

INTERMEDIATE GEAR BOX

DESCRIPTION

The *INTERMEDIATE GEAR BOX* kit provides a choice of 4 gear ratios. Before starting, the desired ratio must be determined, as this defines the parts to be used, and the assembly procedure.

The Gearbox can be used on its own, or as a "building block" for a motorised system or vehicle.

The choice of ratios available at the „Output” shaft are:

- 1:4, 1:13.33, 1:44.44, 1:148.148

Under load, the motor speed is approximately:

- At 3 Volts (i.e. 2xAA batteries) 6,500 RPM
- At 6 Volts (i.e. 4xAA batteries) 12,600 RPM

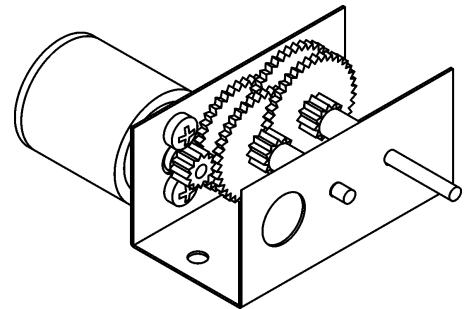


Figure 1 Intermediate Gear Box

INVESTIGATION

If desired, some preparatory research can be carried out, prior to making the gearbox. Some ideas:

- Investigate how gears work and explain gear ratios. Explain the motion of gears in a gear train.
- Give examples of different types of gear systems and where they are used.

1. COMPONENTS SUPPLIED

1.1 The following components are supplied in the kit:

- 1 x Intermediate Gearbox Case
- 1 x 4.5V Electric Motor (round)
- 2 x 2.5 dia x 100-150 long steel rod
- 1 x 3mm ID 1.0 thick Washer
- 1 x 100mm PVC Guide Tube (white)
- 4 x M2.6x4 Self-tapping Screw
- 4 x 40/10T Spur Gears (white) 2.4mm Hole
- 2 x 12T Pinion 2.4mm Hole
- 1 x 10T Pinion 1.9mm Hole

1.2 Also required (and available from us) are 2.6mm drills (refer 2.1.1)

2. MAKING THE GEAR BOX

2.1 PRELIMINARY TASKS

2.1.1. Determine the required ratio, as this will affect the component and rework requirements.

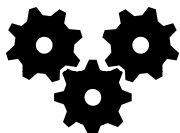
- If making a triple reduction gearbox, one of the 40/10T Spur gears must have the central hole enlarged (drilled) with a 2.6mm drill bit. This will allow the gear to freewheel on the shaft.
- If making a quadruple reduction gearbox, two of the 40/10T Spur gears must have the central holes enlarged with a 2.6mm drill bit. This will allow these gears to freewheel on the shafts.

2.1.2 based on the gearbox reduction, cut appropriate length spacers from the white PVC tube. Make sure that the ends are flat (at right angles to the tube) and de-burred..

2.1.3 Determine the required length of the shafts.

Note: the length of the output shaft must take into account the intended use of this gearbox (eg. will wheels be mounted on both ends, will one pulley be used etc.)

- Use sidecutters to cut the steel rods to the required lengths. Use a file to round off the ends.



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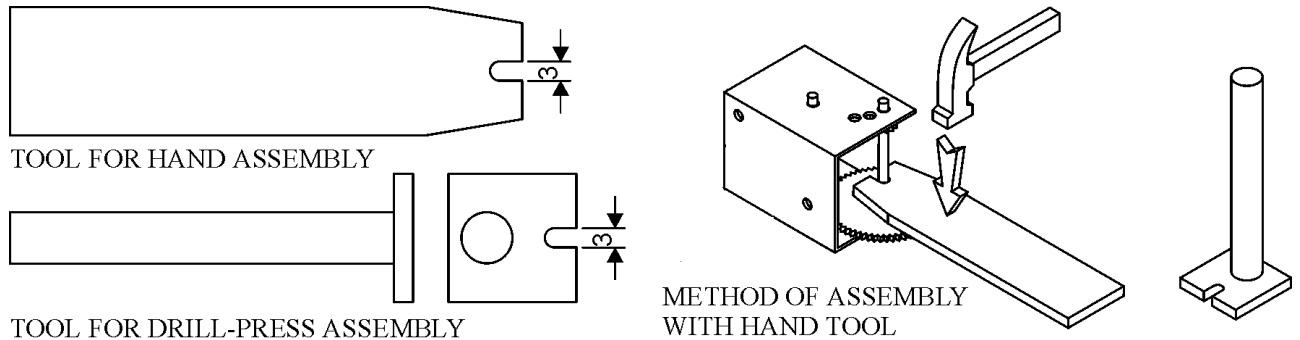
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2.2 ASSEMBLY

2.2.1 ASSEMBLY HINTS AND TOOLS

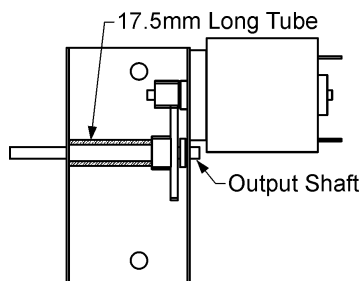
The following will aid your assembly work.

- As a jig, a piece of hardwood 40x60x150, with 3.0 dia holes drilled to varying depths is useful.
- Further, when the shaft starts to penetrate through the gear, a 1 mm thick plastic sheet can be placed, temporarily, between the gear and case to prevent damage.
- For advancing gears along the shaft, the following tool should be constructed. The tool on the right is used with the drill press. The tool shown on the left is used (gently) with the hammer.

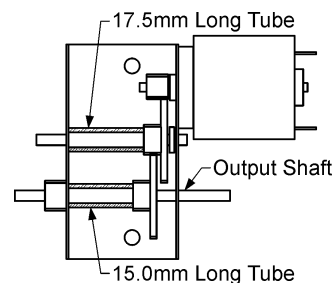


2.2.2 ASSEMBLING THE GEARBOX

- Assemble the steel rods, and all the gears, to the gearcase, as shown in the illustration.
- Use 12T pinion gears to retain the steel shafts in position.
- The gears can be assembled onto the shaft/s with a help of small hammer.



Single Reduction
Ratio = 1:4



Double Reduction
Ratio = 1:13

SINGLE AND DOUBLE REDUCTION GEARBOXES

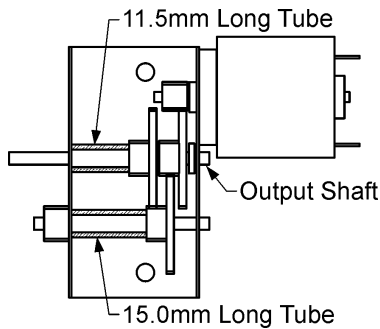
Note: for both Single and Double reduction gear boxes, the Spur gears are press fit.

- Start with the shaft nearest the motor. Insert the steel rod thru the gear case wall and the appropriate spacer tube, and assemble the rod through the 40/10T spur gear, keeping the 1.0mm washer between the gear case and the spur gear.
- Add the 2nd shaft, spacer tube, spur gear and 12T pinion gear (retainer).

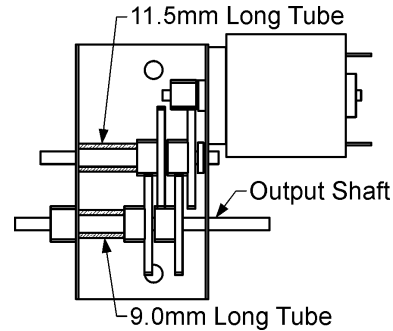
TRIPLE REDUCTION GEARBOXES

Note: for the Triple reduction gearbox, the first spur gear (closest to the gear case wall) has a 2.6mm drilled hole, making it a freewheeling gear.

- Start with the shaft nearest the motor. Insert the steel rod thru the gear case wall, the 1.0mm washer (keeping the washer between the gear case and the spur gear), and a modified spur gear.
- Add the 2nd shaft, spacer tube, an unmodified spur gear and 12T pinion gear (locator).
- Assemble an unmodified spur gear to the first shaft, together with a spacer tube



Triple Reduction
Ratio = 1:44



Quadruple Reduction
Ratio = 1:148

QUADRUPLE REDUCTION GEARBOXES

Note: for the Quadruple reduction gearbox, the first two spur gears (the first to be added onto each shaft, and closest to the gear case wall) are with the 2.6mm drilled holes, making them freewheeling gears.

- Start with the shaft nearest the motor. Insert the steel rod thru the gear case wall, the 1.0mm washer (keeping the washer between the gear case and the spur gear), and a modified spur gear.
- Add the 2nd shaft, with a modified (2.6mm hole) spur gear.
- Assemble an unmodified spur gear to the first shaft, together with a spacer tube
- Assemble an unmodified spur gear to the second shaft, together with a spacer tube

2.2.3 ASSEMBLING THE MOTOR

- Press the 10T pinion (1.9mm hole) onto the motor shaft. To do this, place the gear on the bench, insert the motor shaft into the pinion's hole and gently tap the shaft's end (where it exits the motor) with a small hammer. Stop when the pinion gear is 1mm 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.

- Solder the required length of wire to each of the motor's terminals.
 - Secure the motor to the gearbox case using two self-tapping screws.
- the other 2 self tappers, are for attaching the gearbox, using the 2 holes in the bottom of the gearcase