

MFG: INTAMIN, INC.
NAME: SCORPION/ROLLER
COASTER
TYPE: NON-KIDDIE

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CAR WEIGHT INCLUDING AXLE ASSY COMPLETE:

CAR # 1	(1056 Kg)	2323 lbs.
# 2	(735 Kg)	1617 lbs.
# 3	(817 Kg)	1797 lbs.
# 4	"	"
# 5	"	"

I. SAFETY NOTICE

1. The requirements and regulations listed in this Operating Manual are to be performed or supervised through a "Responsible person", designated by the Owner.
2. The Manufacturer is not responsible for damages, if the ride is not operated and serviced according to this Manual or has been altered.
3. Common general maintenance and inspection procedures are not listed in this Service Manual, but should be performed for the upkeep of the equipment and safe operation.
4. The ride has to be inspected according to the inspection program before each start-up.
5. Any defects of the ride during the operation have to be corrected immediately and the ride shut down, for the duration of the repairs.
6. If the ride perimeter is not completely enclosed, provisions have to be made that guests stay within a safe distance from the ride structure.
7. During the operation of the ride no one, not even the operators, are allowed within the ride area, except for the specific positions

provided for the operators.

8. Make sure that the power is turned off before any necessary work on the ride is to be performed.
9. The keys for the Safety key switches are to be retained by the "Responsible person".
10. The installation of the power supply and grounding of the ride has to be conformed with the local requirements.
11. All work to be performed on the ride, has to be approved and supervised by the "Responsible person".
12. The ride should be operated only by well trained and qualified operators.
13. Following signs are to be installed, readily visible for the guests:
 - a) No smoking on ride
 - b) No pointed objects (like umbrellas or canes) allowed on ride
 - c) Follow instructions of operators (personnel)
14. Do not allow anyone under the influence of drugs or alcohol to board the ride.

II. DESCRIPTION OF MECHANICAL SYSTEM

1. General

The "Scorpion" is a high speed steel roller coaster with one loop.

The ride occupies an area of 65.20 m x 28.50 m (214' x 93'6") and reaches 18.5 m (60'9") at its highest point on the lift. The total length of the track is 550 m (1804'6").

The ride consists of a lift, running track including loop, and brakes.

The lift starts on the station exit, pallet # 2, and ends on support # 4, the highest point. There the running track starts and continues through the loop to pallet # 6, where the brake section and waiting zones start.

2. Track layout

At the end of the station (pallet # 2) the track goes up on an incline of approx. 35° to the top of the lift. After a short horizontal section the track drops sharply with an angle of approx. 33° , which leads, with a right curve, into the loop, at height of 0.7 m (2'4"). Going through the loop, the highest point of the track is 14.50 m (47'6"). After the loop the track enters a left spiral, climbing at a 25° incline to a height of 12.00 m (39'4"), and then descending at a

19° angle to a height of 0.75 m (2'6"). From there the track goes back up again, angle 18°, and crosses diagonally through the loop at a height of 7.20 m (23'8"). The track continues after the loop crossing with a right spiral, decending at an angle of 7° and than entering the brake section. After the trim brake the track has two right curves, going back to the station.

3. Sequence of ride

The passangers enter the first train in the station, located on pallet # 2. The second train is waiting in a waiting zone, located on pallet # 3. Once the train is dispatched, it is pulled up the lift to the highest point of the ride with a speed of max. 1.80 m/sec (354 ft/min). While the first train is going up the lift, the second train is automatically advanced into the station with a friction tire drive. After the first train has passed the highest point, it continues the run through the track and the loop on gravity force only, until it reaches the trim brake, where the speed is reduced to 2.50 m/sec (492 ft/min). Between the trim brake and the station the train is moved through friction tire drive. Should the station be occupied, the train is stopped automatically in the waiting zone.

(18 M / 10 SEC.)
(59 FT / 10 SECS)

(53 FT / 4 SECS)

4. Train speeds and running times

a) Speed:

Lift	:	max	1.80 m/sec	(354 ft/min)
Running track	:	max	18.00 m/sec	(3543 ft/min)
Brake	:	max	14.00 m/sec	(2756 ft/min)
Return to station	:	max	2.50 m/sec	(492 ft/min)

b) Time:

Lift	:	approx.	30 sec
Running track	:	approx.	36 sec
Return	:	approx.	30 sec

c) Points for speed test:

Center of train over support # 5 (after lift) to
center of train over support # 10 (before brake).

Time should be approx. 34 sec

5. Pallets

a) Pallet # 1 : Drive mechanism

Installed on Pallet # 1 are the DC motor and gearbox for the lift drive, chain adjuster, air compressor (supplied locally), power and control panels.

- b) Pallet # 2 : Station

This pallet has to be connected on site to the entrance and exit platforms for the ride. It contains the station brakes, lap bar release mechanism and on one end a deflection sprocket for the chain.

- c) Pallet # 3 : Waiting zone

One brake and two Feeder motors are installed on this pallet.

- d) Pallet # 4 : Waiting zone

One brake and one Feeder motor is installed on this pallet.

- e) Pallet # 5 : Trim brake, rear part

Installed on this pallet is the transfer track, which is approx. 3.50 m (11'6") long. The rest of the pallet contains the end of the trim brake and two Feeder motors with overrunning clutch.

- f) Pallet # 6 : Trim brake, front part

This pallet contains, over the full length, the trim brake front section and one feeder motor with overrunning clutch. Also, the parking track is mounted on the side of this pallet.

III. DESCRIPTION OF ELECTRICAL SYSTEM

1. All switch gear and fuses are installed in the control panel. The ride is operated from the control console and all functions can be checked there.
2. After the main disconnect is turned on, turn the key switch 2b4 "Control voltage" in the control console to the "On" position.
3. All magnetic and proximity switches are now energized and their corresponding contactors pick up.
4. Time relay d40 delays, for one second, the latching of the position contactors from the magnetic switches. This insures that no incorrect functions occur when the system is turned on.
5. The compressor contactor c2 will be energized only if the contactors c5, c6, c6.1, c19 and c19.1 are dropped out. When the air pressure reaches 7 bar (100 psi), the pressure switch 5b15 closes and energizes contactor d8.
6. If none of the emergency stop buttons (2b10 on the control console and 5b11 on the trim brake) are depressed, the contactor d6 picks up and supplies control voltage to the rest of the control circuit. Now all contactors and relays are energized

according to the circuit design.

7. The contactor c3 picks up and energizes the cooling fan for the lift motor, the cooling fan for the rectifier-thyristor unit, the lift motor field, and supplies the control voltage for the rectifier-thyristor unit.
8. The rectifier-thyristor unit supplies the following signals to the control circuit:
 - a) Current flow in the motor field
 - b) Wind flag switch closed
 - c) Rectifier fuses are OK
 - d) Lift motor speed = 0, d13 picked up
 - e) Lift motor not overspeeding, d14 picked up

The signals from a + b + c are needed to energize d12
9. Turning the selector switches for the waiting zones 2 and 3 to the "On" position initiates the automatic movement of the trains to the station.
10. The Feeder motors will operate only if the following conditions are met:
 - a) None of the Feeder motor overloads are tripped, which is controlled through d39
 - b) The waiting zone brake contactor has to be energized

- c) The limit switches on the brake have to signal that the brake is open
11. In case that the automatic is out of order or that trains have to be switched, the Feeder motors may be operated manually from the control console through push buttons.
12. To engage the lift hook on the train, the signal "Ready to engage" through contactor d25 is needed and than d17 has to pick up. The following signals are needed to energize d25:
- a) d8 picked up = air pressure above 7 bar (100 psi)
 - b) c8 dropped out = station brake not energized
 - c) d28 dropped out = station brake limit switches off
 - d) d59 dropped out = 5M6.2 and 5M6.3 actuated, train in start position
 - e) d84 dropped out = time relay not energized
 - f) d18 dropped out = lift hook not engaged
 - g) For manual operation the signals b through f are not needed, contactor d25 is energized through push button 2b28 in the control console.
13. Contactor d25 energizes relay d26 for "Slow speed lift motor"

14. After the lift hook is engaged on the train through d25, following signals energize d18 and complete the cycle:
 - a) d25 picked up
 - b) d17 picked up = with "Slow speed lift motor" the signal Jx from the rectifier-thyristor unit energizes time relay d16, which picks up d17 after 2 sec
 - c) d13 picked up = lift motor speed = 0
15. During regular operation d25 and d18 pick up and drop out automatically. Manual operation is possible any time through push button 2b28.
16. Pressing push button 2b12 on the control console energizes contactor c7 and releases the lap bars. If the push button 5b13 on the trim brake, or the key switch 2b27 "Safety override" is actuated, the lap bars can not be released.
17. The limit switches 5b14.1 through 5b14.4 signal over contactor d7 if the lap bar release mechanism is retracted.
18. When the train is ready to be dispatched, push the button 2b22 on the control console. The key switch "Station brake" 2b23 has to be released for 2b22 to function.

19. Pushing the dispatch button 2b22 starts the dispatch check # 1 and energizes contactor d19 if the following conditions are correct:
 - a) c7 dropped out = lap bar release not energized
 - b) d7 picked up = lap bar release mechanism retracted
 - c) d18 picked up = lift hook engaged
 - d) d16 dropped out = no signal Jx
 - e) d39 dropped out = no overload tripped
 - f) d13 picked up = lift motor speed = 0
 - g) d15 dropped out = lift motor not overspeeding
 - h) d21 dropped.out = rectifier-thyristor unit OK

20. Contactor d19 energizes relay d20, which applies a voltage to the rectifier-thyristor unit that simulates "Lift motor overspeed".

21. The rectifier-thyristor unit should sense the overspeed condition, causing d14 to drop out and d15 to pick up, and therefore energizing contactor d21. This test insures the proper function of the unit before every start.

22. If the contactor d21 picks up as described in point 21, the wiper relay d27 energizes the station brake contactor c8 for 15 seconds. The brake actuates the limit switches 5b34.1 - 5b34.2, which energizes contactor d28.

23. The contactors d19 and d21 give the signal "Start" and pick up contactor d22.

24. This closes the circuit for the start, which consists of the following functions:

- a) e10 closed = overload relay not tripped
- b) 2b26 closed = stop button not pushed
- c) c3 picked up = power on
- d) d8 picked up = air pressure OK
- e) d9 + d11 + d12 picked up
- f) d14 picked up = lift motor not overspeeding
- g) d15 dropped out
again = overspeed test OK
- h) d 22 picked up = signal "Start"
- i) d45 + d45.1 + d50
picked up = safety blocks OK

Contactors c6 and c6.1 are energized now and open the lift brake, also relay d23 picks up and enables the rectifier-thyristor unit.

25. At the same time the relay d24 is energized too, which gives the rectifier-thyristor unit the signal to start the lift motor. The built in starting integrator accelerates the train ~~in~~ in 5 seconds to approx. 1.2 m/sec (236 ft/min). After a preset time the time relay d95 energizes d96, causing the train to accelerate to the maximum speed of 1.8 m/sec (354 ft/min).

- * 26. Should one of the signals in point 24 change or the Tach generator fail, the lift motor is stopped and the lift brake closed.
27. As the train starts to go up the lift, contactor d16 picks up and section 1 of the track diagram in the control console is illuminated.
28. When the double magnetic switches 5M1 and 5M1.1, located near the top of the lift, are activated by a passing train, the circuit of d45 checks that safety block 1 is clear. This means that:
- a) The running track and the trim brake are not occupied, d85 is dropped out
 - b) All proximity switches and impulse sensors in the trim brake are in their correct position, and their corresponding contactors are picked up or dropped out accordingly.
 - c) The trim brake is closed
 - d) The magnetic switches for the safety block 1 and 2 are in their normal position
- * 29. If one of the signals in point 28 is not correct, the contactors d45 and d45.1 drop out, stopping the lift motor and closing the lift brake.

30. Actuating magnetic switch 5M1 also turns off section 1 and turns on section 2 on the illuminated track diagram, contactor d62 picks up.
31. As the train continues to go up the lift, it activates the double magnetic switches 5M2 and 5M2.1, located at the top of the lift, and checks over safety block 2 that:
 - a) Magnetic switch 5M1 has been activated, d44 is picked up
 - b) The running track and the trim brake are not occupied
 - c) d86 is picked up
- * 32. If one of the signals in point 31 is not correct, the train is stopped on the lift, same as in point 29.
33. To restart a train that has stopped on the lift, the safety blocks have to be deactivated through the key switch 2b27 "Safety override", on the control console.
34. Then, the "Responsible person" has to push button 5b13 on the trim brake, which allows the train to pass the magnetic switches 5M1 and 5M2. Pushing this button (5b13) signals that the running track and trim brake are clear.
35. To start a train on the lift, as described in point 33 and 34, the trim brake has to be closed too, d35 picked up and c19 dropped out.

36. To insure that push button 5b13 is not actuated continuously, the lap bar release in the station will not function with this button pushed.
37. When a train activates magnetic switch 5M3, located on the end of the lift, the illuminated field on the track diagram changes from section 2 to 3, d63 picks up.
38. At the same time the time relay d69 is energized, which controls the running time of a train, from the end of the lift to the start of the trim brake. If the train exceeds the time limit, section 3 in the track diagram flashes and a buzzer is activated.
39. Should a train exceed the time limit more times, than the same has to be taken out of service and inspected.
40. A train entering the trim brake has to pass the impulse sensor 5b1 and 5b2 with higher speed than the speed at which the trim brake opens.
41. Impulse sensor 5b1 is connected to impulse relay d2, which energizes contactor d30 if the pulses coming from 5b1 are faster than the preset level on d2.

Impulse sensor 5b2 is connected to impulse relay d3, which energizes contactor d33 if the pulses coming from 5b2 are faster

than the preset level on d3.

As the speed of the train is reduced, the pulses received on d2 fall below the preset level, d2 drops out and picks up contactor d29. Same goes for d3, which picks up contactor d32.

42. The impulse sensor 5b3 is connected to impulse relay d4 and the impulse sensor 5b5 is connected to impulse relay d5.

Should the train pass the impulse sensors 5b3 and 5b5 with a higher speed as preset on d4 and d5, contactors d35 and d87 drop out.

When the speed of the train is reduced and the pulses fall below the preset level, both contactors are energized again.

43. Following functions are necessary for the automatic operation of the trim brake:

- a) The train has to activate at least one of the proximity switches 5F2, 5F3 or 5F4 in the trim brake, causing d64, d55 or d56 to drop out.
- b) Impulse relays d2 and d3 had to be activated with faster pulses as of the preset level.
- c) The speed of the train has to be reduced to the preset level on d2 and d3, d29 and d32 picked up.
- d) Waiting zone 3 is not occupied
- e) The contactors d31 and d34, which check the functioning

- of d2 and d3, have to be picked up
- f) The pulses from the impulse sensor 5b3 and 5b5 have to be lower than the preset level on d4 and d5.
 - g) The limit switches 5b39.1, 5b39.2 and 5b39.3 on the transfer track have to be activated and signal that the transfer track is in operating position and locked, contactor d36 picked up.
44. To switch trains, the trim brake can be operated manually. Turn on the key switch 2b23 on the control console, indicator light 2b47 is lighted: Pushing the button 2b40 now opens the trim brake.
45. The Feeder motors in the trim brake start automatically when the brake is open.
46. As a train enters the trim brake, it actuates proximity switch 5F1. This turns off section 3 and turns on section 4 "Trim brake" in the track diagram.
47. Also, the time relay d70 is energized, which controls the time that is allowed for a train to clear the trim brake, If a train exceeds the time limit, section 4 in the track diagram flashes and a buzzer is activated. Should this occur more times, the trim brake has to be inspected.

48. As a train leaves the trim brake, magnetic switch 5M4 is actuated, which clears safety block 1. At the same time 5M4 checks that safety block 2 is occupied. If contactor d49 from safety block 2 is not picked up, the lift is stopped. This check insures that safety block 2 can not fail.
49. When a train actuates the magnetic switch 5M5, contactor d53 clears safety block 2.
50. A train entering the waiting zone 3 actuates proximity switch 5F5. Contactor d57 drops out and section 5 "Waiting zone 3" in the track diagram is illuminated. If the waiting zone 2 is occupied, the brakes from waiting zone 3 close and stop the train.
51. A train entering the waiting zone 2 actuates proximity switch 5F6. Contactor d58 drops out and section 6 "Waiting zone 2", in the track diagram, is illuminated. If the station is occupied, the brakes from waiting zone 2 close and stop the train.
52. As a train enters the station, it actuates the proximity switches 5M6.1 and 5M6.3, the section 7 "Station" in the track diagram is illuminated. By actuating the proximity switches 5M6.2 and 5M6.3, which are located at the end of the station, the station brake closes.
53. After a train has cleared the lift, it actuates the magnetic

switch 5M3, which stops the lift motor and closes the lift brake.

54. The proximity switch 5M7 has the same function and would stop the lift if 5M3 would have failed to do so.
55. After the train has entered the station and stopped, as described in point 52, the lift hook is engaged automatically on the train - see point 12 through 15.
56. For an easy control of various functions during operation and a quick trouble shooting, control lamps are installed in the control panel.
57. Repairs on the electrical installation are to be performed by highly qualified technicians only.
58. Test rides without passengers must be made after the daily inspections and maintenance or after repairs have been performed.

IV. INSPECTION PROGRAM

1. Lift

Time
interval:

- ✓ a) Check all bolted connections on the lift drive after the first 50 hours of operation, and there after
- ✓ b) Spot check the connections on the chain at two places
Should a loose connection be found, all connections on the chain have to be checked
- ✓ c) Check the function of the limit switch for broken chain
- ✓ d) Check the guides on the chain tension adjuster
- ✓ e) Check the tension of the V-belts, if necessary tighten by moving the gear box
- ✓ f) Check the function of the lift brake
- ✓ g) Clean dust filter on lift motor
- ✓ i) Check brushes and commutator on lift motor for wear, blow out dust and clean commutator

~~MONTHLY~~
yearly

daily ✓

daily

daily ✓

daily ✓

daily

~~WEEKLY~~
monthly ✓

yearly
~~MONTHLY~~

2. Supports:

Time interval:

- ✓ a) Check bolted connections and safety pins
- ✓ b) Spot check the connection from supports to track (socket head cap screw M30) at six places for correct torque:

~~monthly~~

check weekly ✓

$$M_{AN} = 405 \text{ Nm (298 ft-lbs)}$$

daily ✓

Should a loose connection be found, the bolts on all supports have to be checked

3. Loop:

- a) Check bolted connections on various places, first after 50 hours of operation and then

Should a loose connection be found, all bolts on the loop have to be checked

- b) Track on loop (see track)

*6 mos. by well trained
yearly by other workers
including customer*

4. Track

- ✓ a) Spot check the bolted connections on the track at six places for correct torque:

daily ✓

$$M_{AN} = 580 \text{ Nm (427 ft-lbs)}$$

Time
interval

Should a loose connection be found, all bolts on the track have to be checked.

- ✓ b) Also, as the bolted connections are checked, inspect the track joints for a smooth transition. If necessary sand even, to prevent wheel wear

~~daily~~ +
MONTHLY as/mont
yearly

5. Brake:

- ✓ a) Check adjustment of trim brake as following:
Stop fully loaded train, 20 x 75 kp (20 x 165 lbs), in the trim brake by pushing the emergency stop button.

The distance from the start of the trim brake to the front of the train should be approx.

$20.00 \text{ m} \pm 2.00 \text{ m} (65'7'' \pm 6'')$

(Mark with color on trim brake)

~~daily~~ as/mont
WEEKLY

- ✓ b) Check the brake linings for wear, change before rivets start to wear.

DAILY /
monthly

- ? c) Check opening and closing of all switches

monthly

Time
interval:

- d) Check speed of train leaving trim brake,
should be 2.5 m/sec (492 ft/min) monthly

- ✓e) Check adjustment of station brake as
following: weekly
An empty, as well as a fully loaded train,
has to stop in the station to allow for
automatic connection of the lift hook.
(Mark location of train front on station,
with color)

- ✓f) Check air cylinders for leaks ~~Weekly~~
monthly

- ✓6. Lap bar release mechanism:

✓ Check release mechanism in station for
free movement before opening of the ride daily ✓

- 7. Feeder motors:

a) Check bolted connections after first 50 hours
of operation and thereafter frequently ~~MONTHLY~~
yearly

Time
interval:

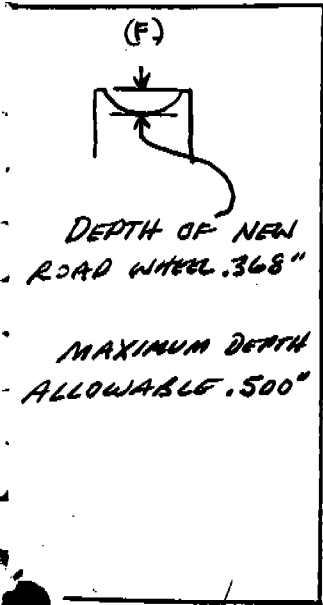
- ✓ b) Check air pressure in tires, approx.
5.50 - 6.00 bar (80 - 87 psi) ~~monthly~~
weekly
 - ✓ c) Check height adjustment of tires:
Contact pressure should be 5 - 8 mm
(1/4" - 5/16") without lifting up the cars monthly
 - ✓ d) Check function of cooling fan ~~yearly~~
MONTHLY
7. Train with 5 cars:
- ✓ a) All bolted connections, especially axles and
brake fins, are to be checked after 50 hours
of operation and frequently thereafter ~~yearly~~
MONTHLY ✓
 - ✓ b) Check the lap bars for free movement and
safe locking of ratchet daily ✓
 - ✓ c) Check the Anti-roll-back dogs on the last
car for free movement daily ✓
 - ✓ d) Check the safety cables between cars for
wear ~~monthly~~
DAILY ✓

INTAMIN INC

RED WHEELS — CONTILAN LINER WHICH IS REASONABLY SOFT — TO BE USED FOR ROAD WHEELS & GUIDE WHEELS (1ST & LAST RIDE)

BLUE — POLYAMID LINER WHICH IS HARDER THAN CONTILAN — TO BE USED FOR WHEELS & GUIDES ON REAR CAR

Time interval:

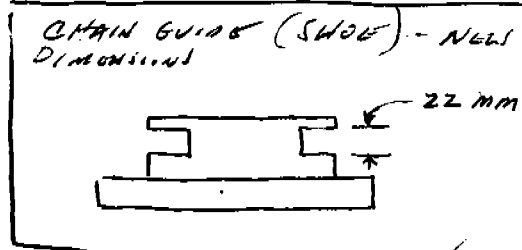


- e) Check wheels for wear and replace as necessary

monthly

Wheel type	New diameter	Minimum diameter
Road wheel	265 mm (10.433")	255 mm (10.039")
Guide wheel	145 mm (5.708")	140 mm (5.511")

(Measure at middle of wheel)



9. Pneumatic system (supplied locally):

- ✓ a) Drain water from tank daily* ✓
- ✓ b) Drain water from filters daily* ✓
- ✓ c) Check lubricators DAILY weekly ✓

*Time interval may change depending on humidity

AIR PRESSURE TO ~~BRAKE~~ ~~SYSTEM~~ BRKS (100-105 PSI)

10. Electrical system:

- ✓ a) After the ride is ready for operation, push the emergency stop button and check that the lift stopped and all brakes are closed daily

Time
interval:

- ✓ b) Actuate magnetic switch 5M1 manually, using a piece of steel or tool, then dispatch a train. The train has to stop by 5M1. (Safety block 1) daily
- ✓ c) Repeat above test (point b) by actuating magnetic switches 5M2, 5M4 and 5M4 respectively. The train has to stop every time on the lift daily
- ✓ d) Place a piece of sheet metal on top of proximity switch 5F1 in the trim brake. The train has to stop on the lift by 5M1. Repeat same test for 5F2, 5F3 and 5F4 ~~DAILY~~
weekly
- ✓ e) Check and record the readings from all voltmeters and ammeters. Compare the readings with the previous ones, if deviations occur find and correct the trouble. ~~MONTHLY~~
weekly
- ✓ f) Check the control circuit for proper function ~~DAILY~~
monthly
- ✓ g) Tighten all connections in the control panel and control console, blow out accumulated dust. ~~MONTHLY~~
yearly

Time
interval:

- ✓h) Check the contacts of all power contactors,
replace contacts or contactors as needed

MONTHLY
yearly

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V. OPERATING INSTRUCTIONS

1. After the daily inspection and maintenance are completed, the ride can be started up.
2. Turn on the key switch "Control voltage" on the control console.
3. When the air pressure reaches 7 bar (100 psi), the ride is ready for operation.
4. Turn the selector switches for the waiting zones to the "On" position.
5. Push the button "Lap bars" to open the safety lap bars.
6. If the train is standing in the correct position in the station, the lift hook engages automatically.
7. After all passengers are seated in the train, the operators have to check that the lap bars are closed snug against the passengers and locked.
8. Push the button "Horn" to sound a warning signal.
9. Dispatch the train through pushing the button "Start" and keep the button depressed until the train starts moving.
10. The operator has to observe the movement of the trains on the

illuminated track diagram.

11. Should a train exceed the allowable running time on the track or in the trim brake, the corresponding section on the track diagram flashes and a buzzer is activated. If this occurs, that train has to be observed closely on the next cycle. A train that exceeds the time limit more times has to be taken out of service and inspected.
12. After a train has completed the cycle on the running track, it is slowed down in the trim brake and then moved automatically to the station by feeder motors.
13. Pushing the button "Lap bars" activates the lap bar release mechanism in the station and the lap bars open.
14. If the station is occupied, approaching trains are stopped in the waiting zones. As soon as the station is clear, the trains move automatically ahead.
15. All feeder motors and the trim brake may be operated manually from the control console through push buttons. This is needed to move trains to or from the parking track.
16. After a dispatched train has cleared the lift, another train may be dispatched as soon as the lift hook is engaged. Should

the second train reach the end of the lift before the first train has cleared the running track and the trim brake, the second train is stopped on the lift. For that purpose two double magnetic switches are located near the end of the lift and connected to two safety blocks. When a train actuates this magnetic switches, they check that the running track and the trim brake are clear. If one of the safety blocks is occupied or one of the switches is defect, the train is stopped before the crown of the lift. Every time a train is stopped on the lift, check first that the trim brake is closed. If a train is stopped in the trim brake, release the train before any other action is taken or any other button actuated.

17. After the malfunction has been corrected, turn on the key switch "Safety override" on the control console. A buzzer is activated as a reminder.
Now the "Responsible person" has to push a button on the trim brake to signal that the running track and the trim brake are clear.
18. Then, the train can be started from the control console.
19. To insure that the button on the trim brake is not actuated continuously, the lap bar release will not work with that button depressed.

20. In case of a power failure, the trim brake and the waiting zone brakes can be operated manually, using a hand valve and air from the storage tank.
21. As soon as a train has cleared the lift, the lift hook is slowed down and stopped automatically.
22. If another train is in the station, the lift hook moves with slow speed and engages automatically. The lift hook can also be engaged manually through a push button on the control console.
23. Should any danger or emergency situation arise, the "Emergency stop" button has to be pushed immediately. This stops all motors and closes all brakes.
24. Following procedure is used to close or shut down the ride:
 - a) Unload the passengers and dispatch the empty train, stop that train in the waiting zone before the station.
 - b) Unload the passengers of the next train and dispatch the empty train, stop that train in the other waiting zone.
 - c) Never park a train in the trim brake.
25. Testrides without passengers must be made after the daily inspection and maintenance or repairs have been performed.

VI. LUBRICATION

1. General

- a) The listing of lubricants in the following table is in alphabetical order. Other brands of the same quality may be substituted, but the mixture of different brands should be avoided.
- b) Perform lubrication at listed time intervals.
- c) If the ride is out of service for a longer period of time (winter time), the lubrication of all moving parts is necessary.
- d) If parts are cleaned, like the bearings or gear boxes, make sure that the cleaning solvent is completely removed before assembly.
- e) Bearings should be cleaned only in white gasoline or kerosene.
- f) After cleaning, lubricate bearings with grease according to table A. Fill bearings approx. $1/3$ up to max. $1/2$ of available space with grease.

2. Lubricants

Table A: Bearings

<u>Brand</u>	<u>Type</u>
Calypsol	H443
Esso	Beacon 2
FAG	Avancol L 78
Shell	Alvania 2 ..

Table B: Gear boxes

<u>Brand</u>	<u>Type</u>	<u>Remarks</u>
BP	Gear lubricant 140	For worm gears
Shell	Gear lubricant 140	For worm gears
BP	Gear lubricant 90	For Bevel and Spur gears
Shell	Gear lubricant 90	For Bevel and Spur gears
BP	SGR - XP 220	For V5/V6 gear boxes
Texaco	Marfak 00	For V5/V6 gear boxes

Table C: Chain

<u>Brand</u>	<u>Type</u>
Molykote	1221 / 1231
Optinol	KL 300

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3. Lift

- a) Chain: acc. to Table C

Lubricate the link chain carefully twice a week ✓

- b) Chain guide: acc. to Table C ✓

Lubricate the track for the chain guides daily ✓

- c) Lift drive motor: acc. to Table A

The DC-motor GNV 250s - 125 KW has a grease fitting for the bearing on the drive shaft side, which should be greased every 2300 hours of operation. The grease in the bearing on the rear of the shaft should be changed every 4600 hours of operation.

6 MONTHS

- d) Gear box: acc. to Table B and Table A

The gear box SEW R 160 is filled with 21.50 Ltr. (5.67 gal) of gear lubricant oil. Check the oil level once a month and add oil if necessary. The oil should be changed ^{6 MONTHS} ~~once a year~~ and the bearings lubricated.

MONTHLY
MECHANICAL

- e) Chain tension adjuster: acc. to Table A

About once a month clean the guide on the chain tension adjuster and lubricate on 4 places.

MONTHLY

- f) Chain sprockets: acc. to Table A

After one year of operation lubricate the bearings.

Each sprocket has one grease nipple each on the left and right side. ✓

Every two years the bearings should be taken apart and inspected for wear, cleaned and re-lubricated.

- g) Lift hook: acc. to Table A

Once a month lubricate the rear pin on the lift hook (one grease fitting). ✓

Every two years the lift hook should be taken apart and inspected for wear, cleaned and re-lubricated.

4. Feeder motors:

- a) Gear box: acc. to Table B and Table A

The gear box is filled with 2.10 Ltr. (2 $\frac{1}{4}$ Qt.) of oil.

Check the oil level once a month and add oil if necessary. ✓

The oil should be changed once a year and the bearings lubricated.

- b) Motor: acc. to Table A

The bearings of the motors should be cleaned and relubricated after approx. 4000 hours of operation.

Yehesky

c) Feeder motor with overrunning clutch: acc. to Table A

The feeder motors in the trim brake have a overrunning clutch added on the drive shaft. The clutch should be lubricated every time the tire is changed.

The overrunning clutch should be cleaned and relubricated at least every 2000 hours of operation. *6 mos*

5. Trim brake

a) Brake shoe mechanism: acc: to Table A

All bolts and pins on the brake shoes should be lubricated once a month.

b) The clevises on the air cylinders should be oiled frequently, at least monthly.

6. Lap bar release mechanism

All sliding areas of the release mechanism in the station should be oiled or lubricated monthly.

7. Transfer track

Grease all moving parts once a month.

8. Air compressor (Supplied locally)

Service the air compressor according to the manufacturer's recommendations. Important is to check the oil level and to change the oil after the specified periods.

9. Cars

a) Axles: acc. to Table A.

Lubricate each axle joint on three places, once a week.

b) Support rollers: acc. to Table A

Lubricate each support roller once a week.

c) Lap bars and ratchets:

Lubricate the fittings on the lap bars and the ratchet housing once a month, if necessary more frequently.

d) Road wheels and guide wheels: acc. to Table A

At least once a year, or every time the wheels are changed, the bearings have to be inspected, cleaned and relubricated.

VII. MAINTENANCE

1. Lift

a) Drive:

Check all bolted connections after the first 50 hours of operation and tighten, if necessary.

Check the V-belt tension, especially during the first days of operation, and tighten right away as necessary.

b) Chain:

Any change in the length of the chain is taken up by the chain tension adjuster on the lift drive.

If, after a longer period of operation, the travel of the chain tension adjuster reaches the limit, the deflection sprocket in the station can be extended back 400 mm (15 3/4"). When the chain has stretched to the point that this extension is no longer sufficient, one section of chain, consisting of 20 links and approx. 1500 mm (5') long, is removed.

Check the chain links, connecting links, sprockets and chain for wear, replace as necessary.

c) Important when working on the chain:

1. The weld of the vertical (standing) chain link has to face down
2. The weld of the horizontal (laying) chain link has to face towards the inside
3. The lock nut of the connecting link has to face towards the inside and is torqued to:
 $M_{AN} = 360 \text{ Nm (265 ft-lbs)}$
4. The lift hook has to be mounted approx. 150 mm (5.9") in front of a chain guide
5. The chain guides are to be installed approx. 1500 mm (5') apart. Special attention has to be paid that the chain guides pass properly over the double sprocket, $Z = 10$ teeth, on the gear box.
6. The two lift hooks are spaced equal on the chain, which is half the chain's length apart. That means that one lift hook has already passed the deflection sprocket on top of the lift, while the other lift hook is still before the deflection sprocket in the station, also below the station.

d) Lift brake:

The lift brake is held closed through spring pressure, and air pressure of approx. 5.0 - 5.5 bar (72 - 80 psi) is applied to open the brake.

FOR PART 141

PART 161 7BAR

The lift brake is maintenance free, but the holding power of the brake should be checked weekly.

To test the brake, lock the Anti-roll-back dogs on the last car of a train in the up position, which prevents them from engaging in the Anti-roll-back teeth on the lift.

Turn off the waiting zones to prevent the next train from entering the station. Now, dispatch the test train, close the station brake as soon as the station is clear. Then, stop the lift when the last car is on the incline, just past the radius of the track. The brake has to hold the train. Lower the Anti-roll-back dogs on the last car to their normal position before restarting the lift.

2. Track

The track joints have to be smooth, without any offset. All irregular joints have to be sanded carefully over a longer distance to achieve a smooth transition and prevent depressions.

The surface, where the wheels contact the track, should not be painted.

If the ride has been out of service for a longer period of time, the contact surface on the track has to be cleaned from rust to insure that the train will run with sufficient speed.

For the first runs it is recommended to lubricate the track in the high speed areas, especially before the loop and the incline after the loop, with a light coating of oil.

3. Supports

Check frequently that the safety pins in the bolts are tight.

4. Feeder motors

Most important on the Feeder motors is the correct inflation of the tires, 5.5 - 6.0 bar (80 - 87 psi).

The height of the tires has to be set for correct contact pressure, which has to be adjusted frequently to compensate for tire wear.

5. Trim brake

The trim brake is installed on pallet 5 and 6. The waiting zone brakes and the station brake are of the same construction as the trim brake, but shorter.

The trim brake has to be adjusted, as to stop a train within $20.00 \text{ m} \pm 2.00 \text{ m}$ ($65'7'' \pm 6'6''$). For reference, mark the 20.00 m ($65'7''$) point with color on the trim brake.

The station brake has to be adjusted, so that a trouble free connection of the lift hook is guaranteed.

If a brake has to be adjusted, make sure that the gap between all closed brake shoes, on that brake, is the same.

The brake linings have to be changed before the rivets start to wear. New lining, that is riveted to the brake shoe, should contact the brake shoe over the entire surface. No gap should be visible. Also, the rivets are reinforced through dowel pins to prevent them from shearing off.

Check that all air cylinders and limit switches work properly.

6. Lap bar release mechanism

The lap bar release mechanism in the station has to be checked for free movement, especially the retraction. If necessary, the tension springs have to be adjusted.

7. Transfer track

Check the transfer track for free movement and watch the gap between tracks, especially during high temperature periods.

Keep the rolling surface for the support wheels clean.

8. Pneumatic system (Supplied locally)

Check all pipes and connections for leaks.

Drain compressor tank and receiver tanks as needed.

9. Cars

Check all bolted connections after 50 hours of operation and tighten if necessary (especially axle joints, connecting bars and brake fins).

Check lap bars and ratchets for free movement and function.

Check safety cable between cars for wear.

10. Table for tightening torque

Torque values for lightly oiled screws:

Size	Grade 6.8		Grade 8.8		Grade 10.9	
	Nm	ft-lbs	Nm	ft-lbs	Nm	ft-lbs
M8	21	15	25	18	35	28
M10	41	30	49	36	69	51
M12	72	53	86	63	120	88
M16	180	133	210	155	295	217
M20	345	254	410	302	580	427
M24	600	442	710	523	1000	737
M30	1200	884	1450	1069	2000	1474

VIII. TROUBLE SHOOTING CHART

1. Trouble: No control voltage

Probable cause:

- a) Phase sequence from line is wrong, lamp h2 is on
- b) Fuse e1, e2, e32 or e34 defect
- c) The main disconnect is off

Corrective action:

- a) Change phase sequence
- b) Replace fuse
- c) Turn on the main disconnect

2. Trouble: The lift hook can not be engaged manually

Probable cause:

- a) Fuse e5, e9, or e12 defect
- b) The air pressure is below 7 bar (100 psi), control lamp d8 is off
- c) Hand valve on trim brake is in manual position, control lamp d8 is off

Corrective action:

- a) Replace fuse, check current if fuse blows again
- b) Turn on compressor
- c) Turn hand valve to automatic position

- d) The limit switch "Broken chain" is actuated
- e) The lift motor is overheated, control lamp d11 is on
- d) Check chain and function of limit switch
- e) Check motor temperature, if hot let motor cool down, then check brushes and current

3. Trouble: The lift hook does not engage automatically

Probable cause:

- a) See point 2, a through e
- b) Limit switches from station brake are not functioning correctly
- c) Magnetic switch 5M6.2 or 5M6.3 not actuated

Corrective action:

- a) See point 2, a through e
- b) Check and adjust limit switches, should not be actuated by closed brake
- c) Magnetic switch 5M6.2 or 5M6.3 has to be actuated, d59 dropped out

4. Trouble: Rectifier-thyristor unit not working

Probable cause:

- a) No lift motor field or defective current relay, control lamp h14 is off

Corrective action:

- a) Check field current, by cold motor approx. 3.8 A, by warm motor approx. 3 A

- b) Cooling fan not working
or wind flag switch defect,
control lamp h15 is off
- c) The fuse control is tripped,
defect rectifier fuse
- d) Lift motor stopped shortly
after start, Tach generator
defect
- b) Check fuse e5, check
overload relay e8, reset,
check wind flag switch
- c) Replace with rectifier
fuse, do not replace with
a common fuse, if fuse blows
again, consult an expert
- d) Check Tach generator
brushes, check voltage
Attention: Do not remove
rotor from Tach
generator

5. Trouble: The train won't start

Probable cause:

- a) Lap bar release not
retracted, limit switch
not actuated
- b) The signal "Lift hook
engaged" is missing, control
lamp d18 is off

Corrective action:

- a) Check release mechanism
and limit switch, control
lamp d7 should be on
- b) See point 2, a through e

- c) One of the overload relays from the transfer motors is tripped, control lamp d39 is on
- d) The signal $n = 0$ or $n = \max$ from thyristor unit not correct
- e) Magnetic switch 5M3 or proximity switch 5M7 is actuated or defect
- c) Check overload relays, reset, d39 should be dropped out
- d) Contactor d13 and d14 should be picked up
- e) Check switches, replace if necessary

6. Trouble: The trim brake is not working properly

Probable cause:

- a) One of the proximity switches 5F1 through 5F4 is defect or not actuated
- b) One of the impulse relays d2, d3, d4, or d5 is defect

Corrective action:

- a) With no train in trim brake, d54, d55, d56 and d64 should be picked up
An incoming train has to reach at least 5F2
- b) Check that incoming train actuates d2 and d3 with a higher speed as the preset level, d2 and d3 must pick up

- c) One of the three limit switches on the transfer track is not actuated or is defect
- c) All three limit switches have to be actuated, d36 picked up

7. Trouble: A safety block was set up, the train stopped

Probable cause:

- a) One of the proximity switches 5F1 through 5F4 in the trim brake is actuated or defect

- b) One of the impulse relays is defect

- c) One of the trim brake limit switches is not actuated or defect

Corrective action:

- a) Check function of proximity switch with a piece of steel, same size as the switch, the steel should actuate the switch from a distance of 25 - 30 mm (1" - 1 $\frac{1}{4}$ ")

- b) Check function of impulse relays on LED's with a train passing, adjust carefully, if necessary

- c) Adjust limit switches, have to be actuated by closed brake, d37 and d38 picked up

- d) One of the magnetic switches SM1, SM2, SM4, or SM5 is defect
- d) Check magnetic switches, replace if defect
- e) One of the contactors in the safety block control circuit is defect
- e) Check if contactors are picked up or dropped out according to the circuit design, replace if defect

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