

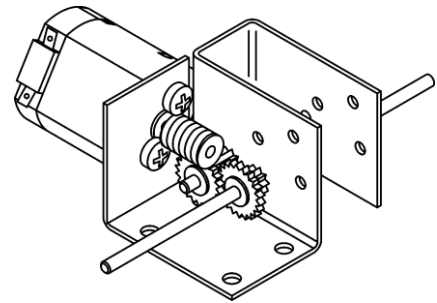
# VERSATILE GEARBOX KIT

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**DESCRIPTION**

The VERSATILE GEARBOX KIT has a number of components supplied. These allow the maker to choose and assemble one of four possible gearbox ratios, according to the desired drive speed.



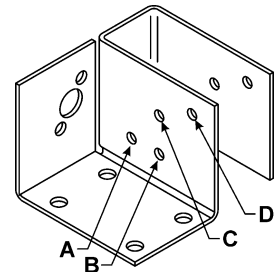
**SECTION 1: GENERAL AND PLANNING INFORMATION**

**1. DESIGN CONSIDERATIONS**

**1.1 SELECTING THE GEARBOX RATIO**

The designer has to determine which of the 4 gearbox speeds will be used. At the same time, you also need to determine whether the axle shaft will be two sided (such as for a vehicle's rear axle) or single sided (such as a windmill), and what the length either side needs to be.

NOTE: The motor is rated at 1.5 to 4.5 Volt, and operates - without load - at approximately 9,000 RPM.



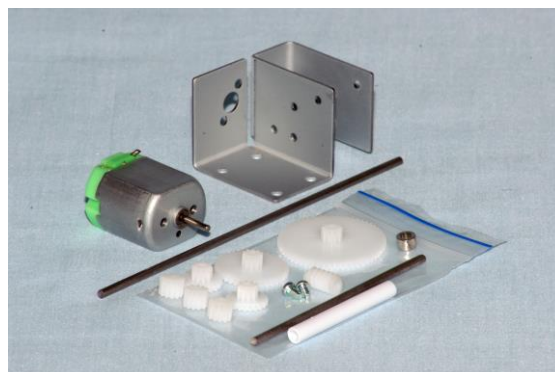
Output Shaft hole	A	B	C	D
Ratio	1:22	1:48	1:88	1:290

OUTPUT SHAFT HOLE LOCATIONS

**SECTION 2: COMPONENTS & MATERIAL REQUIRED**

**2.1 COMPONENTS SUPPLIED**

The following components are supplied in the kit:



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## 2.2 TOOLS REQUIRED

The following tools are required:

- Small hammer
- Wood block, at least 25mm thick.

# SECTION 3: ASSEMBLY

## 3.1 GENERAL ASSEMBLY INFORMATION

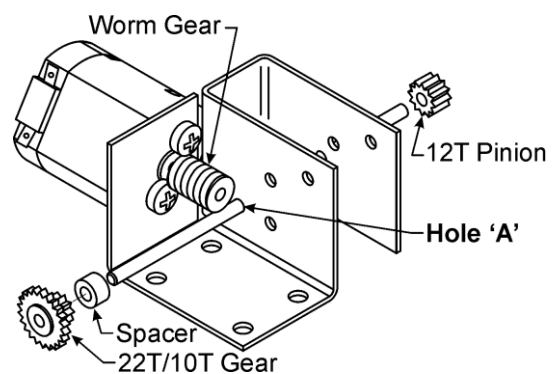
The assembly sequence consists of assembling the outer gear and shaft first, followed by the inner shaft and gear. The last item to be assembled is the motor and worm gear.

NOTE: The 40mm long 3.0mm inside diameter white PVC tube is to assist in assembling gears onto the shafts, but it is not part of the gearbox.

## 3.2 ASSEMBLING THE GEARBOX

### 3.2.1. 1:22 VERSION

- Place a 22T/10T gear on the bench with the 10T gear facing upwards. Place the 120mm long 2.5mm diameter steel shaft into the gear's hole. Use a small hammer to tap the shaft into the hole until the shaft reaches the gear's other side.
- Place the spacer onto the shaft and place the shaft through Hole "A" as shown.
- Place a 12T pinion gear on the bench and insert the end of the shaft into the gear's hole. Use a small hammer to tap the shaft into the gear hole until the shaft reaches the other side of the gear.
- Turn the gearbox over, placing the 22T gear on top of the block of wood. Place the 40mm white tube on top of the shaft with the 12T gear, and use it to tap the 12T pinion gear down to the gear case.



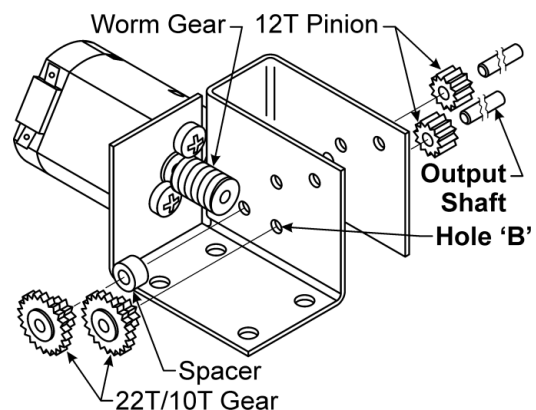
### 3.2.2. 1:48 VERSION

For this gearbox you will need two shafts:

- One longer shaft - up to 120mm long (this is the output shaft).
- One shaft 35mm long (cut from the 70mm shaft).

#### THE OUTPUT SHAFT

- Assemble the 22T/10T gear to the longer of the 2.5mm diameter steel shafts, by placing the 22T/10T gear on the bench with the 10T gear facing upwards. Place the shaft into the gear's hole. Use a small hammer to tap the shaft into the hole until the shaft reaches the gear's other side.
- Place this shaft through hole "B" as shown in the picture.
- Place a 12T pinion gear on the bench and insert the end of the long shaft into the gear's hole. Use a small hammer to tap the shaft into the gear hole until the shaft reaches the other side of the gear.



- Turn the gearbox over, placing the 22T gear on top of the block of wood. Place the 40mm white tube on the top of the shaft with the 12T gear, and use it to tap the 12T pinion gear down to the gear case.
- NOTE: The longer shaft is the output shaft, and the wheel (or other driven item) will be mounted on it.

### THE SHORTER SHAFT

- Assemble the second 22T/10T gear and the 35mm shaft - as previously described.
- Place the spacer onto this shaft and place the shaft through Hole "A" as shown.
- Install the second 12T pinion gear onto this shaft - as previously described.

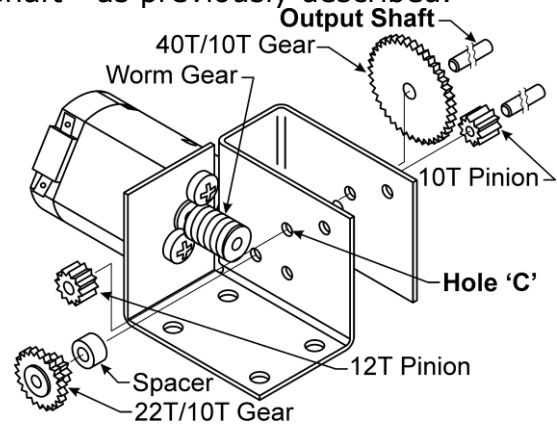
#### 3.2.3. 1:88 VERSION

For this gearbox you will need two shafts:

- One long shaft - up to 120mm long (this is the output shaft).
- One shaft 35mm long (cut from the 70mm shaft).

### THE OUTPUT SHAFT

- Place one 12T pinion gear on the bench. Place the long 2.5mm dia. steel shaft into the gear's hole. Use a small hammer to tap the shaft into the gear hole until the shaft reaches the other side of the gear.
- Place this shaft (with the 12T pinion gear) through hole "C".
- Place the 40T/10T gear with the 10T gear facing down wards on the bench and insert the other end of the shaft into the gear's hole. Use a small hammer to tap the shaft into the gear hole until the shaft reaches the other side of the gear.
- Place the 40mm white tube on the top of the shaft with the 40T/10T gear and use it to tap down the 40T/10T gear to the gear case.



### THE SHORTER SHAFT

- Place a 22T/10T gear on the bench with the 10T gear facing upwards. Place the 35mm long steel shaft into the gear's hole and repeat the process as for the previously described gear and shaft.
  - Place the 12T gear on top of the 25mm thick block of wood.
  - Place the spacer onto the shaft and place the shaft through Hole "A". Repeat the process described previously to put the 12T pinion gear in place.
- NOTE: Ensure that the 12T pinion gear meshes with the 40T/10T gear.

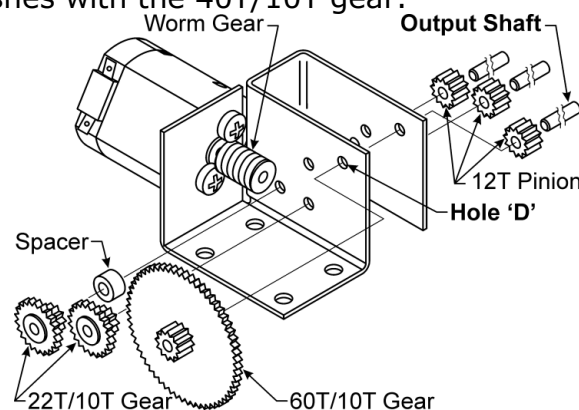
#### 3.2.4. 1:290 VERSION

For this gearbox you will need three shafts:

- One long shaft - up to 120mm long (this is the output shaft).
- Two shafts 35mm long (cut from the 70mm shaft).

### THE OUTPUT SHAFT

- Place the 60T/10T gear on the bench top with the 10T gear facing downwards. Place the long shaft into the gear's hole. Use a small hammer to tap the shaft into the gear hole until the shaft reaches the other side of the gear.
- Insert the shaft with the 60T/10T gear into hole "D" as shown in the illustration.



- Place a 12T pinion gear on the bench and insert the end of the shaft into the gear's hole. Use a small hammer to tap the shaft into the gear hole until the shaft reaches the other side of the gear.
- Place the 60T gear on top of the 25mm thick block of wood. Place the short length of 40mm white tube on the top of the 12T gear and use it to tap down the 12T pinion gear to the gear case.

### **THE INTERMEDIATE AND TRANSFER SHAFTS**

- Place one 22T/10T gear on the bench with the 10T gear facing upwards. Place a 35mm shaft into the gear's hole. Use a small hammer to tap the shaft into the gear hole until the shaft reaches the other side of the gear.
- Repeat this process with the second 22T/10T gear and shaft.

### **THE INTERMEDIATE SHAFT**

- Insert one of the shafts with the 22T/10T gear into hole "B".
- Place a 12T pinion gear on the bench and insert the end of the shaft into the gear's hole. Use a small hammer to tap the shaft into the gear hole until the shaft reaches the other side of the gear.

### **THE TRANSFER SHAFT**

- Place the spacer onto the remaining 22T/10T shaft and insert the shaft into hole "A". Repeat the process used previously for the 12T pinion gears.
- The gears should not press against the gear case and prevent the shaft from turning freely. If it is a tight fit it can be loosened by slightly pulling the "U" section of the gear case apart. The shaft should not be loose, allowing movement of the shaft and possibly preventing proper meshing of the gears.

## **3.3 ASSEMBLING THE MOTOR AND WORM GEAR**

Place the worm gear on a solid bench top. Place the end of the motor shaft into the hole in the worm gear. Tap the end of the motor shaft with a small hammer until the worm gear is within **2-3mm** of the motor body.

Place the motor into position and use the two small self tappers to secure the motor to the gearcase.

## **3.4 GENERAL NOTES**

- The 12T pinion gears should not press against the gear case and prevent the shafts from turning freely. If either gear is a tight fit it can be loosened by slightly pulling the "U" section of the gear case apart.
- The shaft should not be loose, as that will allow movement of the shaft and possibly prevent proper meshing of the gears.

## **3.5 FUNCTIONAL TESTING**

Apply a suitable voltage to the motor to check for proper operation.

## **3.6 UPON COMPLETION**

Silicon spray lubricant can be used sparingly on the gears and gear case holes after assembly to reduce friction.