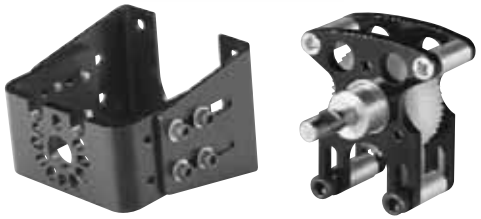
by Great Planes®

AMMO 24mm POWER SYSTEM

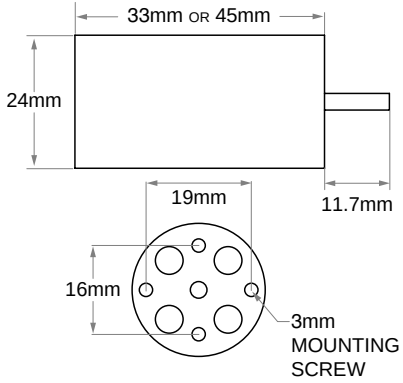


Congratulations, you have just purchased the Ammo 24mm power system components. All the components are sold separately to allow you to customize your power system to your airplane. The components needed to assemble your Ammo 24mm power system are: Ammo 24mm motor, 24mm small gear drive, small motor mount, propeller, propeller adapter and brushless speed control. This instruction sheet explains how to determine what you will need and how to assemble each component.

MOTORS

Model	Stock #
24-33-2500	GPMG5150
24-33-3180	GPMG5155
24-33-3500	GPMG5160
24-33-4040	GPMG5165
24-33-4875	GPMG5170
24-45-2350	GPMG5175
24-45-2900	GPMG5180
24-45-3790	GPMG5185

The Ammo motors are labeled to provide the most information at a glance. For example, the 24-45-2350kV is 24mm in diameter, 45mm long and has a kV (rpm-per-volt) of 2350 rpm.



Motor Output Shaft
Diameter x Length: 3x11.7mm [0.12" x 0.48"]

Weight (33mm): 67g [2.4oz.]
Weight (45mm): 101g [3.6oz.]

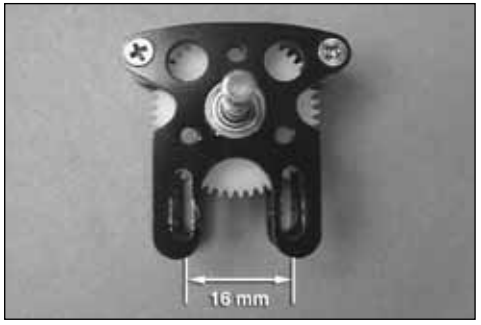
BRUSHLESS SMALL MOTOR MOUNT

1. Front Plate (1)
2. Back Plate (1)
3. 4-40x1/4" SHC Screw (8)
4. #4 Flat Washer (8)

Not Shown:
5. 3x8mm SHC Screw (4)
6. 3mm Flat Washer (4)

The ElectriFly Brushless Small Motor Mount combines ease of installation with the adjustability to fit most motor applications.

GEARBOX

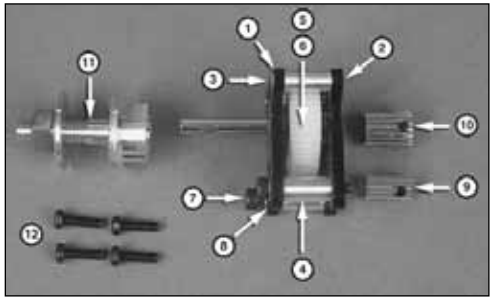


The ElectriFly Ammo motors have high kVs meaning that they like to run at very high rpm. A gear drive is used in order to reduce the rpm allowing a larger, more efficient propeller to be used. Great Planes ElectriFly offers a **24mm Small Gear Drive (GPMG0505)** with several pinions that allow for the following gear ratios:

Low Ratio > 5:1, 4.5:1, 4.3:1, 4:1, 3.6:1, 3.3:1, 3.1:1, 2.8:1, 2.5:1, 2.2:1, 2:1 < High Ratio.

If you use a prop that is too small with a gear ratio that is too low, the motor will draw very little current and the prop will turn at too low of an rpm to produce any usable power. The higher the gear ratio, the smaller the prop will need to be and the higher the rpm will be. If the gear ratio is too high for the prop used, the motor will draw excessive current and overheat. The included chart, on the inside of the header card, shows the motor/prop/gear ratios that have been tested and found to work well.

The 24mm Small Gear Drive is designed to fit the **Great Planes Small Motor Mount (GPMG1250)**.



1. Aluminum Front Plate (1)
2. Aluminum Back Plate (1)
3. 2.5x17mm FH Mach Screw (2)
4. 5.5x11mm Alum Spacer (4)
5. 40 Tooth Spur Gear (1)
6. 50 Tooth Spur Gear (1)
7. 3x20mm SHC Screw (2)
8. 3mm Flat Washer (2)
9. 11 Tooth Pinion Gear (1)
10. 16 Tooth Pinion Gear (1)
11. 4mm Collet Prop Adapter (1)
12. 3x6mm Machine Screw (4)

PROPELLER ADAPTERS

The 24mm Small Gear Drive uses a 4mm prop adapter. If you will be using the Ammo 24mm Motor without a gear drive, it requires a 3mm prop adapter (GPMQ4959).

GPMQ4930 3mm Set Screw Type
GPMQ4936 4mm Set Screw Type

GPMQ4959 3mm Collet Type
GPMQ4965 4mm Collet Type

PROPELLERS

There is a wide selection of propellers available for electric use. The 24mm motors use high performance electric props such as the APC E-Series props. The larger the propeller used, the more current your motor will draw. The smaller the propeller, the less current the motor will draw.

Shown are a few of the recommended electric props. Due to the large range of propellers and the constant addition of new sizes, visit our web sites at **www.electrifly.com** and **www.greatplanes.com** for the most up-to-date listing of electric type props.

APCQ4103.....7x5 Electric
APCQ4110.....8x4 Electric
APCQ4115.....8x6 Electric
APCQ4119.....9x7.5 Electric
APCQ4120.....10x5 Electric
APCQ4123.....10x7 Electric
APCQ4128.....11x7 Electric
APCQ4130.....12x6 Electric
APCQ4133.....12x8 Electric
APCQ4136.....12x10 Electric
APCQ3065.....13x6.5 Electric

BATTERIES: CHEMISTRY

The Ammo Motor/Silver Series ESC combination can use NiMH or LiPo batteries. Typically, NiMH batteries are heavier but much cheaper for the same capacity as LiPo batteries. If you want a very light, high-performance airplane, you might want to use LiPo batteries, but if weight is not a concern, then NiMH batteries might be for you.

BATTERIES: NUMBER OF CELLS

Cells can be connected in series or in parallel. Usually batteries are labeled as 8-cell NiMH or 3-cell LiPo. This means the cells are connected in SERIES (S). Arranging batteries in series gives you more power (higher voltage).

- Each NiMH cell has 1.2V, so an 8-cell NiMH battery has 1.2x8 = 9.6V
- Each LiPo battery has 3.7V, so a 3-cell LiPo battery has 3.7x3 = 11.1V

If you need a higher voltage than what is available in the LiPo battery line, you will need to connect two battery packs together in series. If you need a battery voltage of 14.8V you can use the **series Y-connector (GPMP3143)** to connect two 7.4V batteries together.

If a battery is arranged in PARALLEL it might be labeled as (P). Arranging the batteries in parallel will give you more duration (more capacity).

ElectriFly offers a full line of NiMH and LiPo batteries. Airplanes that use the Ammo 24mm motors will typically use batteries with a capacity of 910 to 2100mAh, with the higher capacity batteries delivering more flying time but also being heavier. Most of the batteries have connectors that fit the recommended ESC.

Due to the constantly changing battery technology, check out the ElectriFly web site at **www.electrifly.com** for the most up-to-date listing of the ElectriFly battery line.

ELECTRONIC SPEED CONTROL (ESC)

An ESC is basically the device that controls your motor through your radio system. Never run any Ammo motors with a brushed ESC. It will not work and you may damage both the motor and the ESC. Always use a brushless ESC. ElectriFly offers Brushless ESCs that will work with the Ammo 24mm motors.

ElectriFly **Silver Series 25** (SS-25) ESC **(GPMM1820)**
for 25A maximum constant current draw.

This ESC comes with 3.5mm female bullet connectors that plug directly into the 3.5mm male connectors installed on the Ammo 24mm motors, so no soldering is required. Also, this ESC comes with a Deans® Ultra battery connector that matches the connectors that are found on most batteries that it will use.

Stock #	Voltage	Capacity	Weight	Battery Type	# of Cells
GPMP0604	7.4V	910mAh	2.0oz (58g)	LiPo	2
GPMP0605	11.1V	910mAh	3.0oz (85g)	LiPo	3
GPMP0608	7.4V	1250mAh	2.6oz (74g)	LiPo	2
GPMP0609	11.1V	1250mAh	3.9oz (110g)	LiPo	3
GPMP0830	7.4V	1500mAh	2.6oz (73g)	LiPo	2
GPMP0831	11.1V	1500mAh	3.8oz (107g)	LiPo	3
GPMP0616	7.4V	2100mAh	4.3oz (121g)	LiPo	2
GPMP0617	11.1V	2100mAh	6.4oz (181g)	LiPo	3
GPMP0250	8.4V	1100mAh	5.6oz (160g)	NiMH	7
GPMP0251	9.6V	1100mAh	6.3oz (180g)	NiMH	8
GPMP0253	12.0V	1100mAh	7.9oz (225g)	NiMH	10

DETERMINE WHAT YOU NEED TO BUILD YOUR POWER SYSTEM

Now that you have a component for your power system, there are several different ways to select the rest of the components of your power system. In time, experience will help you to determine what works best for you, but an easy way to determine what you need now is the following.

PROCEDURE #1: If you know the size of the propeller you want to turn and the rpm, then look at the chart included in the packaging and:

- ❑ 1. Find the combination in the motor/prop chart that delivers the closest performance to what you want.
- ❑ 2. Note the gear ratio you need.
- ❑ 3. Note the recommended battery voltage.
- ❑ 4. Determine if you want to use LiPo or NiMH batteries based on the desired ready-to-fly airplane weight. Select the number of cells based on the recommended voltage shown on the chart.
- ❑ 5. Determine the battery capacity needed based on the current draw of your system and your desired flight time.
- ❑ 6. Determine the ESC you need based on the system current draw shown on the motor/prop chart. See the ESC section.

PROCEDURE #2: If you know the approximate weight of your airplane, including the motor and battery, and the performance you want from it, answer the questions below to determine the correct power system for your plane. You may need to make more than one calculation using different motors and battery combinations. See the battery section for some of the battery weights for the suggested batteries.

- ❑ 1. Perform the following calculation to determine the wattage required:
  - If you expect trainer-like performance then multiply **75** x **Airplane Weight (lbs)**
  - If you expect aerobatic or high speed-like performance then multiply **100** x **Airplane Weight (lbs)**
  - If you expect 3D or extreme performance multiply **150** x **Airplane Weight (lbs)**
- ❑ 2. The number you get is the minimum wattage you will need for your plane to perform as you wish. Look at the chart and determine what combination gives you the performance you want based on wattage and maximum propeller size that will fit on the plane.
- ❑ 3. Note the gear ratio you need.
- ❑ 4. Note the recommended battery voltage.
- ❑ 5. Determine if you want to use LiPo or NiMH batteries based on the desired ready to fly airplane weight. Select the number of cells based on the recommended voltage shown in the chart.
- ❑ 6. Determine the battery capacity needed based on the current draw of your system and your desired flight time.
- ❑ 7. Determine the ESC you need based on the system current draw.

In addition to these two procedures, you can also visit the Great Planes ElectriFly web site for descriptions of the power systems recommended for our line of electric and glow airplanes as well as more detailed explanation on the subject.

UNDERSTANDING MOTORS

kV (rpm/volt): This is a number that gets thrown around quite a bit when talking electrics and it is important to know what it is. kV is the number of rpm a motor will spin per each volt applied (rpm/volt) under no load.

This means that basically a motor that has a kV of 1000 when connected to a 12V battery will try to spin at 12,000rpm (1000x12) under no load. Likewise a 3500kV motor will try to spin at 42,000rpm (3500x12) under no load.

When a propeller is attached to the motor, the motor will try to spin the prop at the rated kV. Depending on the diameter and pitch of the propeller (the larger the diameter or higher the pitch, the harder it is to spin), the motor's current draw can be increased or decreased. There are meters available from your hobby dealer that measure current and voltage.

Because every motor has a maximum current it can take based on its design and cooling ability, the maximum size of propeller that can be used with each motor can be determined. Too large of a propeller and the motor will spin at a much lower rpm than its rated kV, causing it to draw a lot of current and overheat. If the propeller/fan is too small, it will require little effort (current) to turn the prop at the rated kV.

Ideally the motor should be matched with a propeller that causes the motor to draw 80-100% of its rated maximum constant current. Once a power system is set up, it can be fine-tuned by adjusting the propeller size and measuring the amount of current the motor is drawing.

Please note that the kV of a motor does not change with voltage, but if a higher voltage is applied to the motor, it will try to spin the same propeller at a higher rpm. This will cause the motor to draw more current and possibly exceed the maximum rated current of the motor. So, if a battery with lower voltage is replaced with one with a higher voltage, it is recommended that a smaller propeller be used to keep the current in check. If a higher voltage battery is replaced by a lower voltage battery, the size of the propeller can be increased to keep the motor at its rated current.

Another possibility to fine tune the power system's performance is to use another motor with higher kV to increase the current or a lower kV to lower the current.

ASSEMBLE YOUR POWER SYSTEM

INSTALL THE PINION GEAR

Once you have determined the gear ratio required, the brass pinion gear must be installed on the motor shaft. The pinion gear is a press fit on the motor shaft and it will need to be heated and pressed on. Never force the pinion gear on the shaft without supporting the other end of the motor shaft. A small wheel collar works well for supporting the motor shaft. If you have a drill press the motor can be placed in a vise with the motor shaft supported on a small wheel collar. Use a small micro torch to heat the pinion gear and use the drill chuck of the drill press to press the pinion onto the shaft.

Note: The pinion gear uses a small set screw to secure the pinion gear to the motor shaft. When installing the pinion gear make sure that the flat on the motor shaft is aligned with the set screw.

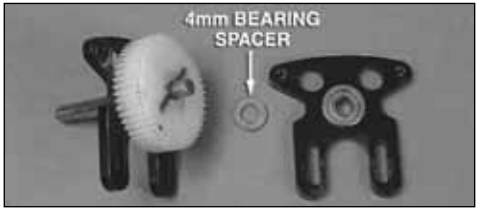
If you do not have a drill press a small vise can also be used. Place the motor between the jaws of the vise with the end of the motor shaft supported and the pinion gear centered on the motor shaft. Heat the pinion gear and slowly close the jaws of the vise. You may need to use a second wheel collar so that the pinion gear can be pressed on past the end of the motor shaft.

Once the pinion gear is in position on the motor shaft, apply a drop of threadlocker to the threads of the set screw and tighten it down on the flat of the motor shaft.

REMOVAL OF THE PINION GEAR

The best method of removing the pinion gear is by heating it with a micro torch and using a pinion puller to carefully pull the gear off.

REPLACING THE SPUR GEAR



To remove the spur gear, loosen and remove the two 2.5x17mm flat head machine screws and 5.5mm aluminum spacers. Remove the backplate, being careful to not lose the 4mm bearing spacer.

Press the output shaft out of the spur gear and remove the spur gear pin. The spur gear can now be replaced. Reverse the order to reassemble the gear drive. Be sure to use a drop of threadlocker on the two 2.5x17mm flat head machine screws to prevent them from loosening during operation.

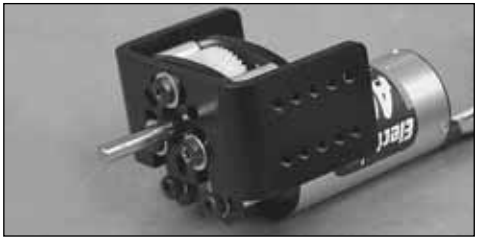
MOUNT THE MOTOR TO THE GEAR DRIVE

Loosely mount the motor to the back of the back plate with two 3x20mm SHC screws and two 3mm flat washers. Place a piece of notebook paper between the pinion gear and the spur gear. Squeeze the two gears together while tightening the two 3x20mm SHC screws. Remove the piece of paper and the gear mesh should be set. Rotate the gears to make sure they rotate smoothly. If they do not, slightly loosen the gear mesh until the gears do rotate smoothly.

MOUNT THE BRUSHLESS SMALL MOTOR MOUNT

In the center of the header card you will find the mounting hole pattern template for the Brushless Small Motor Mount. The Motor Mount can be attached to the firewall using 4-40 machine screws and blind nuts installed in the back of the firewall. Use the center lines on the template to properly align it on the firewall.

Attach the Backplate to the firewall using four 4-40 machine screws and four #4 flat washers. Note that if you are using a gear drive you may have to cut a hole in the firewall for the motor. Most motors and gear drives can be mounted to the Front Plate using 3mm machine screws. If you are using a different gear drive other than the Great Planes gear drive, the hole locations may need to be modified.

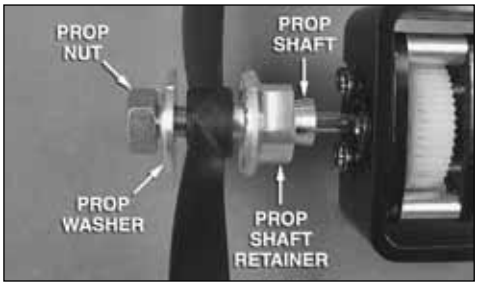


In-runner motors that will be run direct drive or gear drive and are mounted inside the front plate.

Out-runner motors can be mounted inside the front plate in some situations using three 3x8mm SHC screws, but most of the time they will be mounted on the front of the front plate.

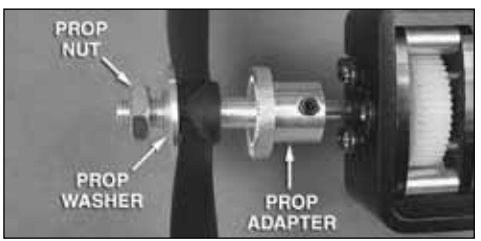
Install the prop adapter on the motor shaft or gear drive output shaft. The Brushless 24mm Gear Drive uses a 4mm prop adapter **(GPMQ4965 Collet Type or GPMQ4936 Set Screw Type).** The Ammo 24mm motors direct drive uses a 3mm prop adapter **(GPMQ4959 Collet Type or GPMQ4930 Set Screw Type)**.

COLLET TYPE PROP ADAPTER INSTALLATION

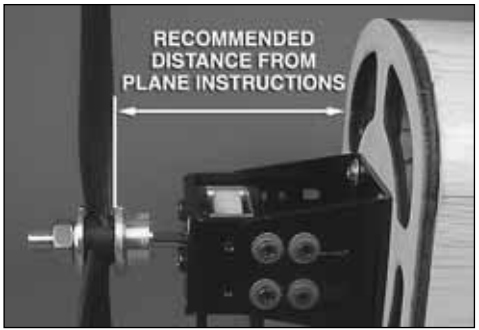


Slide the prop shaft over the output shaft of the gear drive or motor. Next slide the prop shaft retainer over the prop shaft. Note that the hole through the retainer is tapered. Make sure that the side with the larger diameter hole is installed first. Install the spinner backplate (if used, **not included**), the prop, prop washer and then the prop nut. Tighten the prop nut against the prop. This will cause the tapered hole in the prop shaft retainer to squeeze the prop shaft around the output shaft. Carefully pull on the prop to make sure it is securely attached to the output shaft of the gear drive.

SET SCREW TYPE PROP ADAPTER INSTALLATION



Slide the prop adapter over the output shaft of the gear drive or motor. Align one of the set screws with the flat on the output shaft of the gear drive. Apply a drop of Great Planes **Threadlocker (GPMR6060)** to the set screw and install it in the prop adapter, tightening it against the flat of the gear drive output shaft. Remove the second set screw that does not tighten onto the flat. When installing the prop adapter onto a shaft that does not have a flat spot, tighten both of the set screws against the shaft. Install the spinner backplate (if used, **not included**), the prop, prop washer and then the prop nut. Tighten the prop nut against the prop. Carefully pull on the prop to make sure it is securely attached to the output shaft of the gear drive.



Determine the distance the prop adapter needs to be from the firewall by using the recommended distance in the instructions or by installing the cowl and measuring the distance from the firewall to the front of the cowl. Add approximately 3/32" to 1/8" to the distance. Attach the Front Plate of the motor mount to the Back Plate using the eight 4-40x1/4" SHC screws and eight #4 flat washers, spaced out as far as possible. A drop of threadlocker on the screws will prevent them from coming loose.

When mounting some of the Rimfire out-runner motors you may need to remove the brass collar and install the aluminum spacers on the motor shaft to space the collar behind the Front Plate to prevent it from rubbing on the Front Plate.

INSTALL THE BRUSHLESS ESC

Because most of the power systems using the 24mm Ammo motor are drawing less than 25 amps constant, the ElectriFly SS-25 Brushless ESC (GPMM1820) will work well. Note that if you will be operating the motors at the surge currents a higher current ESC will need to be installed. Always make sure that the ESC is installed in a location that allows plenty of cooling air to flow over it.

Follow the instructions included with the Brushless ESC to properly install and program it.

AMMO MOTOR MAINTENANCE

Ammo brushless motors require virtually no maintenance. There are no brushes to wear out and replace. The precision bearings have a very long service life and should last a very long time. The internal parts of the motor should not require any cleaning.

IMPORTANT PRECAUTIONS

- Once the battery is connected to the ESC, stay clear of the motor and prop.
- DO NOT apply an input voltage that exceeds the maximum specification of each motor.
- DO NOT apply currents to the motor that exceed the maximum specifications of each motor.
- DO NOT allow the input connectors to accidentally touch each other while power is applied to the motor. Make sure all input connections are insulated electrically.
- DO NOT allow water or moisture to enter the motor, as it can cause permanent damage to the motor and possibly short out the attached ESC.
- DO NOT cut the coated wires from the motor. If you must remove the bullet connectors, unsolder them.
- Allow the motor to cool after each flight.
- The motor shaft of the motor will rotate at very high rpm. DO NOT attempt to touch the shaft while it is rotating. If setting up the motor/ESC on the workbench, make sure the motor is securely attached and that nothing is attached to the motor shaft BEFORE applying power.
- Never attempt to use a damaged motor (having mechanical or electrical defects).
- Great Planes carries a complete line of Ammo (in-runner style) and Rimfire (out-runner style) brushless motors, gear drives, motor mounts, prop adapters and speed controls. For a complete list of these products, check out our web sight at:

www.greatplanes.com
www.electrifly.com

or visit your nearest hobby shop that carries the full line of Great Planes and ElectriFly products.

