Assembling the rear upper arm

Your parts

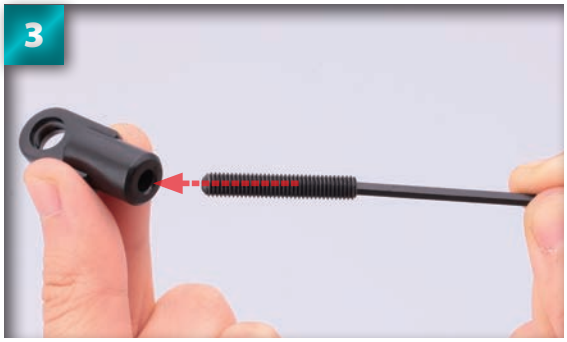
7.8mm ball ends × 4
5 × 30mm set screws × 2
7.8mm pillow balls × 2
3 × 20mm screws × 2

Tools and materials

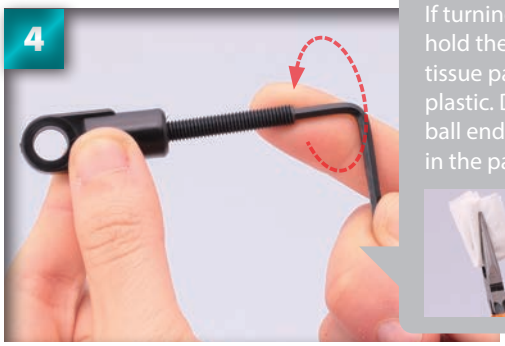
Phillips screwdriver
Pliers
Callipers
Tissue paper
2.5mm Allen key (Stage 7)
Rear bulkhead (Stage 12)
Rear drive shaft (Stage 12)

Insert the 2.5mm Allen key provided in Stage 7 into the hexagonal hole in the end of the 5 x 30mm set screw.

Note the thin line moulded on the one side of each ball end; this line will feature in instructions later on.



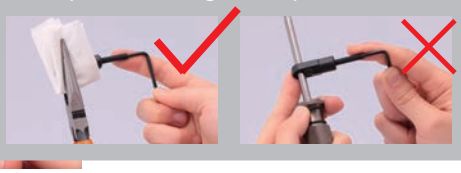
Carefully align the set screw to the hole in the ball end.



Using the Allen key, rotate the set screw until about a third is inside the ball end. Be careful not to force it, as this may damage the threads.

Tip!

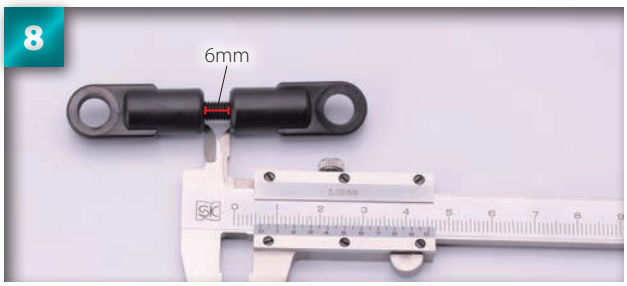
If turning the set screw becomes difficult, hold the ball end in a pair of pliers, using tissue paper to prevent any damage to the plastic. Do not use a screwdriver to hold the ball end through its hole, as this may result in the part becoming misshapen.

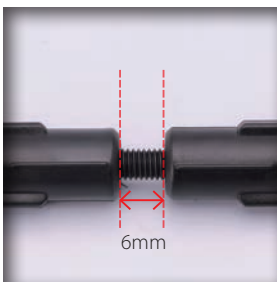


Keep turning the set screw until it resembles this image.

Line up the protruding end of the set screw with another ball end.

Turn the ball end so that the set screw enters the new part.



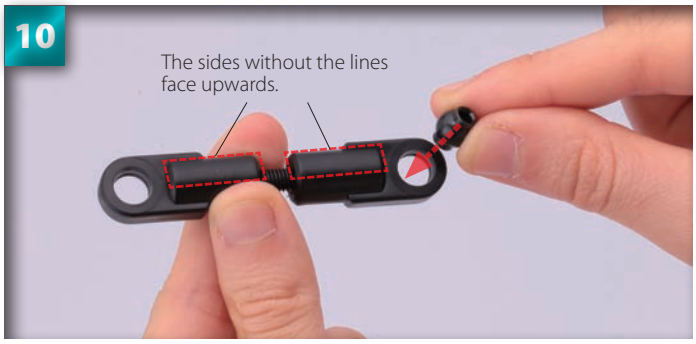


Keep turning until the exposed portion of the set screw measures 6mm. Use a ruler or a set of callipers to measure the gap.

9

Repeat Steps 1 to 8, so all of the ball ends are joined to form two track rods. Make sure that the spacing is the same for both.

10



Hold one track rod so that the side without the moulded line is facing up. Place a 7.8mm pillow ball so that its hole is perpendicular to that of the ball end, as shown.

11

Wrap tissue paper around the ball end and pillow ball for protection, then press into place with a pair of pliers.

12

Repeat Steps 10 and 11 for the second track rod.

13

Line up one track rod with the upper arm pivots of the bulkhead you assembled in Stage 12. The side of the track rod without the line should be facing you.

14

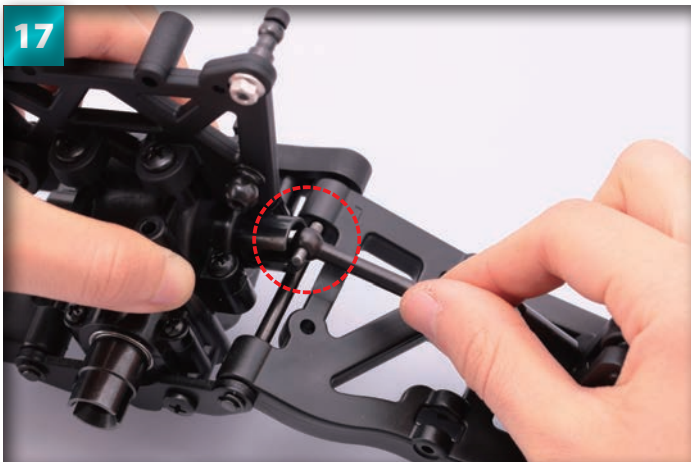
Align the holes of the pillow ball with those in the arm pivot, and insert a 3 x 20mm screw.

15

Carefully tighten the screw.

16

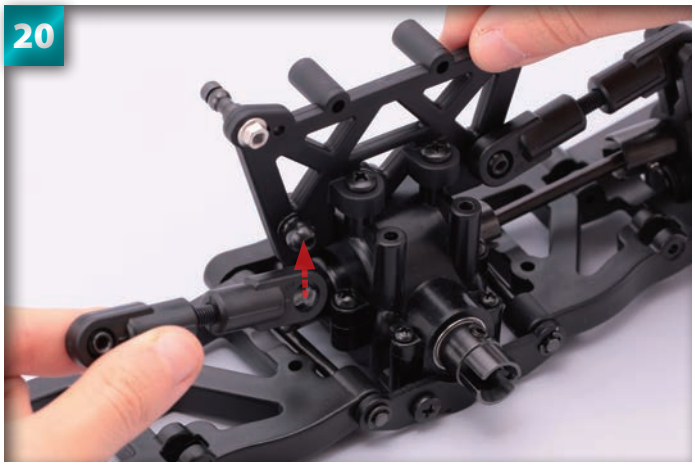
Slot one end of the rear driveshaft supplied with Stage 12 into the cup joint of the hub assembly.



Then slot the other end into the differential cup joint, circled.

Line up the track rod's unattached ball end with the flange ball fitted to the body of the rear dampener.

Again wrapping the parts in tissue paper, push the ball end onto the flange ball with a pair of pliers.



Line up your remaining track rod with the other flange ball on the rear dampener. This time, position it so that the side with the moulded line is facing you.

Wrap in tissue paper and push into place with pliers.

Assembled parts

Remember to keep any parts not used safely as they will be required in the coming stages.

Stage 14

Assembling the shock

Your parts

Shock case
Shock spring spacer
Rear shock spring
Shock spring stopper
2.6mm nut
2.3mm washers × 2
Shock piston
Stopper ring
3mm O-rings × 2
Shock shaft
11mm O-ring
Shock cap
6.8mm ball end

Tools and materials

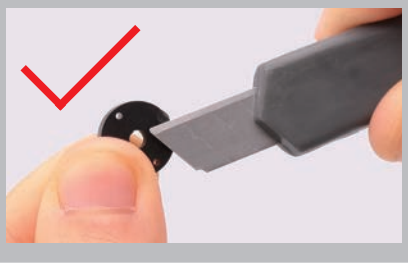
Pliers
Cutter knife
Callipers
Tissue paper
Shock assembly rod (Stage 4)
Shock oil (Stage 9)
6.8mm ball end (Stage 9)

Check the parts for any burrs and scrape off any that you find with a cutting knife, following the advice shown on the right.

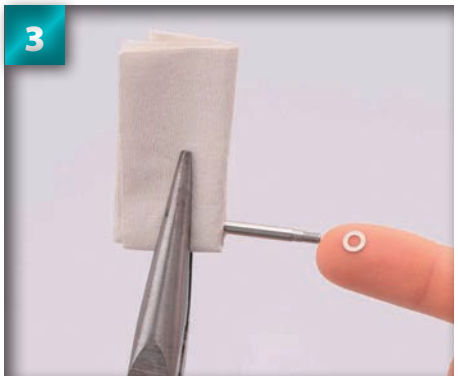
Tip!

Don't cut away anything on the outer surface of the piston unless it protrudes by a few millimetres, as it would be very easy to distort the shape.

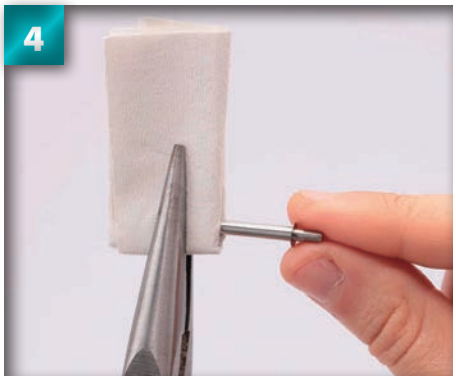
When removing burrs from the larger surface, cut away from you, moving the knife along the flat side of the piston.



To protect the thread on the shaft, wrap some folded tissue paper around it.

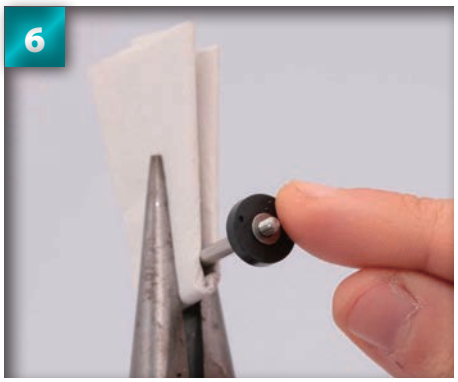


Hold the end of the shaft wrapped in tissue paper with pliers. Pick up one of the 2.3mm washers.



Place the 2.3mm washer over the exposed end of the shaft.

Place the piston onto the end of the shaft, up against the washer.



Place the second 2.3mm washer onto the end of the shaft, sandwiching the piston.

Tighten the 2.6mm nut onto the thread at the end of the shaft.

When you can no longer turn the nut by hand, use pliers to turn it by one more revolution.

Place the stopper ring on a flat surface, with the projections around the sides angled up.

Place the stopper ring onto the end of the shock assembly rod.

Check that the projections of the stopper ring are angled towards the rod.

Place one of the 3mm O-rings over the end of the rod.

Slide the second O-ring onto the rod up against the first.

Apply a small amount of shock oil to the O-ring at the end of the rod.

Place the shock cap onto the end of the rod, over the two O-rings and the stopper ring.

16 Hold the base of the rod and push straight down on the shock cap.

17 Push down hard on the shock cap until the tip of the rod is flush with the cap. The stopper ring's angled projections (see Step 9) should slot into the ridge on the inside of the shock cap, so that the two O-rings remain inside when the rod is removed (see photo in Step18).

18 Remove the shock cap from the rod and check that the two O-rings are held in place by the stopper ring. If not, repeat Steps 16 and 17.

Holding the cap with a tissue, pour a few drops of shock oil over the O-rings and stopper ring.

19

20 Take the shock shaft assembly and insert it into the hole in the centre of the shock cap.

21 Push the shaft all the way into the cap. Wipe off any oil from the shaft.

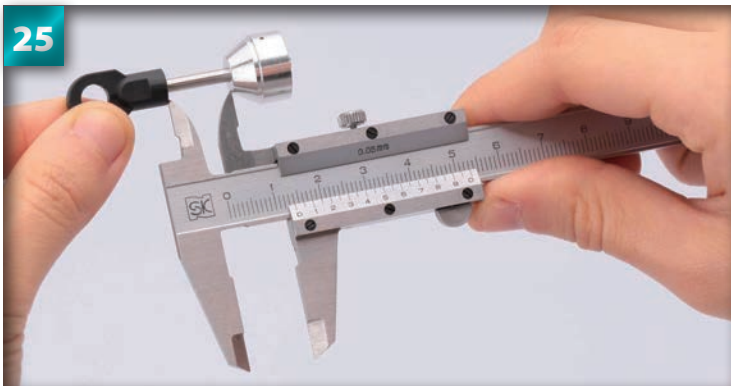
Wrap folded tissue paper around the shaft and grip with pliers.

22

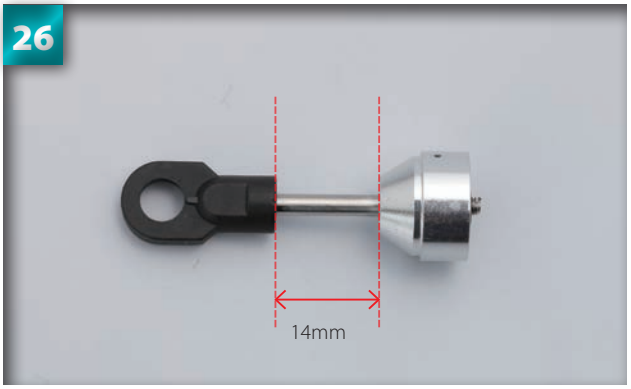
Insert the shaft into the hole on the 6.8mm ball end.

23

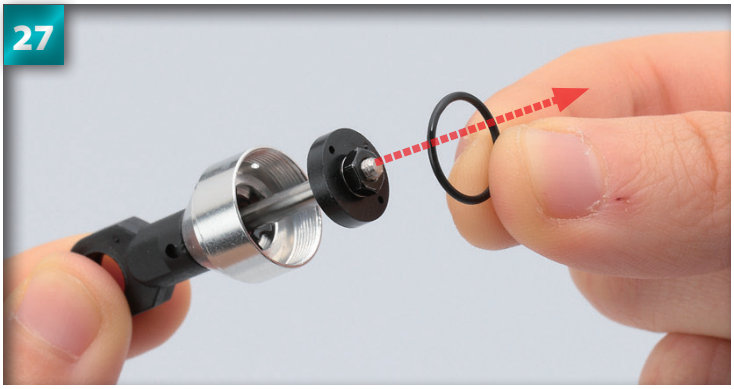
Screw the ball end onto the shaft until you can no longer see the thread of the shaft.



Measure the gap between the cap and the ball end. The ball end should be positioned 14mm away from the cap, so adjust the fit by either tightening or loosening it.



The gap between the cap and the ball end must be 14mm. If you don't have any callipers to measure it, just use a ruler.



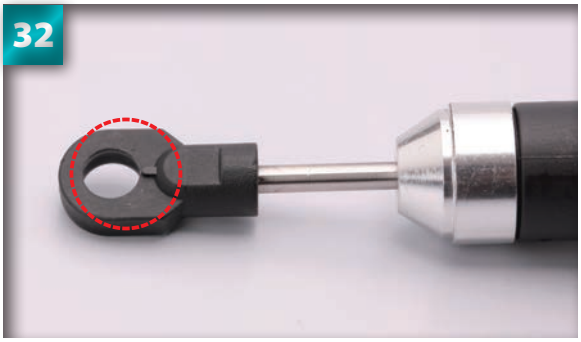
Push the shaft through the cap and then pass the piston through the 11mm O-ring.

Once the piston is through the 11mm O-ring, drop the ring down inside the shock cap.

The 11mm O-ring should rest in the groove on the inside of the shock cap, as shown.

Temporarily assemble the shock by inserting the shaft assembly into the shock case.

Screw the two parts together to temporarily secure them.



If you look carefully at the hole in the ball end, you'll see that it's smaller on one side than the other.

Hold the shock assembly so that the larger side of the ball end is uppermost. The 6.8mm pillow balls you kept from Stage 9 will fit into the hole.

Push the 6.8mm pillow ball into the hole in the ball end, keeping the hole in the ball aligned with that of the ball end.

Place folded tissue paper around the ball end and squeeze into place with pliers.

As this is only a temporary assembly, leave out the spring spacer, spring and spring stopper, and store these away safely for future assembly.

Assembled parts

Stage 15

Assembling the right rear hub

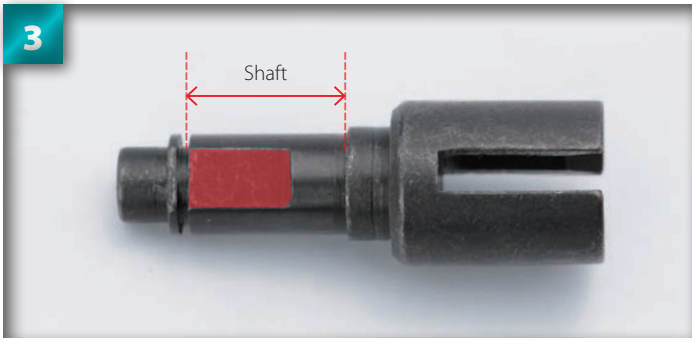
Right rear inside hub
Rear outside hub
15T gear
1260 metal bush
1480 metal bush
E6 E-ring
Differential cup joint
2 × 10mm cap screws × 7
3 × 48mm screw

Tools and materials

Cellophane tape
Marker pen
Grease

Place the 1480 bush into the recess in the rear hub.

Make sure the bush is pushed right into the recess in the hub.



Locate the shaft of the differential cup joint.

Spread a small amount of grease saved from Stage 11 onto the shaft of the differential cup joint, as highlighted in the previous step.

Insert the differential cup joint into the rear hub, so that its shaft protrudes through the metal bushing.

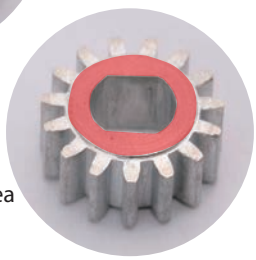
Turn the differential cup joint to spread the grease around, ensuring that the metal bush does not fall out of place.

Spread more grease over the shaft of the joint protruding from the bushing.

Back: flat area is small.

8

Identify the difference between the two sides of the 15T gear, shown here on the right.



Front: flat area is larger.

Hold the 15T gear with the back side showing, then turn it over and place this side first onto the end of the joint.

Push the gear down onto the joint, turning it back and forth to make sure it is correctly positioned.

Push the gear down onto the joint until flush with the bushing.

Assembled parts

Remember to keep any unused or spare parts safely in a plastic parts bag, as you will need these at a later stage.

Die-punched parts

Your remote control Hummer H1 employs a variety of 'punched parts' – small and often overlooked components that are, in fact, vital to automobile design.

Washers and E-rings are cut from plate metals using a metal die. The die is set to the desired shape, then forced down onto the surface of the metal to punch out the part, earning washers and E-rings the name 'punched parts'. On contact, the die's edges sink into the metal, causing indentations that give way to cut straight through – much like how an office hole puncher creates holes in paper. This leaves the front and back with different profiles: the front has curved edges, giving it a slightly inflated appearance, while the back is flat with angular edges. Both have their own uses in the design of your remote control Hummer.

For example, for fixed parts, a washer is sandwiched between the screw head and the part, with the front of the washer facing the screw head. There are two reasons for this. Firstly, the angled edges of the washer's back can be set more precisely into the receiving part. Secondly, with the the front's inflated profile facing the screw, a 'spring effect' is achieved, where the force of the screw turning swells the washer outwards slightly, increasing its axial tension by spreading its pressure, producing a far tighter hold than a screw alone.

For moving parts, the washer is turned around so that its smoother, curved face meets the component, rather than the screw. The sunken edges reduce the surface area in contact with the part, lessening friction and allowing for smoother motion. The use of a washer also reduces the risk of the bolt or screw becoming worn or coming loose through the vibration caused by the part's movement.

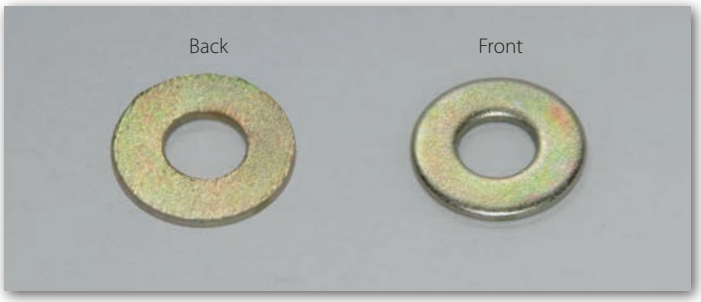
E-rings are used like washers, but their shape allows them to hold components in a more precise position, typically on a shaft. As with washers, they can be placed front or back side to the part depending on its use. The shim washer, or shim ring, resembles a circular washer, but rather than increasing a screw's axial tension, is used primarily to adjust the space between screws and parts. Shim washers are also used to add a layer of protection for components such as the bushes and bearing rings in the drive shaft of your remote control Hummer H1.

Front and back of the E-ring

The E-ring has a flat side and a rounded side, with the flat back offering the stronger hold when facing a part.

Front and back of the washer

The flat, angled back of the washer spreads the pressure when fastened to a fixed part, whereas the rounded front reduces surface contact, offering smoother movement for moving parts.



Fixed parts

A washer with the rounded front facing the screw head will swell out as the screw is tightened, spreading the pressure and creating a far stronger hold.

Moving parts

A washer with the rounded front side facing a moving part will allow smoother motion, where the screw alone would become loose or worn.

Adjusting a screw? Use a shim washer

Shim washers are thin round washers used to adjust the position and clearance of screws and bolts. Used to protect the metal bushing and bearings in the drive system, shim washers perform a vital role in the design of your remote control Hummer H1.

Shim washers come in various thicknesses and sizes, allowing for great precision when building the drive system.

Stage 16

Assembling the rear hub

Your parts

Rear driveshaft
2.5 × 12mm pin
Rear wheel shaft
E7 E-ring
16T gear
1480 metal bush
1680 metal bush
6mm flange nut
Wheel hub adapter
Wheel hub
2.5 × 14mm pin

Tools and materials

Pliers
Pen
Phillips screwdriver
Tweezers
Cross wrench (Stage 8)
1.5mm Allen key (Stage 11)
Grease (Stage 11)
3 x 20mm screw (Stage 13)
1260 metal bush (Stage 15)
3 x 48mm screw (Stage 15)
2 x 10mm cap screw x 6 (Stage 15)
Rear hub (Stage 15)
Rear bulkhead (Stage 15)
E6 E-ring (Stage 15)

1

Remove the 15T gear and differential shaft from the right rear hub inside you built in Stage 15.

2

Apply a small amount of grease to the rear wheel shaft, and place the 1480 metal bush onto it while turning the bush to spread the grease over it.

3

Pull the wheel shaft through the hole pictured, turning it as you do.

4

Insert the 2.5 × 12mm pin into the hole in the shaft. Adjust the angle of the shaft to make it easier to insert the pin.

5

Adjust the pin so that equal parts (circled) protrude on either side. Slide on the 16T gear so that the circled parts sit in the grooves in the back of the gear.

6

Place the E7 E-ring next to the groove on the wheel shaft, shown in red, with the rounded edge facing upwards.

7

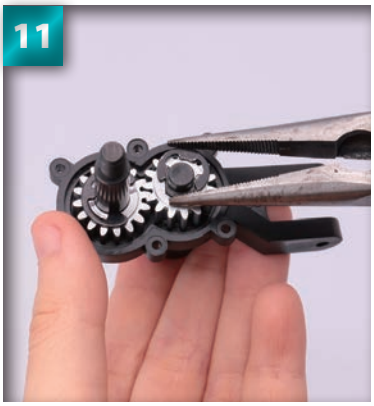
Carefully click the E-ring into place with pliers.

8

Replace the differential shaft you removed in Step 1, reapplying a little grease if necessary.

Apply a little grease to the metal bush, then mount the 15T gear you removed in Step 1. It should lock teeth with the 16T gear.

Line up the E6 E-ring to the groove on the differential shaft, again with the rounded edge facing upwards.



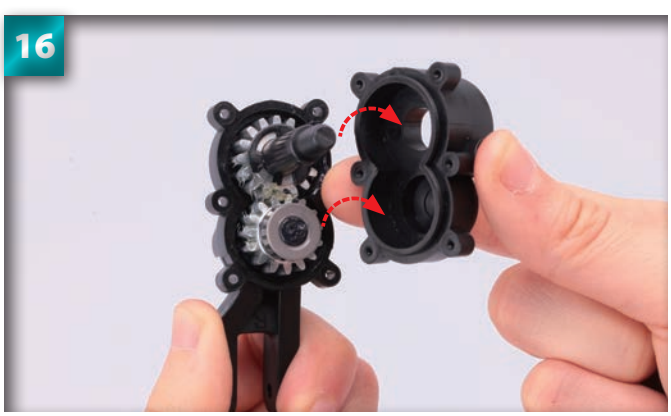
Click the E-ring into place with pliers.

Check that the two gears fit snugly.

Apply a small amount of grease to each tooth of the gears.

Slowly rotate the wheel shaft to spread the grease out evenly.

Grease the tip of the differential shaft, then slide on the 1260 metal bush supplied with Stage 15.



Place the outside rear hub supplied with Stage 15 over the assembly, positioning the hole over the shaft.

Push the two halves together by hand.

Use the 1.5mm Allen key to screw the 2 x 10mm cap screws into the holes lining the assembly.

19

Screw the six cap screws into the holes following the diagonal order shown here. If it is hard to tighten a screw, insert the Allen key into the hole first and turn it to increase the size of the hole slightly, but be careful not to make the hole too large.

Squeeze some grease into the gap surrounding the shaft.

Place the 1680 bush over the end of the shaft.

Push the bush straight down on the shaft, turning it slightly to spread the grease.

Place the wheel hub over the end of the shaft.

Locate the hole on the shaft above the 1680 bush, and align the hole of the hub with it (circled).

Push the wheel hub fully down the shaft, keeping the holes aligned, and insert the 2.5 × 14mm pin into the hole in the hub.

Push the 2.5 × 14mm pin all the way through the hub and the shaft. You may need to turn them slightly if the holes have become misaligned.

When the 2.5 × 14mm pin is fully in place and does not protrude from the sides of the wheel hub, place the wheel hub adapter over the end of the shaft.

Push the adapter down the shaft and over the wheel hub.

Place the toothed side of the 6mm flange nut over the end of the shaft.

Screw the flange nut onto the end of the shaft by hand. You may find it easier to do this if you hold the differential cup joint to prevent the shaft from turning.

Hold the rear bulkhead you built in Stage 13 in one hand, and with the other line up the hub assembly with the shaft at the bottom to the two struts of the left arm.

Insert the 3 × 48mm screw provided with Stage 15 into the hole in the arm strut. Push it through the holes in the hub until it is visible from the hole on the other side of the arm.

Tighten the 3 × 48mm screw into place.

Slot one end of the rear drive shaft into the wheel shaft.

Then slot the other end into the differential shaft on the bulkhead.

Position the track rod you assembled and fitted in Stage 13 in between the two upper arm pivots of the hub.

Insert the 3 x 20mm screw supplied with Stage 13 through the holes in the upper arm pivots and the pillow ball housed in the track rod.

Tighten the 3 x 20mm screw into place, being careful not to over-tighten.

Assembled parts