



# FORMULA GOBLIN

## KIT CAR MANUAL



# ***TOOLS REQUIRED FOR THE BUILD***

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- Metric Spanners (selection including 8,10,13, 17 and 19mm)
- Metric Allen Keys (selection)
- Hammer
- Safety Equipment
- Tyre Pump with Pressure Gauge
- Electrical Screwdriver
- Further tools may be required

# CONTENTS

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|   |           |   |           |
|---|-----------|---|-----------|
| <b>INTRODUCTION TO YOUR GOBLIN G2 KIT CAR</b> | <b>4</b>  | <b>BATTERY TRAY ASSEMBLY</b>              | <b>17</b> |
| <b>IMPORTANT HEALTH &amp; SAFETY NOTES</b>    | <b>5</b>  | <b>FITTING MOTOR CAGE TO CHASSIS</b>      | <b>18</b> |
| <b>CHASSIS ASSEMBLY</b>                       | <b>6</b>  | <b>FITTING BATTERIES</b>                  | <b>19</b> |
| <b>FITTING ROLL BAR</b>                       | <b>7</b>  | <b>SEAT ASSEMBLY</b>                      | <b>20</b> |
| <b>CHASSIS ASSEMBLY</b>                       | <b>8</b>  | <b>FITTING SEAT</b>                       | <b>21</b> |
| <b>STEERING COLUMN ASSEMBLY</b>               | <b>9</b>  | <b>FITTING GREENPOWER N PANEL</b>         | <b>22</b> |
| <b>FRONT AXLE ASSEMBLY</b>                    | <b>10</b> | <b>HARNESS ASSEMBLY</b>                   | <b>23</b> |
| <b>STEERING ASSEMBLY</b>                      | <b>11</b> | <b>WIRING INSTALLATION</b>                | <b>24</b> |
| <b>REAR AXLE ASSEMBLY LEFT</b>                | <b>12</b> | <b>G2 WIRING DIAGRAM</b>                  | <b>25</b> |
| <b>REAR AXLE ASSEMBLY RIGHT</b>               | <b>13</b> | <b>BATTERY CHARGING</b>                   | <b>26</b> |
| <b>BRAKE AND THROTTLE ASSEMBLY</b>            | <b>14</b> | <b>REBUILDS &amp; SPARE PARTS</b>         | <b>27</b> |
| <b>MOTOR CAGE AND ELECTRICS</b>               | <b>15</b> | <b>TEST DRIVING &amp; DRIVER TRAINING</b> | <b>28</b> |
| <b>MOTOR ASSEMBLY</b>                         | <b>16</b> | <b>FINAL PRE-RACE CHECKS</b>              | <b>29</b> |

# **INTRODUCTION TO YOUR GOBLIN G2 KIT CAR**

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- Welcome to your Goblin G2. We hope you enjoy the Greenpower experience!
- The key objective of building a Goblin is to encourage an appreciation and understanding of engineering and technology by the pupils involved. We recommend you involve a local engineer during the build to advise on technical matters and to act as a team mentor.
- If you have a large number of pupils involved, we suggest you divide them into a number of teams to work on different areas of the build such as Chassis Team, Front Axle Team, Steering Team, Rear Axle Team, Wiring Team and Bodywork Team. Each team can then operate separately from the others coming together for the final assembly.
- The method of assembly is basically clean and hence the project can safely take place in a classroom. Be aware that some parts may be covered in a light film of oil to prevent corrosion. It is advisable to use gloves when handling these parts.
- Remember that the completed car will need to be stored somewhere dry and batteries, after use, should be recharged and stored fully charged to maintain performance.
- Please ensure that pupils are carefully introduced to the tools used and that they use the correct tools for the various jobs.
- Before any driving takes place please read the Test Driving and Driver Training page of this manual.
- If you require any help whatsoever, please do contact Greenpower – We are here to help.

E: [info@greenpower.co.uk](mailto:info@greenpower.co.uk)

T: **01243 552305**

# **IMPORTANT HEALTH & SAFETY NOTES**

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**Although Goblin kits are designed to be built by 9-11 year olds there are still some potential risks when working with tools and electricity.**

## **Batteries**

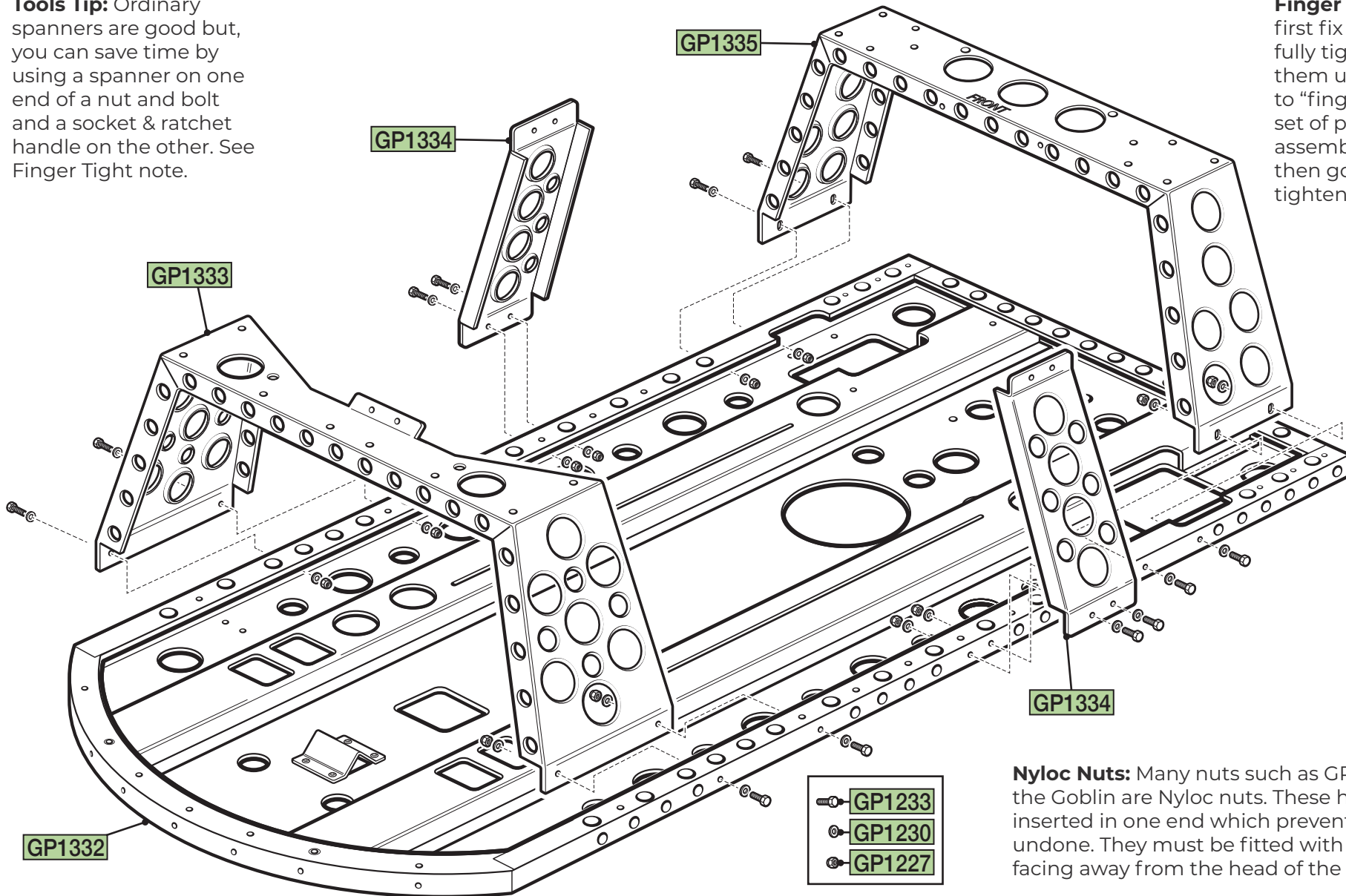
- The batteries are absorbed glass mat (AGM) type batteries, so cannot leak or spill making them safer than other lead acid type batteries.
- Caution must be taken when the batteries are out of their packing boxes as the terminals are exposed. We recommend that batteries are stored in their packing boxes when not in use in the car. Any shorting between battery terminals can be dangerous and damage the battery.
- Before first charging batteries check your charger voltage. A 12v charger will charge a single battery at a time. A 24v charger must only be used to charge a pair of batteries linked in series. Incorrect charging may damage batteries and be dangerous.
- Batteries should be stored fully charged and never be left discharged as this may result in damage. Once charging is complete remove from charge and store the batteries safely to prevent any chance of a short circuit.

## **Tyres**

- There is a risk of tyres bursting if over inflated. Please note the maximum pressure marked on the tyres and do not exceed this.
- Do not store tyres in direct sunlight as overheating can result in increased pressure and the risk of them bursting.

# CHASSIS ASSEMBLY

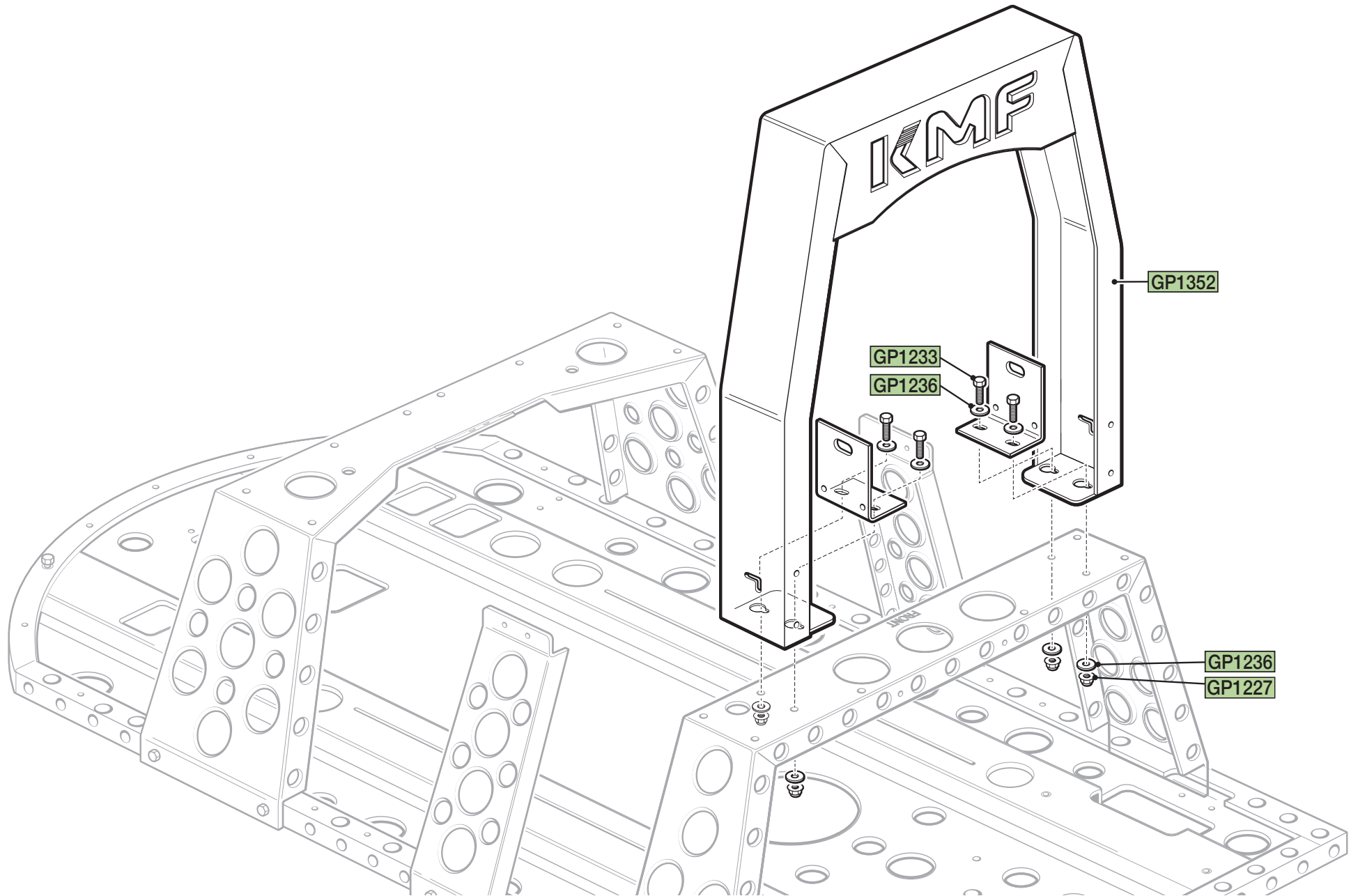
**Tools Tip:** Ordinary spanners are good but, you can save time by using a spanner on one end of a nut and bolt and a socket & ratchet handle on the other. See Finger Tight note.



**Finger Tight:** When you first fix nuts & bolts, don't fully tighten them. Do them up just with fingers to "finger tight". Once a set of parts have been assembled and aligned fully tighten them.

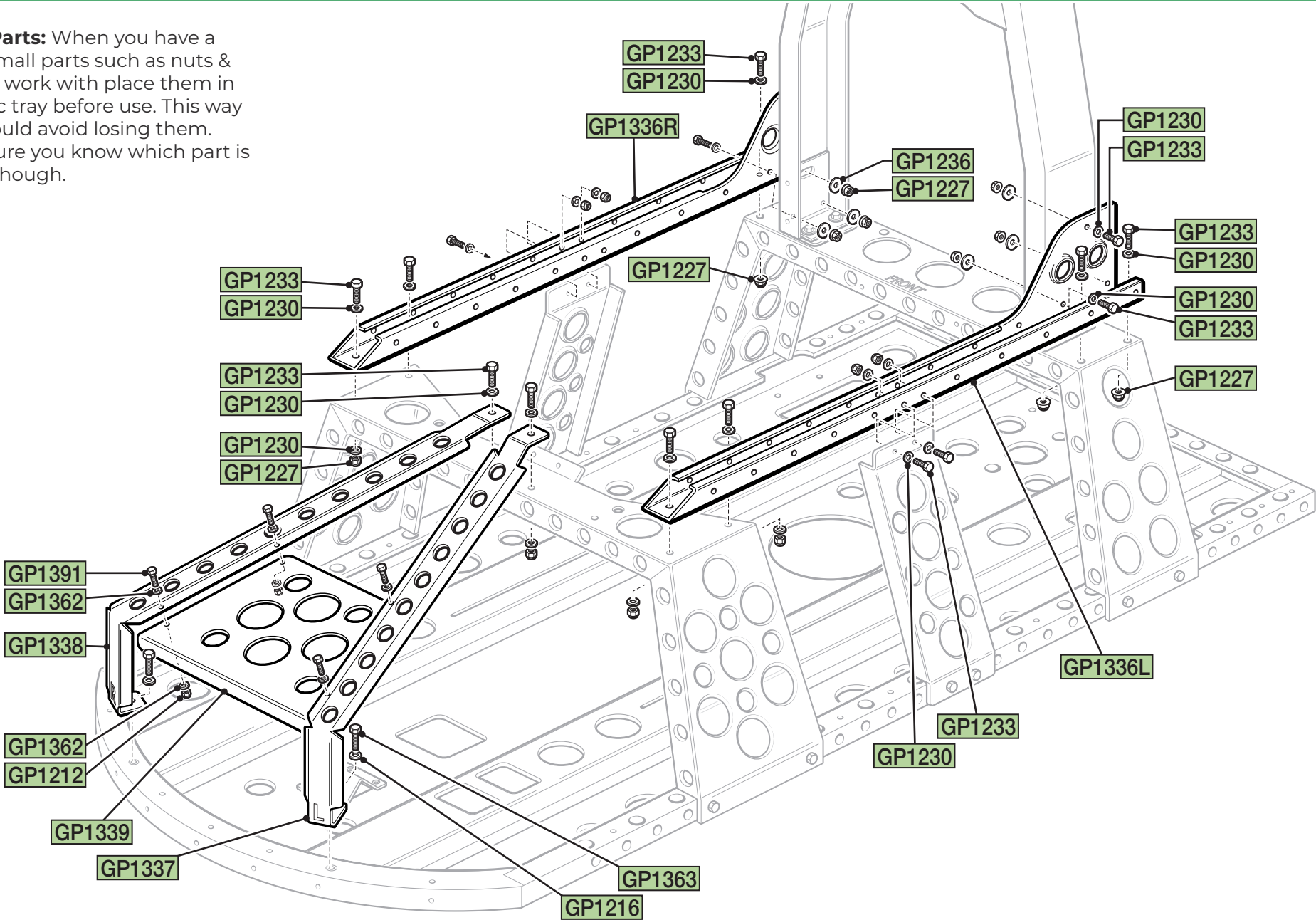
**Nyloc Nuts:** Many nuts such as GP1227 used on the Goblin are Nyloc nuts. These have a plastic ring inserted in one end which prevents them vibrating undone. They must be fitted with the plastic insert facing away from the head of the bolt.

# FITTING ROLL BAR



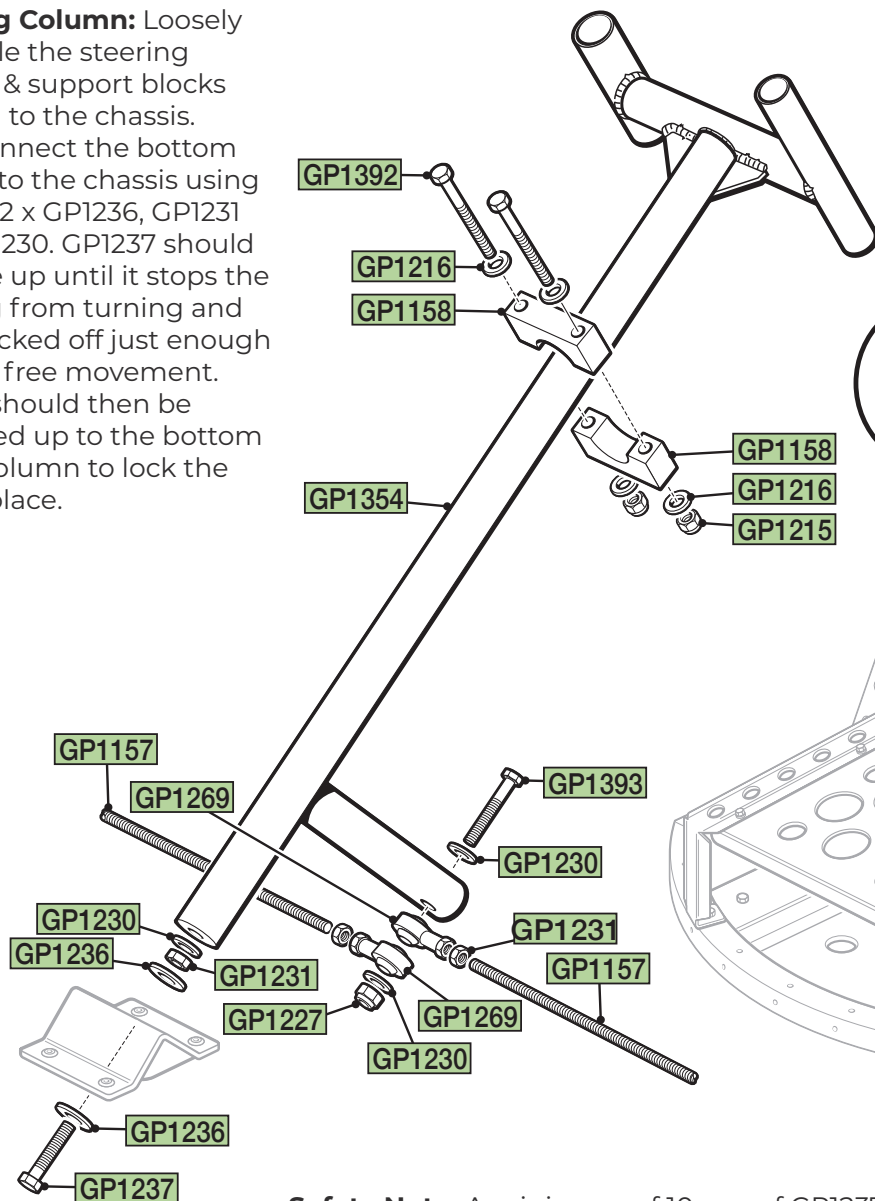
# CHASSIS ASSEMBLY

**Small Parts:** When you have a set of small parts such as nuts & bolts to work with place them in a plastic tray before use. This way you should avoid losing them. Make sure you know which part is which though.

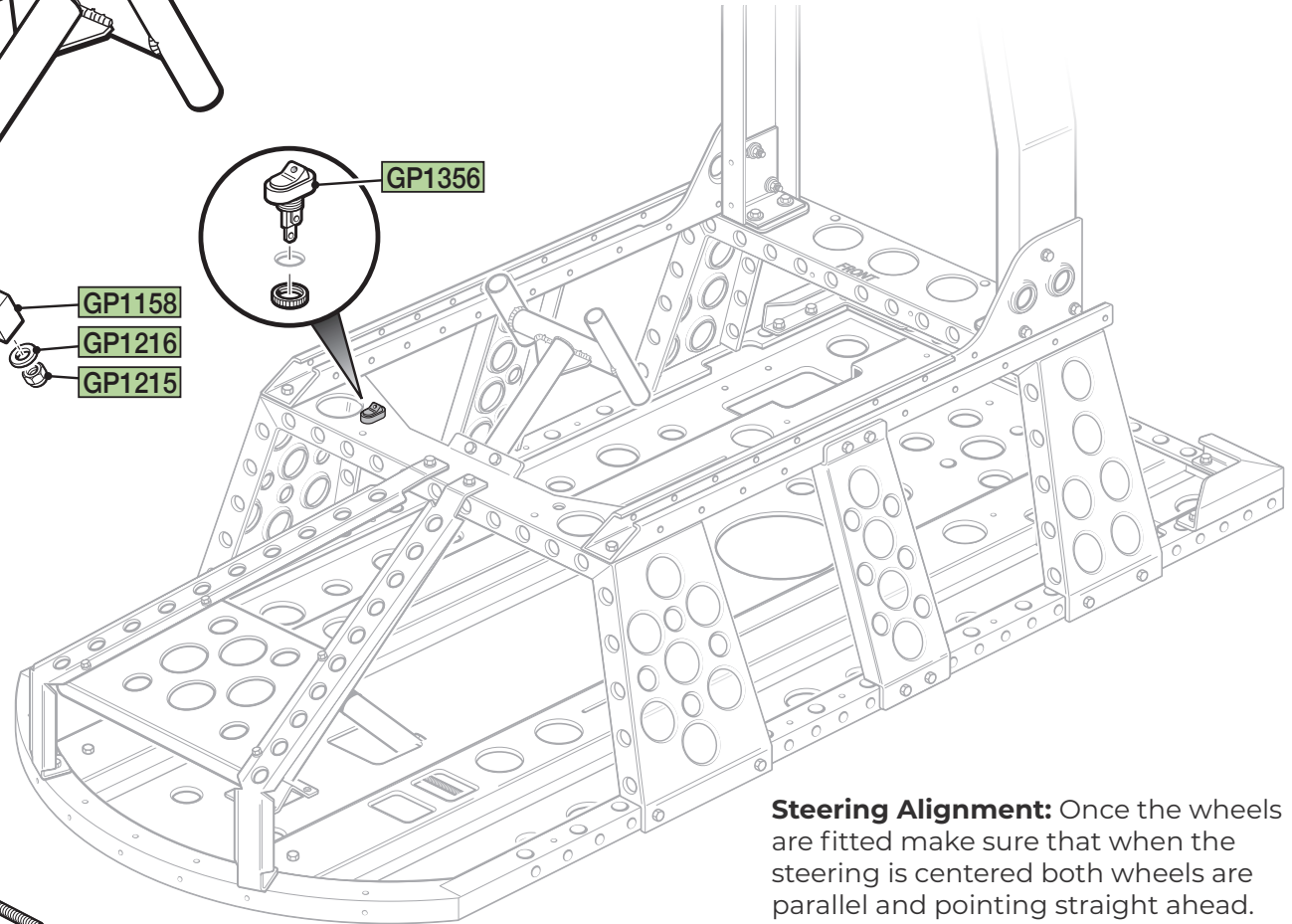


# STEERING COLUMN ASSEMBLY

**Steering Column:** Loosely assemble the steering column & support blocks (GP1158) to the chassis. Then connect the bottom section to the chassis using GP1237, 2 x GP1236, GP1231 and GP1230. GP1237 should be done up until it stops the steering from turning and then backed off just enough to allow free movement. GP1231 should then be tightened up to the bottom of the column to lock the bolt in place.



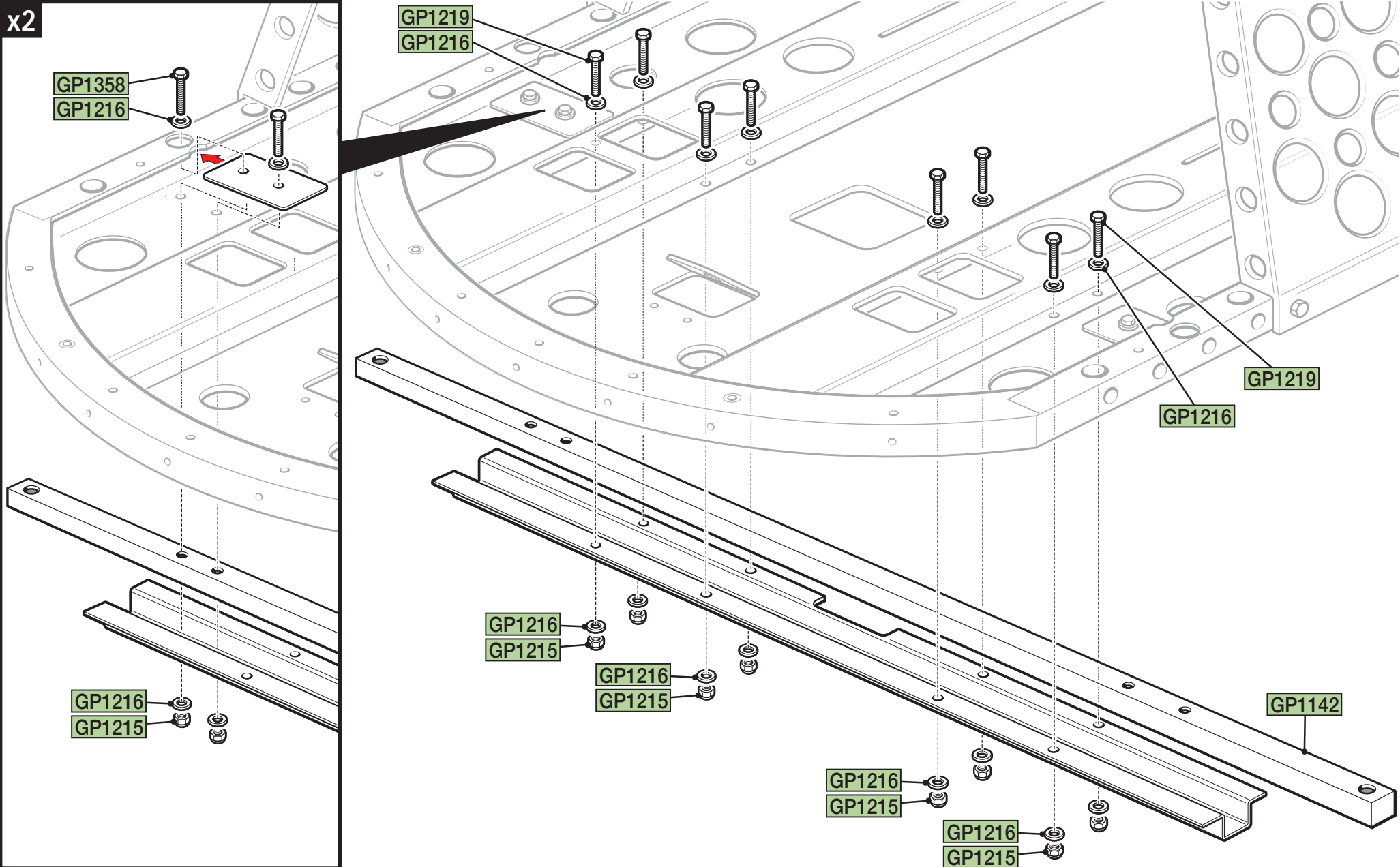
**Smooth Steering:** Once complete the steering should turn freely with no free play in it. Tightening or loosening the bolts on the support blocks and at the bottom can alter the resistance. A small drop of oil or lubricant between the column and support blocks can help.



**Steering Alignment:** Once the wheels are fitted make sure that when the steering is centered both wheels are parallel and pointing straight ahead. Adjustment is done by winding the steering arms (GP1157) in or out of the rod ends (GP1269). However, for safety ensure at least 10mm of the arms are inside each rod end.

**Safety Note:** A minimum of 10mm of GP1237 should be screwed into GP1354. GP1231 should be tightened up to GP1354 to lock GP1237 in place.

# FRONT AXLE ASSEMBLY

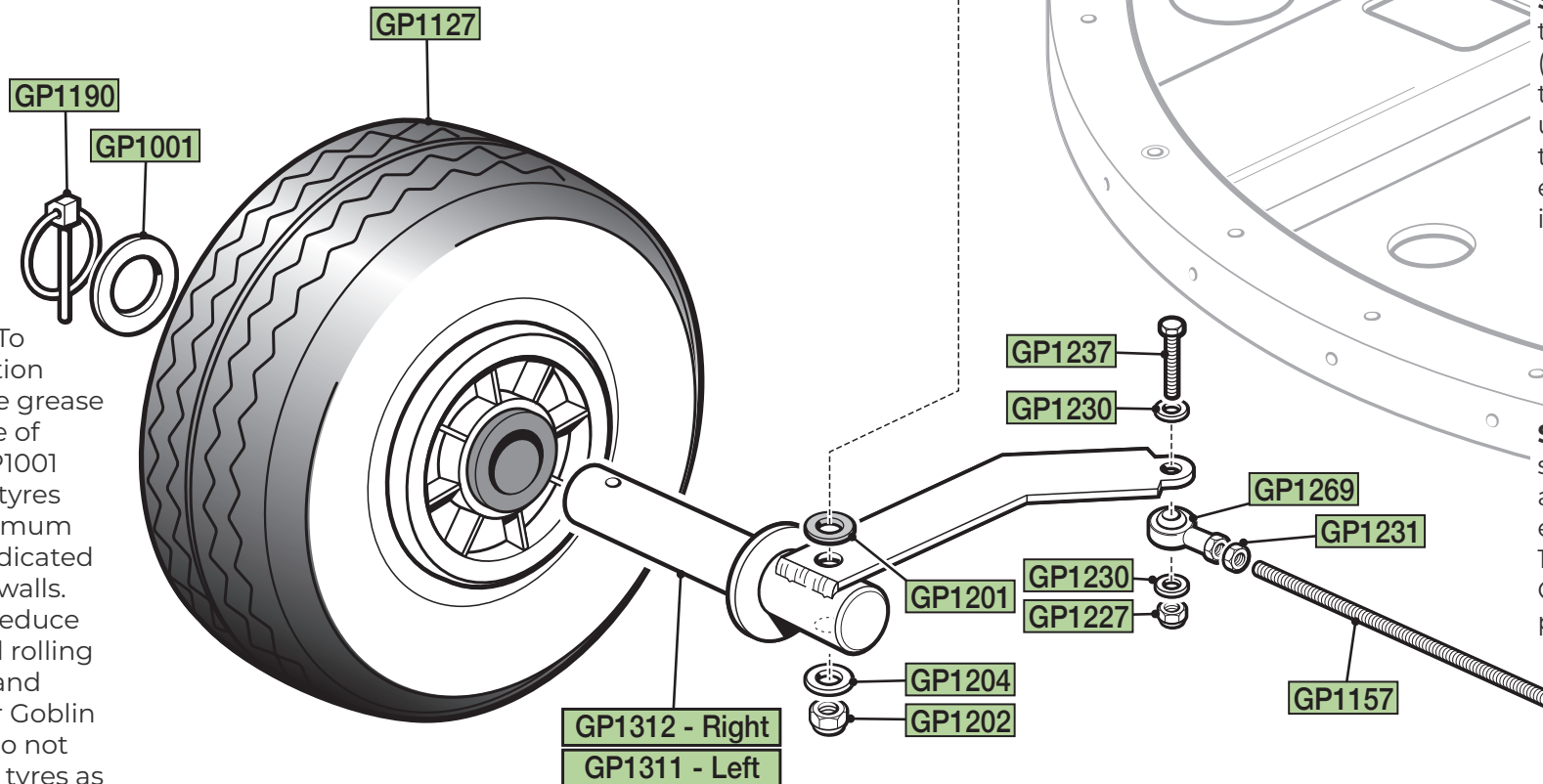


# STEERING ASSEMBLY

**Linch Pins:** Be careful when fitting the linch pins (GP1190) as they will spring shut. Mind fingers!

**Caution:** The bearings inside the wheels will be greasy. This lubrication reduces friction helping speed up your Goblin. Be sure to use the correct wheel. The one without bearings should be fitted to the left rear.

**Go Faster:** To reduce friction apply a little grease to each side of washers GP1001 and inflate tyres to the maximum pressure indicated on the sidewalls. This helps reduce friction and rolling resistance and makes your Goblin go faster! Do not over-inflate tyres as they may burst.



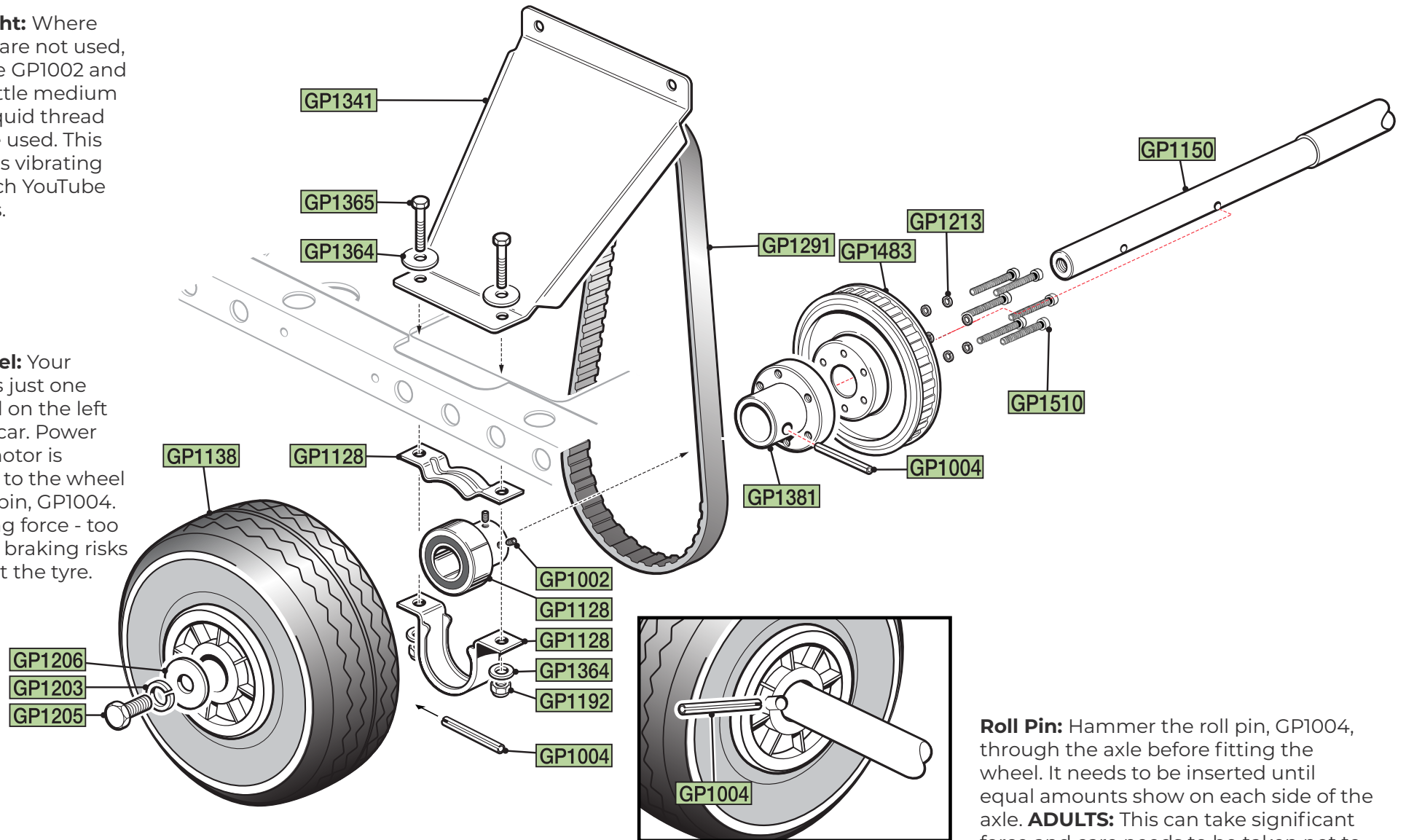
**Safe Steering:** Tighten the large nut & bolts (GP1202/GP1207) until there is no movement up/down but it can still turn from side to side easily, Some lubrication is useful here.

**Steering Arms:** Fit the steering arm GP1157 after the stub axle and ensure a minimum of 10mm is threaded into GP1269 then locked in place with GP1231.

# REAR AXLE ASSEMBLY LEFT

**Keep it Tight:** Where Nyloc nuts are not used, for example GP1002 and GP1005 a little medium strength liquid thread lock can be used. This stops things vibrating loose. Search YouTube for tutorials.

**Drive Wheel:** Your Goblin uses just one drive wheel on the left rear of the car. Power from the motor is transferred to the wheel via the roll pin, GP1004. So is braking force - too much hard braking risks wearing out the tyre.



**Roll Pin:** Hammer the roll pin, GP1004, through the axle before fitting the wheel. It needs to be inserted until equal amounts show on each side of the axle. **ADULTS:** This can take significant force and care needs to be taken not to damage the axle or cause injury. The axle should be well supported.

# REAR AXLE ASSEMBLY RIGHT

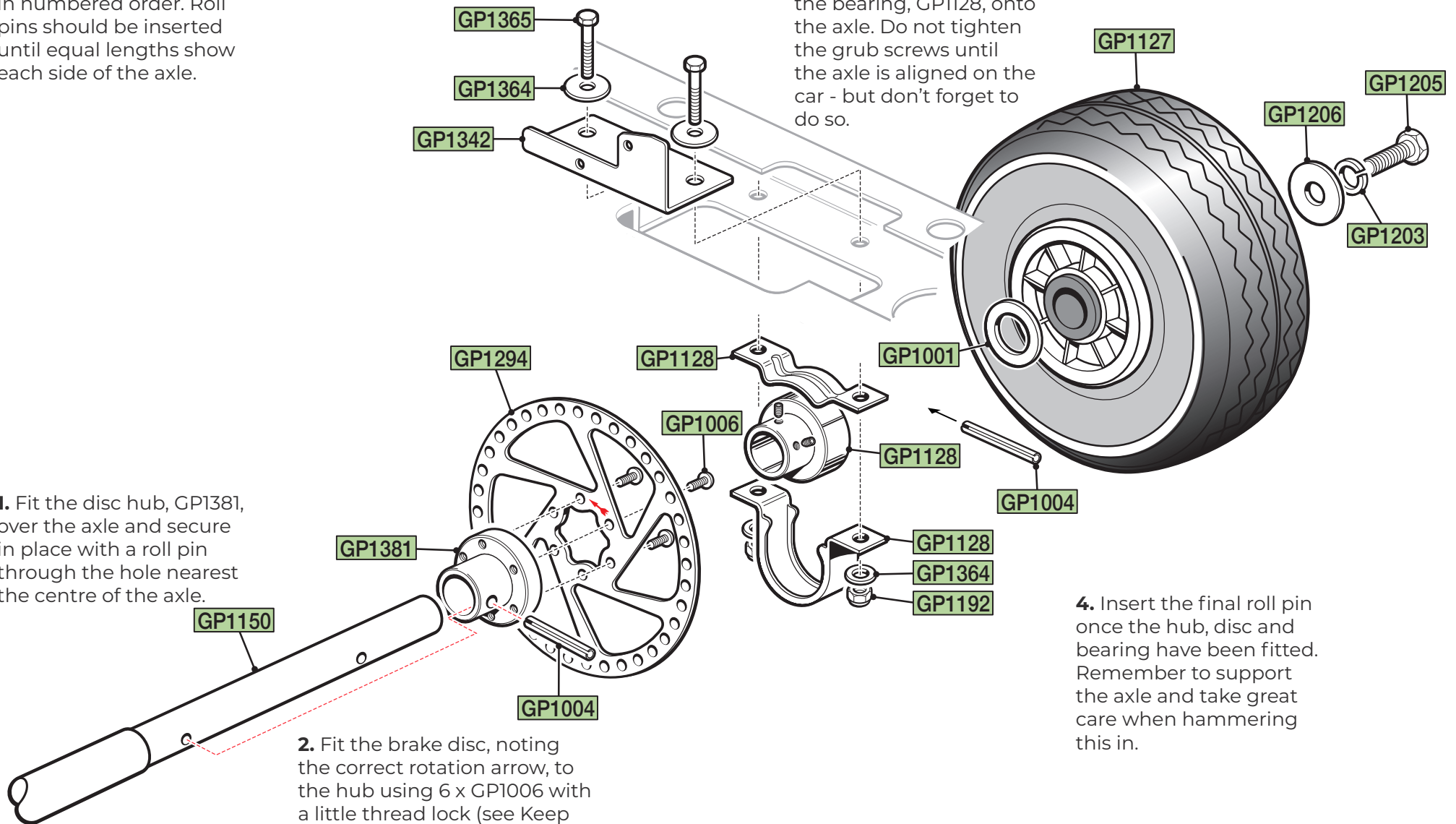
**1, 2, 3...** Follow the notes in numbered order. Roll pins should be inserted until equal lengths show each side of the axle.

**1.** Fit the disc hub, GP1381, over the axle and secure in place with a roll pin through the hole nearest the centre of the axle.

**2.** Fit the brake disc, noting the correct rotation arrow, to the hub using 6 x GP1006 with a little thread lock (see Keep it Tight note on "REAR AXLE ASSEMBLY - LEFT" page).

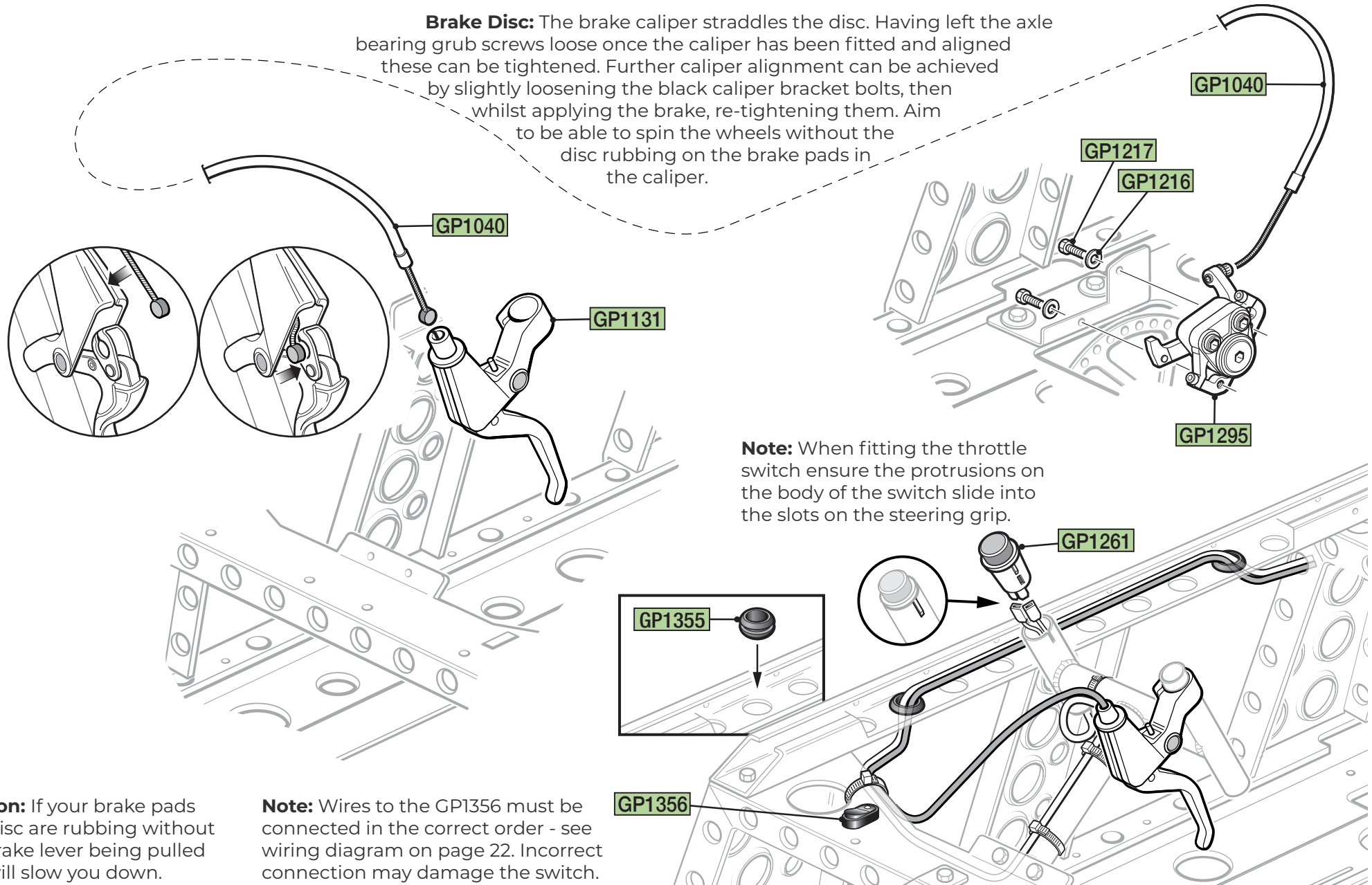
**3.** Slide the centre part of the bearing, GP1128, onto the axle. Do not tighten the grub screws until the axle is aligned on the car - but don't forget to do so.

**4.** Insert the final roll pin once the hub, disc and bearing have been fitted. Remember to support the axle and take great care when hammering this in.



# BRAKE AND THROTTLE ASSEMBLY

**Brake Disc:** The brake caliper straddles the disc. Having left the axle bearing grub screws loose once the caliper has been fitted and aligned these can be tightened. Further caliper alignment can be achieved by slightly loosening the black caliper bracket bolts, then whilst applying the brake, re-tightening them. Aim to be able to spin the wheels without the disc rubbing on the brake pads in the caliper.



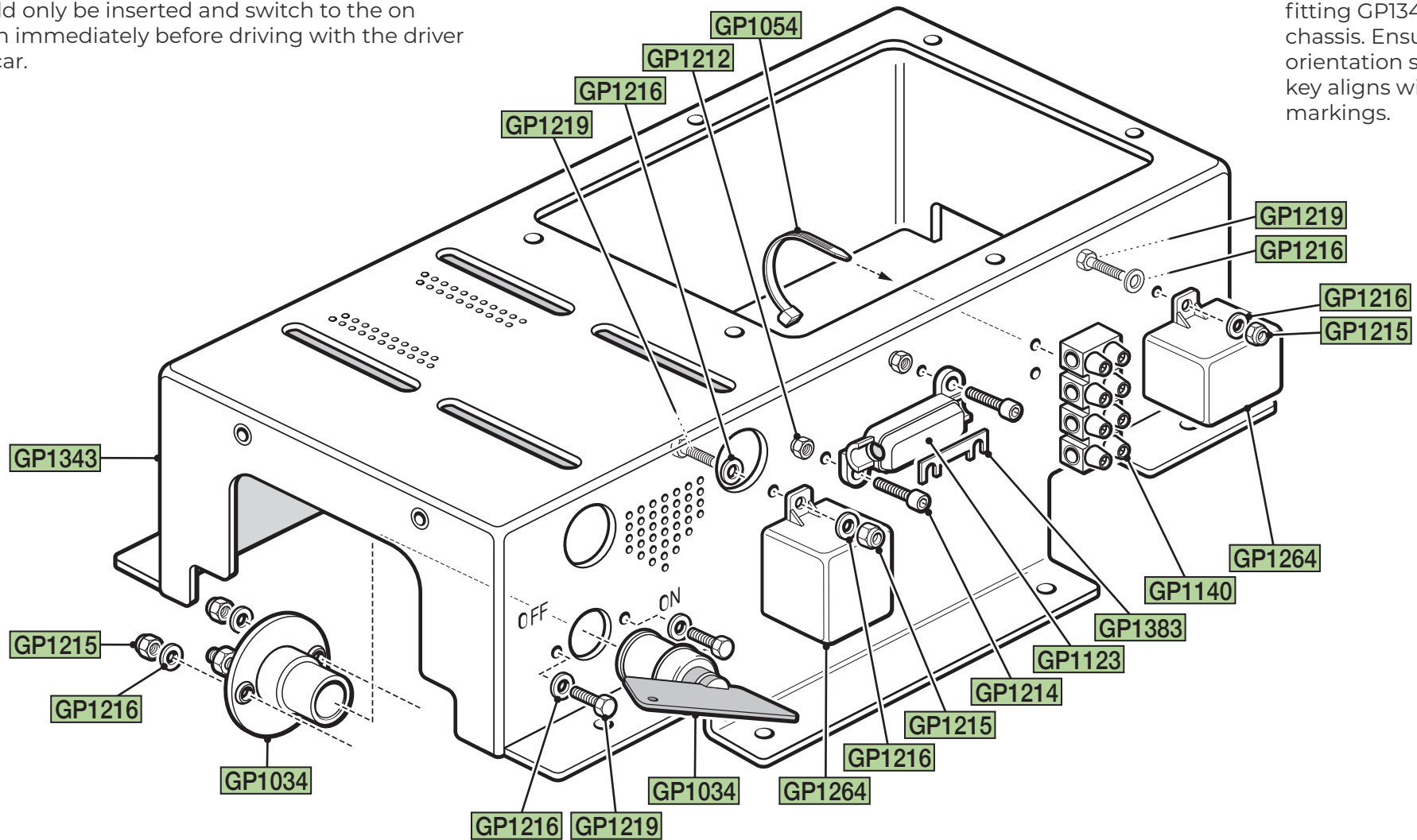
**Friction:** If your brake pads and disc are rubbing without the brake lever being pulled this will slow you down.

**Note:** Wires to the GP1356 must be connected in the correct order - see wiring diagram on page 22. Incorrect connection may damage the switch.

# MOTOR CAGE AND ELECTRICS

**Safety Note:** The red isolator switch key should be out of the switch except when about to drive. This immobilises the Goblin by turning off all power. It should only be inserted and switch to the on position immediately before driving with the driver in the car.

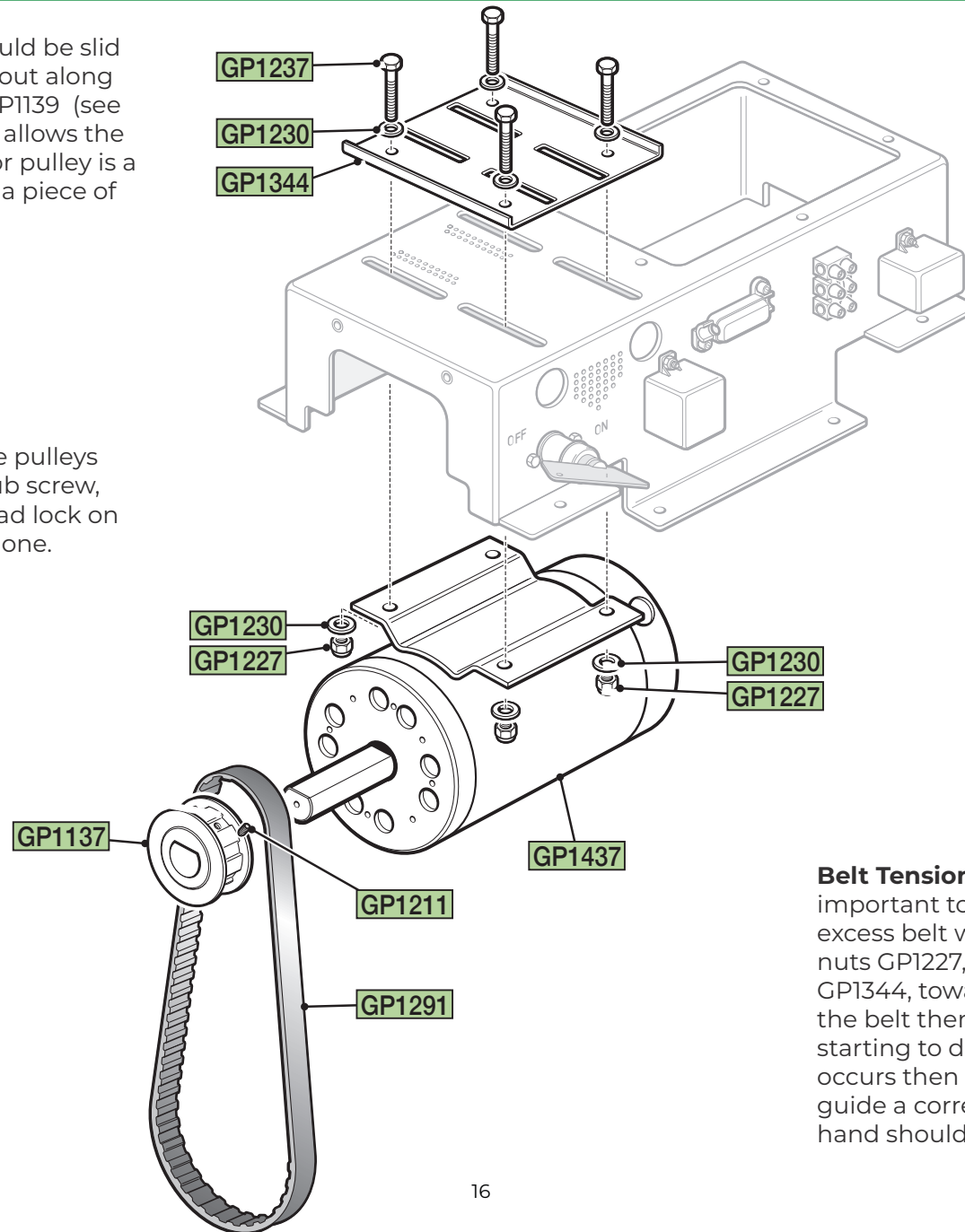
**Note:** Fit GP1034 and associated cables, G2C & G2D, before fitting GP1343 to the chassis. Ensure correct orientation so the red key aligns with the off/on markings.



# MOTOR ASSEMBLY

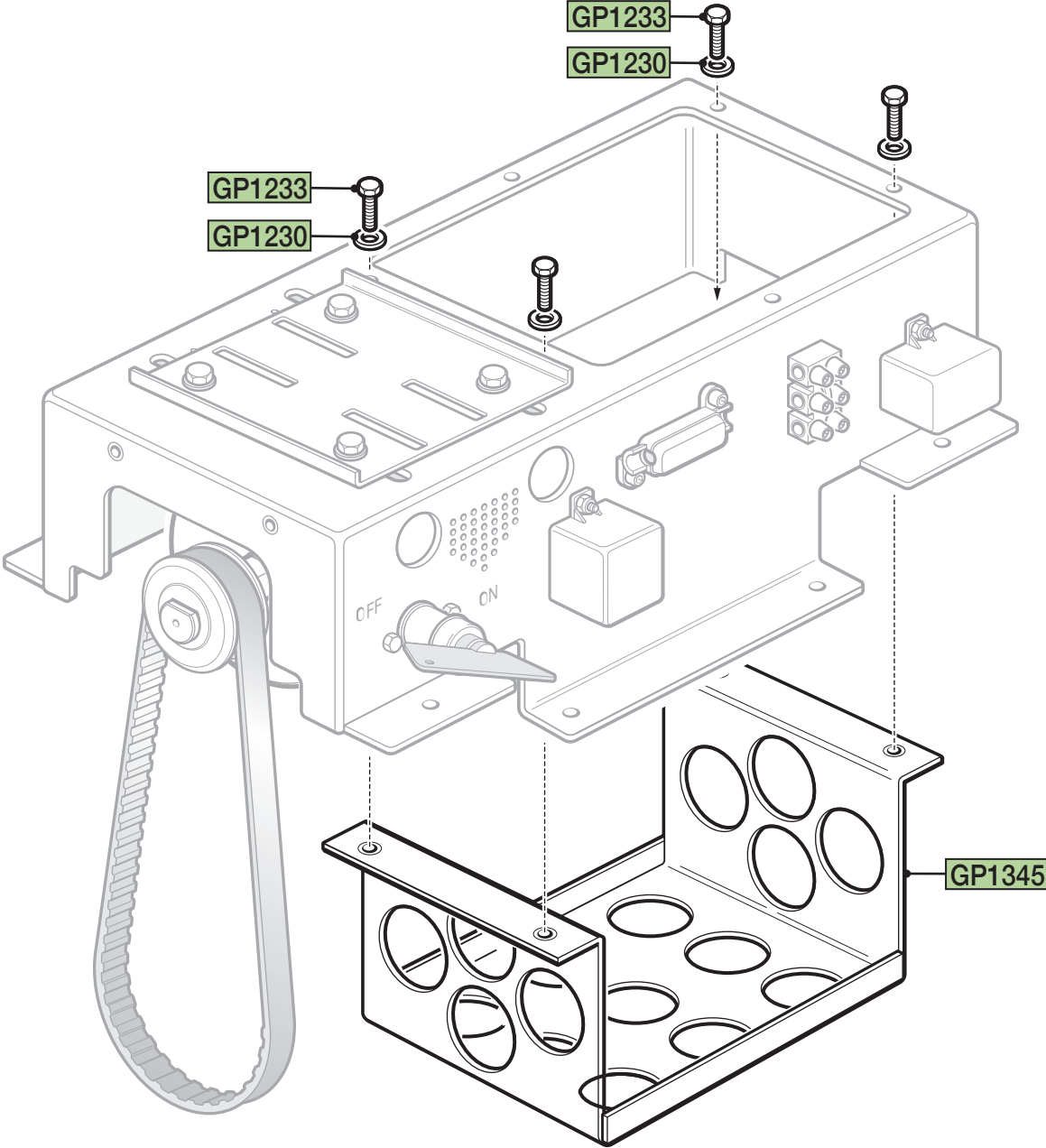
**Motor Pulley:** The pulley, GP1137, should be slid onto the motor shaft. Moving it in or out along with adjustment of the axle pulley, GP1139 (see "REAR AXLE ASSEMBLY LEFT" page), allows the two pulleys to be aligned. If the motor pulley is a tight fit use a softer material such as a piece of wood or rubber mallet to tap it on.

**Tightening:** Once the motor and axle pulleys have been aligned on the car the grub screw, GP1211, can be tightened. A little thread lock on this screw will prevent it coming undone.

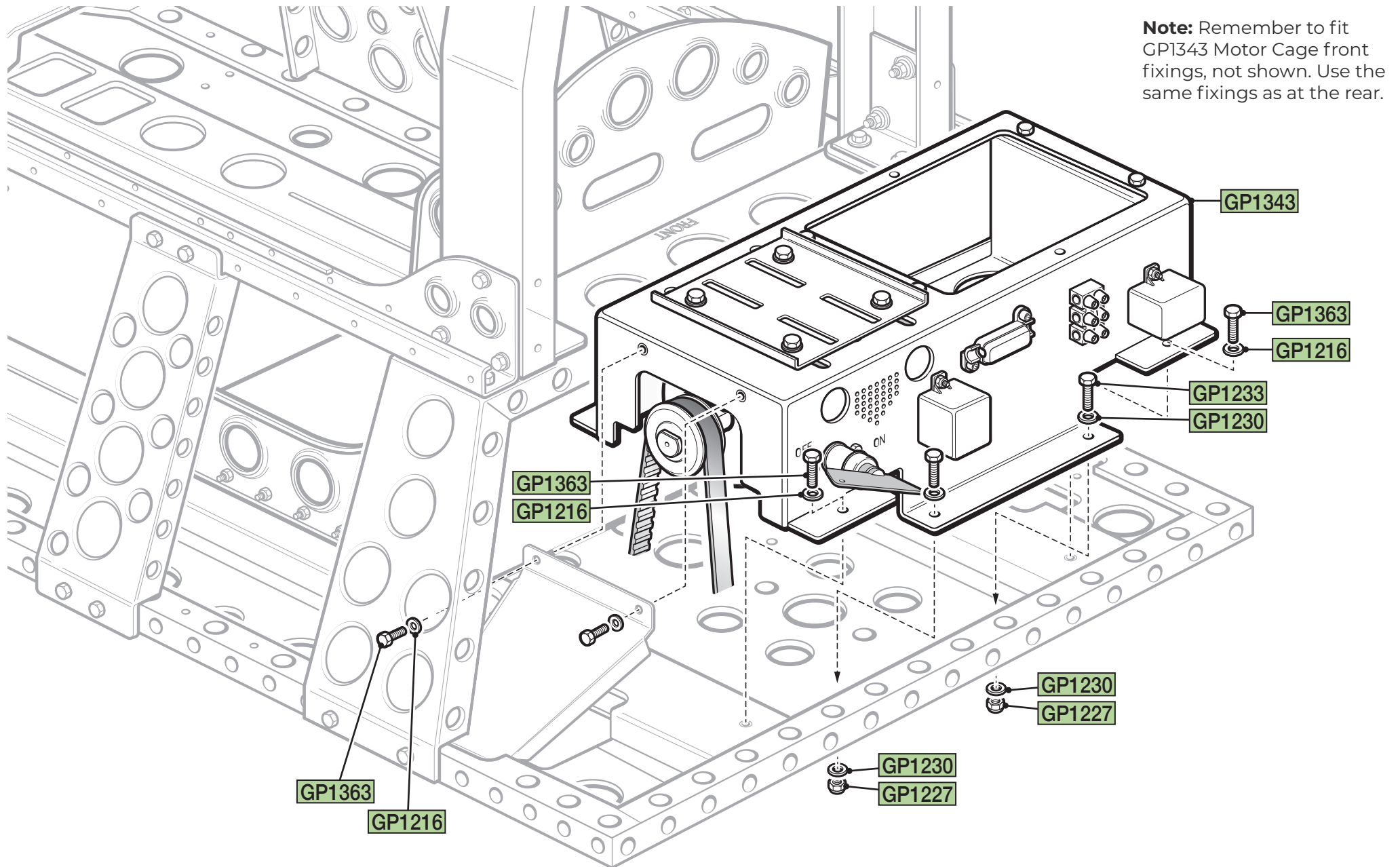


**Belt Tension:** Correct drive belt tension is important to aid a quick start and prevent excess belt wear. Loosen the 4 bolts GP1237 and nuts GP1227, slide the motor mounting plate, GP1344, towards the back of the car to tension the belt then re-tighten the nuts & bolts. If when starting to drive the car a graunching sound occurs then the belt is too loose. As a general guide a correctly tensioned belt when twisted by hand should rotate between 45° and 90°.

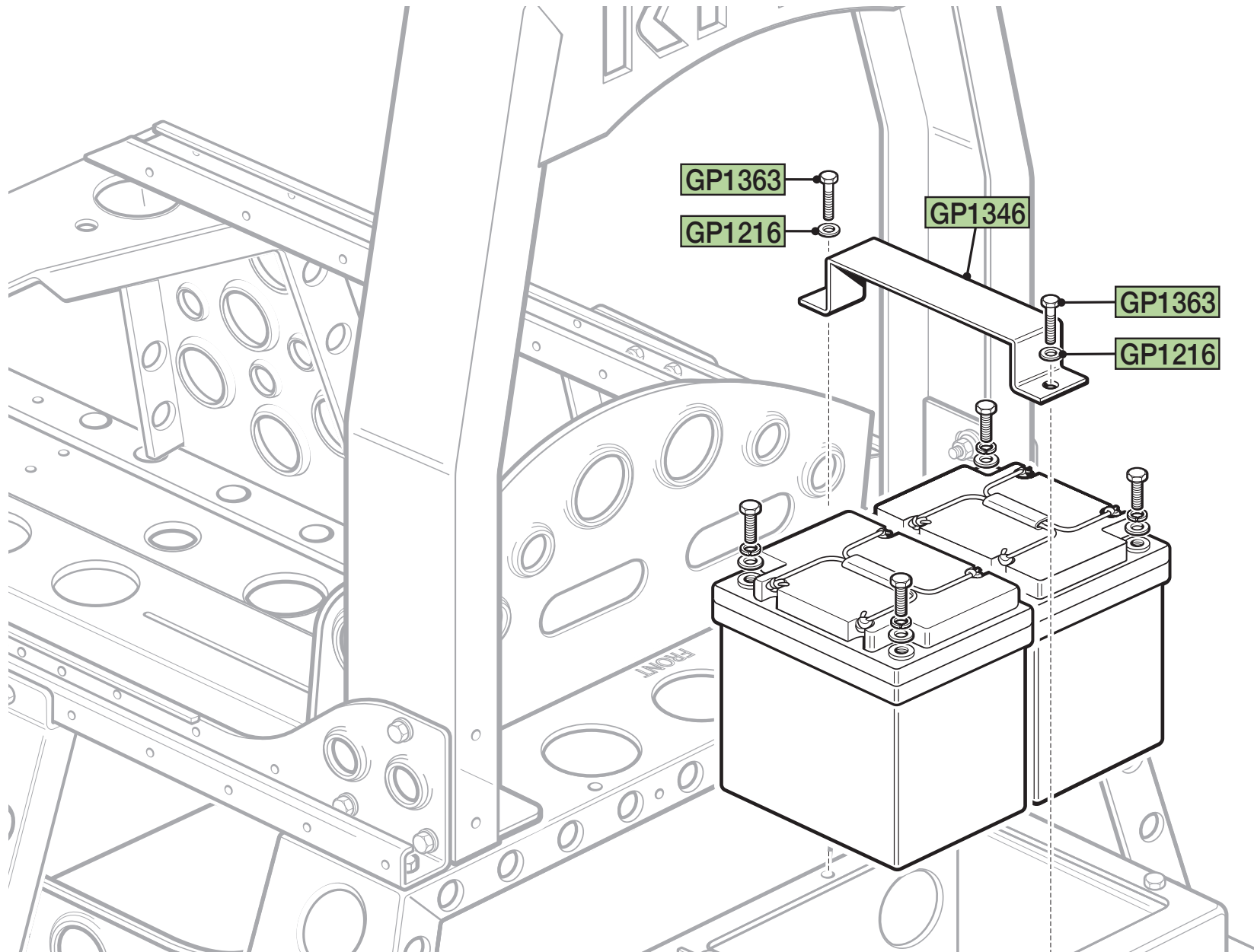
# BATTERY TRAY ASSEMBLY



# FITTING MOTOR CAGE TO CHASSIS



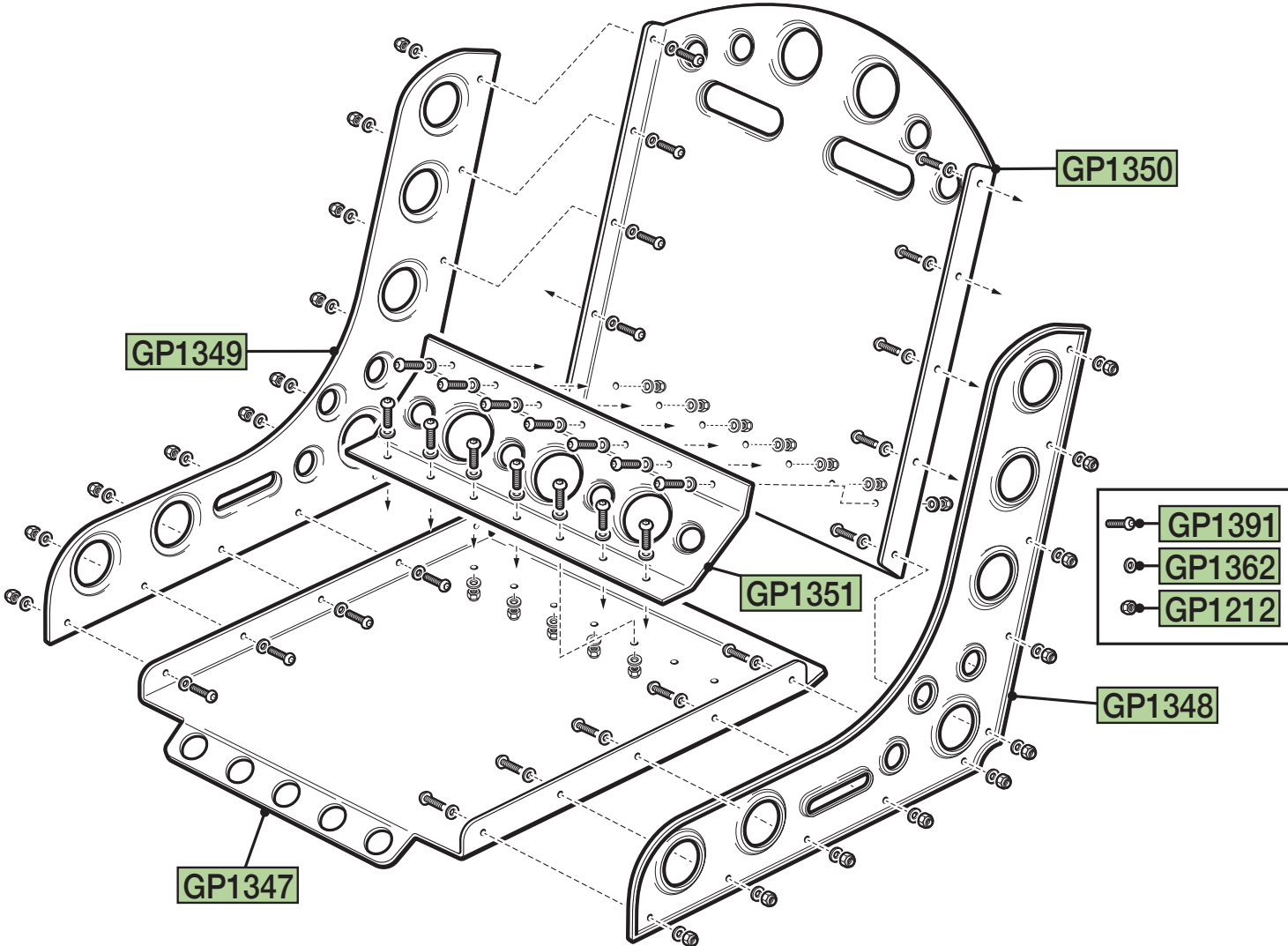
# FITTING BATTERIES



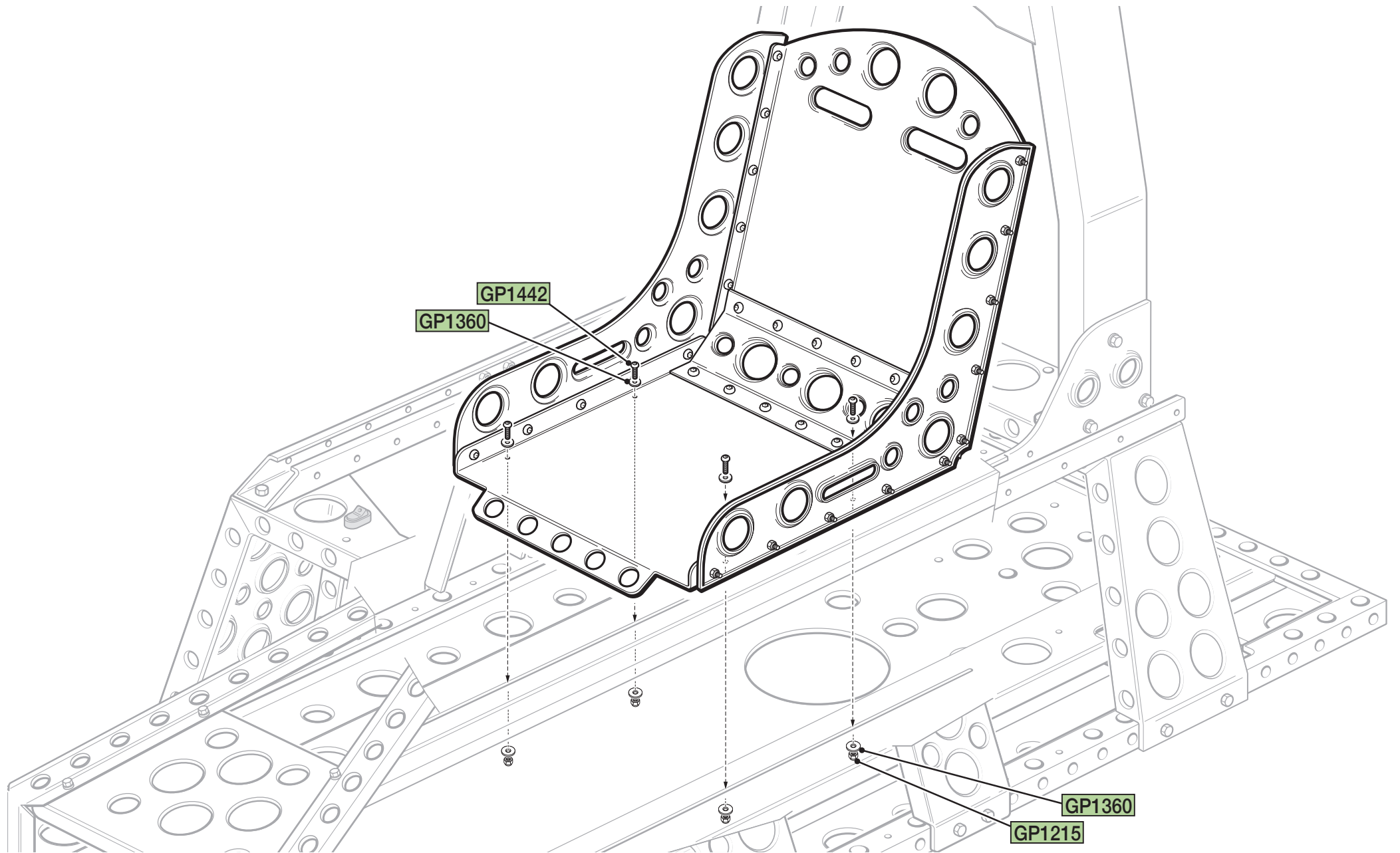
**Safety Note:** Only fit and connect batteries once all wiring is installed and has been double checked.

**Battery Connections:** Take care not to over-tighten the battery terminal bolts.

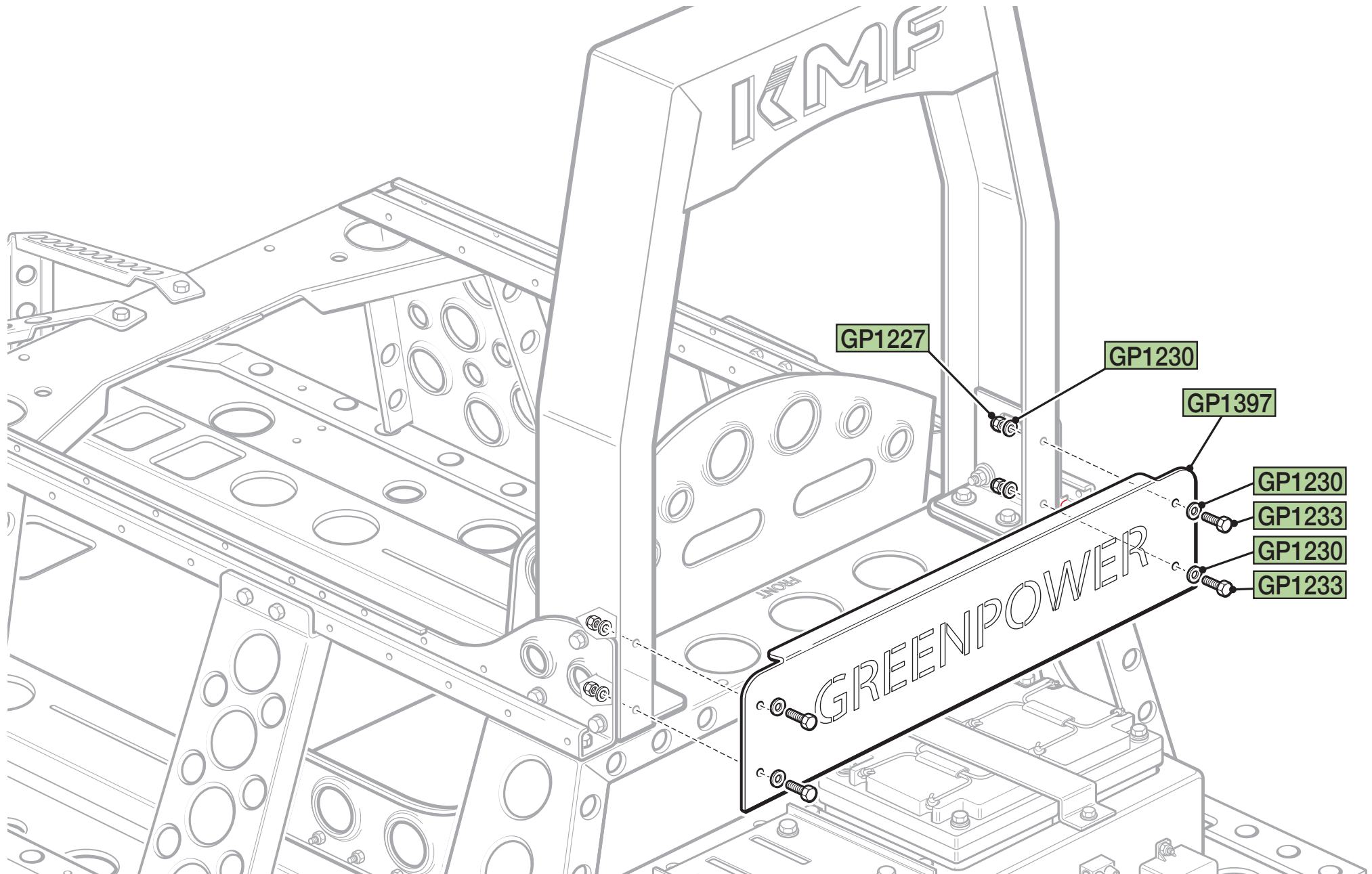
# SEAT ASSEMBLY



# FITTING SEAT

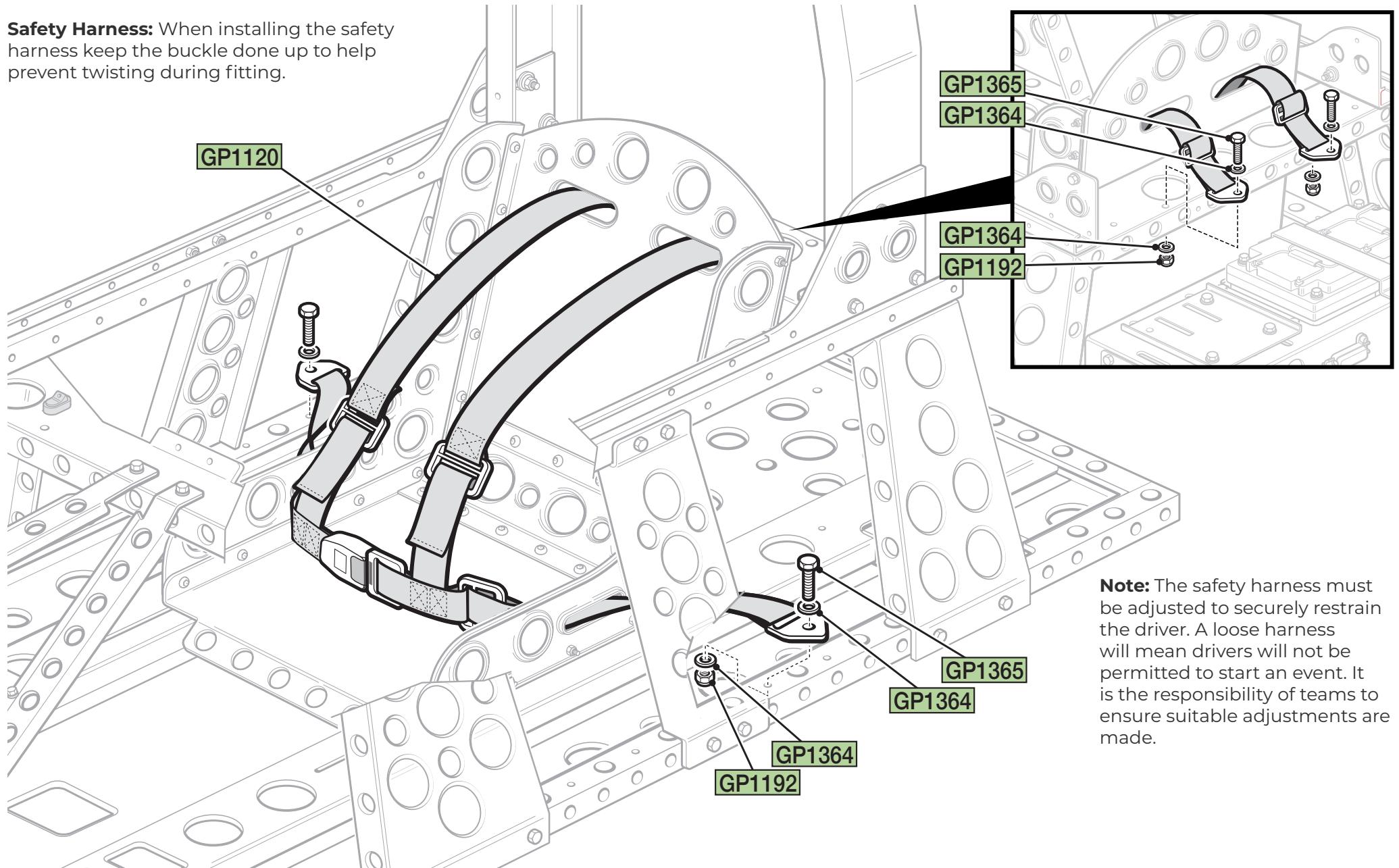


# FITTING GREENPOWER PANEL



# HARNESS ASSEMBLY

**Safety Harness:** When installing the safety harness keep the buckle done up to help prevent twisting during fitting.



**Note:** The safety harness must be adjusted to securely restrain the driver. A loose harness will mean drivers will not be permitted to start an event. It is the responsibility of teams to ensure suitable adjustments are made.

# WIRING INSTALLATION

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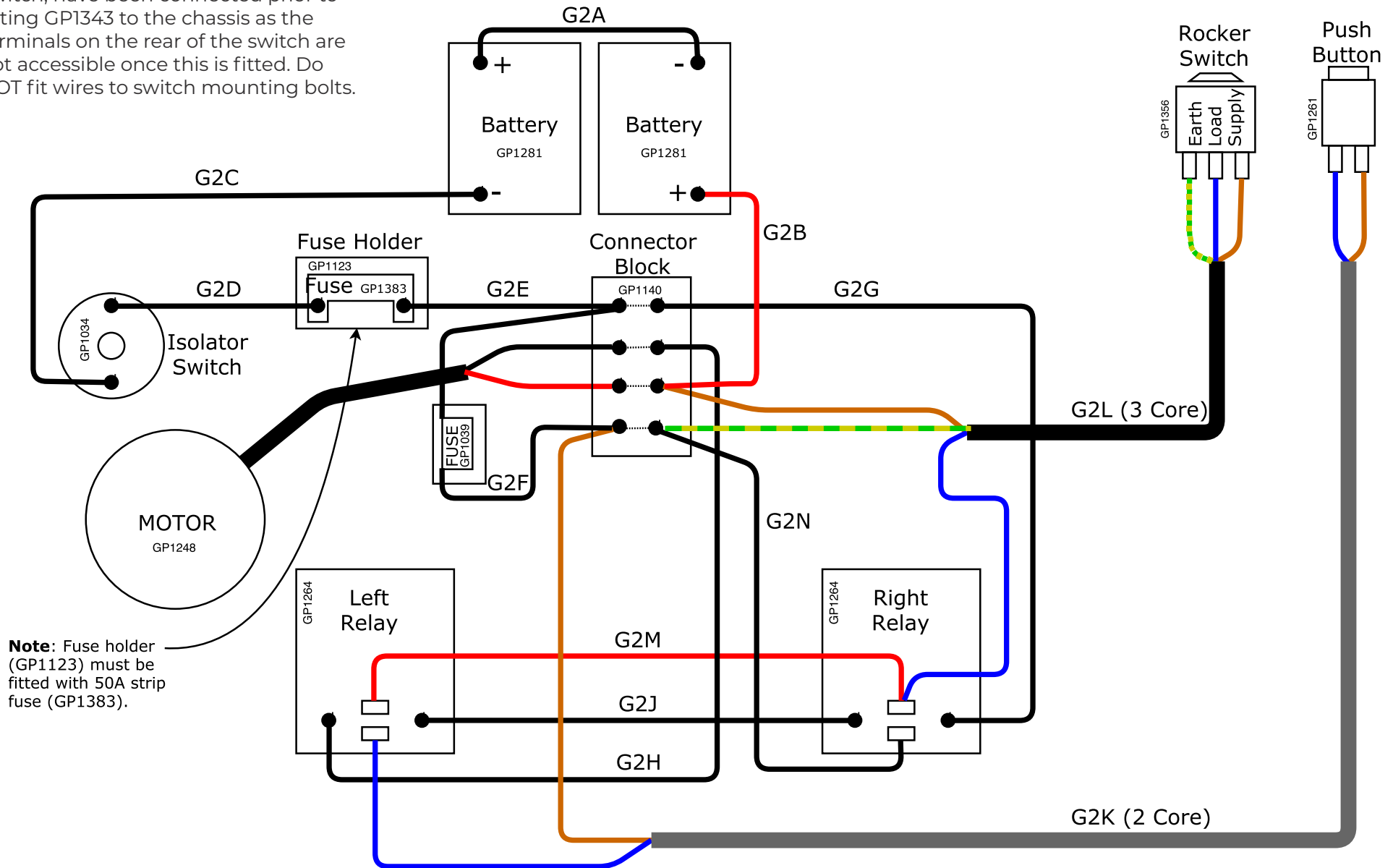
**Note: All wires for your Goblin G2 are labelled and must be connected following the diagram on the next page.**

**Please take great care when installing the wiring to your car as incorrect installation may cause damage, or even fire to wires, motor and or batteries. Always double check before connecting batteries and switching on.**

Before switching on check that the rear axle rotates freely with the only resistance being from the motor. This is best done with the rear of the car supported so the wheels are off the ground. Now switch on the isolator switch at the rear of the car then turn on the rocker switch at the front. The red LED on the rocker switch should now be on. If not then there is a problem which must be investigated before proceeding. If all appears well at this point press the red button on the steering wheel. The motor should run and the rear wheels will be driven. Congratulations!

# GOBLIN G2 WIRING DIAGRAM

**Note:** Ensure wires to GP1034 - Isolator Switch, have been connected prior to fitting GP1343 to the chassis as the terminals on the rear of the switch are not accessible once this is fitted. Do NOT fit wires to switch mounting bolts.



**Note:** Fuse holder (GP1123) must be fitted with 50A strip fuse (GP1383).

# **BATTERY CHARGING**

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Your Goblin G2 kit is not supplied as standard with a battery charger. If you need to purchase one please visit our online shop at [Greenpower.co.uk](http://Greenpower.co.uk) where you will find a range of suitable chargers available.

**Do NOT connect charger to mains supply before proceeding.**

**Batteries can be charged either singly using a 12 volt charger or as a pair using a 24 volt charger.**

**Failure to correctly connect your battery charger may damage batteries and can be dangerous. Please CHECK your battery charger output voltage before proceeding and select step 1 or 2 below accordingly.**

**1. 12 Volt Charger for a single battery**

Disconnect cables from the battery.

Attach red (positive) lead from charger to red (positive) battery terminal.

Attach black (negative) lead from charger to black (negative) battery terminal.

**2. 24 Volt Charger for two batteries**

Disconnect cables G2B and G2C from batteries.

Using cable G2A connect black (negative) of one battery to red (positive) of the other battery.

Connect red (positive) lead from charger to unconnected battery red (positive) and black

(negative) lead from charger to unconnected battery black (negative) terminals.

**3. Switch On**

With the above connections made connect charger to mains supply and switch on. Indicator lights on the charger will show status and completion of charging.

If you have any queries please contact Greenpower: [info@greenpower.co.uk](mailto:info@greenpower.co.uk)

# **REBUILDS & SPARE PARTS**

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Greenpower want you to be able to use your Goblin for many years to come. Each year your Goblin can be dismantled and rebuilt by a new team of pupils. To ensure you have everything necessary during your event season and when rebuilding your car, Greenpower can supply any necessary spare parts. These can be ordered online, by telephone or by email. Details below:

**W: [www.greenpower.co.uk](http://www.greenpower.co.uk)**

**T: 01243 552305**

**E: [info@greenpower.co.uk](mailto:info@greenpower.co.uk)**

For teams outside the United Kingdom please contact your country specific licensed Greenpower agent. If your country doesn't have a licensed agent please email: **[sales@greenpower.co.uk](mailto:sales@greenpower.co.uk)** or call **+44 1243 552 305**.

# TEST DRIVING & DRIVER TRAINING

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- Once your build is complete and the wiring has been double-checked try giving it a test drive! The bodywork does not need to be in place for testing.
- Initial driver training should be undertaken with no power to the car. To familiarise drivers with the steering and brake controls push them around a slalom type course.
- Once drivers are familiar with steering and braking they can conduct their first powered runs. These should take place on a hard surface with no obstructions. All spectators must be behind solid barriers. Goblines are not suitable for use on soft grass surfaces.
- To limit speed on initial runs the car can be powered using a single battery. This will run the car on 12 volts rather than 24 volts and result in the car running at half speed. To do this connect wire G2C to the negative terminal and wire G2B to the positive terminal of the one battery. Wire G2A is then not used.
- Driving should only be conducted with drivers wearing helmet, gloves, eye protection (visor or goggles), long sleeves and trousers. Long hair should be tucked into the helmet to prevent it being caught in any moving parts. Once the driver is comfortable and there is a clear open area, turn on the battery isolator switch at the rear of the car. The driver can then switch on the black rocker switch at the front of the car. If all is well, the red LED on this switch will then illuminate. Give the car a gentle push from behind using the roll over bar. As this is done, the driver can press the throttle button to drive off.
- If a rasping noise is heard, especially when pulling away, the drive belt is loose and requires correct tensioning. Failure to correctly tension the belt will result in premature wear and failure.
- The driver should now practise steering through a course laid out using cones or markers increasing their pace and switching to running on both batteries as they become more experienced.

# FINAL PRE-RACE CHECKS

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- To gain the best performance out of your Goblin it is important to reduce friction:
- Ensure the brake is not binding/rubbing. If it is then adjust the pads and/or the caliper/axle position to ensure free running. Free running is best checked with the wheels off the ground.
- Tyre pressures – check all tyres are inflated to the maximum pressure recommended as marked on the tyres.
- Wheel bearings – Ensure the bearing wheels are greased to ensure they spin freely. This doesn't apply to the left rear driven wheel.
- Front wheel alignment – the front wheels should run parallel to each other. Excessive toe in or out will reduce performance.
- Steering – check that the steering can be turned smoothly without binding or excess slack. This is best done with the front wheels off the ground.
- Brake performance and adjustment – pulling on the brake lever should lock the rear axle such that the car cannot be pulled along with driver on board without the rear wheels skidding. If this is the case then adjust immediately.
- Fasteners – check all nuts and bolts are secure and tight. Loose fasteners will result in failing event scrutineering.
- Batteries – to maintain the best performance from your batteries they should never be left discharged. See the page on Battery Charging for further advice.
- Electrical Faults – Incorrect wiring installation can result in either of the two fuses blowing. If this has happened there is a fault which needs to be corrected before proceeding. Please be very careful as whilst the fuses are there as a safety measure incorrect wiring can in the worst case result in fire!

# MORE INFORMATION

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Greenpowertrust



@Greenpowertrust



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Company/greenpower-education-trust

## **Greenpower Education Trust**

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