Getting the best from your

LYNCH

Marine System

A GUIDE TO SUCCESSFUL INSTALLATION AND COMMISSIONING

Contents

Congratulations!

We thank you for your purchase of a Lynch Marine system. At its heart is a Lynch motor - one of the most power-efficient, space-efficient and reliable motors on the market today.

The Lynch motor has a proven record in industry, where many thousands are in daily use across the world powering heavy-duty pumps, air conditioning units, steering systems and more.

In leisure, too, the Lynch motor is highly regarded. Several hundred Lynch Marine systems are used every day on canals, lakes and oceans in leisure, commercial and competitive situations.

You can have complete confidence in one of our systems - because we do!

We've compiled this booklet to give you the benefit of our thirty-plus years of experience. We hope that its easy-to-follow advice will allow you to really get the best from your Lynch Marine system. You can use it as an aid to designing and installing a new system, a checklist to optimise a system that's already in service - or just a handy reference for day-to-day use.

We're always available to offer advice by telephone or email. In the unlikely event that one of our marine systems requires attention during installation or service, our factory technicians will arrange to resolve the problem, either remotely or by an on-site visit.

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Wiring

Basics

You've spent good money on batteries after doing a lot of careful research. After doing more homework, you've bought a very efficient electric drive in the form of your Lynch Marine system.

What could be less glamorous than the wires that connect them?

But those heavy-duty cables have an important job to do. Choosing the right ones - and installing them correctly - is vital for the safety, reliability and maximum efficiency of the whole system.

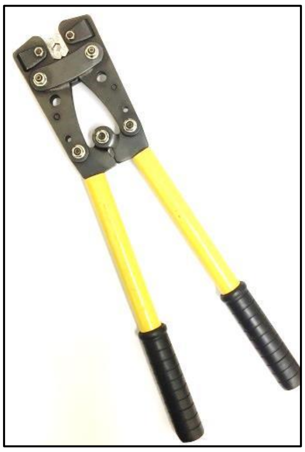
Thin wires, poor connections and over-long cable runs cause electrical resistance. Resistance wastes power by generating heat. Worse still, heat causes a further increase in resistance and more heat, causing more resistance and more heat… which can lead to serious damage.

Wire gauge

The following is a guide to the size of multistrand copper wire that we recommend for our typical 48V systems. If wire runs are unusually long, use the next size of wire up to minimize losses. Low-voltage systems of 24V and 36V carry proportionately higher currents (though the overall power consumption is the same) and may also require larger gauges of wire. We'll be pleased to advise you if you need assistance on this.

System power [48V]	Battery to controller(s)	Controller to motor 1	Controller to motor 2
5kW	25mm²	25mm²	
8kW	25mm²	25mm²	
10kW	35mm²	35mm²	
13kW	35mm²	35mm²	
16kW	25mm²	25mm²	25mm²
20kW	35mm²	35mm²	35mm²
26kW [72V only]	50mm²	50mm²	50mm²

Lugs and crimping



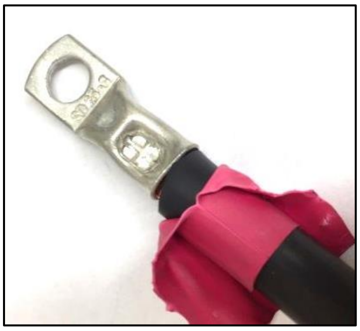
Although we don't supply the heavy-duty wires, we do supply a set of lugs for the wires with every system. It's crucial that these are correctly crimped onto the wires.

A proper crimping tool is needed. These are not expensive, especially relative to your outlay on the system, and give a neat and reliable result every time. Their long handles give the force needed for the crimping operation.

The cheapest tools use hexagonal dies *(pictures)* which rotate to give different crimp sizes. These are usually perfectly adequate. You can easily test a crimp by attempting to pull the cable out of the lug after crimping. It should be impossible.

For the highest-power installations, we prefer to use this heavy-duty tool *(left)* which grips the lug in a vee and pushes a die directly into the lug *(below).*

After crimping, we recommend sleeving the lug and wire with heat-shrink. Sleeve the wires linked to battery positive in red, and negative wires in black.



Negative? Earth? Ground?

At Lynch, we connect the negatives of the battery, controller and motor(s) by wires.
We do not recommend an 'earth return' system using the hull of the boat [or frame of the vehicle]. The motor of a Lynch system must **never** be connected to battery negative - only ever to the designated terminals of the controller (see manual).

Wire lengths and routing

We've discussed wire gauges and crimps - now let's set a few rules for wire lengths.

When a large current travels through a wire, that wire drops a little voltage. We can minimize this voltage drop using thick wires, strong crimps and clean, tight terminals.
But some voltage drop is inevitable, and is related to the length of the wires. Unusually long runs of wire justify being 'uprated' to the next-largest available diameter, which minimizes these unwanted losses.

Installing the batteries, controller and motor as close as possible to each other is obviously an ideal solution, but we understand that's not always practical. Nonetheless, try to arrange things logically.

A power circuit full of random and unequal voltage drops will confuse the electronic circuits of the controller. It won't stop it from working, but it won't work at its best, and it may behave strangely under some circumstances. Also, because of the way the electronic circuits detect the performance of the motor, a tangle of wires can also cause it some confusion.

The simple way to avoid this is to make sure the wires from the battery to the controller are of equal length (an inch either way can normally be ignored). Similarly, wires from controller to motor should be the same length. In the case of a twin-motor power unit, try to arrange the controllers and power supplies as symmetrically as possible in the boat to ensure balanced and equal runs of wiring.

Where wires pass through bulkheads and so on, they must be protected from chafing against metal edges. Use grommets or conduits. Fasten runs of wiring securely in place.

Last but not least, try to install the controller such that the lid can be easily removed for installation and service. Don’t hem it in later on with other fixtures and fittings.

Wiring twin controllers

Twin-motor systems - in most cases - use two controllers. They are referred to as master and slave controllers, since functions such as the ignition key switch and the throttle are driven only from the master controller.

Always use separate pairs of power cables from the battery for each controller. Do not piggy-back one controller’s power supply from the other.

Try to arrange the controllers and power supplies as symmetrically as possible in the boat to ensure balanced and equal runs of wiring.

Always install the B- [battery negative] link between controllers. It synchronises the vital zero-volt reference for the sensitive electronic control circuits in each controller. It should be made of power cable of the same gauge as the other power wires.

Battery isolation

The key switch [ignition switch] of the Lynch system turns off the controller, but does not isolate the system from the batteries.

It’s essential to install an isolator as close as possible to the battery positive terminal.

Make sure the motor drive system has its own isolator.
Do not put it on the same isolator as the domestic wiring, solar panels etc.

Propeller

Propellers and efficiency

Many marine diesel engines (and also many electric motors) are vastly overpowered for the work they have to do. This means they can be set up with an incorrect propeller and still appear to cope with it. It makes them very inefficient, however.

The Lynch system is highly efficient. It isn't configured to waste power needlessly. As a result, it requires the right choice of propeller to operate correctly.

The propeller and 'gearing'

Think of the propeller as being like the chain drive on a bicycle. The bicycle needs the right gearing: choose too low a gear, and you pedal fast while only moving slowly. Too high a gear, and you're straining to push the pedals down - again making only slow progress. Somewhere in the middle is a gear which suits you: you can pedal comfortably and with little effort and the bike makes a good speed down the road.

Clockwise or anticlockwise?

Some propellers turn clockwise to achieve forward motion, and others anticlockwise. This isn't important with our single-motor systems, but if we know which way your propeller turns, we can optimise our twin-motor systems during the final testing process before dispatch.

Testing for peak efficiency

The batteries **must** be fully charged and the boat must be tested in ‘typical’ use. If the boat is used on a river, for example, test it while running against the current.
Beware of mechanical dangers when working near the running motor, and avoid causing short-circuits by careless use of tools and meter probes. If you need to remove a plastic motor cowling for access, do so while the motor is stopped and the battery isolator turned off.

You’ll need a simple multimeter, set to 200V DC on the dial. Make sure the probes of the meter are in the meter’s V/Ω (red) and COM (black) sockets.

Run the boat ahead and build up to maximum speed and full throttle.

Measure the voltage across the motor terminals. It should be within a few volts of the supply voltage. Alternatively, you can measure the voltage across the terminals M1 and M3 of the controller, which should give an almost-identical reading.

If, for a 48V system, the voltage at the motor is above 45V, the motor is operating under ideal conditions. If the voltage is below 40V, the motor is labouring and its pulleys or the propeller - or both - must be changed.

Labouring the motor is bad for the following reasons:

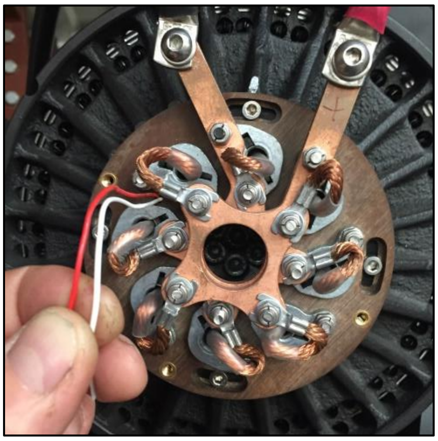
- The boat never achieves full power, and struggles to accelerate or run against winds or river currents.
- Time between battery charging is sharply reduced, as is overall battery life.
- The motor and controller run hot.
- The controller may restrict the maximum current to an overheating motor, further reducing available power.
- A motor which routinely labours and runs hot has a reduced lifespan and in very extreme cases may fail completely.

Cooling

Controller

As a general rule, the controller does not run hot. Ventilation holes are provided in the aluminium casing and the controller is mounted on not one, but two substantial aluminium heatsinks. The controller's peak current and maximum continuous current are well above the requirements of each system.
If the controller is running hot, please contact Lynch for advice. In most cases, we find this is caused by an incorrect choice of propeller which is overloading the motor(s).
The controller has a temperature sensor which will restrict its output or shut it down to prevent damage in the event of severe overheating.

Motor



Temperature sensor on motor

The motor has a temperature sensor which should be wired to the controller during installation. It is not polarity sensitive - in other words, it doesn't matter which way around it's wired. If the motor reaches 85°C, the controller will cut back the power supplied to the motor until it cools off a little.

Again, overheating is often caused by an incorrect propeller. Sometimes, if the boat is put to unusual use (a canal boat running against the current of a river, for example) then the motor may run hotter than usual.

Temperature sensor socket on controller

Note that 40°C is hand-warm; 45°C is hand-hot and 50°C is usually too hot to touch. So a motor may appear to be running hot, but be still within its safe limits. If it runs consistently and excessively hot, perform the full-load voltage test outlined in the previous section.

Motor cooling fan

Unlike a diesel engine, an electric motor is most efficient when cold. Most Lynch marine systems are supplied with a motor cowl with built-in cooling fan(s). This should be wired to a 48V supply with a 5A fuse. One way to do this is to take the feed after the battery isolator so the fan is live when the system is live. This way it will continue to cool the motor even after a journey when the ignition key is off, but it will be turned off if the boat is left for some time.
The fan has red and black wires, which should be connected to positive and negative respectively. After installation, check that the fan blows air **out of** the cowl, not into it. If it does not, double-check the wiring.

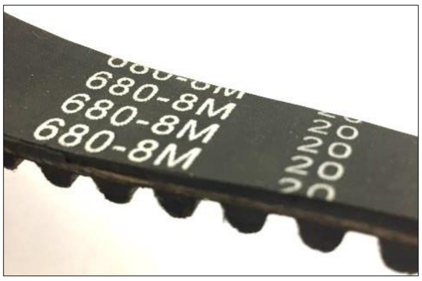
Drive system - belts, pulleys and shafts

Description

The motor is mounted in a frame and drives an output shaft via a toothed belt running on two pulleys. The motor pulley is the smaller of the two.

Belts

Type
The toothed belts are typically marked in the format **680-8M 20** where 680 is the length in millimetres, 8M is the tooth size/shape and 20 is the belt width in millimetres.



Tension
The tension is adjusted by raising or lowering the motor in the frame. A tight belt can be heard to ‘hum’ and a slack belt jumps on the sprockets under load, giving rise to a dull, heavy banging sound.
Instructions on how to adjust the tension are given in the Operating and Installation Manual supplied with the system.

Alignment
The belt should be capable of running in the centre portion of the pulleys, without grinding against the sides. In practice, belts often run lightly against the side of a pulley and this is perfectly acceptable. Where a belt is hard against one side of one pulley, and hard against the opposite side of the other pulley, however, the pulleys are misaligned. The belt may start to wear prematurely on its edge. One pulley should be moved slightly in or out to correct this (see later).

Pulleys and shafts

The pulleys are installed on the shafts by use of taper-lock bushings. These are a highly-reliable method of attachment. Check the tightness of the grub screws holding the bushings occasionally.

Instructions on how to remove, replace and adjust the pulleys are given in the Operating and Installation Manual. Never operate the system with a loose taper-lock or a missing shaft key.

Attaching the propeller shaft to the output shaft of the Lynch drive unit

The Lynch drive unit has a short output shaft with a keyway. It is best attached to the propeller shaft of the boat via a flexible coupling, which will minimize wear and vibration caused by differences in alignment during installation or which may arise during service as parts - including the hull - expand, contract and flex.
Always use the correct steel key in the shaft: if a key is too large, carefully file it until it is a precise fit. The key works together with the clamping device (taper lock, etc) - neither provides security on its own.

LYNCH

Generating
Movement
Efficiently