing and there is no air pocket trapped within the unit. An air pocket can prevent water flow and cause the F14 code. This can also be checked by monitoring the heat distribution across the engine (by hand) – if no water is flowing, no heat will be felt.

F15 - TOO MANY OVERHEATS

This indicates that the unit has been "locked" due to too many overheat codes in succession. Follow the corresponding steps that utilize the display to unlock the control.

NOTE: Prior to following the steps of unlocking the control, the top of the unit must be removed, and the yellow wire must be disconnected from the "ACC" switch and joined together.

The locking of the control unit (F15) is a very rare occurrence, and generally points to a lack of water flow/ restriction within the system. Once unlocked, the system should be reviewed prior to resuming use of the heater.

F50 - TOO MANY NO START ATTEMPTS

This indicates that the unit has tried to start unsuccessfully 10 times in succession.

The same notes as per the above F15 code apply to unlock the heater. Refer to F52 notes to help diagnose why the unit will not start.

F52 - NO START SAFETY TIME EXCEEDED

This indicates that there is no flame detection during start up. Some areas to check include:

- Check exhaust flow path (is exhaust cap removed)
- Check fuel tank vent – small screw on fuel cap must be "loose"
- Check fuel level
- Check to make sure that nothing is plugging the bottom of the fuel tank or the lines.

The codes listed above represent the most common codes that have been triggered over the past 5 years. For fault codes that are NOT listed above, refer to the fault code cross reference located above.

Batteries can be purchased from C&R Racing or from your local Batteries Plus or Interstate Batteries:

Odyssey Battery - 18 amp-hr	#PC625
Odyssey Charger - 7 amp	#BCSC-7A
Braille Battery - 21 amp-hr	#B2015
Braille Charger - 10 amp	#12310