

NetGain Motors, Inc.

900 North State Street / Suite 101 / Lockport, IL 60441 / 630-243-9100 / 630-685-4054 (FAX)

Owner's Manual

WarpTM Motors



ImPulseTM Motors



TransWarpTM Motors



NetGain Motors, Inc.

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Please record your motor serial number and date of purchase on this page.

Motor Serial Number: _____

Date of Purchase: _____

Purchased From: _____

Motor Model:

<input type="checkbox"/> <i><u>ImPulse 8™</u></i>	<input type="checkbox"/> <i><u>ImPulse 9™</u></i>	<input type="checkbox"/> <i><u>WarP 8™</u></i>
<input type="checkbox"/> <i><u>WarP 9™</u></i>	<input type="checkbox"/> <i><u>WarP 11™</u></i>	<input type="checkbox"/> <i><u>WarP 13™</u></i>
<input type="checkbox"/> <i><u>TransWarP 9™</u></i>	<input type="checkbox"/> <i><u>TransWarP 11™</u></i>	<input type="checkbox"/> Other

NetGain Motors, Inc.

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September 28, 2007

RE: Your new ***NetGain Motors, Inc.*** Motor

It is with great pleasure that we at ***NetGain Motors, Inc.*** welcome you to the **WarP™ Motors** owner's family! We would also like to “***Thank You***” for your purchase.

Since electric motors are different from internal combustion engines, this Owner's Manual is being sent to you to provide information on running and caring for your new motor. Please read it carefully and follow the suggestions that will provide for years of great performance from your new motor.

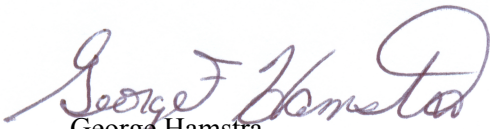
This Owner's Manual contains the new motor warranty, our dealer's safety information sheet, wiring tips bulletin, heat and rpm protection bulletin, care and maintenance information sheet, bench test procedure bulletin and other information of interest and importance.

There is also a substantial amount of content that may be obtained at our website: <http://www.go-ev.com>

Along with your dealer, we definitely want to help make your EV project a success, so please let us know if you have any questions about your motor, safety, wiring or anything else. We'll help you or find resources that can help.

Again, we thank you for your motor purchase – we wish you success in your EV project!

WarP™ Motors – **TORQUE ABOUT IT!**


George Hamstra
President

NetGain Motors, Inc.

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WarPTM Motors

NEW MOTOR WARRANTY*

WARFIELD ELECTRIC COMPANY, INC. (The Company), warrants that new motors sold by it are merchantable and free of defects in material and workmanship at the time that they are shipped from the company's factory.

The company makes no warranty with respect to the new motors other than the warranty stated above. All implied warranties of merchantability and all express and implied warranties of any other kind are hereby excluded.

The company will repair or, at its option, replace any part of any new motor sold by it that fails to conform to the warranty stated above, provided Warfield Electric Company, Inc. (factory) is contacted for a Repair Authorization Number (RA#) and such part is returned to the company's factory or to a factory authorized service station, transportation charges prepaid, within the warranty period specified below:

NEW MOTOR WARRANTY extends for a period of one year or 2000 hours of equipment operation, whichever first occurs, following the date of delivery of such equipment into which the motor has been installed, but warranty coverage will not exceed a period of two years from the date the motor was shipped from the company's factory. Proof of equipment installation date and equipment hourmeter reading must be provided.

LIMITATION OF LIABILITY

The company's liability, whether in contract or in tort or under any other legal theory, arising out of warranties, representations, instruction or warnings (or any lack or inadequacy thereof), deficiencies, failures or defects of any kind or from any cause shall be limited exclusively to repairing or replacing parts (during normal business hours) under the provisions stated above. All liability for damages, including, but not limited to, those expenses, or injury to business credit, reputation or financial standing is hereby excluded.

The warranties contained therein shall not apply to or include any of the following and the company shall have no liability with respect to:

1. Repair or replacement required as a result of: (A) accident; (B) misuse or neglect; (C) lack of reasonable and proper maintenance; (D) operation in excess of recommended capacities; (E) repairs improperly performed or replacements improperly installed; (F) use of replacement parts or accessories not conforming to Warfield Electric Company, Inc. specifications which adversely affect performance or durability; (G) alterations or modifications not recommended or approved in writing by Warfield Electric Co., Inc. and (H) wear and deterioration of motor appearance due to normal use or exposure.
2. Normal replacement of consumable service items, such as brushes and brush springs.
3. Motors in equipment whose ownership has been transferred from the first purchaser for use to another.

* No agent of Warfield Electric Company, Inc. is permitted or authorized to change, modify, or amend any term of this warranty.

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WarPTM Motors

Safety Information

This is not an all inclusive list. Use common sense and act responsibly, electric motors are extremely powerful and could cause death, dismemberment or other serious injury if misused or not safely handled!

Use caution when operating any motor. If you're not sure what you're doing, find a knowledgeable person to advise you!

Remove all metal jewelry and metal objects from hands, wrist, fingers, etc. before working on any electric motor.

If working on an electric vehicle, make certain the vehicle is positioned securely with the drive wheels safely clear of the floor and blocked up so that the drive wheels cannot make contact with the floor under any circumstances. Block the non-drive wheels if they remain in contact with the floor so that the vehicle cannot roll in either direction.

Before troubleshooting or working on any electric vehicle, disconnect the battery and discharge all capacitors. Reconnect the battery only as needed for specific checks or tests.

Motors must only be connected to a power source by knowledgeable and experienced personnel.

Motors should **NEVER** be run without a load. Running a motor without a load could result in harm to people or the motor. Absence of a load is considered misuse and could prove dangerous to anyone in the vicinity and void the motor warranty.

Portions of the motor may become **hot** and proper precautions must be taken.

Motors are heavy and are likely to become damaged if dropped, or cause damage to anything they fall upon (including people and body parts). Use extreme caution when working with motors!

Make certain the motor is disconnected from any power source before servicing.

Motors contain moving parts that could cause severe injury if the proper precautions are not taken. Never touch an operating motor.

Motors should never be operated beyond the limits established by the manufacturer.

Motors must not be modified in any manner; doing so will void the motor warranty and could prove extremely dangerous.

Wear protective or safety equipment such as safety shoes, safety glasses and gloves when working with motors.

Make sure you know where the closest functioning eye wash station is before working on or testing batteries.

Do not defeat any safety circuits or safety devices.

Under no circumstances should you push in any contactor of an electric vehicle while the drive wheels are in contact with the floor. Pushing in a contactor when the drive wheels are in contact with the floor can cause serious property damage, personal injury or death.

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WarPTM Motors

Information

NetGain Motors, Inc.'s WarPTM Motors are produced by Warfield Electric Company in Frankfort, Illinois, USA. Warfield is the nation's largest rebuilder of series wound DC motors. Matching their experience and knowledge with our engineering and racing experiences, makes a perfect team to design motors that will perform under the unusual operational dynamics of electric vehicles.

All aspects of an electric motor were considered - from the components to the methodology of assembly - to make a motor that would perform in an electric vehicle.

Electric motors components are very critical in an electric vehicle, as are voltage and amperage, range, bearings, shaft sizing, commutator and brush coordination, windings and temperature range. Assembly steps critical to performance are clearances, brush "break-in", lacquering/baking process and overall quality of workmanship.

One area of serious study has been temperature. Where most DC motors are made to meet class F temperature rating (155° C.), our **WarPTM Motors** exceed class H ratings (180° C.) (**WarPTM Motors** have been stress tested to 205° C). Whether using your DC motor for drag racing or for an everyday EV, temperatures will normally never approach 180° C. **WarPTM Motors** all have fans and a temperature snap switch as a standard item (normally closed), set to open at 120° C. to protect the motor and all its components. In our larger motors (11" and 13"), the temperature snap switch is set to open at 150° C. The fan not only helps dissipate motor heat, but also clears carbon dust from the brushes, thus preventing a flash-over and would-be damage.

Motor ratings are given for the normal range of the motor's operation under various voltages and loads. Ratings with forced cooling have not been done since there are too many variables that cannot be controlled to allow the data to be useful. Needless to say, the motor will perform closest to its initial HP output the cooler one can keep it!

Some larger DC motors have interpoles. Because of the compactness of most motors 9" or less in diameter, in these horsepower ratings, interpoles cannot fit inside. Our **WarP 13TM** and 11" motors can have interpoles added, but they are not the standard configuration.

Lastly, please remember that **WarPTM Motors** offer distinctive standard features on every motor that we feel make it the best choice for an electric vehicle motor in the industry. Some of these features are:

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Standard ***WarP™ Motors*** Features

- ✓ Specifically designed for street and racing EVs
- ✓ Top quality, sealed, steel bearings with high temperature grease
- ✓ Motor temperature snap switch
- ✓ Brush Wear Indicators (eff. 4/2007)
- ✓ High efficiency fan
- ✓ Optimized brush timing
- ✓ Oversize brushes
- ✓ High quality brushes- not “quick-seat”
- ✓ Fully 90% plus brush wear-in¹
- ✓ Heavy duty, vibration resistant, stainless steel brush springs
- ✓ Pre-drilled advanced timing holes for higher performance
- ✓ Insulation that exceeds Class “H” temperature rating
- ✓ Best in class patented varnishing process
- ✓ Voltage ranges starting at 48 Volts
- ✓ Interlocking commutator construction
- ✓ High peak motor efficiency
- ✓ Dynamically balanced armatures
- ✓ Hand made in the U.S.A. by experts

¹ The brush wear-in process is completed before the brushes are placed into the enclosure so that no carbon dust is allowed into the motor.

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Special Update

Date: April 13, 2005

To: All **WarP Motors** Dealers

Subject: **WarP Motors** Wiring (except **WarP 13**)

Several sources have recently inquired as to what the proper method was for wiring the terminal lugs on the cases of **WarP Motors**. This ***Special Update*** clarifies the proper wiring method.

All **WarP Motors** cases have four terminals, **A1, A2, S1, S2** stamped on the case at the factory. Motors are designed to normally operate in **C**ounter **C**lock **W**ise rotation at the **D**rive **E**nd (**CCWDE**) for forward vehicle operation. When a motor is specified as "advanced timing", it is assumed to be relative to the normal **CCWDE** rotation. Motors that do not have advanced **CCWDE** timing may be wired for **C**lock **W**ise rotation at the **D**rive **E**nd (**CWDE**). These instructions should help clarify the proper wiring method for both rotations.

WarP Motors (except the **WarP 13**) should ALL be jumpered according to these instructions (battery polarity does not matter):

For **CCWDE** rotation wire as follows:

CCWDE preferred connection method:

Connect **A1** to **S1**

Connect **A2** to one input power terminal and **S2** to the other input power terminal

CCWDE alternative connection method:

Connect **A2** to **S2**

Connect **A1** to one input power terminal and **S1** to the other input power terminal

For **CWDE** rotation wire as follows:

CWDE connection method:

Connect **A1** to **S2**

Connect **A2** to one input power terminal and **S1** to the other input power terminal

CWDE alternative connection method:

Connect **A2** to **S1**

Connect **A1** to one input power terminal and **S2** to the other input power terminal

Motors that have "advanced timing" for **CCWDE** rotation should not be run in **CWDE** mode. Doing so may damage the motor and void the warranty.

*Dealers may request a motor be timed advanced for **CWDE** operation by specifying this on their Purchase Order. This will be considered a "Special Order" and may involve an additional cost.*

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Special Update

Date: October 24, 2006

To: All ***WarP Motors*** Dealers

Subject: ***TransWarP 11*** Motor Wiring and errata

The normal wiring for Counter Clockwise Rotation when viewed from the Drive End (CCWDE) of a ***WarP, Impulse*** or ***TransWarP 9*** Motor is: A1-S1 or A2-S2.

However, on the ***TransWarP 11*** the wiring for CCWDE is: A1-S2 or A2-S1. For CWDE the wiring on these motors is A1-S1 or A2-S2.

Additionally, all of the NetGain Motors, Inc.. 11-inch and 13-inch motors incorporate a 150° C snap switch. Other motors utilize a 120° C snap switch.

Wiring information for other ***WarP Motors*** may be found in the ***Special Update*** dated 04/13/2005 and 03/01/2006.

You may locate copies of these and all other ***Special Updates*** on our Web Site at:

http://www.go-ev.com/dealers-only/Dealer_Manual

All motors produced in 2007 will incorporate 2 lifting holes to aid installation. These holes will be positioned 90 degrees apart in order to allow better positioning of the terminal studs.

Broken fins, which occasionally occurred on ***Impulse 9*** and ***WarP 9*** motors due to the placement of advanced timing holes, will now be machined during assembly.

Dealer input is always welcomed, if you have any suggestions on how we might improve our motors, please contact us! 04/13/2005 and 003/01/2006.

You may locate copies of these and all other ***Special Updates*** on our Web Site at:

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Special Update

Date: February 13, 2006

To: All **WarP Motors** Dealers

Subject: **WarP Motors** Heat and RPM Protection Bulletin

Throughout the year we have had inquiries about the effects of heat and RPM's on **WarP Motors**. This **Special Update** summarizes many of our conversations with individual dealers and shares the same knowledge across our entire dealership network. As in our other **Special Updates**, this information does not cover every aspect of the motor's usage. If you have a situation that you are unsure about, please call someone that has the expertise or seek more detailed information. Please act responsibly and protect yourself and your customer from personal harm or damage to the motor.

Motor Heat

1. All **WarP Motors** are rated over Class H, which is 180 degrees C, but one still needs to protect the motor from overheating
2. If you are using your motor for drag racing, with 10-20 seconds of high load, the brushes and comm will heat up faster than the other parts of the motor. To protect your motor in this case, measure temperature in the brushes and the comm surface area using an infrared device that can react quickly. Heat can build very fast, as you would expect and may already know!
3. If your motor is used for normal vehicle travel, the ends of the pole shoes and the motor case by the shoe bolts will generally be the area of greatest heat build up. To protect your motor in this area, the normal temperature snap switch is installed. Connect it to give the driver a warning light or to automatically open the circuit if it indicates overheating. Heating will build slower here, but fast action needs to be taken to protect the system.
4. Consider setting a temperature of 110-120 degrees C for your action starting point as a safe way to manage a potential overheating situation.
5. Lastly, always ensure that sufficient and proper air circulation through the motor is not impaired!

Motor RPM

1. All **WarP Motors** have comms that were tested to over 8,000 RPM, but that does not mean they can be run at that speed indefinitely!
2. Most motor comms built now are composite. Steel comms were used in the past, but are now made for custom orders and very expensive. Steel core comms are generally able to withstand higher RPM speeds.
3. We like to recommend safe speed ranges from 1500- 2500 RPM, even though we know some of our **WarP Motors** are peaked around 5,000 RPM for small intervals of time. When working with a customer, please be sure to design gearing so that the customer gets the speed he wants, but the motor will not be at a high RPM for long periods of time.
4. Lastly, utilize one of the many ways available to protect the motor from exceeding 8,000 RPM and make sure it is installed and working properly. It just needs to work once to pay for itself, save the motor and protect all the people around the vehicle!

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Special Update

Date: February 15, 2006

To: All **WarP Motors** Dealers

Subject: **WarP Motors** Care and Maintenance

This ***Special Update*** summarizes many responses we have given to dealers and customers alike about motor care and maintenance. As the sphere of users continues to grow for electric motors used in vehicles, knowledge about motors needs to be communicated to all those users across our entire dealership network. As in our other ***Special Updates***, this information does not cover every aspect of the subject.

Here are a few simple steps one should take to make the **WarP Motors** give years of great performance.

1. Protection from the elements is important. Utilize good design concepts and materials to protect the motor from rain, snow and ice.
2. Design the motor mounting area to allow for good air flow. The motor needs a continuous supply of clean fresh air to cool properly.
3. Protect the motor from “dirty air” that may be used to cool it. Most airborne grit will act as an abrasive, which will eventually cause harm to the internal parts of your motor.
4. Clean the brushes and comm area regularly from the dust/dirt that occurs during normal operation.
5. Regularly check connections, voltages, tolerances and alignment to assure they are within normal specifications.
6. If you suspect or question the motor's operation, immediately shut it down. Record any visual signs, audio sounds or scents at the time and ask an expert for an opinion prior to operating the motor again.
7. Always operate the motor within the normal safety ranges for voltage, amperage and RPM
8. Follow all the safety rules available to you.
9. Remember your motor will take care of you, if you take care of it.

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WarP™ Motors

Series Motor Bench Test Procedure

(Test at 12 volts ONLY)

CAUTION! Read completely!

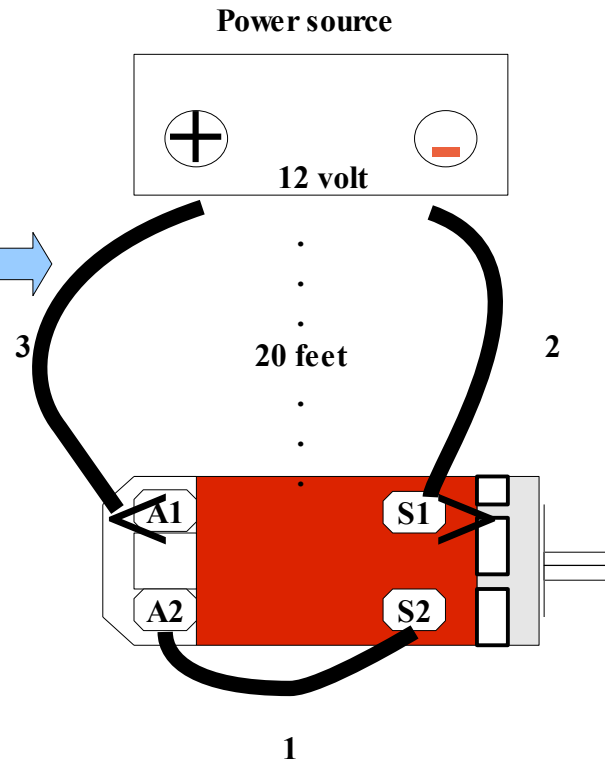
Caution!!!!

Sparks can ignite gases emitted from batteries!

Use quick-connect cables for battery and motor! 

DO NOT HARDWIRE MOTOR AND BATTERY CONNECTIONS!

Make certain that the motor is securely strapped or bolted in position. The motor must **not** be allowed to move!



If a battery is used instead of a charger, the battery must be at least 20 feet away from the motor in a well ventilated area or preferably outside of the building!

The cables **MUST** be connected and disconnected in the order shown!

Connecting sequence:

1. Connect cable #1 and cable #2 first.
2. **Connect cable #3, to power source positive terminal (+) at the power source first, NOT at the motor.**
3. Connect the other end of cable #3 to terminal (A1) at the motor which is 20 feet away from the power source.

Disconnecting sequence:

1. Disconnect cable #1 first. (This deactivates the motor)
2. Disconnect cable #2 and then #3 from the power source.

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Last updated: March 5, 2007

Welcome to the NetGain Motors, Inc. Frequently Asked Questions (FAQ). This document will attempt to answer many of the questions that we are asked related to our products.

1. Where did the **WarP** name come from?

We are not “trekkies”, but we do enjoy *Star Trek*. However, that had very little to do with the original name selection for our motors. The name was a natural way of differentiating our motor series, and also showed that we intended on incorporating new and advanced thinking in the enhanced designs of the motors we planned on building. The “**War**” portion of the name comes from Warfield Electric Motor Company. Jerry Warfield was instrumental in our original designs (and subsequent designs, as were John Wayland and numerous others...). The capital “**P**” at the end of the name is also significant. It stands for “Phil Brown”, a close friend and supporter of our original electric dragster concept vehicle. Unfortunately, Phil was taken by cancer prior to the project gaining momentum. We intend to maintain this method of honoring Phil in the naming of our **ImPulse** motors as well.

2. Which **WarP** or **ImPulse** motor should I use?

The answer to this question depends upon MANY factors! We would be happy to discuss which motor we feel meets your needs the best, and to run your requirements through our motor selection software. The first question you should ask is: What is the intended purpose of the vehicle? Will it be used as a “daily driver”? Will it be used strictly for racing? Will it be a performance vehicle, or will it be designed for greatest range between charges? In addition to knowing the answers to these questions, you should have some realistic thoughts relating to:

1. Top speed to be maintained _____
2. Percent grade the vehicle will travel on _____
3. Wind resistance (frontal area) of the vehicle _____
4. Total vehicle weight (with driver/passengers/load) _____
5. Final gear ratio _____
6. Tire Diameter _____
7. Voltage to be supplied to the motor _____
8. Coefficient of drag _____
9. Battery internal resistance _____

3. How do I become a dealer of **WarP Motors**?

You should visit our Web Page (<http://www.go-ev.com>) and print a copy of the **Dealer Application**. Fill out the form completely and FAX it back to us. You must have a valid state sales tax number in order to even begin the process.

4. What is an ICE, what is an EV?

ICE stands for Internal Combustion Engine. EV stands for Electric Vehicle

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5. What do the abbreviations "DE" and "CE" stand for?

"DE" stands for "Drive End". This is the end of the motor that usually contains the fan and usually has a larger diameter shaft. "CE" stands for "Commutator End". This is the end of the motor where the brushes and commutator are. Motors that are specified as "no CE shaft" do not have a shaft extending from this end. "CE" is also the abbreviation used by Dennis Berube for his world record holding electric dragster: Current Eliminator.

6. What do the abbreviations "CCW" and "CW" mean?

"CW" stands for "ClockWise" rotation and "CCW" stands for "Counter-ClockWise" rotation. These abbreviations are normally used in conjunction with "DE" and "CE" to indicate the perspective of the armature rotation. For instance: "CCWDE" would indicate Counter-ClockWise rotation when viewed from the Drive End – this is the default for all ***WarP Motors***. CWDE would indicate "ClockWise rotation when viewed from the Drive End. Most vehicles require CCWDE, however, some vehicles (i.e. Honda transmissions) may require CWDE. You should verify the rotation prior to ordering as the timing can be requested to be advanced timed for the rotation of the motor.

7. What is "Timing" on an an electric motor?

Timing an electric motor refers to the position of the brushes on the commutator. Normally, brushes are fixed into a position on the commutator during the manufacturing process. The position they are normally set at from a manufacturer is a "neutral" position. A "neutral" position allows the motor to operate and perform almost identically in CCWDE and CWDE rotations at normal voltages. A normal voltage for most series wound motors in a neutral timed arrangement is generally less than 96 volts. Above this range motors should almost always be advanced in the direction of their normal rotation in order to reduce arcing and to provide increased performance at higher voltages. **CAUTION: If a motor is advanced and then powered to run in the opposite direction, significant arcing could result! Regen should not be attempted with motors that have been advance timed!**

8. How do I know how much to advance the timing on a motor?

All new ***WarP Motors*** have pre-drilled holes that allow the end-bell to be removed and the brushes repositioned in a neutral, or an advanced position, either CWDE and CCWDE. The ***WarP 9*** and the ***WarP 11*** motors are each advanced 12 degrees. The ***WarP 8*** motor is advanced 10 degrees. The amount of advancement is based upon the width of the brushes, the number of commutator bars, the diameter of the commutator and various other factors that are monitored when the motor is run on a dynamometer. The proper terminology used to describe an advanced timed motor would be "advanced timed, CCWDE" or "advanced timed CWDE". The term "retarded" that is often used to describe the timing of ICE (Internal Combustion Engine) vehicles is not applicable to electric motors. The ***ImPulse 9*** motor also has pre-drilled holes that allow you to advance the motor timing. You may simply loosen 4 bolts and rotate the bell housing in the direction you desire to advance the timing from the neutral position.

NOTE: The ***WarP 8*** motor has been replaced by the introduction of the ***ImPulse 9***.

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9. How can I order WarP Motors ?

WarP Motors may only be ordered through an Authorized Dealer. A list of Dealers is available on our web page at <http://www.go-ev.com>

10. What if I need something other than the "standard" motor?

NetGain Motors, Inc. will work with our motor manufacturer – Warfield Electric in order to ascertain your specific needs and develop a motor to meet your needs. Custom motor options, such as special materials, components, shaft splining, special composition brushes, or other variances from standard configurations are available at an additional cost. Contact NetGain with your needs and we will provide a quote.

11. Where can I get replacement parts for my motor?

Replacement parts and components can be ordered through any Authorized Dealer.

12. Can I put an alternator or generator or windmill or solar panels on my vehicle to keep the batteries charged?

In brief: "NO"! We receive this question on almost a daily basis! If you figure out a method of actually getting more energy out of something than you put into it – please let us know immediately! To date, no one has figured out how to accomplish this feat – and though you aren't going to receive a ticket for trying, there are certain laws of physics that you would be violating. Though windmills and solar cells may certainly be used to help charge batteries, most of the motors we sell are for use in vehicles that can draw between 340,000 watts (for a short time), and 15,000+ watts at highway speeds. If you have the time and plenty of sunlight and wind, these resources could certainly replace at least some of the energy consumed – just not as fast as people generally use it, or as quickly as you may want.

13. Can I use your motors in marine applications?

Certainly, but don't submerge them, and protect them from saltwater by rinsing them with freshwater. Also, pay particular attention to #12, above. It is extremely difficult to create a watercraft with 10-12 hours worth of wide-open power with today's battery technology.

14. What is the EVDL and how do I subscribe?

The **EVDL** is the **Electric Vehicle Discussion List**. You can find all the details needed to subscribe and view the archives at: <http://www.evdl.org/>

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This image shows a full page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.