

# SHALLOW GEAR BOX and MOTOR

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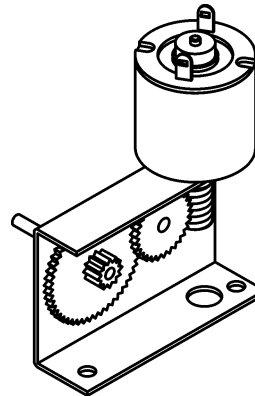
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## DESCRIPTION

The SHALLOW GEAR BOX AND MOTOR kit is an easy to assemble gearbox, and provides a choice of 2 gears. The unit is compact and allows the designer to utilise narrow spaces. It can be used in many applications where rotary motion is required. For example, it can be used in isolation (to drive or steer a model vehicle), or as part of a system, (to drive a pulley and belt assembly).

The gearbox can be used to drive, for example, one wheel or pulley through a single-sided shaft, or two wheels by using a longer shaft protruding through both sides.



## OPTIONAL CONFIGURATIONS

Using the supplied gear set, a choice of two gearbox speeds are available. This choice must be made before starting assembly.

## TECHNICAL DETAILS

With the SHALLOW GEARBOX AND MOTOR KIT, two reduction ratios are possible. The First output shaft is the one closest to the motor.

First output shaft                      Ratio 1:30

Second output shaft                      Ratio 1:125

The nominal voltage of the motor is 4.5V. The speed under load is approximately 9500 rpm. However, use of different voltages allows speeds to be either increased (12,600 rpm @6V/4xAA) or decreased (6500 rpm @3V/2xAA). The use of higher voltages may significantly shorten the motor's life.

## SECTION 1: GENERAL AND PLANNING INFORMATION

### 1. DESIGN CONSIDERATIONS

#### 1.1 GENERAL

Before starting assembly, the usage for the SHALLOW GEARBOX AND MOTOR kit should be decided, and the gear ratio decided upon. In addition, the length and orientation of the drive shaft should be worked out.

Before defining the shaft lengths, we suggest you read the instructions.



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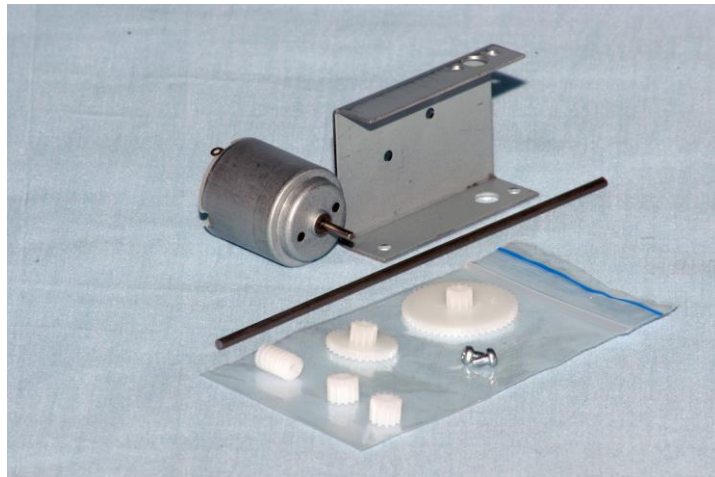
## 1.2 ITEMS FOR INVESTIGATION

This gearbox unit can be used in many ways, depending on the application chosen for investigation. As a starting point, you can look at how the two gear sets in this gear box work, and the power / torque that is provided.

## SECTION 2: COMPONENTS & MATERIAL REQUIRED

### 2.1 COMPONENTS SUPPLIED

The following components are supplied in the kit:



### 2.2 ADDITIONAL REQUIREMENTS

- Depending on the application chosen for this gearbox unit, other items required are available from *Scorpio Technology*. For example: additional gears, pulleys and belts, wheels and additional rods.

## SECTION 3: GEAR RATIO CALCULATION

The mechanical system is made up of a gear train containing 3 gears. The motor has a worm gear attached to its shaft. This drives a 30 tooth gear with a 12 tooth pinion gear. This in turn drives a 50 tooth gear - giving it a gear ratio of 1 to 125. The Gear Ratio can be calculated by the following formula for a gear train. A worm drive gear acts as a 1 tooth gear.

$$GR = \frac{\text{Driver}}{\text{Driven}} \times \frac{\text{Driver}}{\text{Driven}} = \frac{1}{30} \times \frac{12}{50} = \frac{1}{125} \text{ or a 1 to 125 speed reduction.}$$

## SECTION 4: ASSEMBLY

### 4.1 PREPARATION

Cut the steel rods to the required lengths. File and remove any burrs from both ends of the shafts.

## 4.1 ASSEMBLING THE GEARBOX

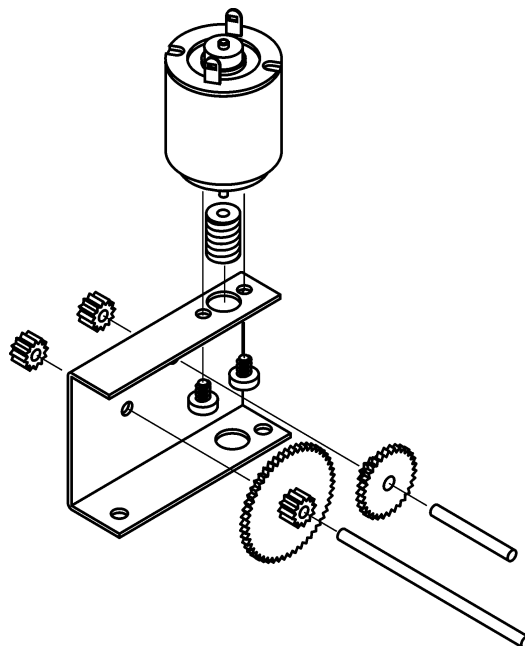
- Refer to the exploded view for a guide to gearbox assembly. Note that, if two gearboxes are needed for a vehicle, they can be assembled facing in the same way, except that the wheel shafts project in opposite directions.

## 4.2 ATTACHING THE MOTOR

- Fit the worm gear onto the motor's shaft.

*NOTE: Place the worm gear on the bench, insert the motor shaft into the hole in the worm gear and gently tap the end of the shaft where it exits the motor with a small hammer. Stop when the worm gear is 3mm from the motor's body.*

*WARNING: Don't just push the motor down by hand as this can push the motor armature out of its bearings and jam the motor.*



- Use two small self-tapping screws to attach the motor to the steel gearbox assembly plate.
- Solder two wires, of the desired length, to the motor's terminals.

## 4.3 ASSEMBLING THE GEARS AND SHAFTS

### 4.3.1. TO USE THE FIRST RATIO FOR THE OUTPUT SHAFT

- If using the first output shaft as the driving axle, the steel rod should be cut (with the end square) to the desired length, and de-burred.
- Tap the shaft into the 30 tooth gear, with the shaft protruding from both sides, as required.
- Fit a 12 tooth pinion gear to the shaft from the plate's other side, to prevent the shaft from sliding out. Tap the shaft into the pinion gear's hole, making sure that the 12 tooth pinion gear fits snugly up against the transmission assembly plate, but not so tightly that the shaft cannot turn.

### 4.3.2. TO USE THE SECOND RATIO FOR THE OUTPUT SHAFT

- Cut a small length of steel rod approximately 15mm long, file the ends square and de-burr it.
- Tap the short shaft into the 30 tooth gear (as shown on the right of the diagram).
- Cut the remainder of the steel rod to the length you require, file and remove burrs. The long shaft is then tapped into the 50 tooth gear.
- First insert the shaft (with the 50 tooth gear) into the transmission assembly plate hole, which is furthest away from the motor.
- Fit a 12 tooth pinion gear to the shaft from the plate's other side, to prevent the shaft from sliding out. Tap the shaft into the pinion gear's hole, making sure that the 12 tooth pinion gear fits snugly up against the transmission assembly plate, but not so tightly that the shaft cannot turn.
- Insert the shaft from the 30 tooth gear into the hole that is left, and fit a 12 tooth pinion gear to the shaft. Again it should be a snug fit, not a tight fit.

## SECTION 5: TESTING

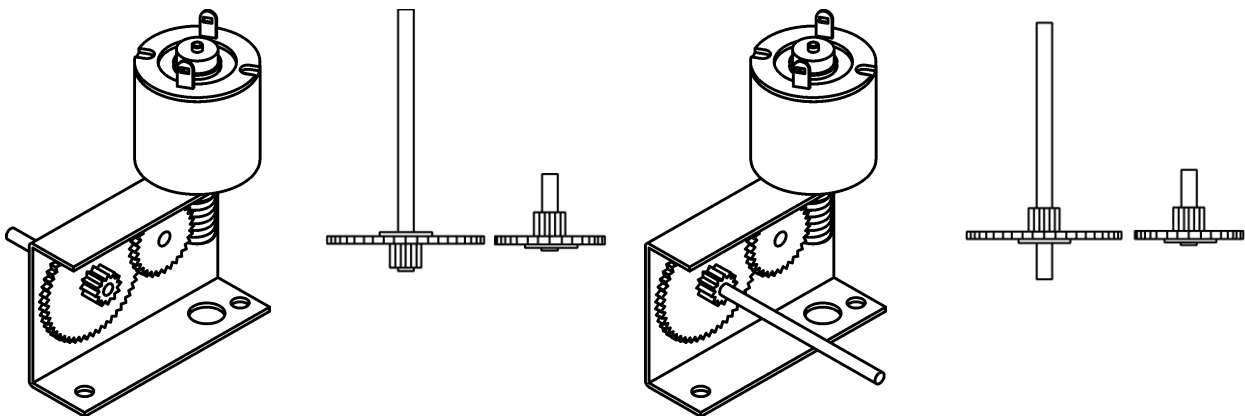
- Test the transmission by temporarily connecting a battery to the motors terminals.
- The motor should now turn the transmission assembly.
- If it does not you may have pressed the gears too firmly against the plate or you may have pushed the worm gear too far onto the motor's shaft preventing it from meshing properly with the 30 tooth gear.

## SECTION 6: ATTACHING THE GEARBOX

Two holes are provided in the gear case's bottom flange to allow the gearbox to be attached to a platform.

## SECTION 7: OPTIONAL CONFIGURATIONS

If the gear box is to be used with the long shaft protruding to only one side, the gearbox can either be turned around, or be set up with a left or right hand configuration.



*RIGHT GEAR TRANSMISSION*

*LEFT GEAR TRANSMISSION*

The diagrams show the fitment of the shafts into the 50 tooth gear and the 30 tooth gear.

*NOTE: One gear is flat side down and the other flat side up (as shown in the diagram). The gear with the flat side down must have the shaft protruding through by at least 7mm. The shaft in the other gear ends flush with the gear face.*