



# ORBITER

## User Manual



Your Serial Number is:

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Please quote this number when ordering parts or seeking telephone assistance.

### Company Information:

	Telephone	
Technical Help	(0)121-773-1827	Ask for Technical
Parts & Accessories	(0)121-773-1827	Ask for the Parts Dept.
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### Addresses:

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A Member of the Tornado International Leisure Group

## 1.0 Conventions used in this Manual

For clarity the following conventions are used in this manual:

<b>Paragraph Heading</b>	<b>Meaning</b>
<b>Tip!</b>	Information which will assist in the operation of <i>ORBITERS</i> .
<b>Note!</b>	Information which is important for the correct operation of <i>ORBITERS</i> .
<b>Caution!</b>	Information which is <b>VITAL</b> to avoid injury to persons or damage to the <i>ORBITERS</i> .
<b>Warning!</b>	Information which is <b>VITAL</b> to avoid <b>serious injury</b> to personnel or the public.

Please take note of the information in shaded areas. If you have any questions with regard to the correct installation or operation of ORBITER please contact Tornado International Ltd.

### **Important – Please Read This!**

This manual is provided in good faith and is believed to be accurate. Because Tornado International have no control over the manner in which the product is used, users should satisfy themselves that any information or instruction contained in this manual is appropriate for the conditions under which the product is being operated.

In the interest of product development, Tornado International reserves the right to alter or modify the product as necessary.

## 2.0 Site Requirements

### 2.1 Introduction

*ORBITERS* are designed to be operated on a flat and level hard surface. This surface may be of tarmac or Concrete (natural, painted or sealed) Whatever material is used for the surface it should be remembered that dust raised by the movement of the *ORBITERS* will settle on the body and chassis components which will require cleaning more frequently. To reduce tyre wear the surface should be as smooth as possible. Should you wish to use a surface of other materials please contact the **Tornado International Technical Help Line**. The area should be gently cambered (max 3 degrees) to avoid water remaining on the surface. An area which slopes must be avoided as this leads to increased vehicle speed down the slope with implications on safety.

### 2.2 Orbiter Barrier

A substantial barrier to contain the *ORBITERS* should be installed. Drawings of a suitable construction method may be found at appendix A. A removable section of barrier will be required in order that the *ORBITERS* may be wheeled out of the area.

### 2.3 Public Fence

The area should be completely fenced (with gates for the entrance and exit) to avoid members of the public who have no intention of using the attraction straying into the path of the cars. The construction method chosen will generally be in sympathy with existing fencing on the site but due consideration must be given to preventing small children from entering the area.

The entrance and exit gates should ideally be separate. This avoids any possibility of people who are entering the area to use the *ORBITERS* preventing people leaving after their ride. These gates should be adequately signed (see appendix D) and should ideally have hinges which allow movement in the appropriate direction. It is vital that the exit gate be prominently marked when viewed from the inside of the area so that guests may expedite their exit after their ride. It would be prudent to paint arrows on the floor to help guide guests to the exit.

The entrance and exit route should be at the same level as the top of the containment barrier so that guests step down into the operating area and step up out of the area. This reduces the possibility of guests tripping over the barrier. If this is not possible then the *ORBITER* containment barrier must be painted a prominent colour where it passes the entrance and exit gates to reduce the chances of guests stumbling over it.

## 2.4 Orbiter Housing

A building should be constructed to provide secure housing when the ORBITERS are not in use. The battery chargers will also be housed in the same building. The size of the building will depend on the number of ORBITERS purchased. Don't forget to allow for expansion if further ORBITERS are required. Appendix B & C show the dimensions of the ORBITERS, batteries and chargers. If the area is secure from vandalism then the ORBITERS may be charged out of doors during the season. This allows the ORBITER to be moved to the edge of the track at the end of the operational day and the batteries charged whilst still in the vehicle. If this system is used then the following points should be considered.

1. A secure location will be needed to store the ORBITERS during the closed season.
1. The chargers will need to be housed in a well ventilated but weatherproof location. If this is a cabinet it must have a volume of at least double the total volume of the chargers installed. Provision for adequate cooling air flow over the charger's heat sink is vital. The ambient air inside any such charging area must not be allowed to exceed 30 degrees centigrade. See the section "Installation – Chargers" for more details and appendix B for the charger dimensions.
1. Protective covers must be used to protect the ORBITER overnight. These may be ordered from **Tornado International Parts and Accessories**.

## 2.5 Signage

In order to inform your guests of the correct and safe operation of the ORBITERS clear and concise signage is essential. At appendix D you will find sample signage in their most basic form. It is assumed that most locations would choose to have their own signs manufactured in their corporate style. The wording of the signs at appendix D is provided for your guidance.

## 3.0 Introduction

The Tornado ORBITER is a single rider, battery powered free roving vehicle. As delivered it consists of three basic parts. The ORBITER, the batteries (two per Orbiter) and the chargers.

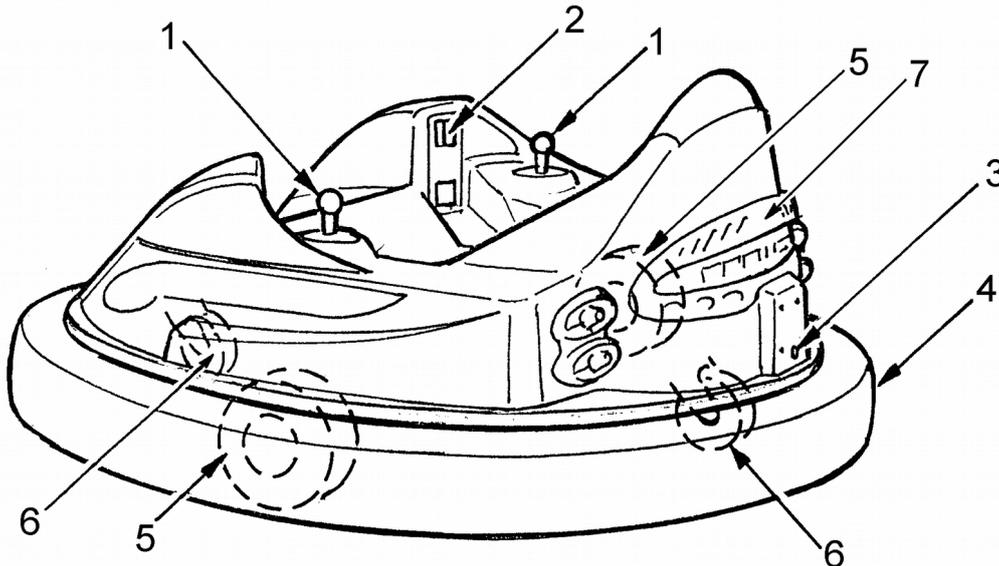
### Note!

If your ORBITERS are fitted with any optional equipment (e.g. Ridemaster, Hit & Spin) you should read this manual in conjunction with the supplementary Owners Manual(s) supplied with the vehicles.

### 3.1 The ORBITER

The Orbiter is a single rider battery powered vehicle designed for use in amusement areas. The chassis is manufactured from mild steel and painted with black powder coat. The vehicle is surrounded by a pneumatic bumper. This is designed to offer protection to the vehicle in the event of a collision but it should be noted that the vehicle is not designed as a “bumper car”. The body is moulded in one piece in glass reinforced plastic. The vehicle is steered using the two control sticks positioned each side of the seat. These control each of the motors which drive the main wheels.

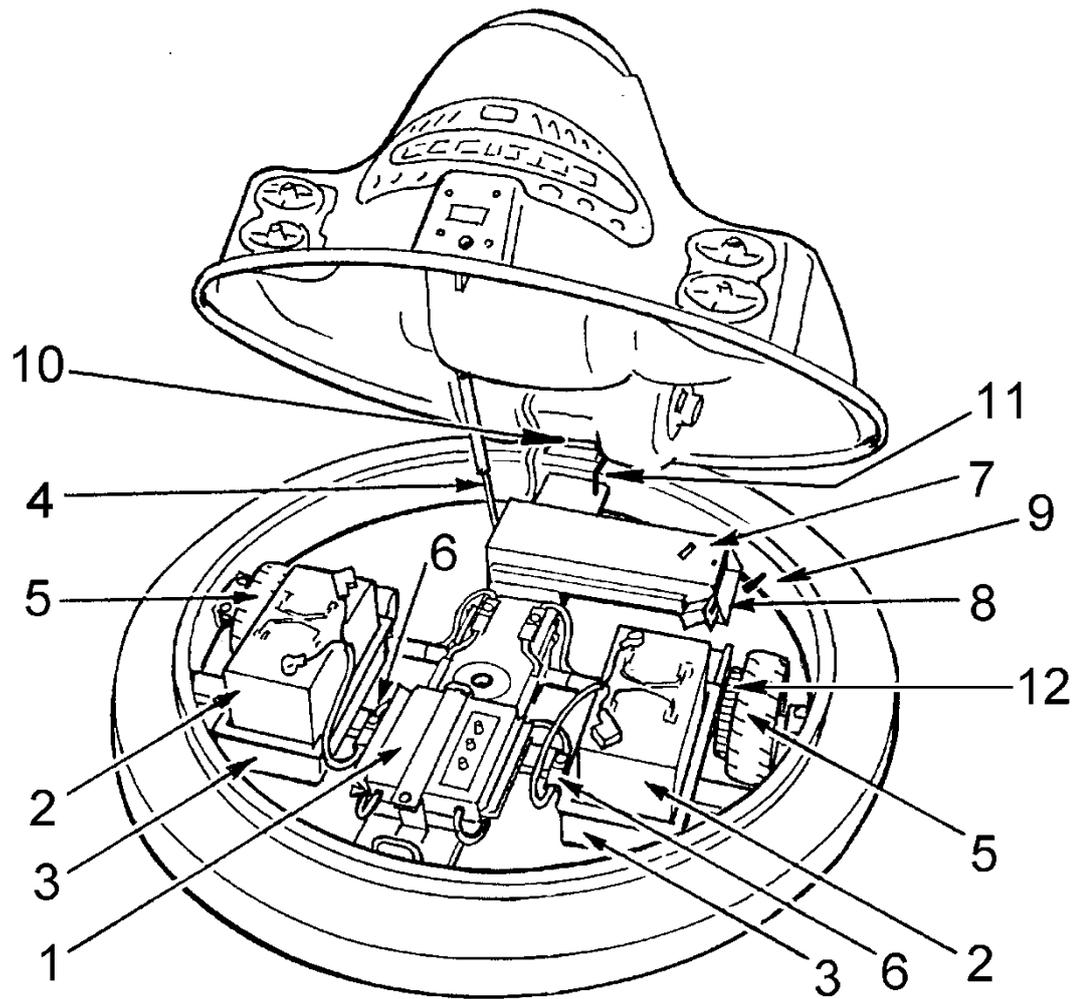
The principal features of the ORBITER are shown in Figures 3.1 & 3.1a below.



**Fig 3.1 - Orbiter with the body closed**

1 - Control Sticks   2 - Coin Entry   3 - Key entry   4 - Pneumatic Bumper  
5 - Main Wheels   6 - Castor Wheels   7 - Recessed Body Handle

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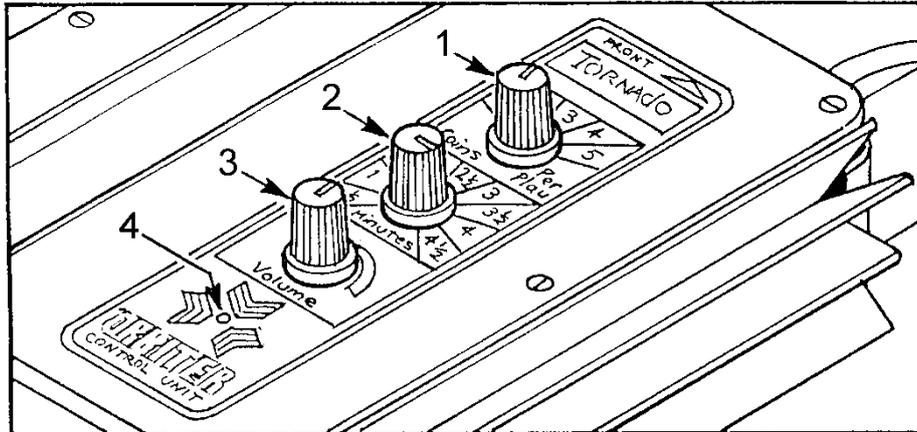


**Fig 3.1a - Orbiter with body open**

1 – Control Electronics   2 – Batteries   3 – Battery Holders   4 – Gas Spring  
 5 – Main Wheels   6 – Battery Connectors   7 – Cash Box   8 – Coin Counter  
 9 – Bumper Valve   10 – Body Hinge   11 – Hinge retaining Pin   12 – Drive  
 Gear

### 3.2 *The ORBITER CONTROL ELECTRONICS*

The principal features of the control electronics are shown in Figure 3.2 below.



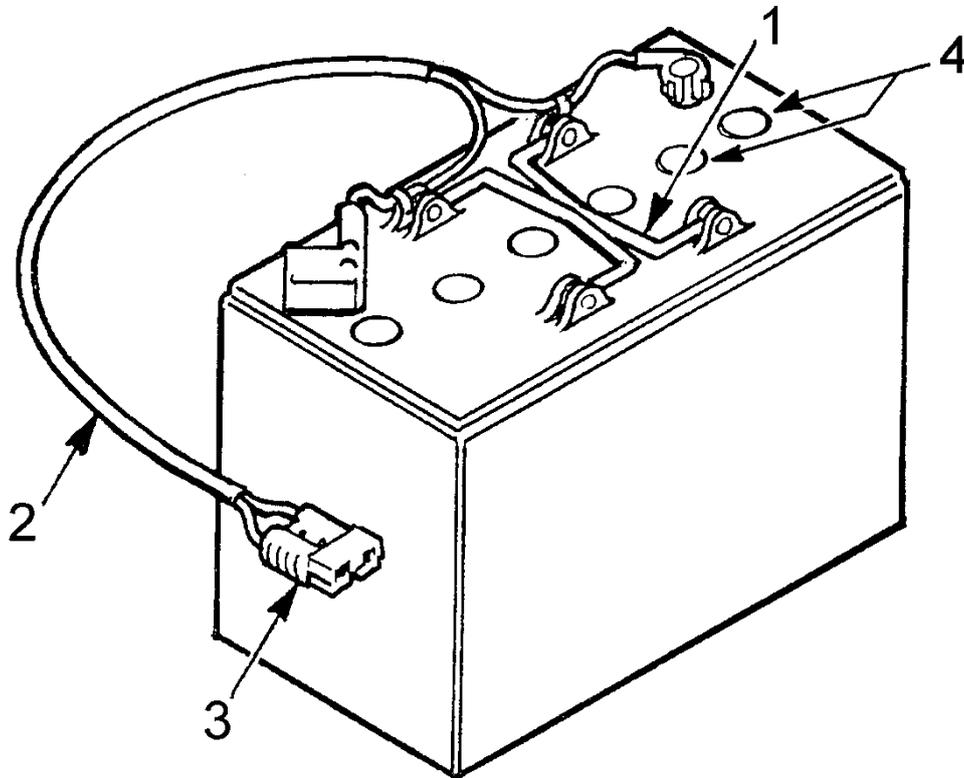
**Fig 3.2 - Orbiter Control Electronics**

- 1 – Number of Coins per Play Selector    2 – Ride Time Selector  
3 – Sound Volume    4 – For Use With Ridemaster Only

### 3.3 The BATTERIES

The batteries are of the sealed lead acid type. They require no topping up and give off no gases when in use or when being charged.

The principal features of the batteries are shown in Figure 3.3 below.



**Fig 3.3 - The Batteries**

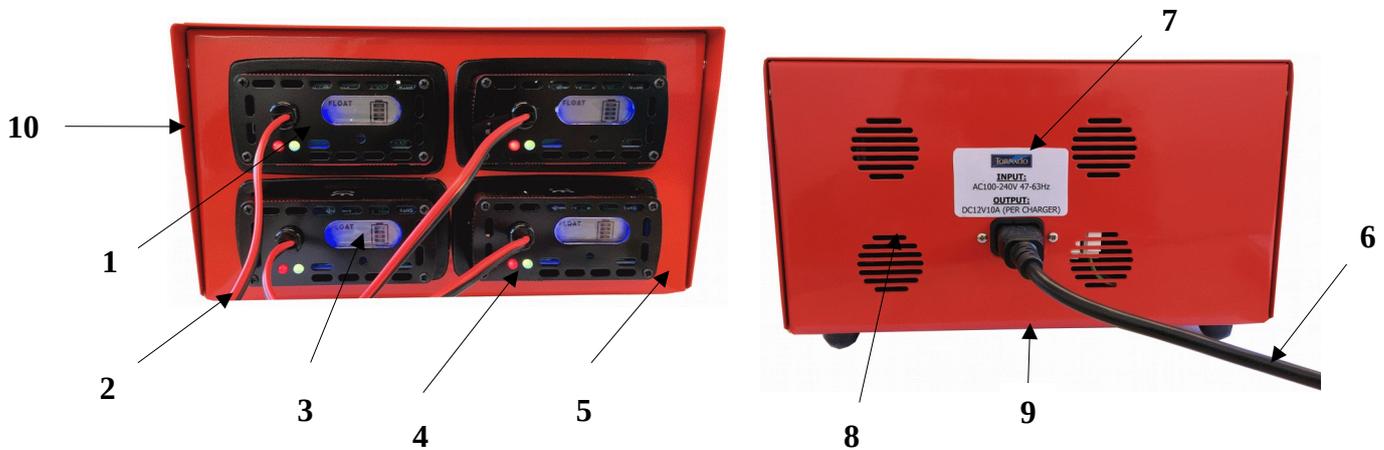
1 – Carrying Handles    2 – Battery Lead    3 – Battery Connector  
4 – Battery Vents (6 off – See Warning below!)

**Caution!**

The battery vents must not be removed for any reason. The battery is maintenance free and water must not be added. Removal of the vents or the addition of water to the cells will invalidate the warranty.

### 3.4 The CHARGER

The charging unit is designed to charge four batteries. Each battery is charged independently of the others. Each output has its own control unit and status indicator display. The battery charger is a well known commercial unit assembled by Tornado International into a custom designed case for convenience. The charging units are completely automatic with no charge rate or time to be set. The charging cycle is set out below figure 3.4. The principal features of the Chargers are shown in Figure 3.4 below.



**Fig 3.4 - The Charger**

- 1 – Battery Charger Units    2 – Battery Charging Lead    3 – Status Indicator  
 4 – LED Indicators (left side RED for mains power / right side RED or GREEN for charging status)    5 – Battery Station Case    6 – Mains Input Lead  
 7 – Specifications    8 – Rear Case Vents    9 – Lower Case Vents  
 10 – Side Case Vents

#### Bulk Charging

The LED light will show AMBER to indicate that bulk charging is taking place.

#### Absorption Charging

When the battery is 95% charged the LED light will flash AMBER/GREEN to indicate that the second stage of charging is taking place.

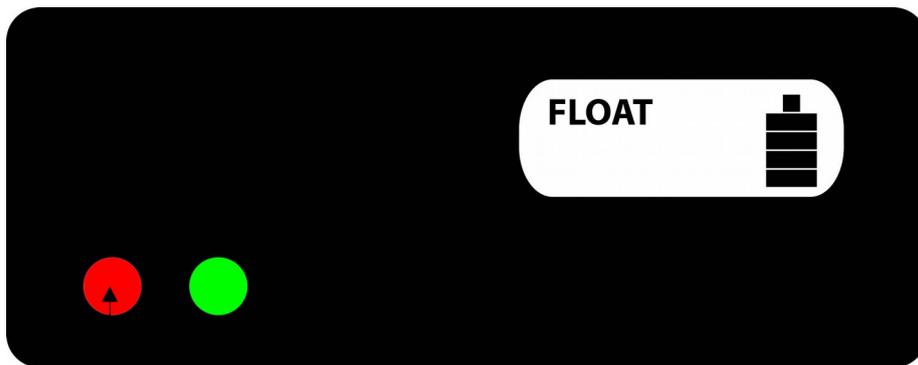
#### Float Charging

When the battery is 100% charged the LED light will turn to GREEN to indicate that the battery is ready for use. The battery can be left connected until it is required for use. A regulated trickle voltage of no more than 13.8 volts and less than 1 amp of current is given to maintain the capacity.

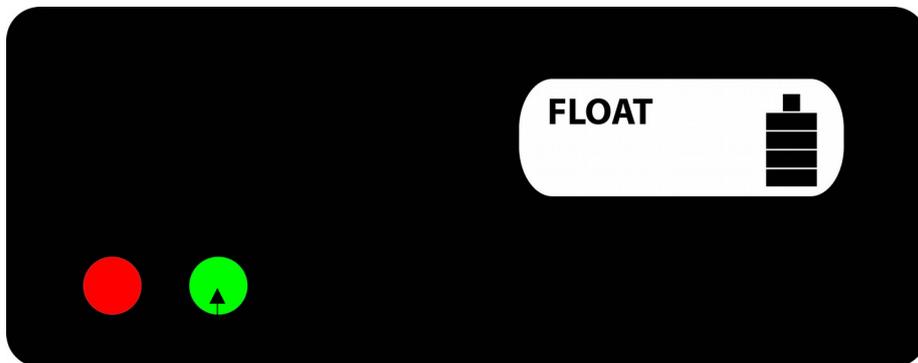
#### Caution!

Connect charger to a mains outlet which has the same voltage and frequency as shown on the specification label in fig 3.4. Battery charging station must be located in a clean dry area free from contact with water and dirt. Re-charging must be carried out at an ambient temperature of 0 deg C to 30 deg C. For extra cable length use only the charging lead extension cables supplied. Do not use if dropped or damaged, contact Tornado immediately if in any doubt about the charging operation.

## Illuminations



RED mains power on indicator light. This should always be illuminated when the unit is connected to mains power.



Charging status indicator light:

**AMBER** = Bulk battery charging taking place

Flashing **AMBER/GREEN** = Charging 95% complete

**GREEN** = Battery ready for use

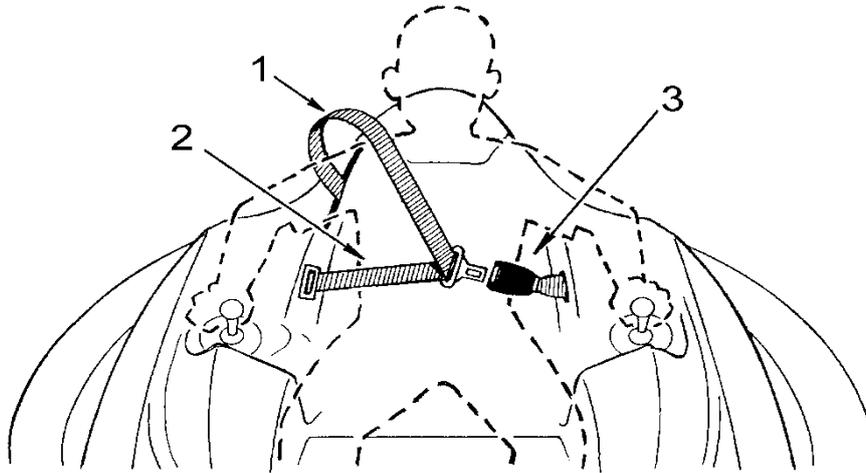
### **Caution!**

Do not connect a battery to a charger if your charger(s) differ(s) from the above examples or if you are unsure about the charging process. Please contact Tornado immediately for assistance.

### 3.5 *The SEAT BELTS (Optional Equipment)*

The seat belts are of identical construction to those fitted to automobiles. They are of the inertia reel type with a unique shoulder strap aligning system to allow the belts to fit a large range of drivers.

The principal features of the Seat Belts are shown in Figure 3.5 below.



**Fig 3.5 – The Seat Belts**

1 – Shoulder Strap    2 – Lap Strap    3 - Buckle

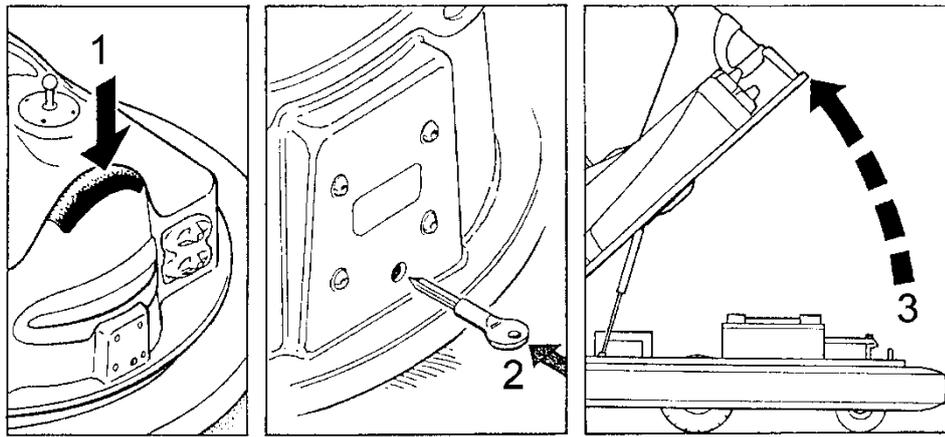
## 4.0 Installation

### Note!

If your ORBITERS are fitted with a **RIDEMASTER** control system you should read this section in conjunction with the Ridemaster Owners Manual supplied with the vehicles.

### 4.1 Opening the BODY

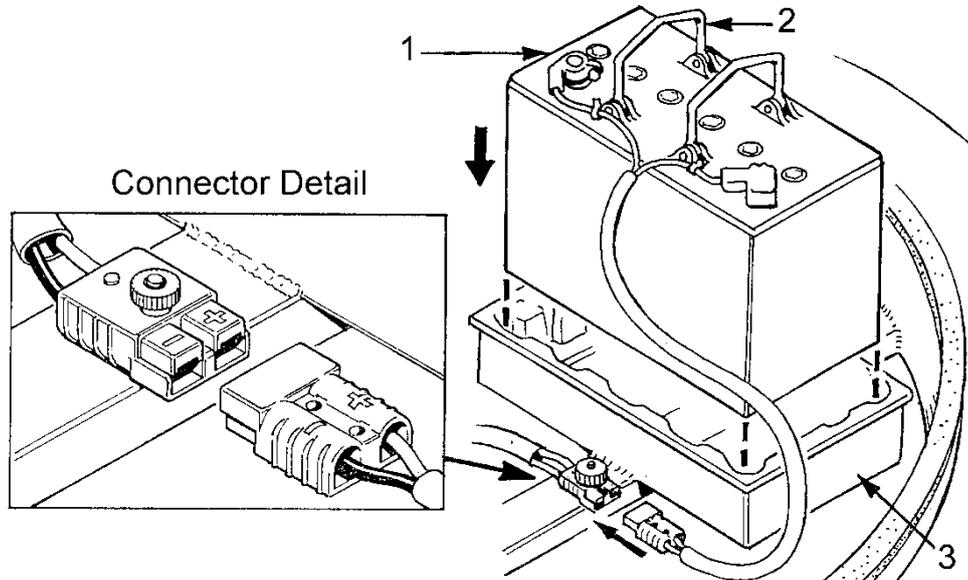
After delivery, place the ORBITERS in the operating area. Attached to the control stick of one of the ORBITERS will be the keys. Remove these and proceed as below.



**Fig 4.1 - Opening the Body**

Referring to Fig 4.1 above, insert the body key into the hole at the rear of the body until resistance is felt. At this point press down on the back of the body (1) and at the same time push the key in to the stop (2). At this time the body may be opened by lifting (3). The body will be supported by the gas spring. Carefully inspect the vehicles for any sign of transit damage. If any damage is present this should be notified to the transport company immediately and preferably whilst the driver is still present.

## 4.2 Fitting the BATTERIES & TESTING



**Fig 4.2 - Fitting the Batteries**

1 – The Battery    2 – Lifting Handles (See note below)    3 – Battery Holders

1. Place two batteries into an ORBITER. Note the position of the cables as in Fig.4.2 and connect the batteries.

**Note:**

The battery handles (2) **MUST** be folded flat on to the top of the battery after fitting.

1. Set the ORBITER control unit selectors (Fig 3.2) to the required settings.
2. Note the coin counter numbers. (Fig 3.1a-8)
1. Close the body by lowering gently until the body touches the chassis. Then push down firmly at the top of the headrest until the catch is heard to click.
1. Introduce the required number of coins/tokens into the coin acceptor. Note the time. After a short delay the sound will be heard.
6. Sit in the ORBITER and test drive around the area. This is a good time to ensure that the barrier is correctly and substantially constructed.
6. Drive the ORBITER until it times out. Check that this corresponds with the time set on the Ride Time Selector (Fig 3.2-2)
7. Open the body and check the coin counter has advanced by the correct number.

**Tip**

The counter will count **ALL** coins/tokens inserted irrespective of when the ride triggers.

6. Repeat for each ORBITER.

The pneumatic bumpers are shipped inflated to the maximum air pressure of 1 bar. The pressure should now be adjusted to suit the particular conditions at each site. Using the valve (Fig 3.1a-9) partially deflate the bumper to provide the maximum impact protection.

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The correct pressure is obtained when two ORBITERS meet head on and the bumpers deform but do not allow the bodies to come into contact with each other.  
Take this opportunity to record the pressure that you have set the bumpers to in this box:

BAR
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### 4.3 *The CHARGERS*

The chargers (Fig 3.4) should be placed on a suitably positioned shelf and a number of factors must be taken into consideration. The size of the chargers may be found at appendix B.

1. The chargers are designed to operate indoors only and if not placed in the ORBITER storeroom they must be protected against any ingress of water.

#### **Warning!**

If the chargers are to be located in a position where an operator who may be wet from rain can touch the case then the chargers must be protected by a *residual circuit breaker*. If in doubt contact **Tornado International Technical Help**.

1. ***At all times there must be a free flow of cooling air over the charger case!*** It is vital that this precaution is observed. The top of the charger case must not be within 300mm of any horizontal surface.
1. If chargers are mounted one above the other then a gap of 600mm must be allowed.
1. If the chargers are mounted in any type of box or housing then the volume of the box must exceed twice the volume of the chargers installed. In addition the minimum ventilation required is as follows. For convection cooling the vents in the housing must each be at least equal to the total area of the vents respectively in the chargers themselves (Fig 3.4). For fan assisted cooling the top and bottom vents in the housing should be equal to 75% of the total area of the top and bottom vents respectively in the chargers themselves.

#### **Note:**

The volume of a charger is approximately 12 litres. The area of the top and bottom vents in a charger case is 132 square centimetres each.

5. Attention must be paid to the length of the battery leads (Fig 3.4 items 2) fitted to the charger. The charger should be positioned in such a manner that the cable will reach the battery without undue operator effort or strain on the cable. In particular it should be noted that the batteries are too heavy to be lifted onto a shelf.

#### **Tip:**

Battery cable extensions are supplied for each battery charging position. These should not be altered in any way.

6. Each charger requires either a 110 or 220/240volt 13amp socket. UK chargers will be supplied with a 13 amp plug. Export models will be set to local voltage and will be supplied *with* a local mains plug where available.

## 5.0 Operation

### **WARNING**

It must be understood that *ORBITER* is a free running vehicle and as such all steps must be taken to ensure that it is only used by guests who are of a suitable size and age. To determine if a guest is large enough to drive *ORBITER* is easy. The guide is as follows. With the guest seated in the car and their back against the backrest their arms must reach the controls without leaning forward. It should be understood that the position of the body when correctly seated is an intrinsic part of the in-built safety of the ride. To determine if the guest is old enough to understand the principles behind safe operation of the ride is far more difficult. It could be assumed that a child of ten or older would have sufficient understanding to operate the vehicle correctly. However there is great latitude in children's development and understanding during the ages of five to twelve. It is suggested that the decision as to whether a particular child is suitable for this ride should be left to the parent or adult accompanying the child. It is of course vital that suitable signage is erected in order to convey these points to such adults. See appendix D.

### 5.1 DAILY

#### **At the Start of the Operating Period:**

1. Check the charging indicators on the front of the charger (Fig 3.4 items 3&4). The digital display should read 100%, with the GREEN LED illuminated when fully charged. If the indicators do not show this then notify your supervisor and do not disconnect the battery.
1. Disconnect the batteries from the chargers.
1. Move the ORBITERS into the playing area and polish and clean the bodies.
1. Open the ORBITER body (Fig 4.1) and carefully place the batteries into the battery carriers (Fig 4.2). *Note the position of the battery leads and ensure that the battery lifting handles are folded flat against the top of the battery.*

#### **Caution!**

Exercise care when lifting or moving the batteries. They are heavy! Lift using only approved techniques keeping your back straight. Be aware of the battery lead and avoid the plug becoming caught as this might cause a sudden increase in the load. Avoid putting the battery down on the plug or lead.

5. Connect the battery leads to the ORBITER control electronics (Fig 4.2).

#### **Note:**

The ORBITER must always have two batteries connected when in service.

#### **Tip:**

Red handles are fitted to aid connecting and disconnecting.

6. Conduct a thorough visual inspection of the chassis.
7. Note the coin counter reading.

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8. Close the body by lowering it gently until it touches the chassis, then push firmly down on the top of the headrest until a click is heard.
9. If seat belts are fitted the shoulder strap (Fig 3.5-1) should be extended as far as possible. It should then be checked visually for any signs of wear or fraying. The buckle (Fig 3.5-3) should be checked for correct operation.
10. Coin and test drive each ORBITER.
11. If RIDE MASTER is fitted check the emergency stop function as follows.
  - a) **Referring to the RIDE MASTER user manual**, make a note of the position of the mode selector (Fig1 item1), and then set to “Session Play – Pay Attendant”.
  - b) Start all of the ORBITERS by pressing the start button (Fig 3 item 1). Wait for 10 seconds after which all of the sound effects will have started.
  - c) Press the red emergency stop button (Fig 3 item 4). All of the sound effects will stop and the start and finish light (Fig 3 items 2&3) will flash.
  - d) With the emergency stop button still pressed move the control sticks on each ORBITER in turn. The vehicles should not move. Release the emergency stop button by rotating the head. All of the vehicles should now drive normally.
  - e) After the go has finished return the mode selector to the previously noted position.If any defects are found notify your supervisor.

**At the end of the operating period:**

1. Move each ORBITER close to the storage area and open the body.
2. Disconnect the batteries from the ORBITER control electronics and remove from the battery carrier for charging.

**Caution!**

Exercise care when lifting or moving the batteries. They are heavy! Lift using only approved techniques keeping your back straight. Be aware of the battery lead and avoid the plug becoming caught as this might cause a sudden increase in the load. Avoid putting the battery down on the plug or lead.

**Tip:**

The batteries may be charged in the ORBITERS. See section 2.4. Extension leads are provided.

3. Place the batteries close to the chargers and connect to the charger leads. Note that each charger unit feeds four batteries but that each battery is charged independently.

**Caution!**

The battery plug is grey with a red handle and the charger plug is black or black with a red handle if the extension leads are being used. As you connect the batteries to the chargers check that each connection consists of one grey and one black plug. Failure to do so may result in damage to the charger and batteries.

4. Check that there is a reading on each charger status indicator. (Fig 3.4 item 3). If there is an indicator without a reading, investigate the cause. The chargers are fully automatic so there are no settings to adjust.
5. Empty the cash box (Fig 3.1a-7) and note the coin counter readings (Fig 3.1a-8). Return the body to the closed position.

**Caution!**

If the batteries are to be charged inside the ORBITER, ensure that the charging leads are positioned in such a manner that they will not be damaged by closing the body.

6. Remove the ORBITERS to the storeroom or fit the covers if left outside overnight.

## 5.2 Batteries and Battery Charging

It must be understood that batteries are an expendable item and in this respect are similar to the tyres and brakes on your car. They will benefit from correct use and be permanently damaged by misuse or inappropriate charging regimes. There are three areas where you can have a direct effect on the overall life of the battery. These are, *Charging, Use and Storage.*

Before we examine the factors relating to battery life, this vital fact must be appreciated.

**Every rechargeable battery leaves the manufacturer with a finite life!**

This life is usually expressed in terms of charge/discharge cycles. Each time a battery is charged and discharged a part of the battery life is used up and cannot be replaced.

### 5.3 Charging.

**Caution!**

The battery vents (Fig 3.3-4) must not be removed for any reason. The battery is maintenance free and water must not be added. Removal of the vents or the addition of water to the cells will invalidate the warranty.

It is vital to use a quality charger. The charger supplied is a well known commercial product and is purchased from a respected, proven and worldwide manufacturer. It has been chosen by us to be used with the dry-fit batteries supplied. Do not charge the batteries with any other charger and do not use the Tornado chargers on other batteries. The batteries should be charged at the end of each operating period even if the ORBITER has only had a little use.

Repeated under charging will lead to reduced battery capacity and premature failure. With this in mind it is important to charge the battery fully after each use and this will normally be achieved by overnight charging. Incomplete charging can be diagnosed by charger displays which are not at 100% at the start of the operating period and a gradual and progressive reduction of the batteries capacity as evidenced by a reduction in the number of rides the batteries achieve. If these symptoms are accompanied by late closing and early opening times then steps must be taken to avoid the premature failure of the batteries due to undercharging. If the reasons for the undercharging are of a temporary or spasmodic nature then it is permissible to charge the batteries for a full 24 hours each week of operation. This can be achieved by charging the batteries in rotation, removing one of the ORBITERS from service, or by purchasing one pair of spare batteries and a spare charger. If the reasons for undercharging are continuous then the best solution is to purchase spare batteries and chargers for each ORBITER.

### 5.4 Use

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When fitting and removing the batteries handle them with care. Avoid dropping them into the ORBITER or onto the floor. Dropping the battery will cause the plates to deform with the result that some cells will become useless. Do not allow the ORBITER to be used with discharged batteries. Customer satisfaction will be reduced as will the battery life. Charge the batteries or remove the ORBITER from service as soon as the vehicle speed is visibly reduced. Do not part charge and re-use the batteries as this will lead to premature failure.

### 5.5 Storage

If the ORBITERS are to be removed from service the correct storage of the batteries is vital. As soon as the batteries are removed from service they should be charged for 24hours. They should then be stored in a FROST-FREE place and be charged for 24hours each month of storage. Failure to follow these instructions will result in permanent damage to the batteries.

### 5.6 Summary

1. Only use the chargers supplied.
2. Charge the batteries at the end of each operating period.
3. Do not allow repeated undercharging.
4. Remove batteries from service before they are completely discharged and recharge immediately.
5. Charge for 24hours before storage and recharge for 24hours for each month of storage.
6. Store in a FROST-FREE place.
7. Handle the batteries with care.
8. Keep the terminals and plug clean.
9. Do not remove the vents, or add water to the cells.

**The batteries are expensive. It pays to look after them!**

## 6.0 Inspections

### 6.1 Weekly Inspection:

#### Caution!

This is a safety inspection and as such should only be undertaken by suitably qualified and experienced personnel.

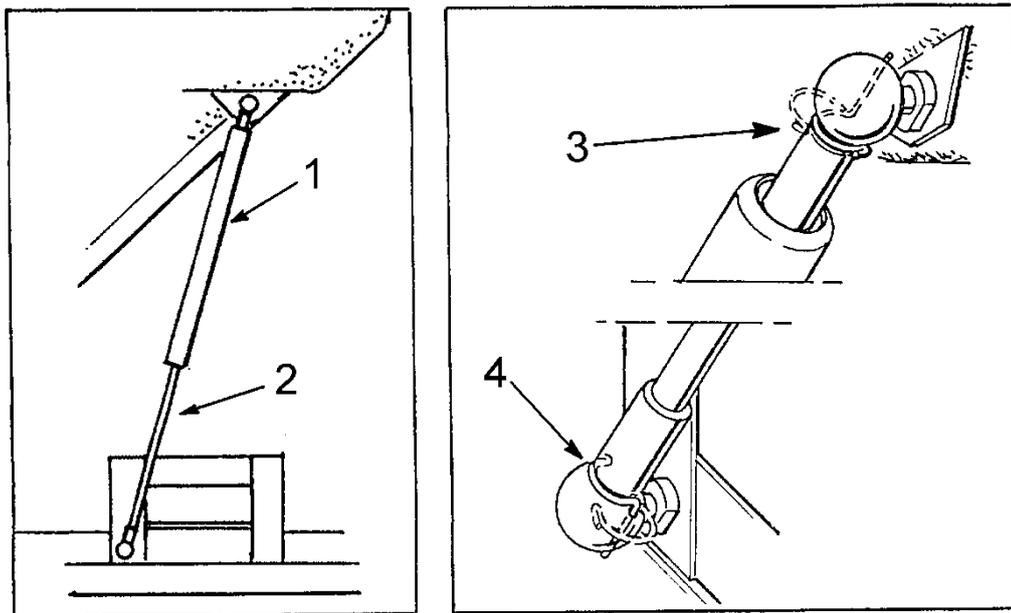
*Inspections printed in italics are safety critical. Any ORBITER failing a safety critical inspection **must** be removed from service until the fault is rectified.*

With the body open check the following:

### 6.2 The condition of the body hinge assembly at the front of the chassis. (Fig 3.1a-10)

- Check for any signs of bending or deformation.
- That there is no sign of rust around the hinge pin.
- That the retaining pin is correctly in place. (Fig 3.1a-11)
- That there is no sign of delimitation of the hinge plate from the body moulding.

### 6.3 The condition and operation of the gas spring.



**Fig 6.3 - The Gas Spring**

- 1 – Body    2 – Ram    3 – Upper Ball Joint & Retaining Clip  
4 – Lower Ball Joint & Retaining Clip

#### Warning!

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The gas spring contains gas at very high pressure. Treat a compressed spring with great respect and care. Do not attempt to dismantle. Dispose of carefully. Do not incinerate or crush.

- a) Check operation by lowering the body to the almost closed position. Wait a few seconds and raise the body to approximately the half way position. At this point the gas spring should open the body by itself. The operation should be smooth and the last part of the cycle should be damped. The speed of opening and extent of the damping will vary depending on the ambient temperature.
- b) *With the body in the fully open position push down on the top of the head rest. It should take a push of 4 Kilos to begin to close the body.*
- c) *Check that the ball joint retaining clips are in good condition and fitted correctly. (Fig 6.3 items 3&4)*
- d) Check the ram (Fig 6.3-2) for any sign of the gas strut leaking. An oily deposit will be the first indication of this. If any malfunction of the gas spring is noted it must be changed. Proceed as in Chapter 7.9.

**6.4 Check the condition of the body retaining catch as follows:**

- a) *Close the body gently. It should then take a firm push on the top of the head restraint to lock the catch. An audible click should be heard. After the catch is latched correctly it should not be possible to open the body by lifting. If necessary the catch may be adjusted as per Chapter 7.1.*

**6.5 Check the condition of the pneumatic bumper as follows:**

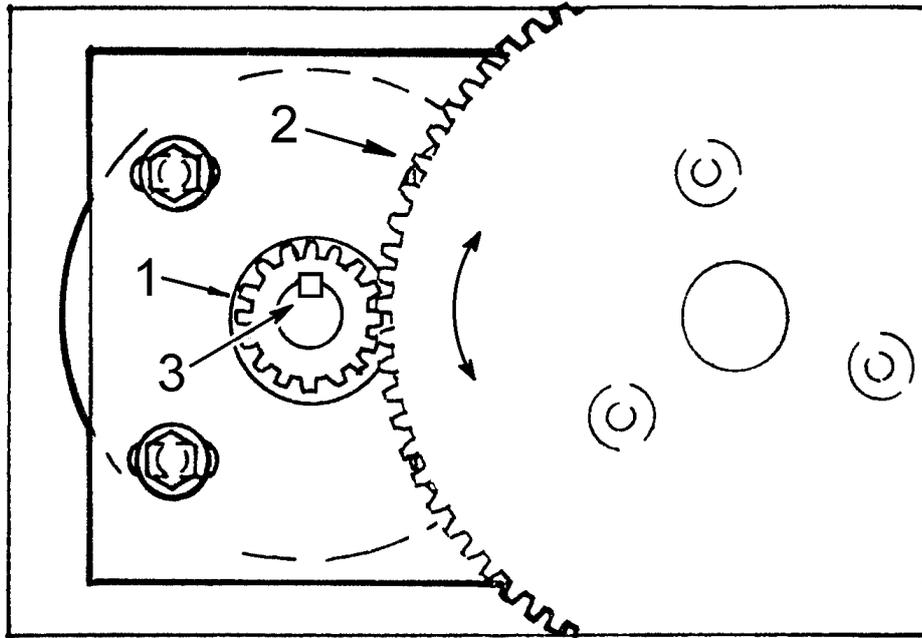
- a) *With the body open, visually inspect the valve stem for damage. (Fig 3.1a-9).*
- b) *Using a tyre gauge check the air pressure against your normal setting. Do not forget to allow for variations in ambient temperature.*
- c) *Thoroughly inspect the perimeter of the bumper.*

**6.6 Check the condition and mesh of the drive gears as follows:**

- a) Using a suitable block of wood raise one side of the ORBITER so that the wheel can be rotated freely.
- b) With the body open, visually inspect the condition of the gears (Fig 3.1a-12). They should be clean with no obvious signs of wear. If there is any dirt in the gears clean with a stiff (not wire) brush.

**Note:**

Do not use any solvents to clean the Delrin gear (Fig 6.6-2).



**Fig 6.6 – Drive Gears Free Play**

1 – Motor Pinion    2 – Delrin Drive Gear    3 – Drive Key

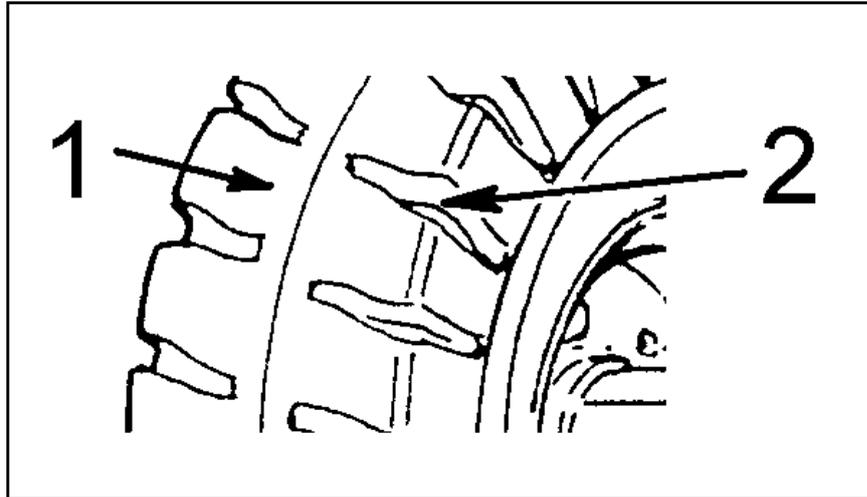
- c) With reference to Fig 6.6 above, hold the motor pinion (1) stationary and gently rotate the wheel. There should be a small amount of free play. (2mm at the circumference of the wheel).
- d) Any excessive play can be removed by adjusting the motor. Proceed as per Chapter 7.8.
- e) Check that the pinion (1) is securely fastened to the motor and that the square drive key (3) is not displaced. Check that the Delrin gear (2) is securely fastened to the wheel. Tighten if necessary.
- f) Repeat for the other side.

#### **6.7 Check the condition and security of the castors as follows:**

- a) Using a suitable block of wood raise the rear of the ORBITER so that the castor can be rotated freely.
- b) Rotate the wheel and listen for any sound of rough running. A dry sound may be remedied by greasing, proceed as per Chapter 7.6.
- c) Rotate the whole castor and listen for any sound of rough running. A dry sound may be remedied by greasing, proceed as per Chapter 7.6.
- d) *If either of the above tests show the bearings to be damaged then the castor must be replaced. Proceed as per Chapter 7.7.*
- e) Visually inspect the tyre for wear or cracking.
- f) *Check the mounting nuts are tight.*
- g) *Check that the castor spindle nut and bolt are tight.*
- h) Repeat for the front castor.

**6.8 Check the condition of the main tyres as follows:**

- a) Visually inspect the tyres for wear or cracks. A diagram of acceptable wear will be found at Fig 6.8. The tyre has reached the end of its useful life when the outer circumference (Fig 6.8-1) meets the wear marks (Fig 6.8-2).

**Fig 6.8 – Main Tyre Wear**

1 – Original Circumference    2 – Wear Marks

**6.9 Check the condition of the loom as follows.**

- a) Visually inspect the loom for any physical damage. Pay particular attention to the hinge area and where the loom passes through any securing device.

**6.10 Check the condition of the batteries and Battery Looms as follows:**

- a) Remove the batteries from the ORBITER. Do this even if the batteries are normally charged in the car.

**Caution!**

Exercise care when lifting or moving the batteries. They are heavy! Lift using only approved techniques keeping your back straight. Be aware of the battery lead and avoid the plug becoming caught as this might cause a sudden increase in the load. Avoid putting the battery down on the plug or lead

**Caution!**

Follow the next instruction only if you are using Sonnenschein batteries as supplied by Tornado International Ltd. **DO NOT PLACE ANY OTHER TYPE OF BATTERY ON ITS SIDE**

## ORBITER MANUAL

- b) *Place a clean dry cloth on the ground to protect the battery and roll the battery on to its side. Inspect the case of the battery for any damage. If any is noted it should be assessed by a competent person. A battery with a hole or crack, or any damage which may lead to a hole or crack must be removed from service immediately.*

**Warning!**

Any such battery must be treated with care! Handle only with protective clothing. Dispose of in accordance with local by-laws.

- c) Roll the battery upright and check that the battery post connections are clean and tight.  
d) *Visually inspect the battery loom for any damage. Replace if any is found.*

**Warning!**

In the event of a short circuit the batteries are capable of generating large currents. There is a fire risk if damaged battery looms are used.

At this time check the battery connections and leads entering the ORBITER control electronics.

**6.11 Check the condition and operation of the battery chargers as follows:**

- a) *Visually inspect all of the charger cables for damage (Fig 3.4 items 2&6).*  
b) Using a discharged, or part discharged battery connect to each charger in turn. Note the status indicator at each position and that they are the same.  
c) If any malfunction is noted the charger should be returned to Tornado International Ltd for repair.

**6.12 Check the condition and operation of the seat belts (if fitted) as follows:**

- a) *Visually inspect the webbing straps (Fig 3.5 items 1&2) for any signs of fraying. The shoulder strap (Fig 3.5-1) should be fully extended for this inspection.*  
b) *Engage the strap into the buckle (Fig 3.5-3) and check that the shoulder strap recoils into the body. Grasp the shoulder and lap straps and pull hard against the buckle. It should remain fastened.*  
c) *With the shoulder strap extended to the position normally used when in operation, grasp the strap in one hand and sharply pull the shoulder strap away from the Orbiter body. The strap should lock after a few millimetres of movement. Repeat this snatch test with the strap at three other positions of extension.*  
d) *Open the Orbiter body and check that all of the seat belt anchor fasteners are secure.*

**6.13 Check the security of all fasteners.**

Carry out a thorough visual check and mechanical test of all fasteners and fittings. Tighten as required.

**Coin the ORBITER and test drive.**

### **6.13 EVERY SIX MONTHS OF OPERATION:**

**Perform all of the Weekly Checks and in addition:**

- a) Remove the main wheels from the ORBITER, remove the roller bearing and thoroughly clean. Clean the axle, re-assemble and grease (proceed as per Chapter 7.4.)
- b) Remove the castors and remove the castor wheel axle. Thoroughly clean, re-assemble and re-grease. Proceed as per Chapters 7.6 & 7.7.
- c) If seat belts are fitted - *perform an operational and visual check of the seat belts as in chapter 6.12. Consider their replacement. In any event the seat belt should be replaced after 12 months of operation.*

### **6.14 BEFORE STORAGE:**

**Perform the weekly check and six-month service and in addition:**

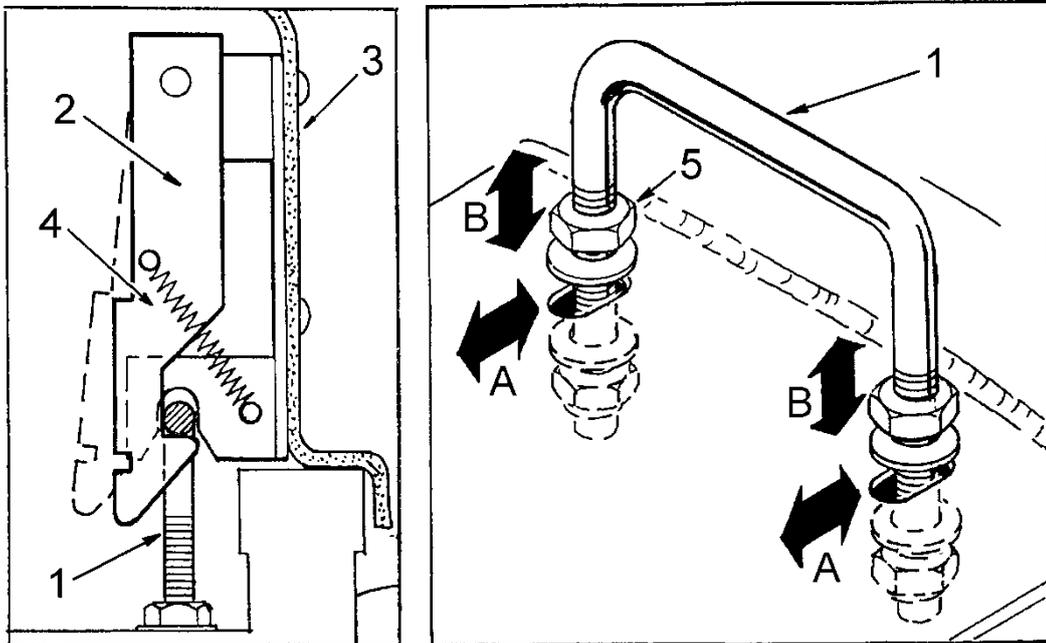
- a) Note any parts required and order them from Tornado International NOW!
- b) Thoroughly clean the body and chassis.
- c) Apply a good polish to the body and treat any damaged paint on the chassis.
- d) Deflate the bumper to 0.25 bar.
- e) Ensure that the batteries are removed from the ORBITER.
- f) Store the ORBITER in a dry well ventilated place. Cover with clean sheets. Do not use the overnight covers for extended storage.
- g) Store the batteries in a FROST-FREE place. It is vital to charge the batteries for 24HRS EACH MONTH OF STORAGE. Failure to observe these two precautions will result in premature battery failure.

### **6.15 TO RETURN TO SERVICE:**

- a) Remove the ORBITERS from storage and thoroughly clean.
- b) *Carefully check the bumper for any signs of cracking or damage.*
- c) Using a car tyre foot pump inflate the bumper to your normal pressure but in no case above 1bar.
- d) *Carry out the weekly check and test each ORBITER in turn.*

## 7.0 Maintenance

### 7.1 Body Catch Adjustment



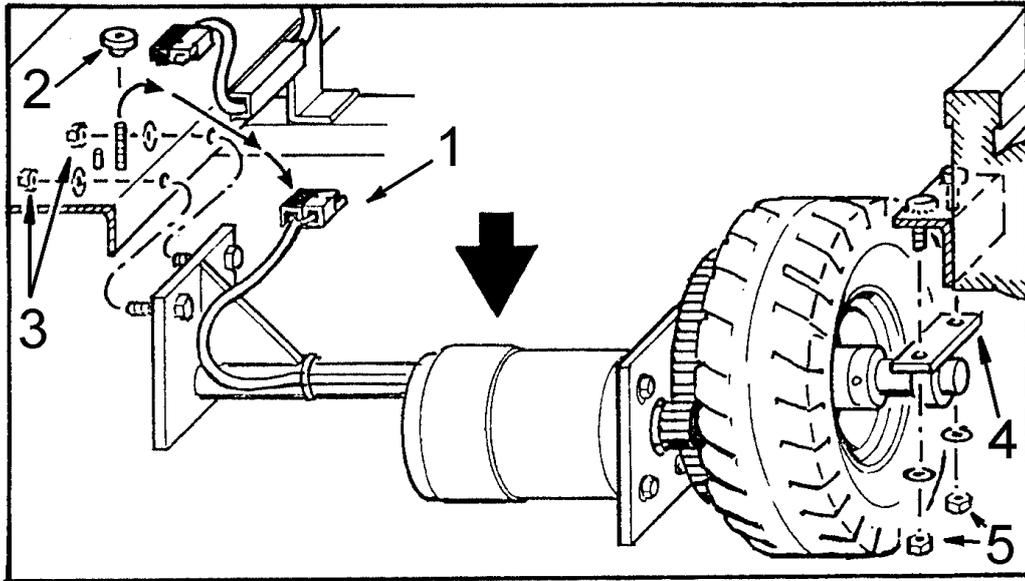
**Fig 7.1 – Body Catch Adjustment**

1 – Chassis Bar    2 – Body Catch Assembly    3 – Body    4 – Retaining Spring  
5 – Chassis Bar Adjustment Nuts (4 off)

The body catch can be adjusted to compensate for general wear. It is adjusted correctly when the chassis bar (Fig 7.1-1) is positioned in the recess in the body catch assembly and a firm push on the body is required to engaged the catch. Proceed as follows:

1. Remove the batteries from the ORBITER and close the body.
2. Lift the ORBITER to the vertical position with the catch at the top, have a colleague hold the ORBITER in this position.
3. Loosen the chassis bar lower adjustment nuts (Fig 7.1-5).
4. Slide the bar in the direction “A” in Fig 7.1 to place the bar in the centre of the body catch assembly.
5. By adjusting the nuts the bar can be adjusted in direction “B” to pull the body into close contact with the chassis.
6. Tighten the adjustment nuts.

## 7.2 Axle Removal



**Fig 7.2 – Axle Removal**

1 – Motor Connector    2 – Motor Connector Retaining Nut  
 3 – Inner Retaining Nuts    4 – Outer Support Bracket    5 – Outer Retaining Nuts

Remove the batteries from the ORBITER. Leave the body open.

Support the ORBITER above the floor by 400mm. Axle stands are ideal for this.

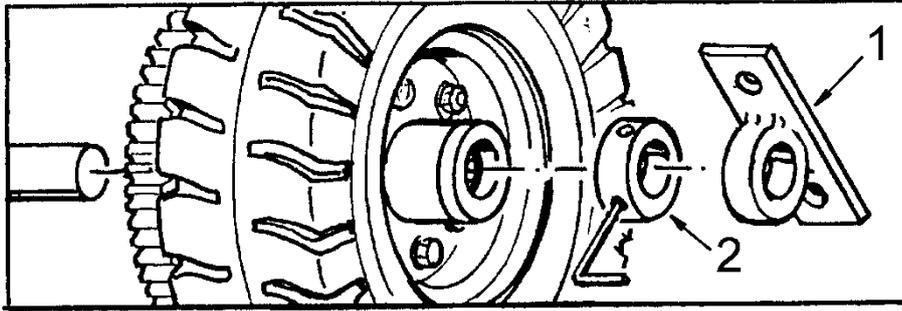
Disconnect the motor lead from the loom (Fig 7.2-1).

Remove the inner retaining nuts (Fig 7.2-3). The bolts are welded into the axle.

Support the axle and remove the outer retaining nuts (Fig 7.2-5). The bolts are welded into the chassis.

The axle assembly can then be removed from the chassis.

### 7.3 Wheel Removal



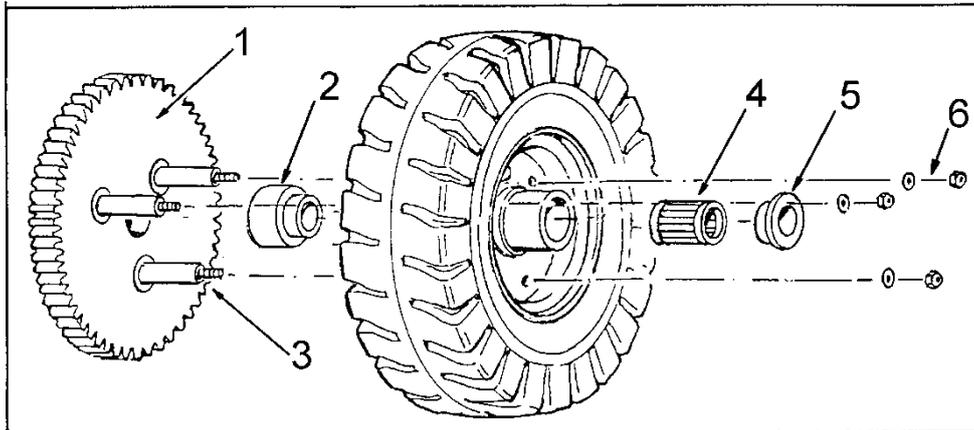
**Fig 7.3 – Wheel Removal**

1 – Outer Support Bracket 2 – Wheel Retaining Collar

Remove the outer support bracket (Fig 7.3-1).

Using a hex key remove the **TWO** retaining screws from the wheel retaining collar (Fig 7.3-2). The screws are retained using thread-lock which must be reapplied on reassembly.

### 7.4 Removing the Wheel Bearing.



**Fig 7.4 – Wheel Bearing, Removing and Lubricating**

1 – Delryn Drive Gear 2 – Inner Spacer 3 – Gear spacers and Bolts  
4 – Wheel Bearing 5 – Outer Spacer 6 – Gear Retaining Bolts

1. Remove the three gear retaining nuts (Fig 7.4-6). Be careful to remove the correct three nuts. The gear can then be separated from the wheel.
2. Remove the inner and outer spacers from the wheel. (Fig 7.4 items 2&5)
3. The bearing can then be removed from the wheel.

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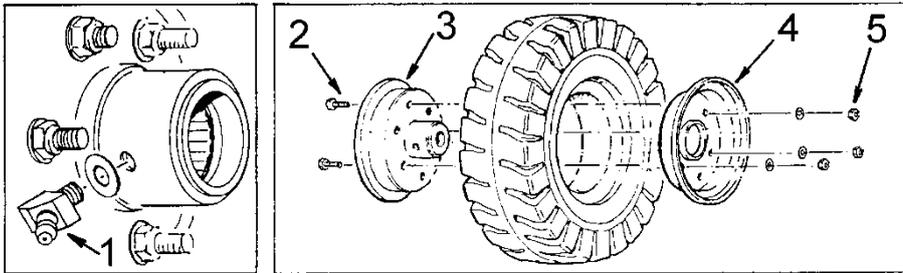
4. All of the components should then be thoroughly cleaned and inspected for wear.

**Note!**

Do not use any solvents to clean the Delrin gear .

5. The bearing should then be packed with fresh auto wheel bearing grease and re-assembled.

## 7.5 Tyre Changing

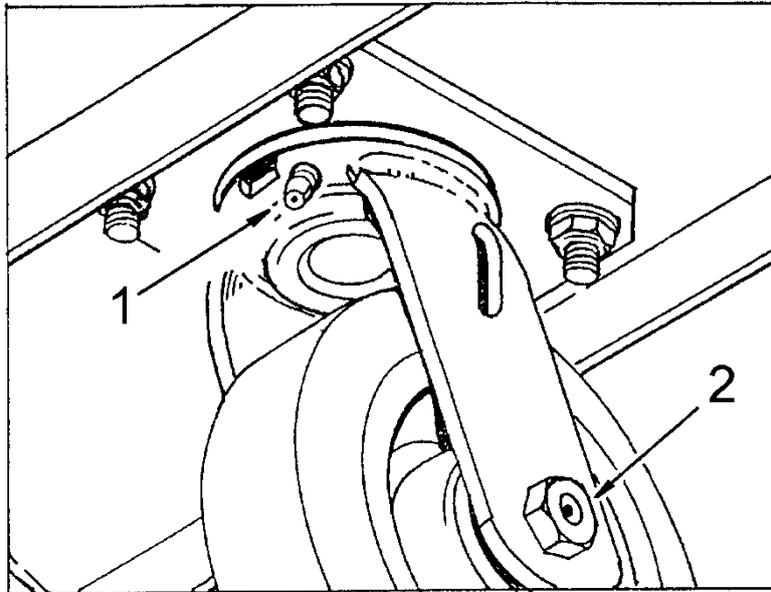


**Fig 7.5 – Tyre Changing**

1 – Grease Nipple 2 – Wheel Bolts (3 off) 3 – Inner Wheel Rim  
4 – Outer Wheel Rim 5 – Wheel Nuts (3 off)

1. Unscrew the grease nipple (Fig 7.5-1).
2. Unscrew and remove the three wheel bolts and nuts (Fig 7.5 items 2&5).
3. Remove the inner and outer wheel rims (Fig 7.5 items 3&4) from the tyre. This may require a press.
4. To re-assemble apply water to the new tyre and place the inner and outer wheel rims in position.
5. Using a press force the rims together and replace the nuts and bolts.
6. Re-fit the grease nipple.

## 7.6 *Castor Lubrication*

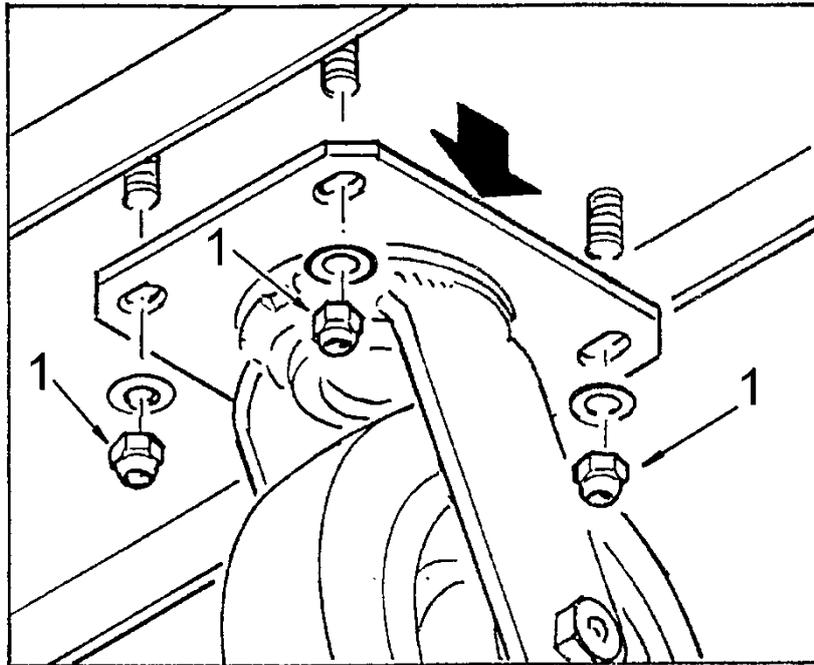


**Fig 7.6 – Castor Lubrication**

1 – Turntable Grease Nipple    2 – Castor Axle Retaining Nut

1. Remove the batteries from the ORBITER and close the body.
2. Place the ORBITER in the vertical position and have a colleague hold it in this position.
3. Using a standard grease gun filled with auto wheel bearing grease apply to the nipple (Fig7.6-1) until fresh grease is seen at the perimeter of the bearing.
4. Remove any old grease expelled during this process.
5. Remove the axle retaining nut (Fig7.6-2) and remove the axle. The bearing and axle should then be cleaned and fresh auto wheel bearing grease applied.
6. Re-assemble the bearing and axle.

## 7.7 *Castor Replacement*

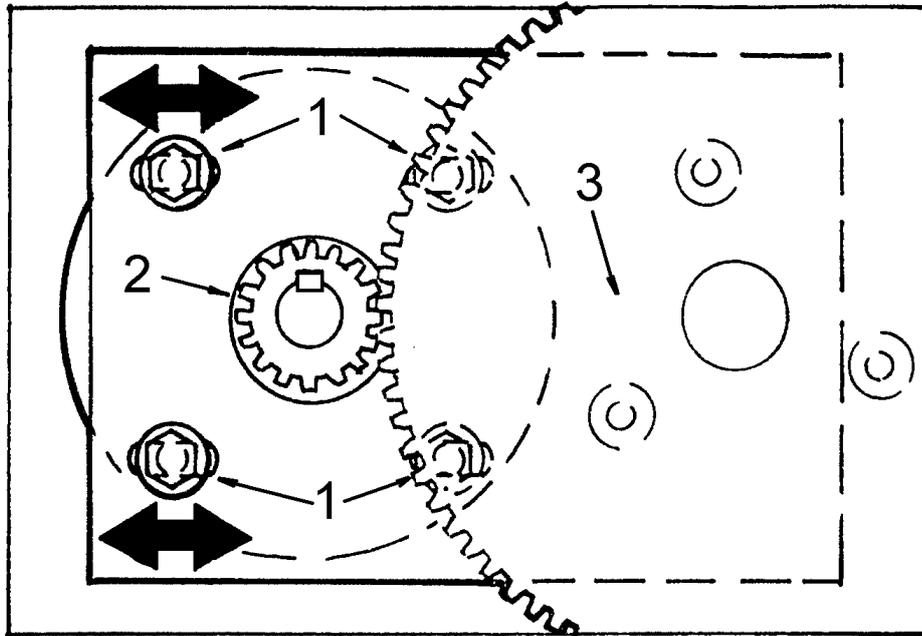


**Fig 7.7 – Castor Replacement**

1 – Castor Retaining Nuts

Remove the batteries from the ORBITER and close the body.  
Place the ORBITER in the vertical position and have a colleague hold it in this position.  
Remove the castor retaining nuts (Fig 7.7-1). The bolts are welded into the chassis.  
Remove the old castor and re-assemble using its replacement and new Nyloc nuts.

## 7.8 Drive Gear Backlash Adjustment

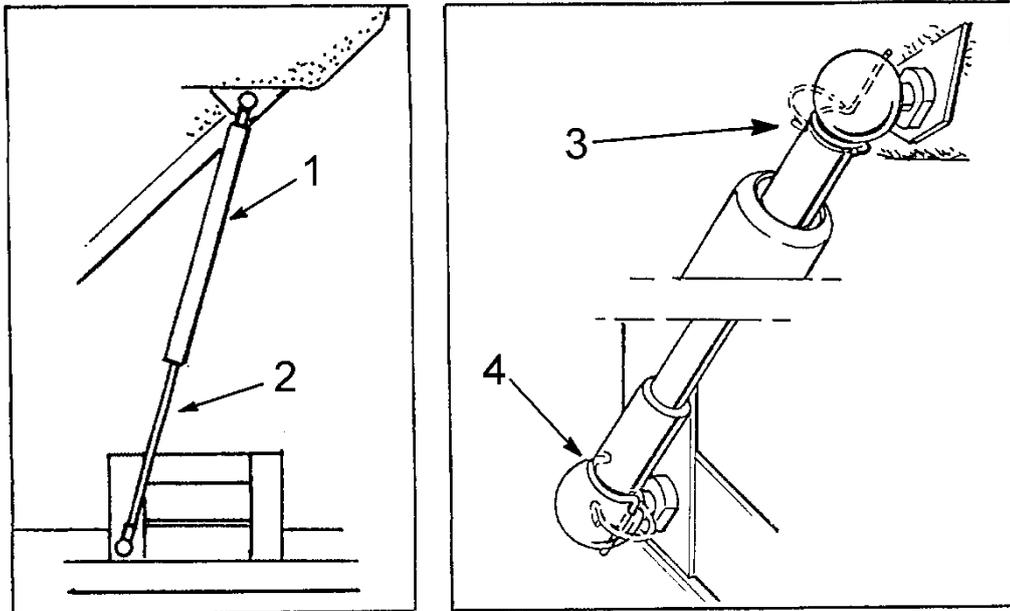


**Fig 7.8 – Drive Gear Backlash Adjustment**

1 – Motor Mounting Nuts (4 off) 2 – Motor Pinion 3 – Delrin Drive Gear

1. Using a suitable block of wood raise the ORBITER off the ground so that the drive wheel is free to rotate.
2. Remove the batteries from the ORBITER.
3. Loosen the motor mounting nuts (Fig 7.8-1) four off.
4. Slide the motor towards the drive gear to adjust the backlash to 2mm at the circumference of the wheel.
5. Re-tighten the motor mounting nuts.
6. Rotate the drive wheel at least once and check for any tight spots.

## 7.9 Gas Spring Replacement



**Fig 7.9 – Gas Spring Replacement**

1 – Body 2 – Ram 3 – Upper Ball Joint & Retaining Clip  
4 – Lower Ball Joint & Retaining Clip

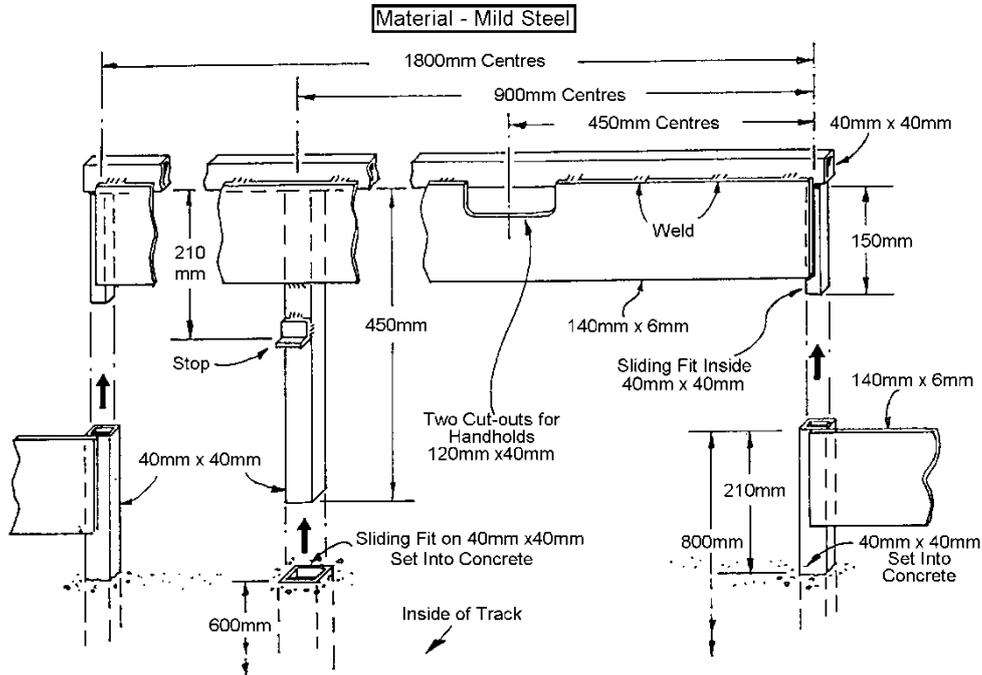
### Warning!

The gas spring contains gas at very high pressure. Treat a compressed spring with great respect and care. Do not attempt to dismantle. Dispose of carefully. Do not incinerate or crush.

1. Open the body and have a colleague support the body
2. Rotate and remove the lower ball joint retaining clip (Fig 7.9-4)
3. Rotate and remove the upper ball joint retaining clip (Fig 7.9-3)
4. Remove the gas spring from the ball joints.
5. Fit the replacement spring with the body (Fig 7.9-1) attached to the ORBITER body and the ram (Fig 7.9-2) attached to the chassis.
6. Re-fit the upper and lower retaining clips ensuring that they are seated correctly.

## Appendix A

### Barrier Details



## Appendix B

### Battery & Charger Dimensions

#### Battery

Manufactured by: Exide Technologies  
Sonnenschein Model Number GF1276V

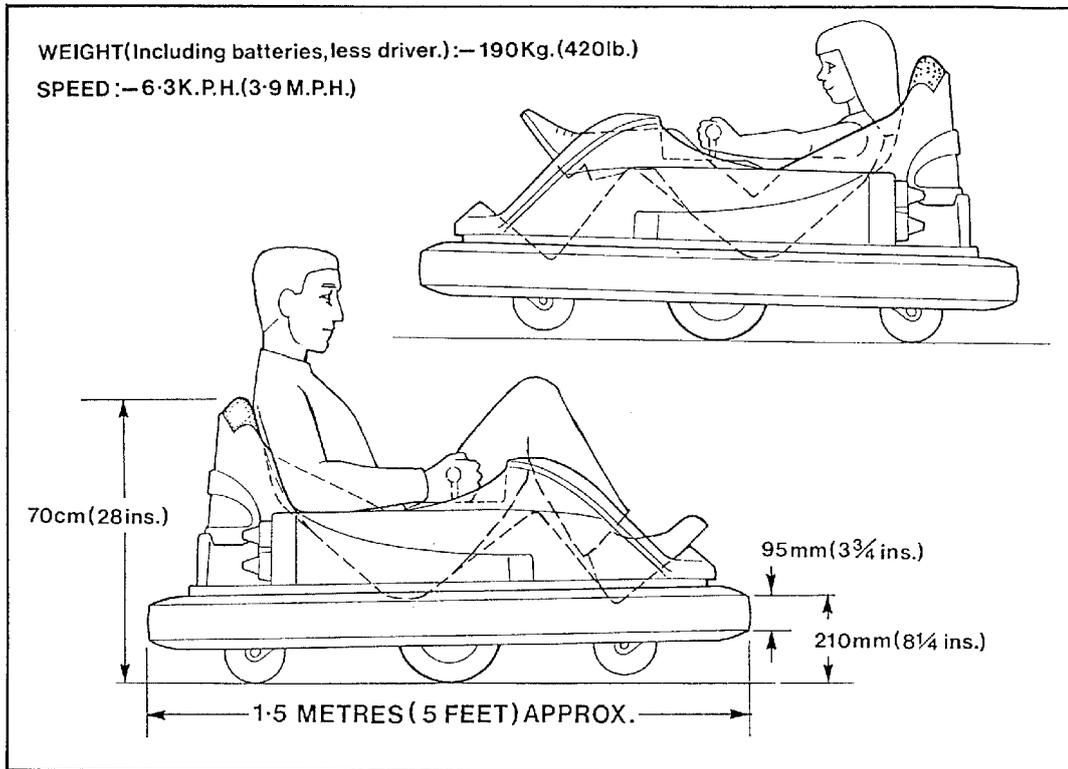
Dimensions: 330mm (l) x 171mm (w) x 236mm (h)  
Weight: 29Kg

#### Charger

Charging Station (4 Chargers)  
Dimensions: 285mm (l) x 205mm (w) x 170mm (h)  
Weight: 6Kg

## Appendix C

### Orbiter Specifications



Speed	6.3 kph
Capacity	110Kg
Riders	One
Weight (Inc Batteries)	190Kg
Batteries	76AH Sealed Lead-Acid (Sonnenschein Model GF1276V)
Battery Life	200 Charge/discharge cycles. Charge/discharge cycle = Fully charged to 100% discharge. Capacity at the end of rated life = 80%
Motors	24vDC 2000rpm
Transmission	Single stage spur gears.
Chargers	Quad station single input. Automatic charge rate.
Output	10A at 14v per Station
Recharge time	8 – 14 hrs (Depending on the level of discharge)

## Appendix D

### *Signage:*

# Guest Notice

These Vehicles are free roving and not guided in any way. Guests should assure themselves that children who will drive these vehicles are old enough to understand the method of control and their responsibilities, both to themselves and other riders.

A sign with this or similar wording should be placed in a prominent position where it will be seen on the approach to the ORBITER area.

# Caution! Moving vehicles

Take care when entering or leaving this area

These vehicles are designed  
to carry one person only  
***No bumping at any time!***

A sign with this or similar wording should be placed in a prominent position at the entrance to the ORBITER area.