NetGain Motors, Inc.

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FAQ's

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Welcome to the ***NetGain Motors, Inc.*** Frequently **A**sked **Q**uestions (**FAQ**). This document will attempt to answer many of the questions that we are asked related to our products. It is not intended to provide answers to all your questions. We suggest you contact one of our Authorized Dealers for further assistance and guidance.

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 a part of of one of our motor manufacturers name that 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 **P**hil in the naming of our ***ImPulse,*** and ***TransWarP*** motors as well. As the ***ImPulse*** motors are the least powerful of our motors and the ***TransWarP*** motors utilized a transmission style armature shaft, the TV series names were a natural fit and also allowed us to use the capital "***P***".

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

3. What is the difference between *WarP, ImPulse , TransWarP,* and *HyPerDrive* motors?

The ***ImPulse*** line of motors were designed to be lower power and/or smaller motors than our traditional ***WarP*** series motors. The ***ImPulse 9*** is shorter than a ***WarP 9***, and is less powerful. However, it is more powerful than the 8" diameter motor it was designed to replace. In addition to being more powerful than an 8" motor, it shares many of the beefy components of the ***WarP 9*** motors (commutator, bearings, brushes, etc.). The ***ImPulse 9*** also has the same bolt pattern and mounting characteristics of an 8" motor. The ***WarP*** motors are our most common motors. The ***WarP 9*** and ***WarP 11*** were designed to be interchangeable with one another. The ***WarP*** motors are the most common motors we make for EV conversions. The ***TransWarP*** motors were designed to meet the needs of direct drive, racing applications, as well as being used by ***EMIS*** **.** The "rule of thumb" when dealing with direct drive is that #1 it is not good for use as a daily drive #2 it will require twice the motor and twice the controller of a vehicle with a transmission. Our latest offering is the ***HyPerDrive 9*** motor. These is actually two specially race prepped ***WarP 9*** motors with different shafts, brush rigging, etc. from our normal ***WarP*** motors. The ***HyPerDrive*** is two motors that are designed to be fitted together and work as a single motor. The " ***Pe*** " portion of the name is my thanks to Mike **Pe**thel who helped fund the development of this radical design.

4. 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 existing business with a state resale sales tax number in order to even begin the process. We also consider proximity to other Dealers, experience converting vehicles to electric, and other factors, web only Dealers will no longer be considered.

5. What is an ICE, what is an EV, Hybrid?

ICE stands for **I**nternal **C**ombustion **E**ngine. **EV** stands for **E**lectric **V**ehicle. A hybrid vehicle is one that uses a mixture or combination of technologies to propel the vehicle. Hybrids are generally one of two types: series or parallel. A parallel hybrid uses multiple, possibly combined, means of powering the vehicle, while a series hybrid generally uses a source to produce electricity in order to power an electric motor that actually drives the vehicle.

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

"**DE**" stands for "**D**rive **E**nd". This is the end of the motor that usually contains the fan and usually has a larger diameter shaft. "**CE**" **stands** for "**C**ommutator **E**nd". 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: **C**urrent **E**liminator.

7. What do the abbreviations "*CCW*" and "*CW*" mean?

"**CW**" stands for "**C**lock**W**ise" rotation and "**CCW**" stands for "**C**ounter-**C**lock**W**ise" 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 **C**ounter-**C**lock**W**ise rotation when viewed from the **D**rive **E**nd – this is the default for all ***WarP Motors*** with the exception of the TransWarP 7 which is neutrally timed from the factory (but may be ordered with advanced timing. **CWDE** would indicate "**C**lock**W**ise rotation when viewed from the **D**rive **E**nd. Most vehicles require **CCWDE**, however, some vehicles (i.e. Honda transmissions) may require **CWD**E. You should verify the rotation prior to ordering as the timing can be requested to be advanced timed for the rotation of the motor.

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

Timing an electric motor refers to the area of the commutator that is being energized has been moved from a normally centered position. 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 voltage motors should almost always be advanced in the direction of their normal rotation in order to reduce arcing, improve RPMs, and to provide increased performance at higher voltages. **CAUTION: If a motor is advance timed and then powered to run in the opposite direction of the advancement, significant arcing and damage and could result if high power is applied! Regen should not be attempted with motors that have been advance timed!**

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

All new ***WarP Motors*** have pre-drilled holes that allow the commutator end-bell to be removed and the brushes repositioned in a neutral, or an advanced position, either **CWDE** or **CCWDE**. The ***WarP***, ***ImPulse*** , and ***TransWarP 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 dynomometer. 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** (**I**nternal **C**ombustion **E**ngine) vehicles is not applicable to electric motors. In order to change the 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. All of our motor cases are stamped with “CW” “N” and “CCW” - you can determine the advance state by

seeing which commutator **end bell bolt** is aligned with the letters stamped in the case. THE TERMINAL STUDS SHOULD NOT BE USED TO DETERMINE POSITION OF THE END BELL!

10. 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

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

NetGain Motors, Inc. will work with our motor manufacturers 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 Motors, Inc.*** with your needs and we will provide a quote.

12. Where can I get replacement parts for my motor.

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

13. Can I put an alternator or generator or windmill or solar panels on my vehicle to keep the battery 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 that you would be in violation of. 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.

14. Can I use your motors in marine applications?

Certainly, but don't submerge them, and protect them from saltwater. Also, pay particular attention to previous question. It is extremely difficult to create a watercraft with 10-12 hours worth of wide-open power with generally available battery technology.

15. What are the two wires that come out of the motor case and how do I use them?

These wires are connected to a normally closed 120C thermal switch. On 11” and 13” diameter

motors a 150C thermal switch is used. This switch is used to determine whether a motor is nearing a temperature that could cause internal damage to the motor. Some people refer to this switch as a "nuisance switch". We do not suggest that this switch be used to automatically disable the motor if a heat condition arises as circumstances may require driving the vehicle to a safe area before shutting down. Some people use this switch to keep a contactor open by applying 12-volts to the switch. If the voltage is dropped (by the switch opening), then a light could be lit, or a buzzer sounded to indicate a potential problem exists. The two wires were changed to a recessed plastic connector that has two 1/4" mail spades. This makes it extremely easy to connect with. Additionally, the Normally Closed (NC) switch has been replaced with a Normally Open (NO) switch. This also makes it simpler to wire a warning indicator.

16. What is the round black connector on the commutator end bell used for?

Some motors may have been made with a brush wear indicator. If you look carefully into the connector you will see that the round black connector actually accepts flat, female, tab connectors. When the brushes wear to a point where the brush wear indicator wire touches the commutator, **a voltage equal to the commutator voltage will be fed through the brush wear indicator connector**. As this could be a high voltage, appropriate care should be given if this connector is used. Once the brushes wear to the point where the wire touches the commutator surface if is necessary to replace the brushes quickly or damage to the commutator could occur from the indicator wire. This feature has been removed from most motors as it was difficult to use the pack voltage for an indicator.

17. What are *TransWarP Motors?*

The ***TransWarP Motors*** are not a motor with a transmission. Rather the Drive End (DE) of the ***TransWarP Motors*** have a 1.375", 32-tooth, involute splined shaft that matches a Chevrolet Turbo 400 transmission output shaft. The drive end bell has been pre-drilled to accept an optional "shorty" tail-shaft housing. The output shaft accepts an optional industry standard 1350 series slip-yoke for easy connection to almost any manufacturers drive-shaft (with matching 1350 series yoke. The commutator end shaft has also been increased in size to 1.125" with a 1/4" key-way. This allows easy coupling of ***WarP Motors*** to ***TransWarP Motors*** . These motors were designed to be part of the ***EMIS System*** which was also available from ***NetGain Motors, Inc.*** You can couple a ***WarP Motor*** to a ***TransWarP Motor*** of the same size for direct drive applications.

18. Can I direct drive my vehicle using your *TransWarP Motors?*

Our motors like to spin 2000-4000 RPMs. Running the motors at very low RPMs will generally draw significant amperage and not allow the fan to cool the motor. Direct drive works well in racing applications, however it is not the best choice for a daily street driven vehicle. The generally accepted rule of thumb is this: Direct drive will require twice the motor and twice the controller of

vehicle with a transmission. This means you would have to use a ***WarP 9*** coupled to a ***TransWarP 9*** in an application where a single ***WarP 9*** would normally suffice if a transmission was used. Additionally, if a single **Zilla 1K** controller could have been used, you will need a **Zilla 2K** for a direct drive application. Additionally, you must force cool air into direct drive motors if the normal RPMs of the driven vehicle are below 2000 RPMs.

19. How do Volts and Amps affect a motors performance?

VOLTs=RPMs in an almost linear manner. If you double the voltage you will double the RPMs of the motor. Usually, RPMs increase just slightly more than double as most losses are fixed. You will notice that the performance graphs for our motors are all at 72 Volts. If you plan on running at 144 volts you can simply multiply the RPMs by 2. AMPs=Torque. Torque will remain constant if the amperage does not change, regardless of the RPMs. If you look at our 72 Volt graphs and find a ft. lbs. of torque and the amps required to produce that torque, you can simply double the RPMs if you are planning to run at 144 volts, - the torque will be produced at twice the RPMs if the amperage doesn't change. If you increase the AMPs, the torque will increase, but in a non-linear manner that is difficult to extrapolate. If you increase the voltage you will basically extend the torque curve of the motor.

20. What voltage and amperage should I run at?

Your budget and performance expectations will normally be the deciding factor, but generally speaking you should consider a voltage between 120 and 156 volts to the motor armature. Motors should never see more than 170 volts to the armature. However, the battery pack voltage should be as high as the controller will allow if using lead-acid batteries. You should generally have a higher pack voltage (ideally) than the motor voltage due to a condition referred to as “voltage sag”. When most lead-acid batteries are required to deliver 1000-2000 Amps the battery voltage can easily sag to 5-5.5 volts per battery. Lead-acid batteries have been known to explode during racing applications from heavy discharges – a credit to the **Zilla** controllers! However, if the voltage of a 12 volt battery sags to 6 volts, the motor will only see ½ the voltage you intended, and consequently only spin at ½ the RPMs you thought it should!

21. What motor controller should I use with these motors?

For many years the only controller that was **ever** recommended in a pure electric vehicle application by ***NetGain Motors, Inc*** were the **Zilla** Controllers from http://www.cafeelectric.com! The two most popular controllers as of the date of this FAQ are now the **WarP-Drive** by ngcontrols.com, and the **Soliton 1** by evnetics.com. You may certainly use other controllers, such as the ever popular **Curtis 1231C**, **Raptors**, **T-Rex's** and **MaxForcer** – just to name a few of the more popular and highly regarded EV controllers. Due to the communications necessary in the ***EMIS System*** , **Alltrax** brand motor controllers are required in this application, no other controller will currently

work.

22. How much power can these motors produce?

Series wound motors, such as these, are renowned for the massive torque they produce from 0 RPM. These motors will suck every AMP they can in order to try and start the armature spinning. Though our motors are regularly abused by **Zilla** controllers delivering 1000-2000 Amps for brief periods, the 9" motors (and 11HV) are actually rated at 450 Amps for 5 minutes, 225 Amps for 1 hour, and 190 Amps continuous duty. The 11" motors are rated at 500 Amps for 5 minutes, 250 Amps for 1 hour, and 200 Amps continuous. We believe these are conservative ratings. The difference in the variously sized motors is the amount of torque and RPM at which the torque will be delivered. If the ratings of a single motor are exceeded, you can divide the figures in ~½ and use multiple motors. There are additional losses of around 8-10% when using dual motors.

23. Where can I obtain an adapter plate made for my vehicles transmission?

Many ***WarP Motor*** dealers specialize in making transmission adapter plates, as well as providing the other components used in EV conversions. Our **Authorized Dealers** are listed on our web-site at http://www.go-ev.com/dealers.html. You can check the annotations in each Dealers listing to locate the best match for your specific needs.

24. Can I run the motors at 10,000 RPMs?

With no load and high voltage these motors can spin to excessive RPMs **EXTREMELY** quickly! The motors should ONLY be spun at no load with a maximum of 12 volts. The bearings are rated to ~14,000 RPMs, however we do not recommend running these motors beyond 5500 RPMS (7800 RPM for the 7" motors). For short durations (i.e. drag racing) the motors have been known to approach 10,000 RPMs, but this is strongly discouraged! If high RPMs are an essential requirement of your application you should consider requesting Kevlar banding and other optional modifications that can be performed at the factory or by a few of our Authorized Dealers.

25. Where can I get additional assistance with my conversion?

An excellent resource is your local chapter of the Electric Auto Association. These groups have been doing conversions to pure electric for 30+ years and have extensive knowledge. Some of the Members of the EAA are world renown for their abilities. There are numerous books available, (i.e. ***Build Your Own Electric Vehicle*** by Seth Leitman and Bob Brandt or ***ICE FREE*** by John Hardyt) and most of our Dealers are willing to discuss your project with you and offer guidance advice. There is also a very active discussion group on the Internet called the EVDL (http://www.evdl.org/index.html) and the DIY forums (http://www.diyelectriccar.com/forums/). Our Authorized Dealers are some of the best resources in the world. They have generally completed numerous conversions and will work with you to supply parts and insight into a vehicle conversion,

as well as supplying you with the various components you'll need.

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

The **EVDL** is the **E**lectric **V**ehicle **D**iscussion **L**ist. You can find all the details needed to subscribe and view the archives at: http://www.evdl.org/

27. What components do I need to make an electric vehicle?

You will obviously need an electric motor. You'll also need a motor controller, and a device to act as the throttle and signal the motor controller as to the power needed - a 5K potentiometer is by far the most typical method, but the Hall Effect method is a safer/better alternative. You'll also need batteries, a battery charger(s), possibly a battery management system, possibly a transmission adapter plate, battery boxes/enclosures, a DC-to-DC converter, a transmission adapter plate, lots of cable, lugs, contactor[s], connectors, gauges and wiring.

28. What makes a good conversion vehicle?

First pick a vehicle you like that is in good condition. It is not uncommon for people to keep EVs for many years. As the weight of the vehicle will probably increase (I've never seen one that decreased if lead-acid was being used), consider the gross vehicle weight constraints. Choose a lightweight vehicle with strong suspension and brakes - sports cars and small pick-up trucks make ideal candidates. Do not change the ride height of the vehicle, or the ride characteristics. The heavier the vehicle, the more likely you are to be dissatisfied with the range and performance. Small pickup trucks make very good candidates, as the batteries can be placed under the bed along the frame rails, and they are designed for carrying additional weight (i.e. Batteries). They also have brakes designed to stop the vehicle with the extra weight you may add.

29. I want to go 300 miles on a charge at 75 miles per hour in my Suburban – okay?

NO! The typical range of a lead-acid EV is 25-50 miles on level terrain – depending upon the batteries and weight of the vehicle. Even with the most advanced battery chemistry currently available this is beyond current technology. Conversions using the various Lithium batteries available are claiming 75-150 mile ranges, so we are headed in the right direction, just not there yet... And the same goes for recharging the batteries in 5 minutes – it won't happen for quite awhile.

30. I want to use a small generator to run the electric motor while I am driving on the highway.

At first this sounds plausible, but using $5.00/gallon fuel (gasoline) to derive $1.00 per gallon fuel (electricity) is only the beginning of the issues surrounding this. Generators are noisy. Most generators are not designed to operate in a mobile environment and gas can spill from their tanks..If you try to quiet them you will reduce their ability to produce electricity. When generators are running

they typically produce more pollutants in one hour that 250 hours of driving an ICE. Even in a lightweight vehicle you will require around 150 amps at 144 volts to maintain 60 MPH – that's more than a 21Kw generator! So the question is "Trains do it why can't a car?". The simple answer is that trains run level, and straight as much as possible, with few stops, and cost millions of dollars. Trains are not concerned about their 0-60 MPH time, or merging with traffic. It only takes a small fraction of the power needed to obtain a speed to maintain the speed. Additionally, steel wheels on steel tracks offer 1/50th of the rolling resistance of rubber on concrete. A typical EV will use 144 Volts and 500 to 1000 Amps to get started from a dead stop. This is 144 Kw of power – a VERY big generator.

31. Can I use capacitors to power the vehicle?

Probably not entirely. Though capacitors offer very high power density, their energy densities are very low (the opposite of fuel cells). Super-capacitors (aqueous based) and ultra-capacitors (organic based) usually become a slave to the batteries. There is potential for the use of capacitors in EVs, particularly when used with regen braking, but regen braking should not be done with series wound DC motors. The use of capacitors might be beneficial in obtaining a speed, but probably doesn't make much sense to use them to maintain speed.