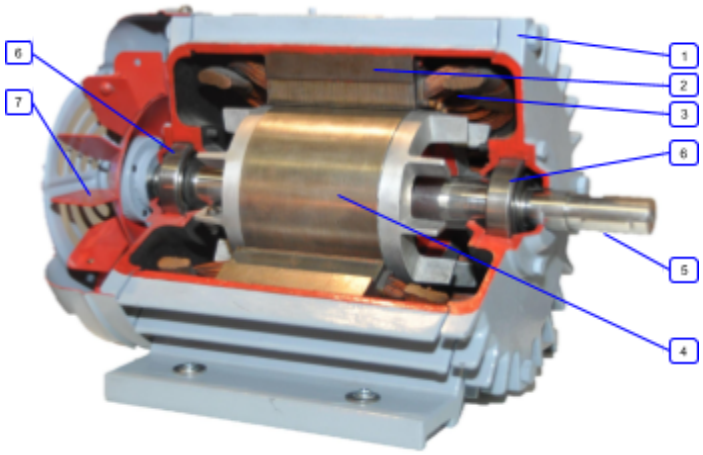
Boat Lift Motor Overheating Guide

Most boat lift motors are NEMA 56 Frame, single-phase, 120/240V AC induction motors characterized by their simplicity and high value offered in two case configurations: Totally Enclosed Non-Ventilated (TENV) and Totally Enclosed Fan Cooled (TEFC). For TENV motors, as the name suggests, there are no vents or holes in the motor housing which keeps out contaminants and moisture to prolong the life of the motor. The tradeoff is that TENV motors will run hotter and for shorter periods of time before needing to cool down. TEFC motors have the addition of a fan to promote air cooling and allow for longer run times.
Most boat lift motors are wired from the factory in either the 120VAC or 240VAC configuration but can be rewired to either voltage by referencing the motor wiring diagrams.
Boat lift motors are also provided with either a foot or face mount or both. Some companies like BH-USA actually test the motors after being assembled before leaving the facility.

The Anatomy of a Boat Lift Motor

A boat lift motor consists of the following components:

1. **Motor Housing/Frame:** Provides protection and is the primary structural support for internal components.
2. **Stator**: Connected to the motor housing and holds the windings.
3. **Windings:** Coils of wire that create magnetic fields to drive the motor's rotation.
4. **Rotor:** Rotating component connected to the shaft.
5. **Shaft:** Transfers the motor's rotational force to the boat lift mechanism.
6. **Bearings:** Allow smooth rotation of the shaft.
7. **Fan (TEFC only)**: Cools the outside of the motor (if equipped)



NEMA Electric Motor Specifications

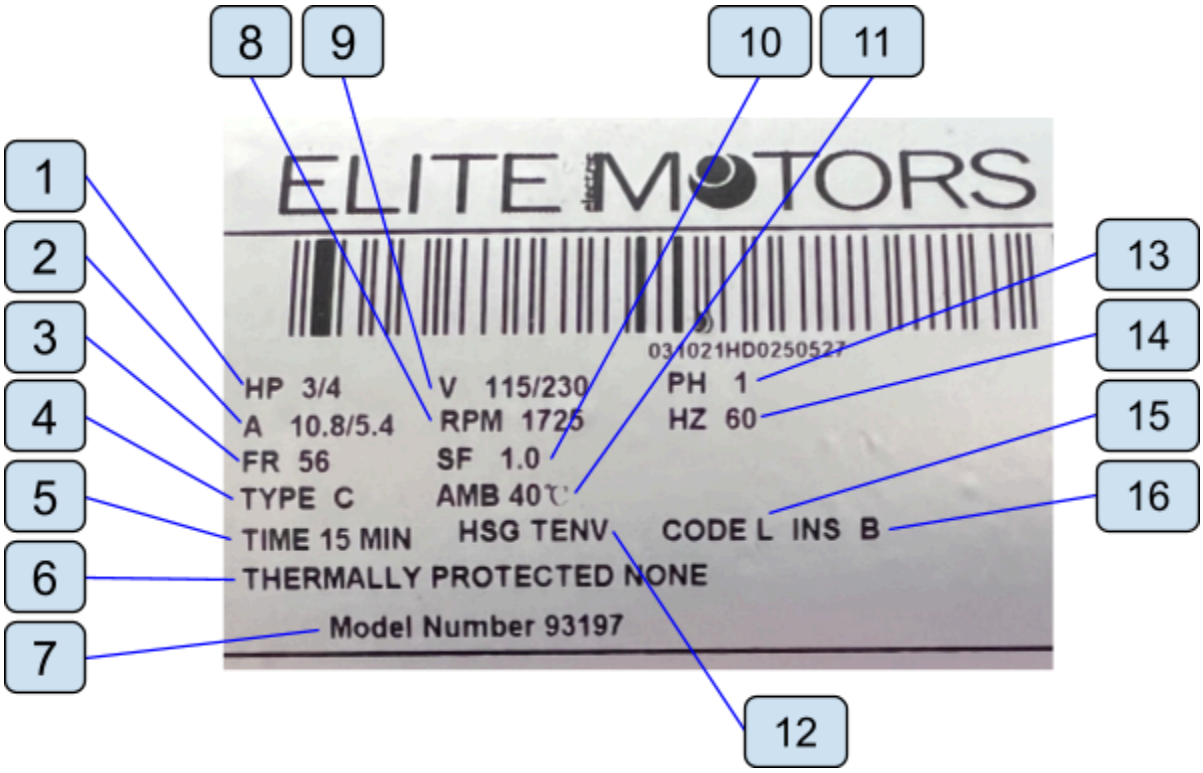
The National Electrical Manufacturers Association (NEMA) is an organization that has standardized the physical dimensions and operating parameters of electric motors to ensure compatibility between installations.

What is a NEMA Class A Insulated Motor

Class A insulation is a designation for motor insulation that can withstand a maximum temperature rise of 60°C (140°F) when tested in accordance with industry standards. This type of insulation is commonly used in motors.

Motor Nameplate

Boat lift motors are a type of single-phase AC induction motor that has a specific operating envelope specified by the National Electrical Manufacturers Association (NEMA). The nameplate label provides the operating specifications for the motor.



1. HP: Horsepower - Horsepower is an expression of the motor's mechanical output rating, or its ability to deliver the torque needed for the load at rated speed. This value is based on the motor's full-load torque and full-load speed ratings and is calculated as follows:

Horsepower (Hp)=[Motor speed (rev/min) × Torque (lb-ft)]÷5,250]

2. A: Amps or Full-load amps represent the amount of current the motor is designed to draw at the rated load and rated voltage. In this example, the motor will draw 10.8 amps at 115 VAC or 5.4 AMPS at 230 VAC.
3. FR: This is the NEMA frame size which dictates the physical parameters of the motor including the shaft size and location and mounting details.
4. Type: Design Type - The letter indicates the torque/speed characteristics of the motor. NEMA specifies design letters to indicate the torque, slip and starting characteristics.
5. Time: Run Time - The amount of time the motor is designed to run for at the stated operating temperature (AMB).
6. Thermal Protection - This is to let the customer know that there are no components to prevent the motor from overheating and causing the motor windings to melt the insulation causing a short. This is why it is important to have this motor installed in a properly designed electrical circuit.
7. Model: The manufacturer's model number
8. RPM: Revolutions per minute - This motor is a single speed motor and will rotate at 1725 revolutions per minute when powered on.
9. V: Voltage - This is the rated voltage at which the motor is designed to operate most efficiently; however, a motor can still operate effectively at plus ±10% tolerance of this value. This motor is capable of being wired for either 115 volts AC (VAC) or 230 VAC.
10. SF: Service Factor - The service factor indicates the amount of continuous overload the motor can be expected to handle, under nameplate conditions, without overheating or damaging the motor. When the voltage and frequency are at the same values as shown on the motor nameplate, the motor may be overloaded up to the horsepower indicated by multiplying the rated horsepower by the service factor. For example, a motor with a 1.0 service factor cannot be expected to handle more than its nameplate horsepower on a continuous basis. A motor with a 1.15 service factor can be expected to safely handle infrequent loads up to 15 percent past its rated horsepower.
11. AMB: Ambient operating temperature - The maximum temperature the motor is designed to operate at the stated voltage and run time.
12. HSG: Housing - The housing/enclosure designation for which the motor is designed. Most boat lift motors are of the design TENV (Totally Enclosed Non-Ventilated) which protects the windings, bearings and other mechanical parts from moisture and ingress of contaminants.
13. PH: Phase - The motor is wound to accept single phase power.
14. HZ: Hertz - The motor's required power frequency. All North American AC power is 60 Hz.

15. CODE: Locked rotor code - NEMA defines locked rotor [kilovolt-ampere (kVA) per horsepower (Hp)] with a series of code letters (A to V). Generally, the farther the code letter is from A, the higher the inrush current per Hp.
16. INS: Insulating Class - Insulation classes are expressions of the thermal tolerance of the motor winding, or the winding's ability to survive a given operating temperature for a given life. The classes are designated in order of thermal capabilities by the letters A, B, F and H. The higher the designated code letter, the greater the heat capability. Class B insulation is suitable for 80°C rise from the maximum rated ambient temperature.

Supply Power

How Power Companies Provide Service

Power companies supply electricity to residential, commercial, and industrial areas through a distribution network. This network consists of power plants, transmission lines, substations, and distribution lines. Electricity is generated at power plants and transmitted at high voltages through transmission lines. At substations, the voltage is lowered for distribution through local distribution lines to homes and businesses. The power utilities are typically required to regulate the supply voltage within ± 10% of the nominal voltage.

Common Reasons for Low Supply Voltage

Low voltage in residential areas can result from various factors, including:

- **High Demand:** During peak usage times, heavy electrical load on the grid can cause voltage drop.
- **Long Transmission Lines:** Voltage drop occurs over long distances due to resistance in the transmission lines.
- **Faulty Transformers:** Malfunctioning transformers can reduce voltage levels.
- **Inadequate Wiring:** Poor or undersized wiring in homes can lead to voltage drop.
- **Faulty Equipment:** Defective electrical appliances or motors can cause voltage fluctuations.
- **High Ambient Air Temperatures**: The temperature of the transmission lines increased the resistance of the line therefore causing a drop in voltage.

- **Faulty Installation**: A broken underground conduit or wire from the main panel could be damaged and cause a short to ground.

In some cases, rural areas might experience less reliable power due to longer distances from power plants and substations, resulting in higher resistance and greater voltage drop. However, this is not always the case, as power companies strive to provide consistent service across all regions.

Voltage Drop in Lines

Voltage drop occurs in power lines due to the resistance of the conductors. As current flows through the lines, some energy is lost as heat, causing a decrease in voltage along the length of the line.

During heatwaves, power demand typically increases due to higher air conditioning usage. This increased demand can lead to voltage drop, especially if the power grid is already operating near its capacity. During a heat wave, power companies may experience increased demand, which can put a strain on the power grid. To manage this, power companies might implement measures like load shedding or adjusting power generation to meet the higher demand.

The longer the electrical run, the greater the voltage drop across the line and will increase the current through the line. Ensure the voltage is maintained at the end of the run by using a multimeter to measure the voltage from the main panel, at the boat lift switch and at the motor. There should not be more than a 4% voltage drop from the panel to the motor(s).

Proper Breaker Size

The breaker size should be appropriately matched to the motor's full load amps (FLA) rating to prevent overcurrent situations.
BH-USA recommends using a 20 Amp breaker to ensure that the electrical circuit can handle the current drawn by a single motor. An adequately sized breaker protects the motor and wiring from overcurrent situations.

Overheating

Summer temperatures can wreak havoc on electric motors. Heat reduces the efficiency of a motor and accelerates wear on internal components. Excessive heat can lead to insulation breakdown, bearing failure, and other issues. Single-phase AC induction motors can overheat due

to various factors. Motors used in the boat lift industry tend to be constructed without ventilation openings to prevent insects and dirt from getting inside the motor. Keeping the dirt and insects out also means the heat created inside the motor is trapped and takes longer to get out causing a condition known as “heat soaking.”

Understanding the root causes of what causes a motor to overheat can help prevent overheating issues. Some common reasons include:

- **Excessive Load:** Running the motor beyond its rated capacity can lead to overheating. Ensure the motor is appropriately sized for the load it needs to handle. NOTE: Excessive friction due to lack of lubrication and binding can add to the load seen by the motor.
- **High Ambient Temperature:** Operating the motor in extremely hot surroundings decreases cooling efficiency and can cause overheating.
- **Long Run Times**: Unless the motor states that it is rated for continuous duty, the motor is only designed to run for a certain amount of time before it needs time to cool down as shown on the label.
- **Poor Ventilation**: Placing a hoist motor in a location where there is poor ventilation will not allow the motor to shed heat effectively.
- **Electrical Issues:** Problems like low supply voltage from long cable runs, voltage imbalance due to multiple motors, or excessive current can all lead to motor overheating.

Load

Lifting a load beyond the motor's rated capacity can cause excessive current draw and lead to overheating and potential motor failure.

Situations that add to the load lifted by a boat hoist:

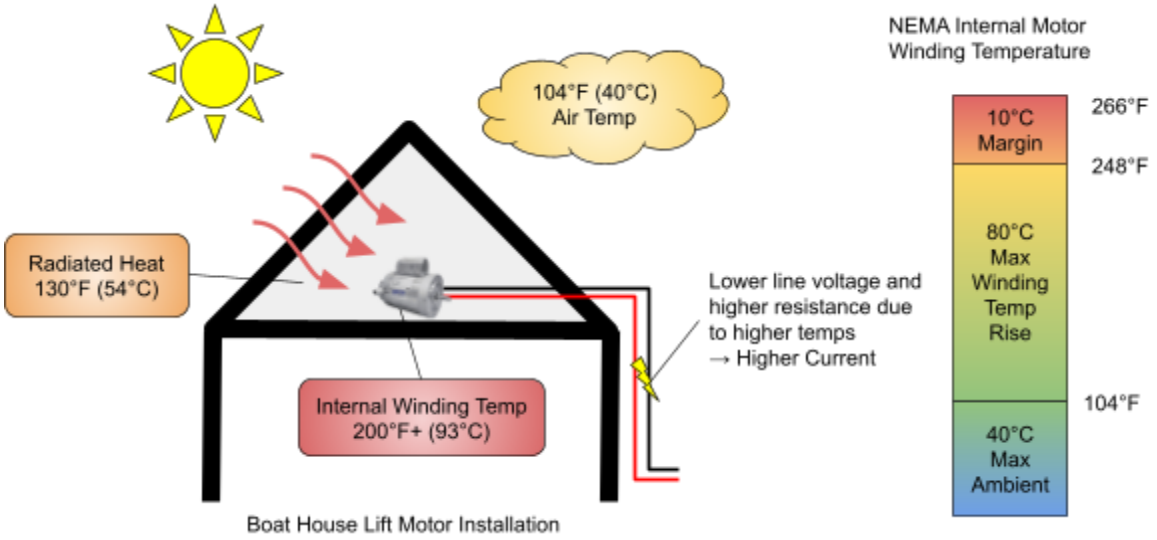
- Not accounting for fuel weight
- Not emptying ballast
- Poorly maintained/lubricated bearings in the hoist and pipe hangers
- Cargo (coolers, personal items, skis, etc.)
- Not accounting for weight of the cradle
- Drive pipes bent or in a bind

Straight Line vs. Compounding with Motor and its Effects Power Draw

One way to reduce the load on a boat hoist is to reconfigure the lift from a single straight line lift to a compounded lift. This will reduce the load on the lift by ½.

Ambient Operating Temperature Rating of the Motor

The ambient operating temperature of a motor refers to the temperature of the surrounding environment where the motor operates. Motors are designed to operate within specific temperature ranges, and exceeding these limits can lead to overheating.



Motor Ventilation

Electric motors use acronyms to describe the ventilation configuration. BH-USA and many other manufacturers' motors are offered in two configurations: TENV and TEFC.

- **TENV** stands for "Totally Enclosed, Non-Ventilated," which means the motor is enclosed to protect it from external elements and contaminants. It does not have ventilation openings.
- **TEFC** stands for "Totally Enclosed, Fan Cooled," meaning the motor still does not have ventilation openings but does have a fan on the rear of the motor to provide airflow to cool the outside motor casing. These motors will have a longer run time but still cannot efficiently cool the internal windings of the motor.

Because boat hoist motors are “Totally Enclosed,” it is important the motor has as much air flow over it to pull as much heat as it can from the outside motor housing. Because the heat can be trapped in the motor, it can build up heat more easily becoming “heat soaked” like a sponge soaks up water.

Boat hoist motors need as cool of an environment as possible to prevent heat soaking. Only run below the rated ambient temperatures and run times to prevent overheating.

Why an Overheated or Burned Motor is not Considered "Bad" or Defective

An overheated or burned motor is typically a result of external factors like excessive load, electrical issues, or environmental issues. It does not necessarily imply a defect in the motor's engineering or manufacturing. Proper installation, usage, and maintenance will alleviate your motor from overheating. NEMA and UL regulations ensure motor safety and performance standards.
Remember, electrical work and motor repairs should be carried out by qualified professionals to ensure safety and compliance with local regulations. Always consult with an electrician or motor specialist if you encounter any issues with your boat lift motor.

Troubleshooting

Most issues with motors are caused by incorrect wiring in the switch and/or the motor itself so check that the motor is wired correctly for your switch.

Issue	Possible Solution
Motor making a loud hum (turning or not turning)	Shut off power to the motor and check wiring in motor and at switch.
Smoke or burned smell from motor	Replace the motor.
Motor not turning and no noise	Check the power supply voltage and breaker. Check the wiring at the motor and at the switch.
Motor won't start turning but will start if moved manually.	Check that the motor is wired correctly for your switch. Motor may not be receiving proper power. Check the voltage at the switch AND at the motor. Sometimes bad connections or corrosion cause insufficient power Check the Start Capacitor. Ensure the motor is not installed with the capacitor housing facing down.
Motor won't start turning and cannot be turned manually.	The motor is frozen and must be replaced.

Issue	Possible Solution
Motor starts & runs, but won't pick up the load	Check for a low-voltage problem. Check the full-loaded weight of the boat on the lift. Check the lift for problems with something rubbing or causing additional resistance that may cause additional strain on the motor.
Breaker keeps tripping	1. Check the voltage at all the motor. 2. Ensure the breaker is properly sized for the motor load. 3. Check to see if the lift has any components in a bind or if it is overloaded. 4. Check the switch and motor wiring. 5. Check for a burned smell inside the motor. If burned, replace the motor.

What Can I Do

- Regularly inspect and maintain the motor and hoist components are working smoothly.
- Avoid overloading the motor and follow its rated capacity. May need to compound the lift to reduce the load on the hoist/motor.
- Keep the motor and surrounding area clean and free from debris.
- Ensure proper ventilation and cooling for the motor.
- Monitor voltage levels and address any electrical issues promptly.

When to Just Not Use Your Lift

If the ambient air temperature is close to the motor's rated operating temperature or if the boat lift motor is experiencing issues such as overheating, strange noises, or irregular operation, it's best to stop using the lift immediately and have it inspected by a qualified technician.

BH-USA Motor Trouble-Shooting Guide

1. Shut off the power to the switch and motor.
2. Spin the shaft of the motor to ensure it spins freely and there are no bearing noises.
    a. A frozen or hard to turn shaft may indicate damage during handling.

b. Noise coming from the bearings can also indicate a motor that requires more torque to run than normal.

3. Check the slack in the shaft to see if it moves back and forth.

There should be little to no side to side movement of the shaft in the motor.

4. Examine the exterior of the motor for discoloration, shrinking of the labels, cracks or bent mountings.

a. Discoloration and shrinking of the labels is an indication the motor was overheated, voiding the warranty.

b. Cracks or bent mountings are an indication of damage while handling the motor.

5. Open the access cover on the back of the motor.

a. There should be no burnt smell.

b. Check to ensure the motor is properly wired for either 220 volts or 110 volts.

c. Make sure there are no loose wires.

d. Rotate the motor housing around and see if any loose debris is inside the motor like corrosion, rust or dirt dauber nests.

6. If wired to a wiring harness and switch, open the switch up and check to ensure the switch is properly wired and that no loose wires exist.

a. Check the terminals of the switch for loose or burnt connections.

b. Check the interior of the switch housing for signs of ants, submersion or other signs of problems.

7. If the problem still hasn't been located then access the capacitor and examine it to ensure that it isn't damaged. Replace if necessary.

8. When powering up the motor check the GFCI

a. Check to make sure it properly engages

b. If it trips before the switch is engaged then the GFCI is faulty or there are wires touching each other inside the switch housing.

9. Test the motor to ensure it runs in both directions, without any unusual noises, and at a high speed. If the motor still isn't operating properly then it needs to be returned to BH-USA for warranty evaluation.

Note: All wired motors are tested to make sure they operate properly in both directions before leaving the facility.