MFG: A.R.M. (UK) LTD.
NAME: HIGH FLYER
TYPE: NON-KIDDIE

# OPERATION AND MAINTENANCE MANUAL

## ' HIGH - FLYER '

COMPILED BY:- MAGER DESIGNS & ASSOCIATES.

MANUFACTURER: ARM ( UK ) LTD

# INDEX

# SECTION 1

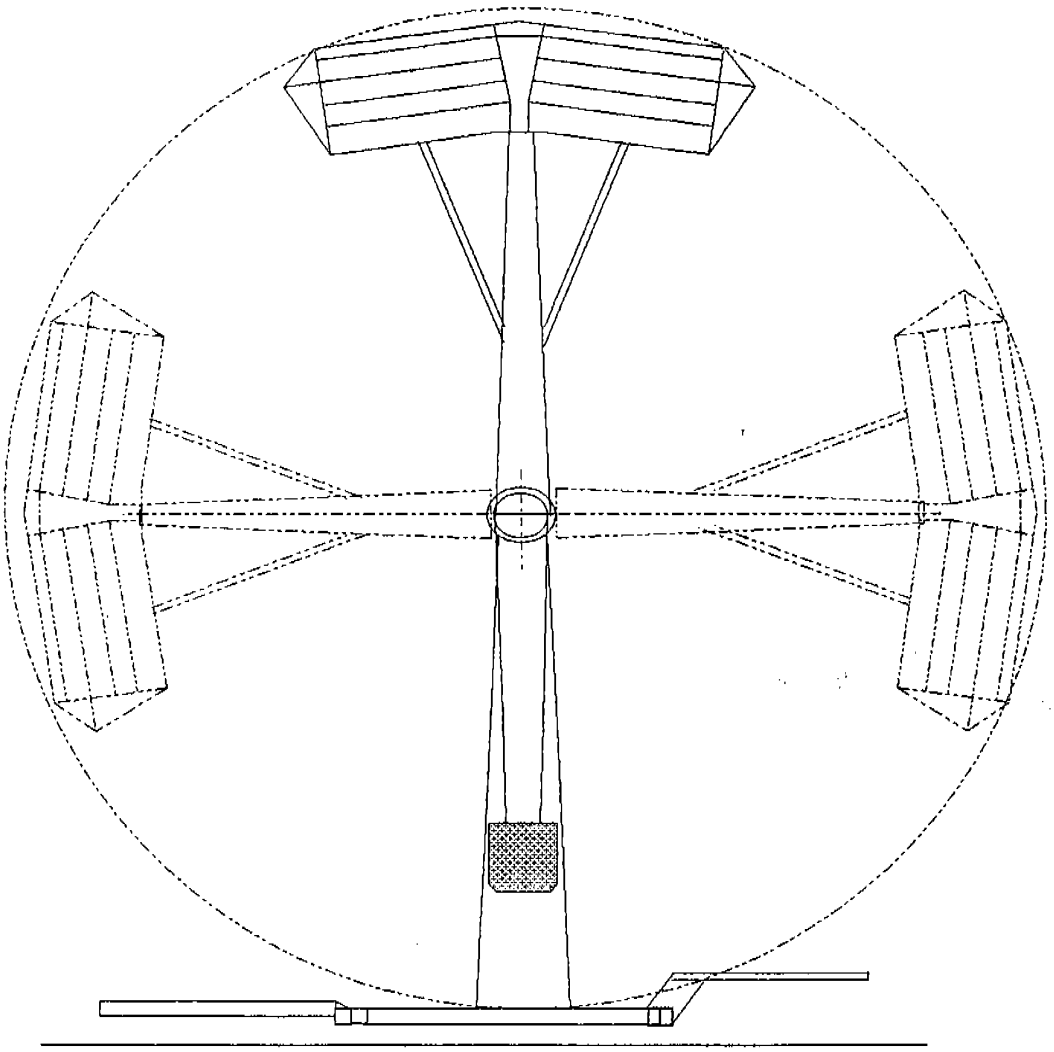
# TYPE DESIGNATION

## TYPE DESIGNATION

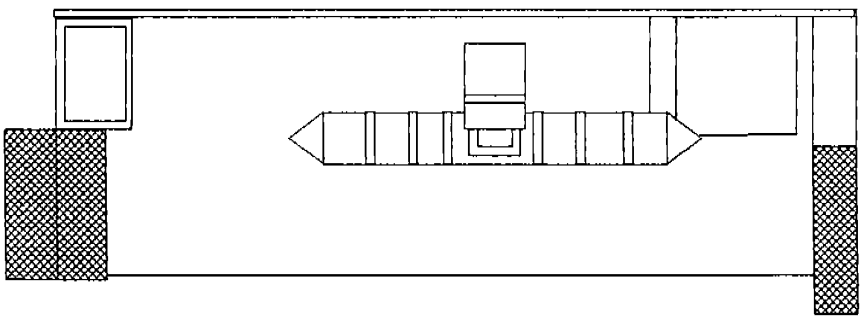
| | |
|---|---|
| TYPE DESIGNATION | ' HIGH - FLYER ' |
| SERIAL NO: | |
| MONTH OF MANUFACTURE: | |
| YEAR OF MANUFACTURE : | |
| MANUFACTURER : | ARM ( UK ) LTD |
| ADDRESS : | UNIT 1 ENSTONE AIRFIELD,<br>ENSTONE,<br>OXFORD,<br>ENGLAND. |

# SECTION 2

# DESIGN SPECIFICATION



Side Elevation



Plan View

## Overview of "High - Flyer" Amusement Ride.

The High - Flyer amusement ride is of the fully mobile type all being carried on a single road going trailer comprising of fold out floor, fold out flash panels, lighting etc. and being erected in some 120 minutes.

The ride is capable of one man operation but when busy it is intended to use an assistant to shepherd the passengers and check passenger security, a pay box is situated to the rear of the ride giving maximum visibility and control of the passengers and ride.
Steps and queuing rails are provided giving a smooth thro put of passengers with an orderly queuing system thus providing crowd control and safety.

The ride motion is derived from a single rotating arm carrying the passenger car at the extreme outer end. The arm is counterbalanced by a counterweight which counterbalances the unladen weight of the arm and car. The main arm is attached to a slewing ring which is mounted on a horizontal axis and driven by a single electric motor the drive being taken by propshaft to a bevel reduction gearbox and pinion to the slewing ring. Control is provided by a computerised electronic control unit which gives total programmable control over the motor speed and torque output both driving and in the overrun condition and also allows optimum conditions for the initial swinging phase.

The effect of this arrangement is to provide a rotating system so that each passenger is constrained to rotate about a fixed point centered on a horizontal center line drawn through the slewing ring or point of rotation. Passengers are seated in an upright position and constrained from free movement by a fully adjustable lap bar which is pivoted about a point above the passengers head, thus providing full upper body restraint.

The maximum dynamic accelerations at full speed are in the order of 0.5 'g' at the top most position and 2.3 'g' at the lower most position and the resultant forces combined with the circular motion combine to give an exciting and robust ride which has proved to be very popular with the public.
All controls are situated in the pay box and grouped in a single control panel giving ease of operation and providing excellent control. The main rotary movement of the ride is controlled by a forward and reverse joystick.

Overrun from the mass of passengers and car in the downward direction and the resultant voltages generated in the main drive motor are all monitored and controlled by the electronic control system, the whole combining to give a smooth uninterrupted circular motion.
Due to the excellent control and response available the ride can be stopped at the top most position at random thus adding further variations of motion and excitement.

Thro-put in the order of 300 passengers per hour is readily achieved with an experienced operator and loading/unloading is in the order of 60 seconds max.
Ride capacity is 16 passengers and ride operating speed is 12 rpm dynamic braking is achieved via the main electronic control system and drive motor while parking is achieved by pneumatic drum brake and mechanical system inertia.

Dismantling the ride is achieved by folding the counterbalance weight, folding flash panels and folding floor, power systems to achieve this are all provided on board. the whole ride when folded has the appearance of a drop sided vehicle.

## Design Standards Used.

**Standards complied with or exceeded.**

Health and Safety Executive Code Of Practise (current draft copy) .

Health and Safety Executive Code Of Practise 1984.

ASTM Amusement Rides and Devices 1987.

| | | |
|---|---|---|
| Structural standard | | BS 5400 PT 10 |
| Material specification | Plate | BS 4360 - 43A. |
| Material specification | Hollow Sections | BS 4360 - 43C |
| Material specification | Bright Bar | BS 970 - EN8 |

**Minimum Static Safety Standards**

| | |
|---|---|
| Min static F.O.S. on yield of any fully loaded structure | 3 : 1 |
| Min Static F.O.S on ultimate shear stress | 10 : 1 |
| Min Static F.O.S. on ultimate tensile stress | 10 : 1 |

## Minimum Material Specification.

| | Yield | U.T.S. |
|---|---|---|
| All Plate and Rolled Sections | 240 n/mm$^2$ | 430 n/mm$^2$ |
| All Hollow Sections | 255 n/mm$^2$ | 430 n/mm$^2$ |
| All Bright Bar and Fixing Pins | 280 n/mm$^2$ | 540 n/mm$^2$ |
| All I.S.O. Bolts Grade 8.8 | 530 n/mm$^2$ | 750 n/mm$^2$ |

**I.S.O. (Grade 8.8) Bolt Torques Based On 85% Proof Stress**

| | |
|---|---|
| M 6 | 11.7 n.m |
| M 8 | 28.0 n.m |
| M10 | 56.0 n.m |
| M12 | 98.0 n.m |
| M16 | 244.0 n.m |
| M20 | 476.0 n.m |
| M24 | 822.0 n.m |
| M30 | 1633.0 n.m |
| M36 | 2854.0 n.m |

Note:-

Torques shown are for bolts in the unplated condition with marginal lubrication only and using flat washers under the mild steel nut, torques to be rechecked after running ride empty for three minutes to allow for bedding of threads and washer etc.

| | | mm | ins |
|---|---|---|---|
| Max Length | Travelling | 14,630 | 576 |
| Max Width | Travelling | 2,590 | 102 |
| Max Height | Travelling | 4,111 | 161 |
| Max Length | Erected | 16,385 | 645 |
| Max Overall Width | Erected | 5,000 | 197 |
| Max Height Swept By Car | Erected | 18,300 | 720 |
| Max Height Top Of Machine | Erected | 10,165 | 400 |
| Max Height Of Decking | Erected | 1,400 | 55 |
| Max Width Of Seating ( Internal ) | Erected | 940 | 37 |
| Max Car Length Front To Back (Internal ) | Erected | 7,700 | 303 |
| Min Clearance To Any Adjacent Ride | Erected | 1,000 | 39 |

| | | kg | Lbs |
|---|---|---|---|
| Max Weight Gross | Travelling | 24,000 | 52,848 |
| Max Passenger Weight Per Car | Erected | 1,235 | 2,270 |
| Max Passenger Weight Total | Erected | 1,235 | 2,270 |
| Max Loaded Weight Of Machine | Erected | 24,235 | 55,567 |
| Max Load On Footings | Erected | 6,000 | 13,212 |
| Direction Of Rotation | Erected | Clock Or Anticlock | |
| Max No Of Passengers Per Car | Erected | 16-No | |
| Max Average Design Speed Of Rotation | Erected | 12 rpm | |

| | | |
|---|---|---|
| Max recommended passenger time per ride | 3.0 | Min |
| Min recommended passenger height | 1220 | mm ( 48 ins ) |
| Max force on passengers outwards from centre @ B.D.C | 2.27 | 'g' |
| Max linear velocity of passengers @ max radius | 48 | kph |
| Max drive motor torque @ max passenger load | 142 | nm |
| Max motor power @ max passenger load | 27 | kw |

| | | |
|---|---|---|
| Max imbalance when full | 100 | % |
| Max overturning moment @ max imbalance longitudinally | 203 | knm |
| Min restoring moment available | 487 | knm |
| Max horizontal force at max imbalance | 23 | kn |
| Min coefficient of adhesion required unladen | 0.14 | |
| Min available on hardstand ( steel on concrete ) | 0.30 | |
| Min factor of safety @ max imbalance and load tipping | 2.4 : 1 | |
| Min factor of safety @ max imbalance and load sliding | 2:1 | |
| Max recommended deviation from horizontal when erected | 2.5 | +/-Deg |

# SECTION 3

# ERECTION AT SITE

## Trailer and Packing

1) Check site for flatness.

2) Position trailer.

3) Connect power supply.

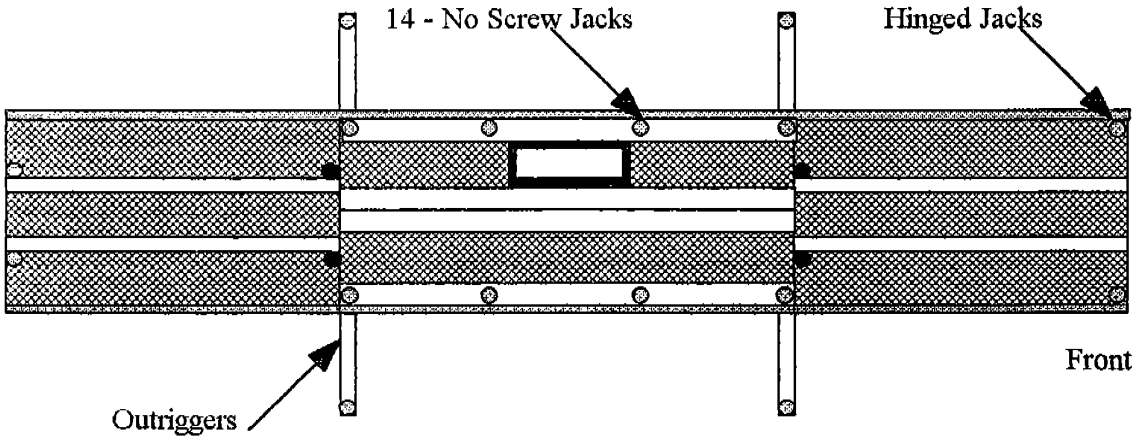
4) Put down 4 levelling jacks and level trailer. Note air suspension may be used to manipulate rear of trailer depending on site conditions.

5) Pull out 4 stabilising outriggers and pin in position.

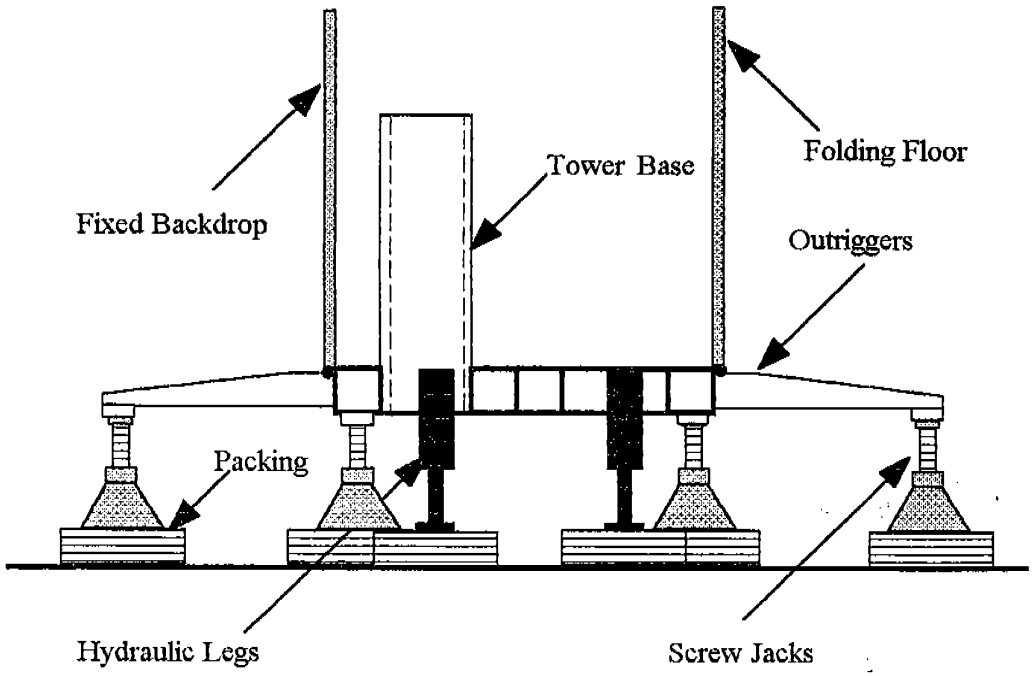
6) Position and adjust chassis and stabiliser jacks 14 - no and 2 - no hinge down jacks positioned at front of trailer and tighten locknuts.

7) Fully deflate air suspension .

Note:-
**Packing away is a reversal of the above.**




Plan View




Typ Section Thro Chassis

## Folding Floors

1) Fit winch pulley frame to top of tower base.

2) Fit winch hook to bracket on inside of folding floor and tension cable.

3) Fold down hinged apron and pin in position (with winch rope attached ).

4) Fold out bowstrings (with winch rope attached ).

5) Remove securing pins and attachments on floor (with winch rope attached)

6) Lower floor (on winch) and fit adjustable feet.

7) Repeat procedure 2 to 6 on other side.

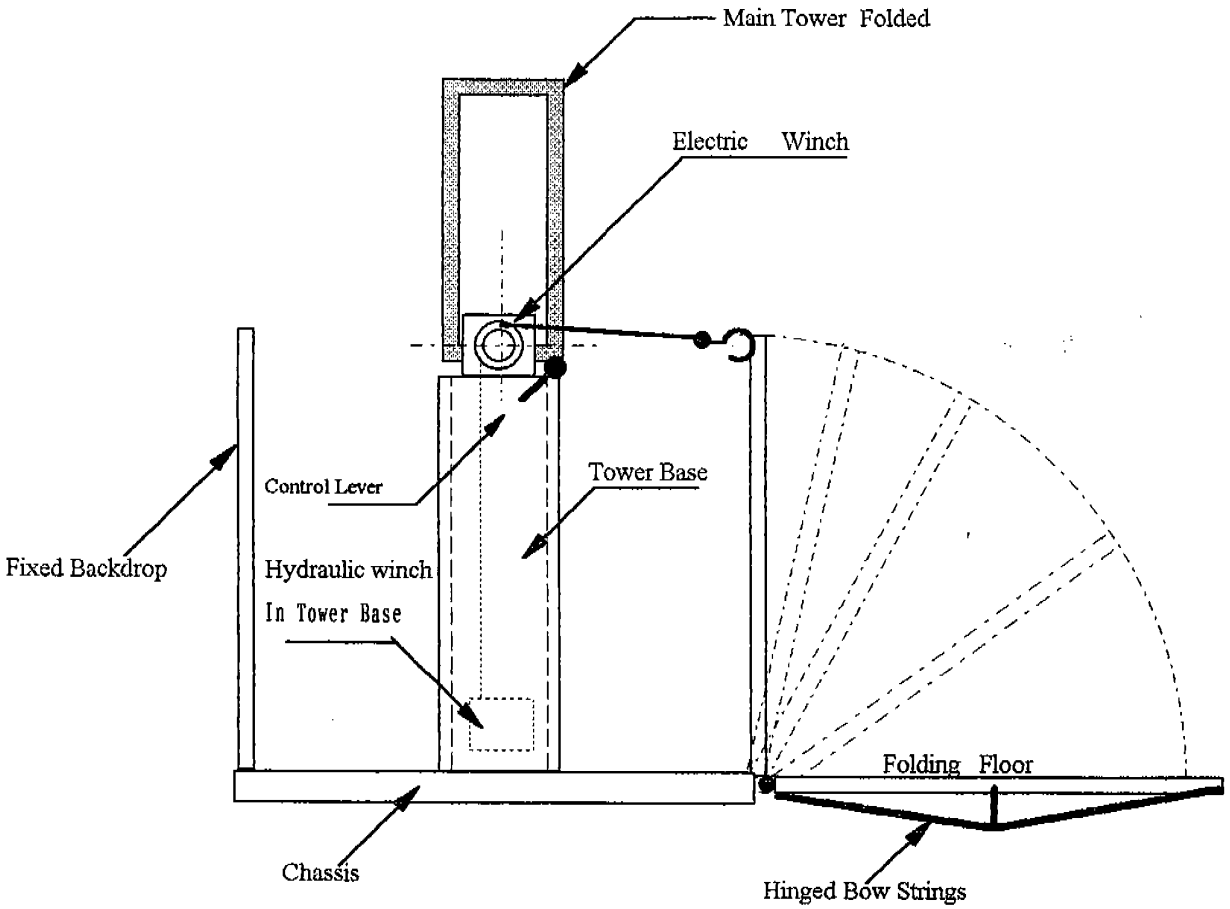
8) Unfold front section of floor.

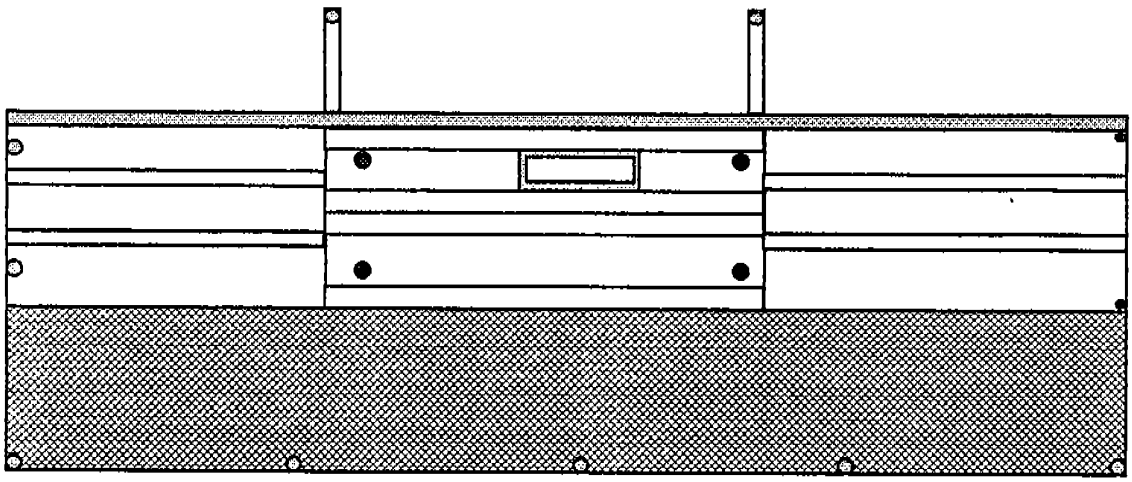
9) Unfold rear section of floor.

10) Level up with adjustable feet.

**Note :- To Prevent Possible Injury**

Do Not Stand In The Vicinity Of Floors Before Or During The Lowering Procedure.


Main Tower Folded
Electric Winch
Control Lever
Tower Base
Fixed Backdrop
Hydraulic winch
In Tower Base
Folding Floor
Chassis
Hinged Bow Strings



## Counterweight Arm

1) Ensure there are no loose items lying on counterweight arm such as tools etc. which fall and cause injury during the unfolding procedure then remove counterweight arm stowage securing pin from bracket provided.

2) Manually unfold counterweight arm to its final position ensuring no personnel are within its arc of swing.

3) Ensure light panel misses control panel while unfolding.

4) Fit safety shear pin and 'R' clip into side bracket provided on counterweight arm.

5) Fit counterweight arm securing nuts and bolts and finger tighten only to make a rigid assembly.

6) Tighten counterweight arm securing bolts to 636 n.m (450 lb.ft) torque.

7) Fold up hinged light panel and pin in position.

8) Fold up light panels on main arm and pin in position.

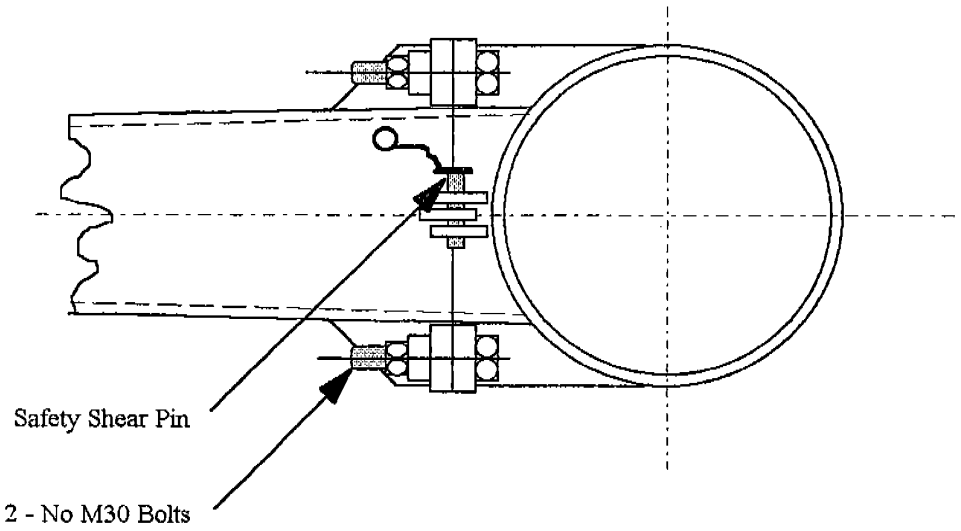
9) Take light panels from front rack and fit to main arm centre and side.

10) Make all electrical connections.

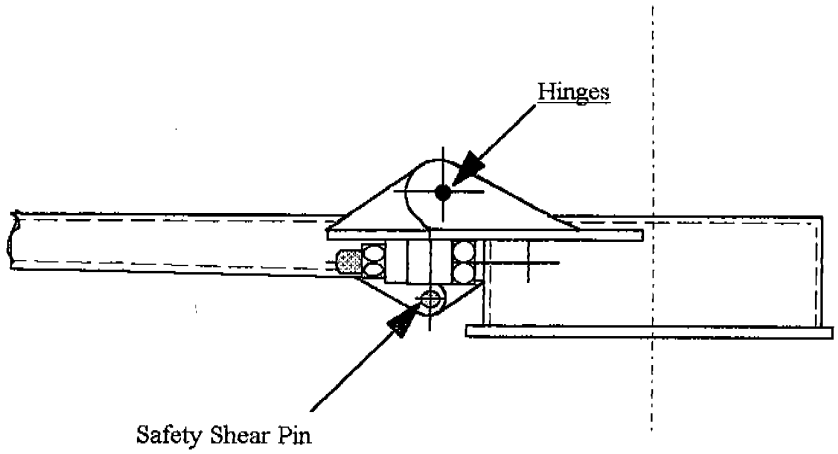
11) Fit pillar lights and spot lights around floor area. Take from front stack.

12) Fit guard rails all round, take from front rack.

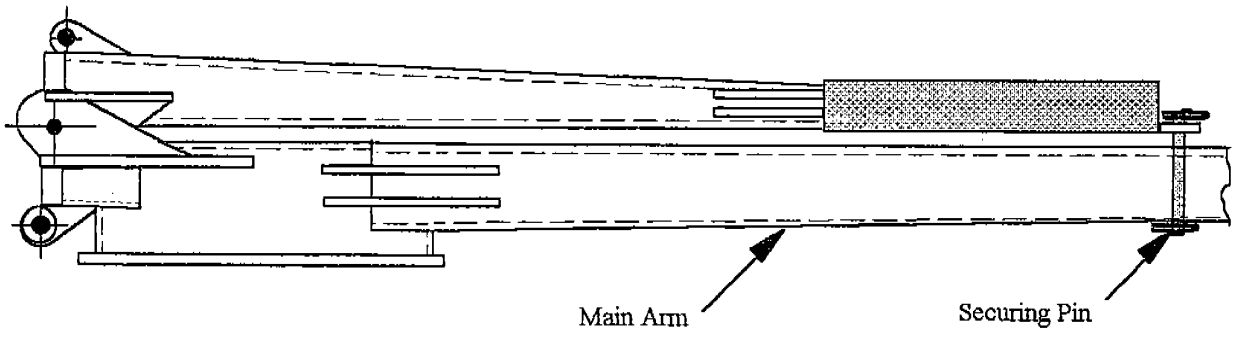
13) Make all electrical connections.




Side Elevation




Plan View




Plan View With Counterweight Folded

## Car Positioning

1) Ensure safety chain is attached to car and tower.

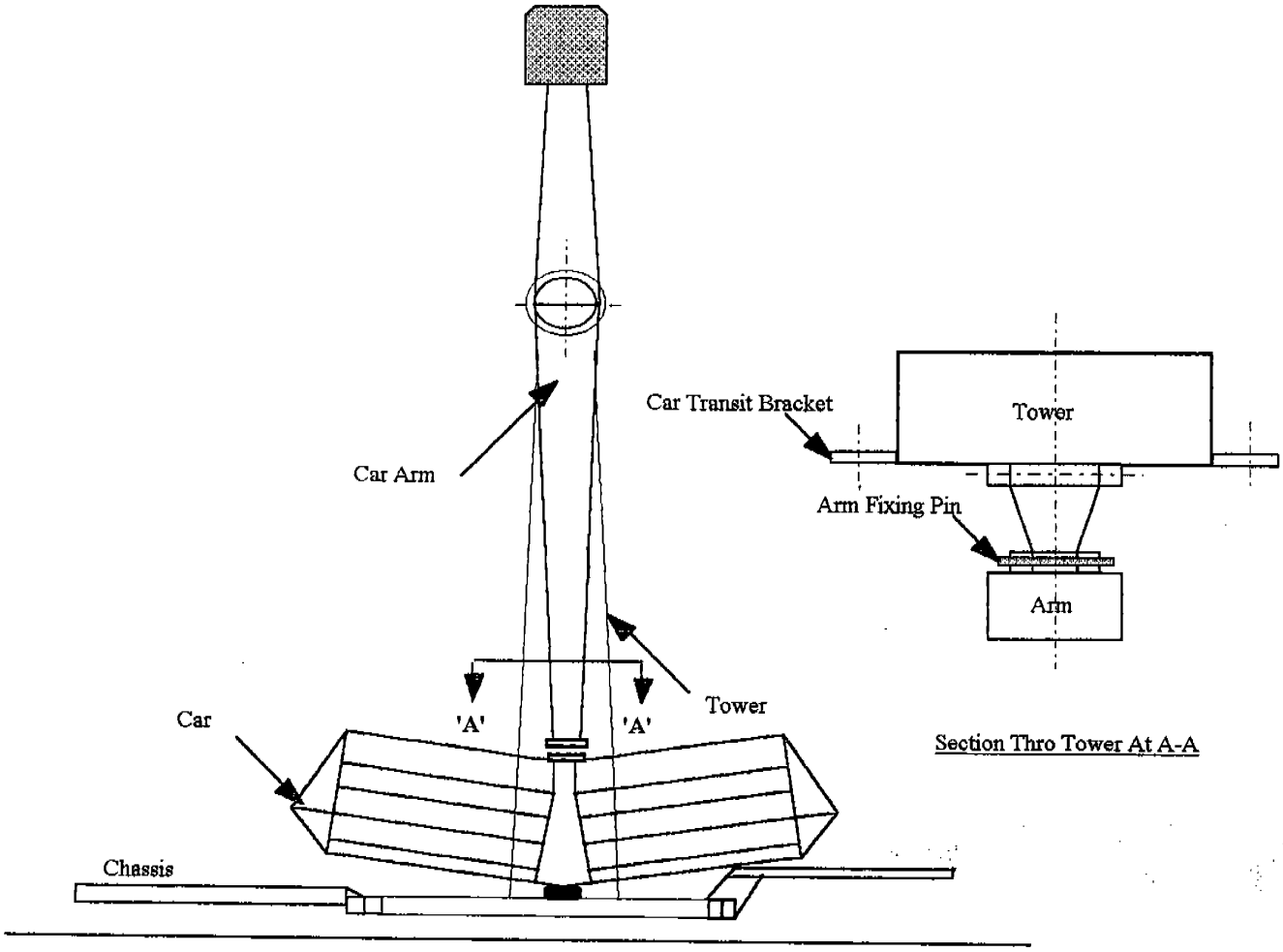
2) Fit hinged doors and gas struts to outer face of car.

3) Attach extension roller angles.

4) Release car from front side of tower (by removing transit bolt and nut) and roll outward to stop on angle runners.

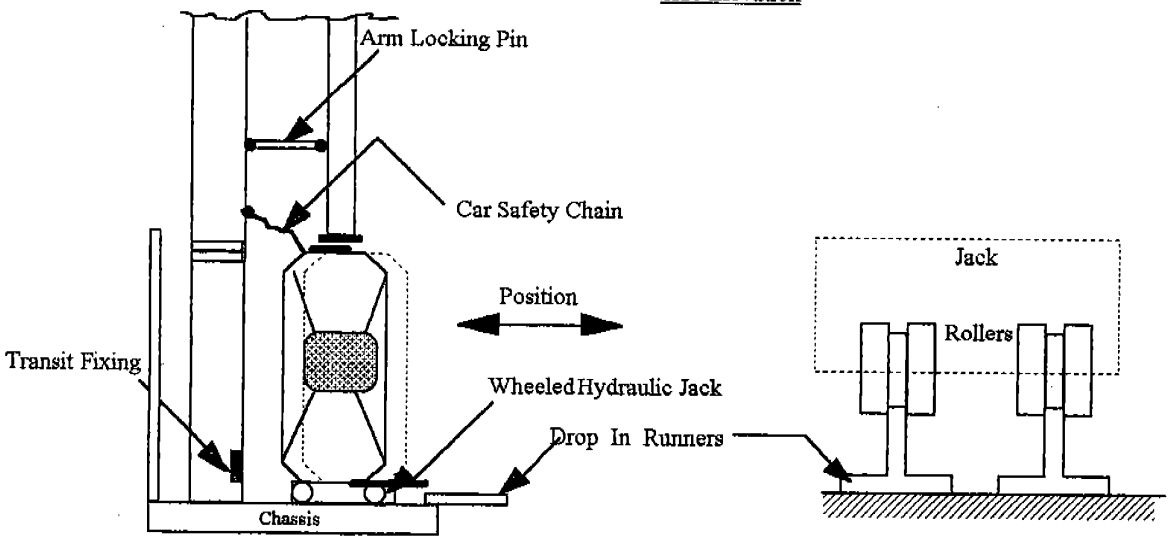
5) Lower with hydraulic jack to lever mounting position. Repeat with second car.

Note:-
On no account release car safety chain or main arm fixing pin at this stage.




Section Thro Tower At A-A

Side Elevation




End Elevation

Tower

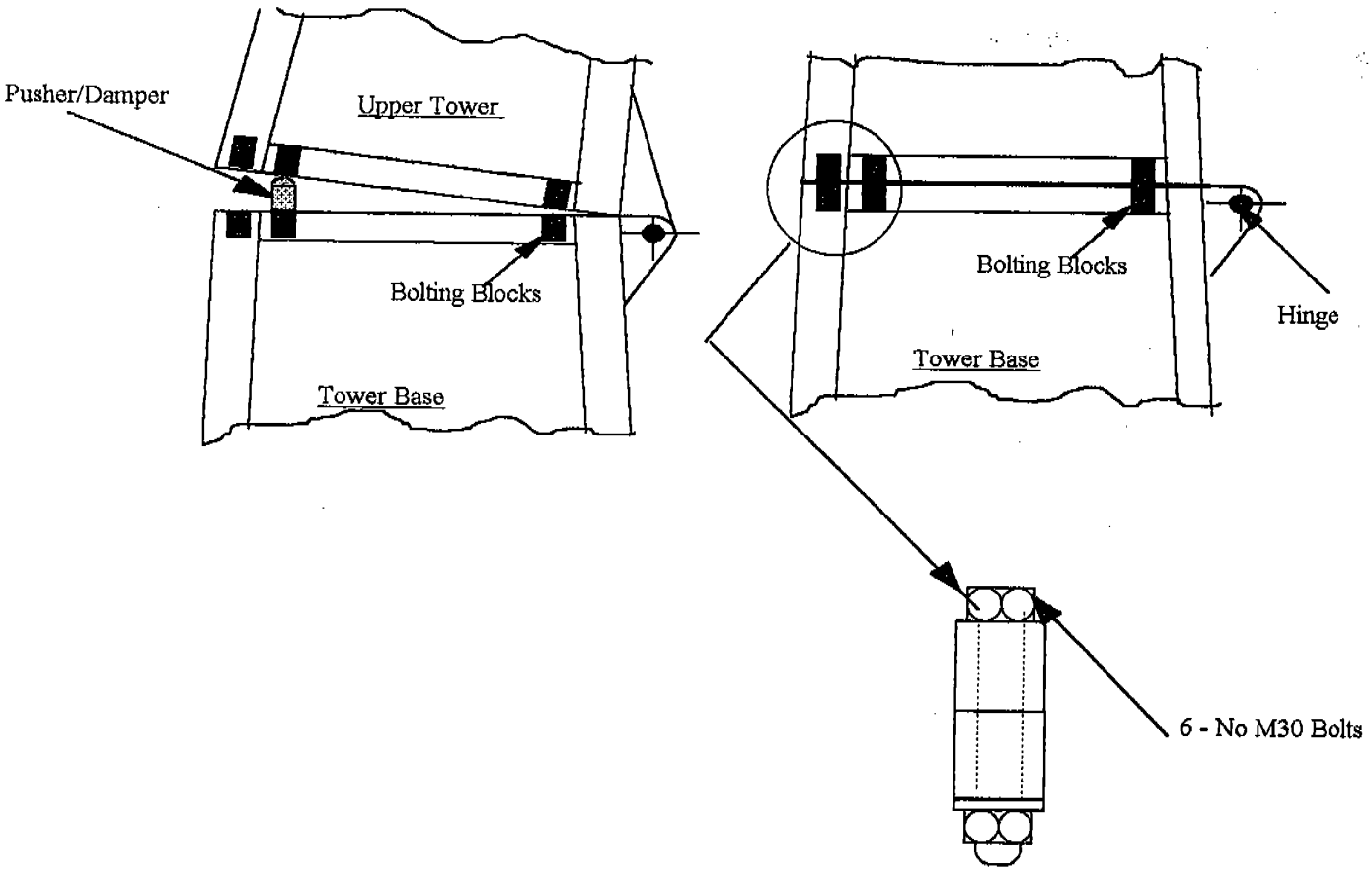
1) Before elevating tower ensure pusher ram is fully charged with fluid by operating down lever (located on chassis) for 5 seconds.
Before elevating tower ensure there are no loose items lying on tower such as tools etc which could fall and cause injury during the elevating procedure. Inspect counterweight arms and main arms to ensure that all securing bolts and shear pin are in position and the securing bolts are correctly torqued and that all light panels are properly secured on both counterweight and main arm, also check to ensure there are no loose items lying on arms such as tools etc which could fall and cause injury during the elevating procedure

2) Elevate Tower slowly and progressively without pause via control lever (located on chassis) ensuring that no unauthorised personnel are within 10 m (33 ft) of the ride vicinity during this procedure.

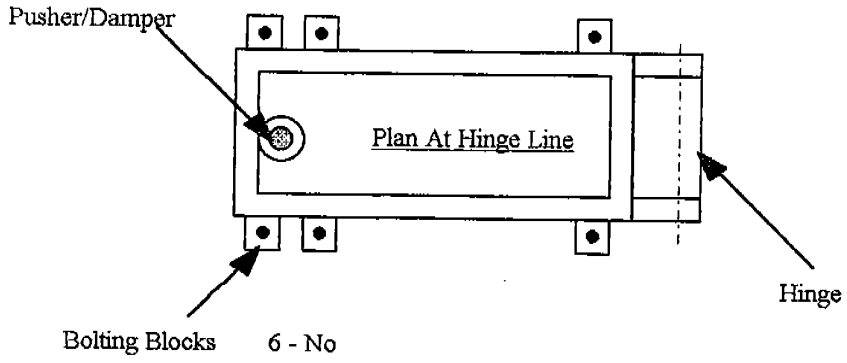
3) When Tower has attained its true vertical position fit securing bolts at top of base in the bolting blocks provided and tighten to 637 n.m ( 450 lb.ft.).Before fitting securing bolts ensure pusher ram stem is fully retracted this can be verified by observation the pusher ram stem will no longer be visible.

4) Position car accurately under main arm flanges taking care not to tilt car and line up bolt holes in arm and car.

No Unauthorised personnel are to stand within 10 m (35 ft) of the tower while it is being elevated/lowered into its final position.




Typ Bolting Detail



## Car Attachments

1) Ensure car safety chain and main arm hinged bracket and securing pin are in position. **Note ! that without main arm pin in position the main arm would immediately rotate and cause potentially serious injury** **on no account remove pin until car is bolted to main arm.**

   Jack up the car so that the car bolting flange is within 6mm (1/4") of the main arm bolting flange. Fit bolts through car and main arm flange bolting holes using a tommy bar to align holes as necessary. Tighten bolts progressively to 490 n.m (350 lb.ft).
   Note during the above procedure ensure that no hands or fingers are placed between bolting flanges at any time nor take any action to provoke car tipping ensure that no personnel are within 3 m (10 ft) of the car at any time during this procedure.

2) Slide mobile hydraulic jack back to its stowed position and remove roller angle extensions stow away securely .Remove Car Safety Chain.

3) Ensure car main arm hinged bracket and securing pin are in position fit tie bars between main arms and car using pins and brackets provided do not forget to fit retaining 'R' clips to tie bar pins, note that tie bars have left and right hand threads and there fixing centers may be adjusted to suit. Ensure that no unauthorised personnel are within 3 m (10 ft) of the car at any time during this procedure.

4) Connect air and power supply to connections provided on car.

5) Ensure pneumatic parking brake is working before removing main arm safety pin and lowering main arm hinged bracket flat to tower.

6) Fit safety bars on inside face of car.

7) Lift up passenger access ramps in floor and fit front wedges.

Important

8) With ride stationery parking brake on and both cars at bottom dead centre and empty of passengers, adjust tie bar rods as below.

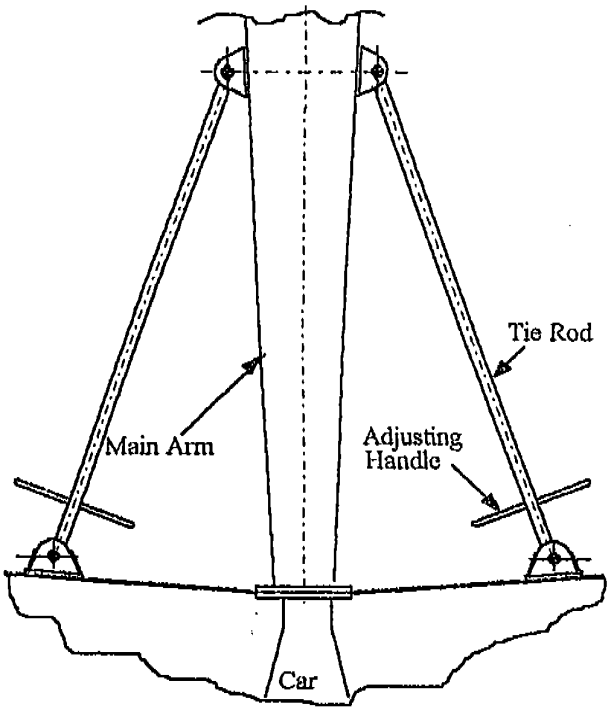
9) Grasping hand grip bars at base of tie rod rotate bar 10 degrees in the direction that reduces tie bar centres and puts the tie bar into tension. ( Note **Rod must go into tension** not compression.)

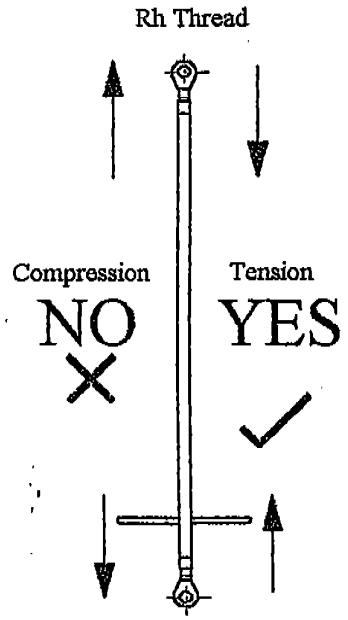
10) This must be performed **By Hand Only** do not use mechanical means.

    **Maximum force on hand grip 15 Kg - ( 35 lbs.)**

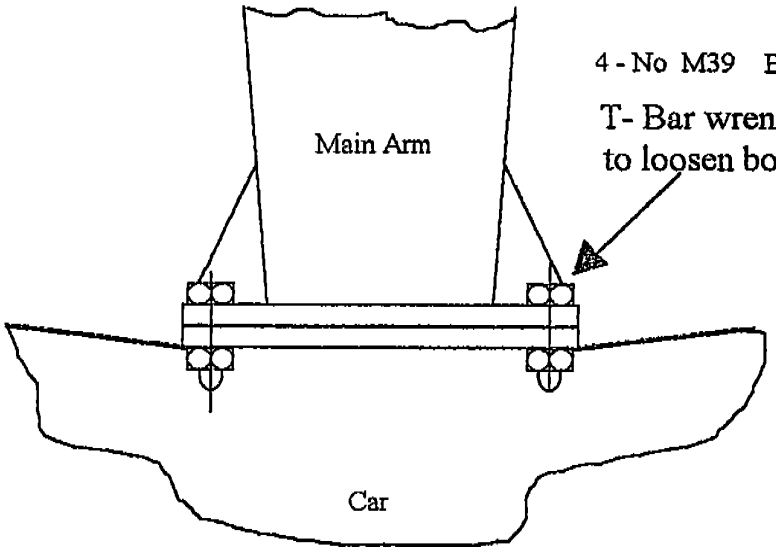
    Note:-

    When packing away ensure main arm hinged bracket and securing pin and car safety chain are in position before commencing any other operation and no unauthorised personnel are within 3m (10ft) of main arm while erecting/packing away.




Tie Rod

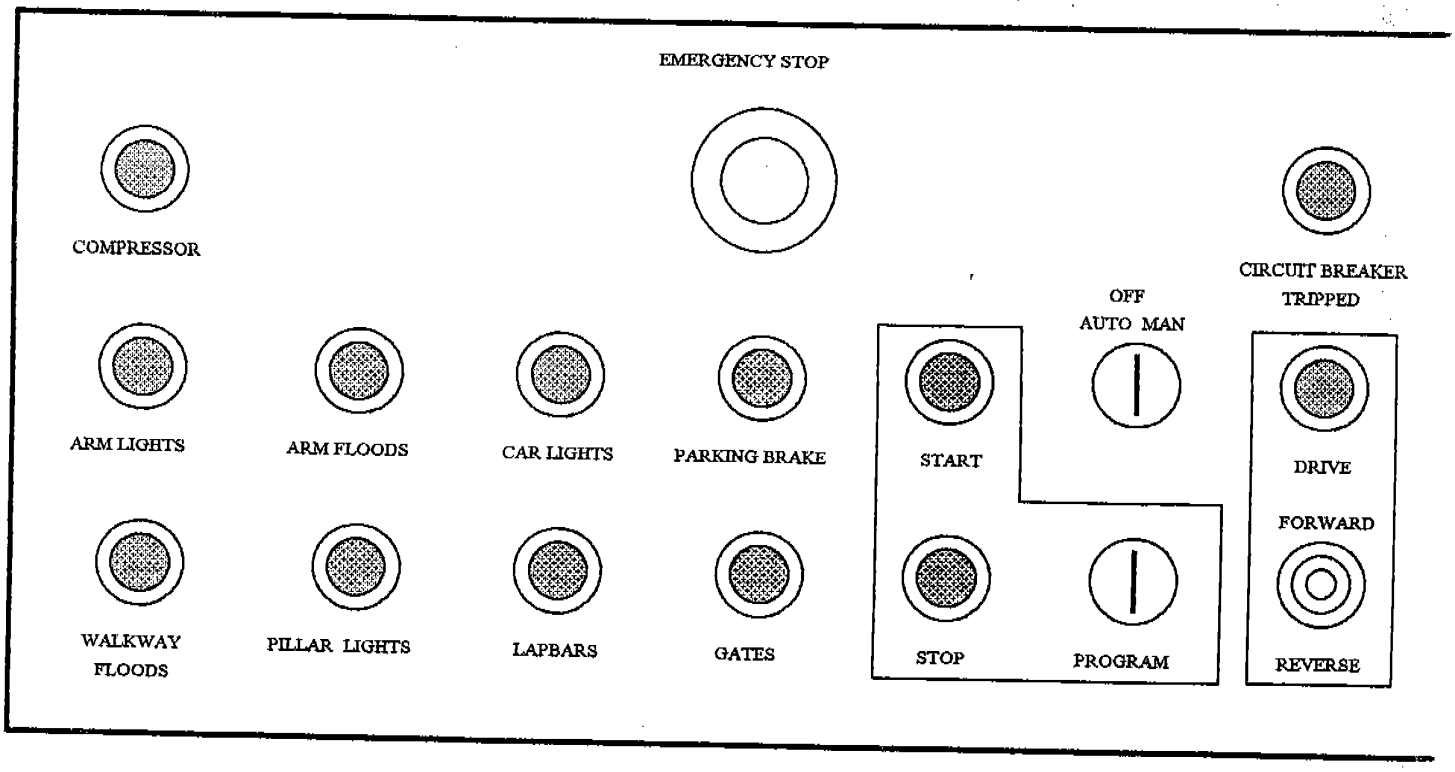



Car To Main Arm Attatchment

# SECTION 4

# OPERATION AND CONTROLS

## Control Box Manual and Automatic Version




KEY

Push Switch With Light

Key Operated Switch

Joystick Control

## Pre-Operational Check List

**Before Start Up It Is The Operators Responsibility To Check The Following**

1) Each passenger to be a **minimum** height of 1220 mm - 4'0".

2) Each car must contain a maximum of 16 passengers.

3) Each passenger is seated correctly and retained **securely** by lap bar.

4) Ensure by **physical check** that in the event of a **single rider** the vacant passenger restraint bar is in the down locked position. This is to prevent slightly built passengers from being able to move sideways and escape under the adjacent raised restraint bar.

5) Ensure by **physical check** that lap bars and side gate are securely **locked** in position.

6) Ensure no limbs are protruding outside the car.

7) Ensure there are no personnel in the vicinity of any moving parts of the machine.

8) Ensure both tie bars are in position and secured.

9) **Ensure ride is not operated if wind speed exceeds 65 kph (40 mph).**

Note:-

**If Wind Speed Exceeds 130 kph (80 mph) Then Depending On Site Conditions The Ride May Need Additional Anchorage To Prevent Sliding. If These Wind Speeds Are Anticipated Then Advice On Anchorage Must Be Sought From A Suitably Qualified Person.**

## Operation

1) To operate machine release air parking brakes and move joystick in direction of travel.

2) Repeat in opposite direction to initiate the initial swinging motion of car.

3) A fully laden car will require approximately 10 swings before it goes over the top.

4) When the car has gone over the top then hold the joystick in position to maintain steady rotation.

5) To stop ride put joystick in central position which initiates automatic stopping sequence.

6) When ride is stationary put on air brakes to hold car in position while passengers disembark.

**Normal Operational Speed 1 2 rpm**

THIS MUST NOT BE EXCEEDED

Maximum Recommended Passenger Time Per Ride - 3 Min

# SECTION 5

# INSPECTION AND MAINTENANCE PROCEDURE

## Overview Of Inspection And Maintenance Procedure.

Due to the demanding environment suffered by amusement machines and the large number of duty cycles possible in a busy season it is felt prudent to err on the conservative side regarding inspection and maintenance procedure. This approach is felt to be justified in view of the fact that certain safety critical components cannot be duplicated to give a secondary backup system due to the specific type of motion or nature of the machine.

Mindful of the above and bearing public safety in mind an inspection procedure has been devised which accommodates all areas of a safety critical nature while maintaining a direct approach and minimising wasteful duplication.

The procedure relies on the operator for a day to day basic inspection routine he being the person ideally placed to spot any unusual events being intimately familiar with his particular ride and its idiosyncrasies.
It also allows the operator full involvement and the opportunity to carry out his duties under the H.S.E. code of safe practise at fairs.

The procedure is split into daily and weekly checklists which are the responsibility of the operator and his employees to carry out and three other procedures of a specialist nature.
These are a twelve monthly safety critical inspection, a twelve monthly general inspection and a two yearly N.D.T. inspection all carried out by an independent appointed person and carrying certification status.

The twelve monthly safety critical inspection is to incorporate the areas depicted in figures 1 to 6 inclusive which are included for the guidance of the inspecting body. These same areas are also to be included in the two yearly N.D.T. inspection.

## Summary of inspection procedure.

| | | |
|---|---|---|
| 1) | Daily inspection and maintenance checklist. | (by operator) |
| 2) | Weekly inspection and maintenance checklist. | (by operator) |
| 3) | 12 monthly safety critical inspection. | (for certification) |
| 4) | 12 monthly general inspection | (for certification) |
| 5) | 24 monthly N.D.T. inspection | (for certification) |

**On Completion Of Inspection Or Maintenance Procedure**

**Run The Machine Up To Full Operational Speed**

**Unladen And Check The Following.**

1) Check all gauges and warning lights for correct function.

2) Check machine does not exceed max design speed.

3) Check for unfamiliar noises or vibration.

4) Check proper function and smoothness of controls.

5) Check proper function of safety devices or interlocks.

6) Check for any unusual movements, vibrations or deflections.

7) Check for any signs of overheating or smoke.

8) Check for any loose panels or covers.

9) Check the braking and stopping system at least twice in succession.

10) Check for any loose packing at all packing points.

11) Check any fire extinguishers are in position and correct type.

**Run the machine for at least 30 seconds in either direction when carrying out the above checks.**

# DAILY

# INSPECTION AND MAINTENANCE

## Daily Checklist.
## ( General )

1) Check platform area for any loose debris or grease.

2) Check platform steps for security.

3) Check all handrailing for security.

4) Check all perimeter fencing for security.

5) Check lap bars and locking mechanism for security.

6) Check counter-weight securing bolts for security.

7) Check tie rod adjusting and securing bolts/pins for security.

8) Check all flash panels are secure and 'R' clips in situ.

**Operational**

9) Check lap bar operating mechanism and all system interlocks.

10) Check ride operation and all system interlocks.

11) Check lap bars will not open with ride operating.

12) Check emergency stop operation.

13) Check all braking systems function including parking brake.

14) Check all information and warning lights are operational.

## Daily Checklist.
**(General.)**

**Maintenance.**

1) Lubricate slewing ring drive teeth through hatch provided.
(Small amount open gear lubricant.)

2) Lubricate slewing ring at nipples provided .
(Small amount daily of G.P. grease. See lubricants list.)

3) Drain compressed air tank.

4) Check main electrical drive motor current level while operating.

5) Check all electrical trips are functioning.

# WEEKLY

# INSPECTION AND MAINTENANCE

## Weekly Checklist.
**( General )**

1) Check slewing rings for wear and correct operation by rocking main arm.

2) Check slewing ring drive teeth for wear and bright spots.

3) Check drive pinion for wear and bright spots.

4) Check drive shaft universal joints for wear and cracks.

5) Check hydraulic motors for wear and noisy operation.

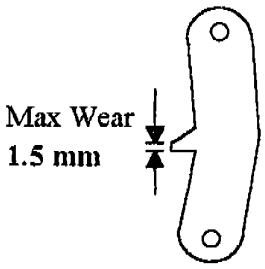
6) Check hydraulic motors for leaks.

7) Check pneumatic brake for wear and noisy operation.

8) Check pneumatic brake for leakage.

9) Check lap bar quadrant for wear and defects.

10) Check lap bar pawl tip for wear and defects.
Max tip width not to exceed **1.5 mm.**




Side View On Pawl.

11) Check all lap bar weldments and bracketry for cracks.

12) Check tie rod bearings for wear and noisy operation.

13) Check tie rod end weldments for cracks.

14) Check tie rod weldments for cracks.

15) Check tie rod adjusting bolts for cracks.

16) Check all flash panel hinge weldments for cracks.

17) Check slewing ring/tower weldments for cracks.

18) Check tower base/chassis weldments for cracks.

19) Check stabiliser leg weldments for cracks.

## Weekly Checklist.
## (General.)

**Maintenance.**

1) Check hydraulic oil level in main tank.

2) Check hydraulic filters have spare capacity change as required.

3) Check all main hydraulic hoses for leakage and fretting.

4) Check all hydraulic operating pressures and circuit function.

5) Check Slewing ring drive gearbox oil level at filler/level plug.
(Top up with EP 90 oil as required.)

6) Lubricate driveshaft bearings.
(Small amount weekly of G.P. grease.See lubricants list.)

7) Lubricate lap bar teeth and pawl.
(Small amount weekly of E.P. grease.See lubricants list.)

8) Check oil levels in the compressed air lubrication system.
(Top up with air lube oil.)

9) Check oil levels in the compressor.
(Top up with SAE 40 diesel engine oil.)

10) Oil all panel hinges with SAE 30 oil.

11) Oil all lap bar hinge points with SAE 30 oil..

12) Oil counter weight hinges with SAE 30 oil.

13) Check and maintain all hydraulic oil levels.

## Lubricant List.

| Manufacture | Type | Designation | Ambient Temperature $^0$C |
|---|---|---|---|
| ARAL | G.P. | Aralub HLP 2 | -25 To 130 |
| | E.P. | Arulub LFZ 1 | -25 To 250 |
| BP | G.P. | Energrease LS-EP 2 | -25 To 130 |
| | E.P. | Energol WRL | -0 To 80 |
| Castrol | G.P. | Spheerol EPL 2 | -20 To 120 |
| | E.P | Grippa 33 S | -20 To 80 |
| ELF | G.P. | Epexa 2 | -30 To 120 |
| | E.P. | Cardrexa DC 1 | -20 To 120 |
| ESSO | G.P. | Beacon EP 2 | -25 To 130 |
| | E.P. | Surett Fluid 4K | -20 To 150 |
| Kluber | G.P. | Cenoplex 2 EP | -20 To 120 |
| | E.P. | Grafloscon CA 901 | -20 To 150 |
| MOBIL | G.P. | Mobilux EP 2 | -20 To 120 |
| | E.P. | Mobiltac 81 | -30 To 120 |
| REINER | G.P. | Stabyl LEP 2 | -20 To 120 |
| | E.P. | Ceplattyn KG 10 | -30 To 250 |
| SHELL | G.P. | Calithia EP FettT 2 | -25 To 130 |
| | E.P. | Cardium Fluid C | -30 To 60 |
| TEXACO | G.P. | Multifak EP 2 | -30 To 130 |
| | E.P. | Crater 2 X Fluid | -20 To 120 |

G.P. = General Purpose Grease i.e. pivot points etc.
E.P. = Extreme Pressure i.e. slewing ring gears etc.

# ANNUAL SAFETY CRITICAL INSPECTION

# N.D.T. PROCEDURE.

## Structural Examination
## ( Safety Critical )

1) Safety critical areas must be examined periodically by N.D.T .

2) The maximum time period between examination of these areas is not to exceed 1 year

3) The areas designated safety critical by the manufacturer are depicted on page 5.05

4) These safety critical areas are to undergo an N.D.T. inspection of parent metal in the direct vicinity of the joint weldment.

   The joint weldment must also be given an N.D.T. inspection.

   The inspection to examine the complete length of these joints.

5) The manufacture also recommends that bolts in the following areas are discarded at this time to accommodate bolt damage and inadvertent fatigue from incorrect bolt torque etc.

   Note:- This does not apply to park models infrequenly dismantled.

   Designated areas requiring new bolts.

   Counterweight hinge bolts
   Tower base fixing bolts
   Car to car arm fixing bolts

Note:-

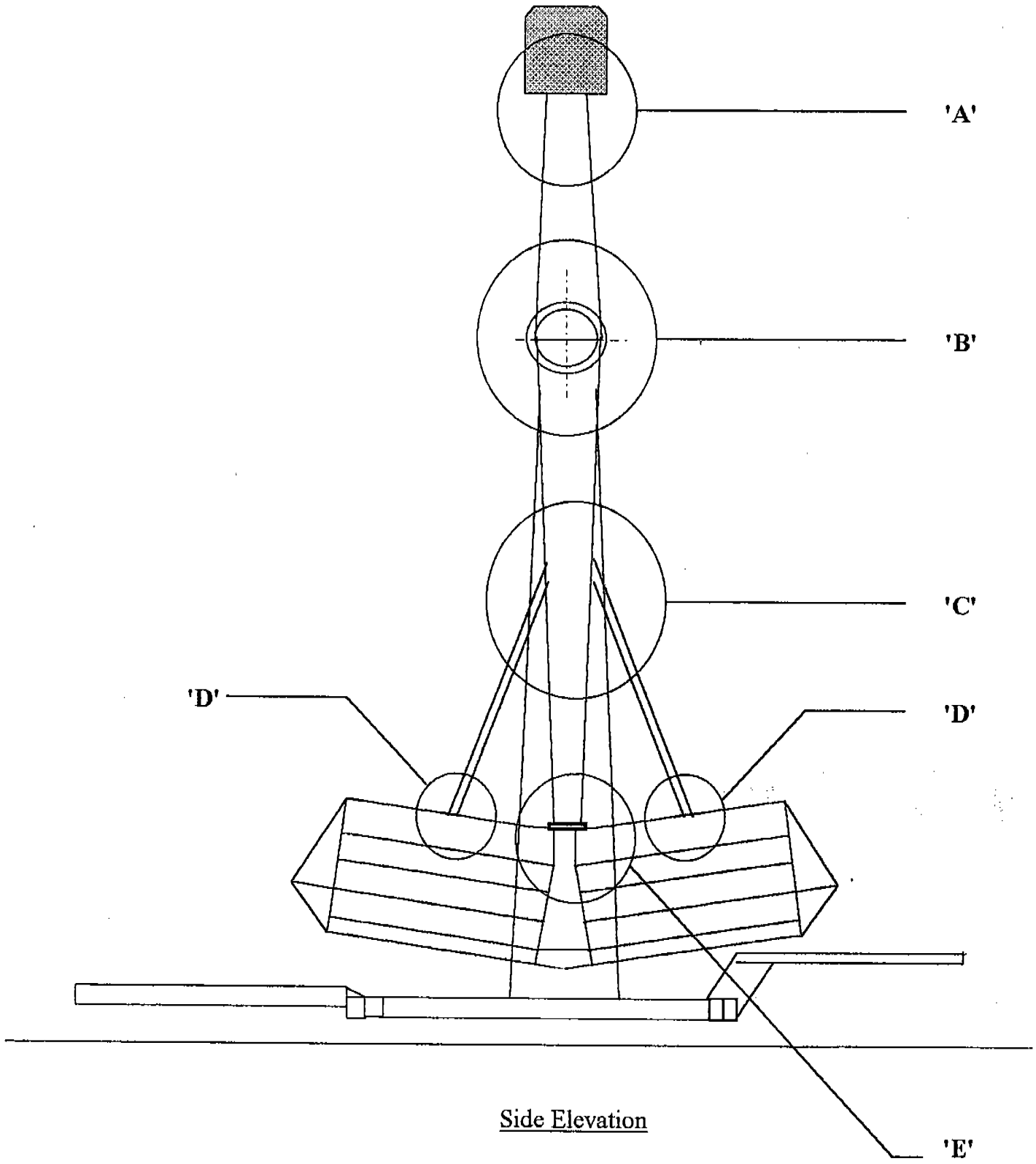
In countries outside the United Kingdom where legislative requirements may differ and no clear seasonal pattern of operation exists then the annual safety critical inspection may be taken to mean the following.

1500 Site hours.

That is hours where the machine is erected on site and connected to a power supply available to do useful work.

600 Operating hours.

That is hours where the machine is erected on site and connected to a power supply and working to its full passenger capacity




Side Elevation

## Safety Critical Areas

| | | |
|---|---|---|
| 'A' ) | i | Counterweight to arm joint |
| | ii | Counterweight gussets to arm joint |
| 'B' ) | i | Counterweight arm to drive centre joint |
| | ii | Hinge gussets to drive centre and arm joint |
| | iii | Tower top to main tower joint |
| 'C' | i | Tie rod brackets to arm joint |
| | ii | Tie rod end plate to tie rod tube joint |
| | iii | Tie rod threaded end ( threaded root ) |
| 'D' | i | Car mounting plate to car arm joint |
| | ii | Car mounting plate gussets to car arm joint |
| 'E' | i | Tie rod bracket to car roof joint |
| | ii | As 'C' ii |
| | iii | As 'C' iii |

# ANNUAL

# GENERAL INSPECTION

## Twelve Monthly Inspection And Maintenance.
(General)

Every twelve months the machine must undergo a thorough examination by an appointed person who is an independent examiner suitably qualified to undertake this task and preferably having experience of non-destructive testing (N.D.T.) on steel fabrications.

To aid this examination, all weldments not visible by virtue of being masked by other structures must be made visible and reasonable access provided by appropriate dismantling, in part, or whole, of the relevant sub-assemblies.

The following are the major areas of the machine to be examined using the appropriate procedure and working to the relevant checklist in a methodical manner.

**Structural Examination**

**Mechanical Examination**

**Electrical Examination**

**Hydraulic Examination**

**Pneumatic Examination**

Any defects found, to be noted, and the implications for the structural the machines safe operation to be noted. Any serious structural defects must be communicated to the manufacturer at the earliest opportunity so that suitable rectification methods may be formulated and any necessary design modifications may be incorporated in future machines.

If satisfactory, sign logbook and issue inspection certificate. If not, replace unsatisfactory members and test machine as relevant checklist.

## Structural Examination.

1) Check all structures for gross deformation and signs of impact.

2) Check all connecting pins and bolts for deformation, cracks, surface fretting and correct material grade. If in doubt **discard.**

3) Check slewing ring securing bolts for defects and correct material grade. Must be grade 8.8.

4) Check structure for corrosion and cracking of parent metal or weldment especially in highly stressed regions in the vicinity of securing and retaining bolts or pins. If in doubt use N.D.T. such as dye penetrant test to corroborate findings.

5) Check deck plates for damage and cracks. If in doubt, **discard.**

6) Check any timber fabric for security and damp rot. If **doubt, discard .**

7) Check any superficial covers for security.

8) Check general level of upkeep and comment in writing.

9) Check general condition of paint finish and corrosion i.e. superficial or deep corrosion.

10) Check for general correctness of assembly, with particular attention to securing pins, i.e. positioned correctly or incorrectly.

11) Check bolts for correct torque and grade , i.e. grade 8.8.

Note.

Prior to examination of 1 to 3 inclusive, degrease and clean thoroughly.

Prior to examination of 1 to 4 inclusive, remove any paint or corrosion and clean thoroughly.

## Mechanical Examination

1) Check slewing ring for roughness in operation, also check for play between races.

2) Check slewing ring for adequate greasing and any corrosion.

3) Check slewing ring drive gears for pitting, flaking and backlash.

4) Check slewing ring bolts for correct grade and torque.

5) Check drive motor pinion for lubrication and corrosion.

6) Check drive motor pinion for pitting, flaking, corrosion and correct backlash.

7) Check all bearings for lubrication and corrosion.

8) Check all bearings for pitting and movement between races.

9) Check all bolted connections for correct torque and grade.

10) Check all friction drives for wear, splits and resident material.

11) Check all drive shafts for straightness, cracks and corrosion.

12) Check all stabiliser legs for correct operation and security.

13) Check all passenger restraint devices for lubrication and corrosion.

14) Check all passenger restraint devices for wear and operation.

15) Check all passenger restraint devices locking mechanism for security and correct operation. Check any back up systems and interlocks for security and operation.

16) Check all 'R' clips or securing pins for correct material specification and damage. If in doubt **discard.**

17) Check all bolts used for erection purposes for correct material grade, thread damage and straightness. If in doubt **discard.**

## Electrical Examination - 240 Volt And 415 Volt A.C.

1) Check all generator terminals. Single or three phase are enclosed

2) Check all sockets and connectors are of industrial type L.E. BS.4343.

3) Check that all neutral of conductors are connected to the metal enclosure of all the equipment and where possible and are connected to an earth electrode via a protective conductor. The connection to earth should be made at one point i.e. the generator.

4) Check no switches are inserted in any protective conductor and no single pole switch inserted in any neutral conductor.

5) Check if a rotary inventor is used to produce AC from DC. Earthing requires special consideration.

6) Check residual current circuit breakers for max setting of 30 m.a.

7) Check residual current circuit breakers are installed in the conductors between earth reference point and the distribution equipment.

8) Check all metallic parts of the ride carrying electrical equipment should be bonded and connected to the protective conductors.

9) Check where the ride is on hard standing it may not be possible to earth. It is imperative that protective bonding is checked regularly.

10) Check all cables are flexible multi-core with correct rating.

11) Check any flexible armoring is connected to system protective ductors..

12) Check all cable joints and terminations are mechanically protected and provided with the appropriate strain relief.

13) Check that any 13 amp domestic fitting is weatherproofed and properly supported.

14) and with a Check that all motor starters are provided with overload and short-circuit protection where restarting after power loss may cause danger ensure the starter is fitted device which opens the starter switch on loss of power.

15) Check all A.C. motors are fully enclosed.

16) Check that where 3 phase supplies are used for lighting the separate phases are at least 2 metres apart and clearly identified.

17) Check all fuses and circuit breakers are correctly rated.

18) Check all cables, couplers or plugs and sockets are connected so that live pins cannot be exposed.

19) Check neon lights are inaccessible and the transformer and cables are out of reach and weatherproofed.

20) Check that if A.C. and D.C. lighting is used, plugs and sockets are not to be cable or cross connected.

21) Check all parts of the system for earth leakage and remedy faults.

22) Check continuity of protective conductors. Max voltage 50 volts max current 25 amps. Check the measured value of resistance low enough to protect the system by removal of the supply in the event of a short circuit to metal parts.

23) Check insulation resistance. Max test voltage 500 V D.C. The measured resistance to be not less than 1 megohm. Ensure test voltage is not applied across electronic components that may be damaged.

24) Check residual circuit breakers with suitable RCCB instrument. They should trip to the rated current. Also check the test button to ensure tripping mechanism is free.

25) Check all electrical enclosures are properly secured to prevent unauthorised access. Check where such enclosures are accessible to the public, they should be fitted with lockable handles so a tool is necessary to gain access.

26) Check interlocking control systems with wiring diagram to ensure system integrity is maintained after any modifications. The devices should be examined for mechanical wear and deterioration of insulation resistance between conductors and also checked for correct operation.

## Electrical Examination - 110 Volts D.C.

1) Check generator output is not connected to earth.

2) Check there is a generator isolator switch in each pole.

3) Check for correct fuses on output panel, one per pole.

4) Check isolators and fuses are not shorted out by wire links.

5) Check terminal connectors are brass and not ferrous.

6) Check all exposed live points have covers of robust insulating material.

7) Check all metal enclosures are connected by low resistance bonding conductors, including the generator frame.

8) Check cables are flexible with tough outer cover, not metal armored.

9) Check all cables are protected from mechanical damage by conduit etc.

10) Check all cables on output panel are restrained to prevent strain on terminations.

11) Check if ride is on hardstanding, cables to be clear of main thoroughfare.

12) Check all joints to make good electrical contact and to be of adequate mechanical strength and properly insulated. Twisted wire joints are not acceptable.

13) Check joints for signs of overheating and high resistance.

14) Check all motor starting systems incorporate a no-volt device to ensure that if supply fails it reverts to off position.

15) Check the resistance elements enclosure is adequately ventilated and robust.

16) Check all cable terminations, starters and motors are shrouded with robust covers.

17) Check all terminations under rides are shrouded and enclosed.

18) Check fuses are fitted in each pole at the starter to protect from overloads.

19) Check lighting circuits are fused against overloads.

20) Check flashing light contactor panels are enclosed.

21) Check all D.C. conductors and cables for faults to earth are correct.

22) Check continuity of bonding conductors. Test volts max 50 current not exceeding 25 amps. Resistance of conductors 0.5 ohms max.

23) Check the insulation resistance of equipment. Max test voltage 500 min resistance not less than 0.5 megohms.

## Hydraulic Examination.

1) Check hydraulic pump for smooth operation with no signs of cavitation, noise or leakage.

2) Check shaft drive coupling for wear and security ( if not close coupled).

3) Check for hoses or fittings leaking and kinked or damaged pipes.

4) Check any indicators on oil filters (where provided) for evidence of sludging.

5) Check oil filler cap is not sludged and tank is open to atmospheric pressure.

6) Check oil is not heavily contaminated, sludged or carburised.

7) Check any bundy tubing is not pitted or corroded.

8) Check drive motor for jerky running or loss of power (leakage).

10) Check settings of any relief or cross over relief valves.

11) Listen for squealing noises from valves.

12) Check control linkage for smooth consistent operation.

## Pneumatic Examination

1) Check for leaks in cylinders or pipework.

2) Check cylinder stems for pitting or corrosion.

3) Check cylinders for retention of fluid.

4) Check main filter for sludge and water retention.

5) Check cylinders for jerky or intermittent operation.

6) Check cylinders for bent rods.

7) Check main reservoir for leaks and retention of water.

8) Check all valves for function, especially the exhaust section.

9) Check pressure is within design specification.

## Test Procedure.

1) Request all parts found defective are replaced.

2) When satisfied that the ride is erected in the correct manner, request that the ride is operated unladen to its maximum design speed.

3) Observe ride in unladen operating condition.

4) If satisfied, request that the ride be loaded to its maximum design specification .

5) Request that the ride be operated to its maximum design speed .

6) Observe the ride in fully laden operating condition.

7) Request that the ride is unloaded and re-examine as in :-

Structural check list :- 1 - 11

Mechanical Check list :- 1 - 17

Hydraulic check list :- 1 - 12

8) If satisfactory, issue certificate and sign logbook.

9) If the second examination reveals defects, downrate the ride and repeat examination. The nature of the defects should be communicated to the manufacturer for their dissemination and appraisal .

# BI - ANNUAL

# GENERAL N.D.T. INSPECTION.

## Two Yearly Inspection ( N.D.T.)

Every two years the machine should be submitted to non - destructive testing (N.D.T.) of its structural components.

This should be carried out by an appointed person who is an independent examiner (as in the annual inspection ) and an N.D.T. technician certified to appropriate in a nationally recognised certification scheme, viz :-

1) PCN - ( Personal Certification In N.DT. )

2) ASNT - ( American Society Of N.D.T. )

Appropriate level for evaluation of results is level 2. It is the responsibility of the appointed person to verify the technician is suitably qualified and agree the test method and technique to be used.

The appointed person must distinguish between original manufacturing flaws and ones developed during use. Also he must distinguish between significant and insignificant flaws.

It is advised that the appointed person consults expert opinion as appropriate in the following disciplines :-

1) N.D.T.

2) Stress Analysis.

3) Welding Technology.

See checklist for N.D.T. of machine structure.

## N.D.T. Inspection.

**Recommended Methods Of N.D.T.**

| | | | |
|---|---|---|---|
| 1) | Dye Penetrant Test | DPT | For surface cracks. |
| 2) | Magnetic Particle Test | MT | For surface cracks. |
| 3) | Ultrasonic Testing | UT | For flaws and thickness. |

**Applications checklist.**

1) Check for surface cracks in parent metal at weld toes, edges of holes and any flamecut edges, in general terms in the vicinity of any stress raisers.

2) Check for cracks in the surface of weldments. These should appear along the throats of weldments.

3) Check for cracks in drive shafts in the vicinity of keyways, holes, changes in diameter or any other geometrical discontinuity.

4) Check for reduction in wall thickness in hollow sections caused by internal corrosion, also check for serious external corrosion (this is less likely). This is important on thin walled hollow sections in the vicinity of weldments and high stress areas.

Note:-

Use DPT/MT for 1 to 3 after thorough surface preparation and degreasing of structural surface.

Use UT for 1 to 4 . Remove paint and thoroughly clean, coat with grease to give a good acoustic coupling.

On completion of testing, re- paint all surfaces.

## Specific Areas To Be Checked

1) Check main arm joint weldment ( At mid position ).

2) Check main arm to centre weldment.

3) Check car top beam and stay bracket weldment.

4) Check tower bolt block weldment.

5) Check tower to trailer weldment.

6) Check tie rod end weldment.

**Note : These Are All Areas Of Maximum Stress**

Other areas to be checked are at the discretion of the appointed person.
Machine to be dismantled as in annual inspection to allow sufficient access for the N.D.T. technician and equipment.

**The Following Information Is Required On N.D.T. Report.**

1) Date of examination.

2) Technicians name and qualification.

3) Details of N.D.T. technique.

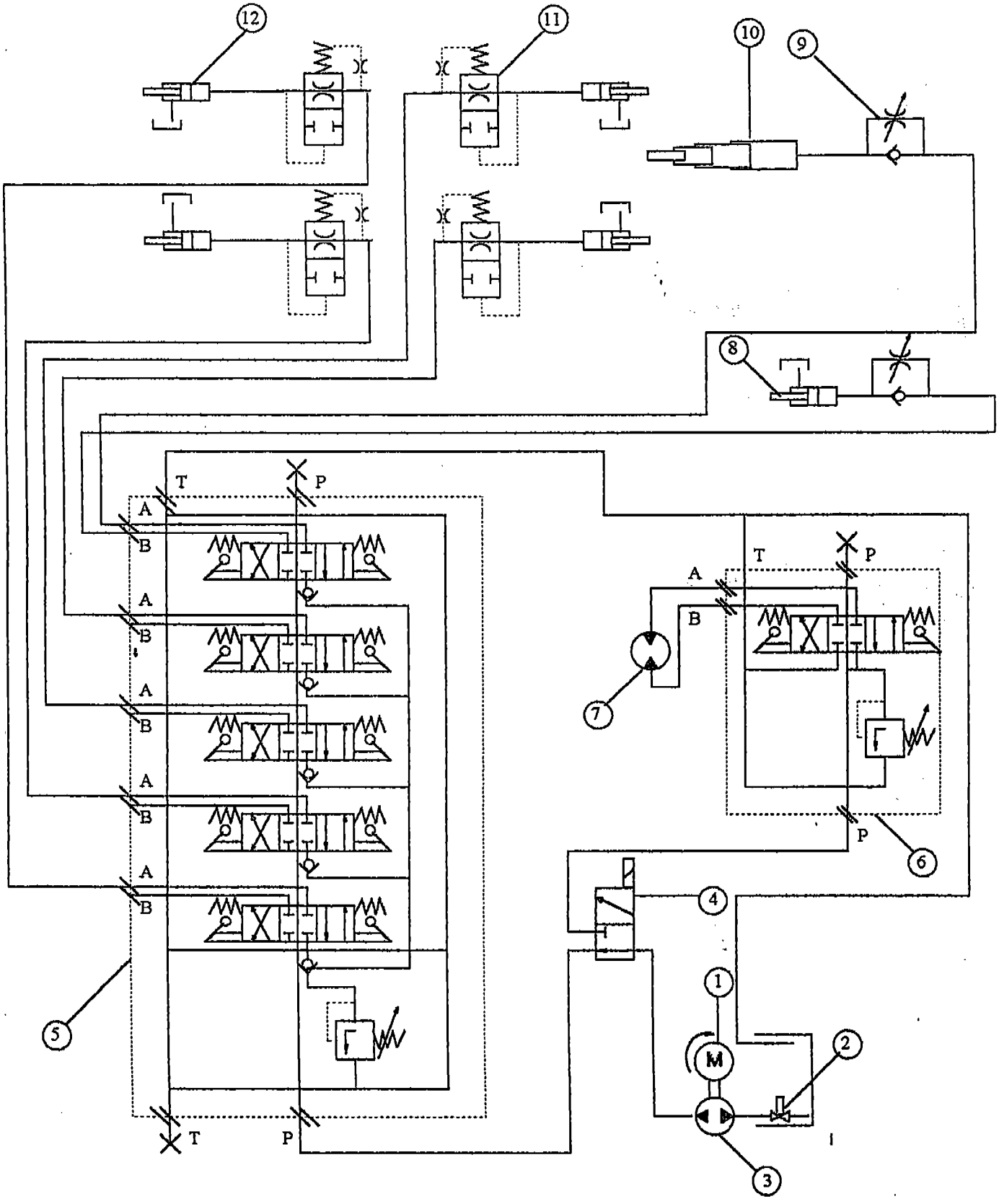
4) Parts examined and which elements comprised part of sample.

5) Parts unavailable for examination, if any.

6) Results of examination.

**All Reports To Be Kept Available By The Ride Owner**

## Hydraulic Circuit.



## Hydraulic Circuit.

1) Three phase motor

2) Isolating valve

3) External gear pump

4) Manual two way valve

5) 5 Stack manual spool valve

6) Manual spool valve

7) Hydraulic motor on winch

8) Pusher ram ( Tower )

9) Flow control valve

10) Main lift ram ( Tower )

11) Velocity fuse

12) Levelling rams ( Trailer )

# SECTION 7

# SERVICE BULLETINS

Number: S.B.SKY 002

Date: 14th Feb 1992

Supercedes: N/A

# SERVICE BULLETIN

Effective Serial Numbers: Skymasters 001 to 014

Subject: Passenger Restraint Bars.

We have been advised by a State Inspector to alert operators that in the event of a single rider occupancy of a seat, the operator must ensure that the vacant Passenger Restraint Bar is in the down locked position before allowing the Ride to commence.

This is to prevent slightly built passengers from being able to move sideways and escaping under the adjacent raised Restraint Bar.

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