



Zierer Rides & Parts GmbH - Moosgasse 4 - D-94550 Offenberg

To: WAVE SWINGER OWNERS

Zierer Rides & Parts GmbH  
Moosgasse 4  
D-94560 Offenberg  
Tel. (+49) 9 91/91 06 40  
Fax (+49) 9 91/99 90 27  
e-mail: mw-evg@zierer.com

March 29<sup>th</sup> 2000

Ihre Nachricht:  
Your message dated:

Ihre Zeichen:  
Your reference:

Unsere Zeichen:  
Our reference:

Datum:  
Date:

## WAVE SWINGER MAINTENANCE DIRECTIONS

Dear Sirs

Since we have experienced strong requests for maintenance instructions for the Wave Swinger ride from our clients during the past months, we take the opportunity to provide you today with a general compilation of the major and regular maintenance measures required for the ride.

This general check list and instructions will help you to eliminate periods of disuse or down time of your Wave Swinger ride or at least to reduce them.

Subsequent listed you will find the required inspection and maintenance work as well as general references of tolerances and permissible limits for safety units of the ride which have to be checked and maintained regularly.

### 1 To be checked and exchanged regularly:

The primary change of the hydraulic oil has to be carried out after 5000 hours of operation at the latest. Afterwards an oil change will become due after every 2500 hours of operation or after two years at the latest.

When exchanging the hydraulic oil the filter elements have to be replaced as well. Apart from that the filter elements shall be regularly exchanged once a year.

Die Ware bleibt bis zur restlosen Bezahlung unser uneingeschränktes Eigentum. Erfüllungsort für Lieferung und Zahlung ist Neubäumen. Gerichtsstand ist Deggendorf.

Telefon  
(+49) 9 91/91 06 40

Telefax  
(+49) 9 91/99 90 27

Bank: Sparkasse Deggendorf  
BLZ: 741 600 00  
Kto.-Nr.: 380 304 725

Ust.Id.Nr.:  
VAT.No.:  
DE 168 612 663



The complete set of lift cables (4 pieces) needs to be thoroughly checked for break, deformation, undue elongation and wear after 400 hours of ride operation or every second month (please refer to DIN 15020 for detailed information or to the supplement to the manual)

But basically it is essential to completely replace the lift cables after every second year.

- High pressure hose compl. (to be exchanged after every six years according to BG-regulation HZ1/74 - Safety rules for hydraulic hose piping)

- 2 Experiences proved that after 5-6 years of ride operation especially those ride units described hereunder are strongly worn out and require an exchange (the rates of wear and tear always apply for the most worn out part):

3

<u>Unit</u>	<u>Limit of wear</u>
- shackle 1,0 to.	1,5 mm
- shackle 1,6 to.	1,5 to 2,0 mm
- S-hook	1,5 to 2,5 mm
- spreader bar	2,0 to 3,0 mm
- chain ring/ VA-shackle	0,8 to 1,0 mm
- seat chains and split links	1,5 to 2,0 mm

in addition also the following parts are worn out after 5-6 years

- rubber element for cado coupling
- nylon pads at telescope
- carbon brushes at mast and basket

- 3 As a rule the parts listed hereunder are worn out after 10 years:

- guide rollers and bolts for basket
- bolts and bushes of the cable pulley
- slewing rim basket / mast
- pinion basket / mast



we have experienced that the following parts will be worn out after 10 years as well and therefore need to be exchanged or require new bearing:

- hydraulic motors
- rotary switch unit
- lifting cylinder

We very much hope that the above directions and recommendations will assist you in carrying out maintenance works at the Wave Swinger much more calculated and effective so that the operational and service life of the ride will be increased significantly.

If you should require help and assistance from an expert technician we will be glad to provide you with an appropriate quotation.

Best regards

Dieter Hopfner jr. / Project Manager

A handwritten signature in black ink, appearing to be "Dieter Hopfner jr.", written over the printed name.

ZIERER RIDES & PARTS GmbH

Postfach 4

D-94560 Offenberg

Tel: (+49) 991/91 06 40

Fax: (+49) 991/99 90 27

# ZIERER

State of New Jersey  
Attn: Paul Sachdeva, P.E.  
Bureau of Code Services  
P.O. Box 816  
Trenton, NJ - 08625-0816

Karussell- und Fahrzeugbau GmbH  
Moosgasse 4, 94560 Offenberg  
Deutschland / *Germany*  
TEL : +49/991/9106-38  
FAX : +49/991/999027  
E-MAIL : service@zierer.com

**DATE :** 20.06.01

**Wave Swinger 042x45 at Six Flags Great Adventure**  
**Re: Your letter from June 13, 2001 - Flying Wave Ride (NJ#00342)**

Dear Paul


Regarding your questions I would like to inform:

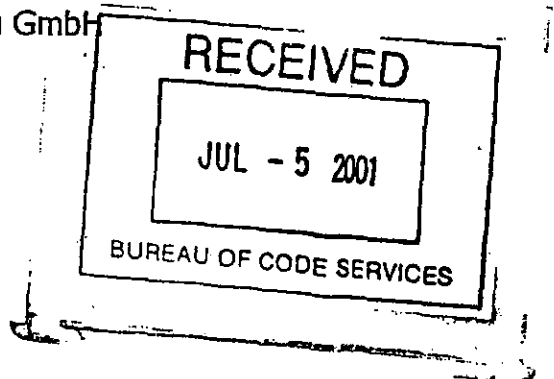
- 1) we made no recommendations for NDT, further we do not have a bulletin or manual which shows recommendations for NDT on the Wave Swinger
- 2) we have not received a notification
- 3) we didn't get consulted regarding setting up of the NDT criteria
- 4) we didn't make a recommendation regarding setting up of the NDT criteria

Regarding questions 5 to 9 please get in contact with Six Flags.

Hope above is helpful for you

Best regards

  
Martin Weichselgartner  
Zierer Karussell- und Fahrzeugbau GmbH



■ ZIERER Karussell- und Spezialmaschinenbau GmbH  
Josef-Wallner-Str. 10, D - 94469 Deggendorf



Karussell- und Spezial-  
maschinenbau GmbH

**Versand-/Lieferanschrift:**

**Delivery Address:**  
Neuhausen  
Moosgasse 4  
D-94560 Offenberg

**Telefon:**

(+49) 991 91060 Zentrale  
(+49) 991 910638 Service

**Telefax:**

(+49) 991 910684 Verkauf/Sales  
(+49) 991 910683 Service  
(+49) 991 910624 Technik/  
Engineering

**E-Mail:**

info@zierer-rides.de  
service@zierer-rides.de

**Internet:**

www.zierer-rides.de

Ihre Nachricht vom: Ihre Zeichen:  
Your message dated: Your reference:

Unser Zeichen:  
Our reference:

Tel.-Durchwahl:  
Direct Line:  
+49 991 9106-40

Datum:  
Date:  
08.07.2003

## Update on wear limits – Zierer Wave Swinger Ride

To whom it may concern

Regarding some confusion on some wear limits we would like to update our customers with an extract from our service/maintenance manual of the latest Wave Swinger Model.

**Remark:**

Please note that the attached text and drawings relates to our latest Wave Swinger – Park model. So, there might be some slight differences in comparison with the hanging system of our older Wave Swingers as well to the transportable Wave Swinger models. For example:

- chain rings are used on the older Wave Swinger models instead of our new chain shackles
- transportable model does not have the 1,6to., 1,0to. shackles and has no nylon bush at the center bore hole of the spreader bar
- ...

The indicated allowable tolerances and wear limits are valid for all Zierer Wave Swinger models, and relate to the original Zierer parts and units.

For questions don't hesitate and get in contact with us.

ZIERER Karussell- und  
Spezialmaschinenbau GmbH  
Martin Weichselgartner

Tel.: (+49) 991 910640  
Fax: (+49) 991 910683  
Mobil: (+49) 170 3137666  
E-Mail: m.weichselgartner@zierer-rides.de  
Net: [www.zierer-rides.de](http://www.zierer-rides.de)

## Wear Limits and NonDestructive Testing

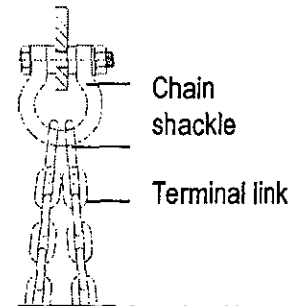
Material wear of 3% is to be reported to the manufacturer; components showing a material wear of 5% should be replaced. However, this is only a rough guideline and the system must be inspected and maintained on a regular basis. Unusual noises or instability occurring during operation should be reported to the manufacturer in order to make necessary adjustments or to even replace components before they reach the wear limit.

**At the end of each season** at least **once a year** all structural components, such as sweeps, basket and mast base along with any attachments and fasteners have to be inspected thoroughly. After 3 to 5 years or when cracks in material or in welding seams appear the components should undergo non-destructive material tests.

### Seat Chains, Seat Chain Terminal Links and Chain Shackles

After a maximum of 1200 hours of operation or semi annually a thorough check of chains and suspension has to be carried out. Chain links and terminal links worn down to a remaining strength of 3.5mm must be exchanged. The measurement has to be taken at those links, which show the most wear. It is the responsibility of the ride owner to see to these inspections being carried out.

Chain shackles should be inspected together with the seat chains and have to be replaced if the remaining strength is 6.0mm (1mm wear) or less.



### Visual Inspection

Look for external failures, deformation, cracks, wear and corrosion pits. If necessary clean the chains before visual inspection. Only use cleaning agents, which do not affect the material of the chain.

### Replacement

#### a) Wear

Terminal links and chain with links which show wear of more than 10% of the nominal thickness (in this case 0,5mm) are to be discarded.

#### b) Elongation caused plastic deformation

When the outside length of a chain link (terminating link) has exceeded 3% of the nominal dimension (28,3mm) due to plastic deformation, the chain (or the terminating link) has to be exchanged.

#### c) Enlargement of pitch through wear

Chains, which have experienced an enlargement of the pitch (pitch = inner length) of 8% caused by wear, including single links, (In this case inner length = 20mm) are to be discarded. On suspension links and end links the enlargement of pitch may not exceed 10%.

### Checking for Flaws

The chains have to undergo a special examination after maximum 3 years. The chains can be examined either by using the crack detection method, (magnetic crack detection or dye penetration test) or a load test with subsequent visual inspection. This load test is to be performed with 1,5 times the load capacity. Subsequent to the load test the chains have to undergo another visual inspection. If deformed and damaged links are detected the respective chain has to be replaced.

## ESSENTIAL INFORMATION FOR THE USE OF CHAINS MADE OF STAINLESS STEEL

Improper treatment of stainless steel chains will lead to loss of rust protection!!

If the protective layer on the chain surface is damaged the chain is no longer protected against corrosion.

Please follow the instructions below to avoid loss of rust protection:

- Do not drag the chains along steel or metal parts during installation.
- Do not do any grinding (using an angle grinder for instance) or welding jobs near the chains. Sparks too will damage the chain surface.
- Do not use tools, which are normally used for working on untreated steel (for example wire brushes, grinding wheels ...)
- Always remove industrial dust by cleaning the chains regularly.
- Tempering colors as caused by welding for instance, will also result in corrosion if the stains are not thoroughly removed from the chains.

NOTE: Any corrosive material touching stainless steel chains may cause deterioration of the chains rust protection!

That means only correct treatment of the chains will guarantee rust-free chains. Improper handling and disregarding the above guidelines will probably lead to strong corrosion of stainless steel chains within only one year.



Neither Zierer nor the chain manufacturer will grant any warranty in case of improper treatment of stainless steel chains. Therefore please check every new stainless steel chain for any damages immediately when receiving it. Later complaints cannot be considered since inexperienced treatment and handling of the chains must be assumed.

The above guidelines for proper treatment also apply to all stainless steel parts that have been installed in attractions and ride manufactured by Zierer.

### **Shackles**

The shackles have to be checked when inspecting the seat chains. They have to be replaced when the wear measures 1,5mm-2,0 mm.

### **S Hooks**

#### **Maintenance / Replacement of S-hooks**

The Shook is a special product manufactured and supplied by ZIERER Karussell u. Fahrzeugbau GmbH. For safety reasons it is absolute necessary to follow the instructions of the manufacturer regarding maintenance and / or replacement.

Subsequent treatment of the hooks by a third party is not permitted. Especially surface welding of the unit moulds (radius) leads to embrittlement of the material and can cause fractures. The hook has to be replaced if the wear measures more than 1,50 mm more on the unit moulds.

### **Spreader Bars**

Examine together with the chains. The spreader bar needs to be exchanged if the maximum allowed wear of 1,5 - 2,0mm at the boreholes for the shackles is reached. Also check the polyamide bushing in the center for cracks and to replace it if necessary.

### **Lifting Cables:**

In accordance with DIN 15 020, and TÜV Bayern both sets of lifting cables have to be magnaflux tested or have to be replaced at least every two years of operation

In addition, these cables have to be checked daily over the entire length for wire breaks, corrosion, abrasion, structural abnormalities or deformation and may have to be replaced at even shorter intervals if necessary.

### **Wire Breaks**

Wire breaks initially occur after a certain running period and then continue to occur after increasingly shorter time periods.

- a) a) The wire rope is to be replaced when the number of breaks and the wear increases to 10% and more within 0,5 meters anywhere along the cable.
- b) The wire rope is to be discarded immediately when wire break clusters appear.
- c) The wire rope is to be discarded immediately when a wire strand is fractured.

### **Corrosion**

Corrosion occurs particularly in corrosive environment, e.g. sea climate. Wire ropes stored outdoors for longer periods will also corrode. Corrosion of the outer wires can easily be noticed by visual inspection. Corrosion of wires not visible from the outside is difficult to detect. Both, the static breaking strength as well as the stability of the wire rope will be reduced by corrosion due to corrosion pits and reduction of the metallic cross section.

The cable must be replaced when the cable diameter in any given spot has decreased by 10% compared to the nominal size, even though no wire breaks are visible.

### **Abrasion**

Wire abrasion occurs as "internal abrasion" due to the movements of strands and wires against each other by bending the wire rope and as "external abrasion" due to movement between wire rope and pulley. A dusty environment increases the abrasion. Both the static breaking strength as well as the stability of the wire rope becomes reduced by abrasion, due to fretting pits and reduction of the metallic cross section.

The wire cable has to be replaced if anywhere along the cable the cable diameter is decreased by 10% compared to the nominal size, even though there are no visible wire breaks.

### **Structural Changes**

Strain on the wire rope during operation causes structural changes, which will reduce the rope diameter.

The cable must be replaced when over a longer stretch the cable diameter has decreased by 15% compared to the nominal size, even though there are no visible wire breaks.

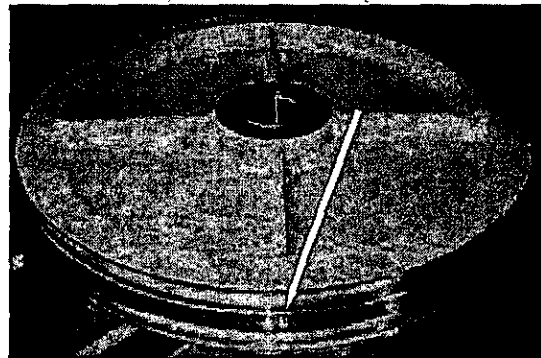
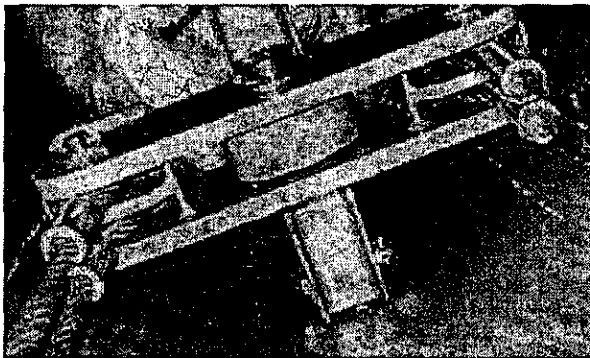
### Deformation

Deformations of the wire rope are visible changes in the rope structure. Deformation usually generates a destabilization of the rope structure, at least near the deformed area.

When a wire rope is visibly deformed an exchange of the lift cable sets is recommended, as the destabilization of the rope structure also means increased abrasion. The consequential damage leads to an accelerated rate of wire breaks, which are crucial for the replacement state of wear.

Please proceed as follows to exchange the cables:

- 1) Bring the ride to its load/unload position.
- 2) For manual lowering use the setup unit (see function description of hydraulic system, 4.3.5), the carrousel is lowered until it comes to rest on the basket stops and the lift cables become slack.
- 3) Slide up securing pins. The pins attaching the cables to the basket may now be removed through the basket openings by using the special tool.
- 4) Remove the top dome, the cover plate on the side of the mast and the safety clip above the pulleys
- 5) The cross-brace inside the mast is now accessible. The cable attachment bolts may now be removed.
- 6) Now the pulleys can be removed. For easier lifting and disassembly an eyebolt can be inserted into the borehole on the pulleys. Pull out the center pins



Picture 24

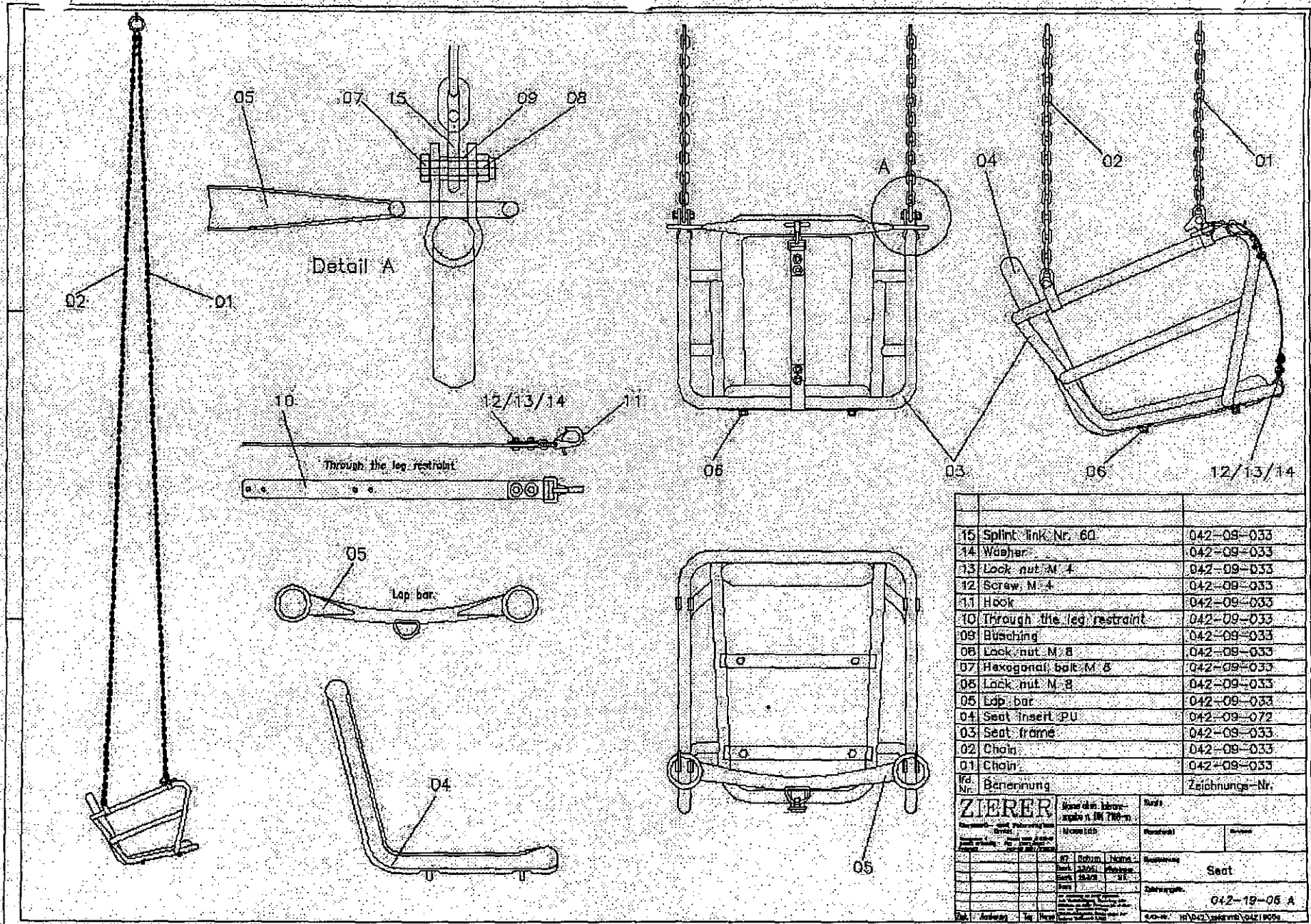
Special care must be taken of the nylon washers between the pulleys and the walls.

- 7) Now the cables can be exchanged.  
When inserting the new cables make sure they are not twisted.
- 8) Installment is in reverse order to the sequence of disassembly. Make sure all safety plates and safety pins are put back in place.

### Sheaves

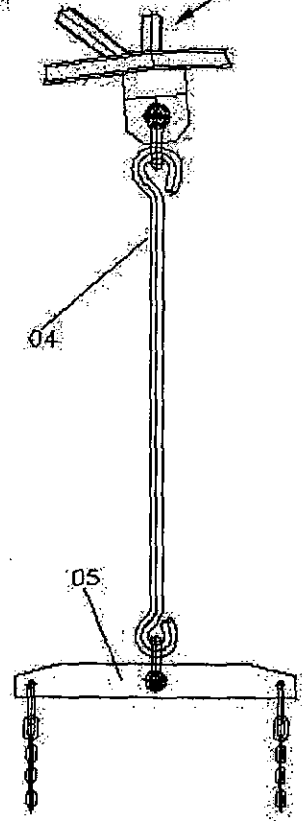
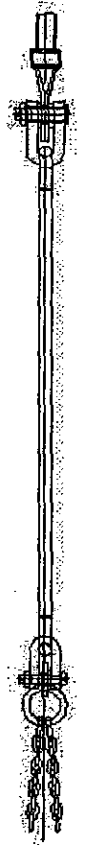
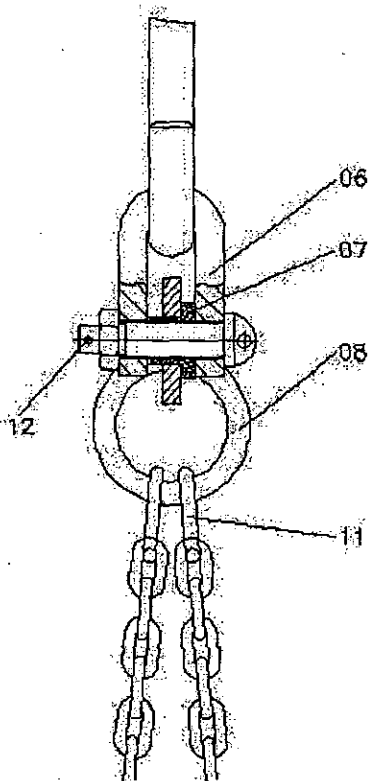
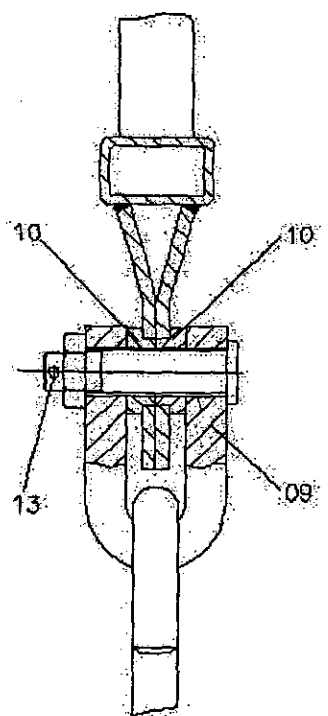
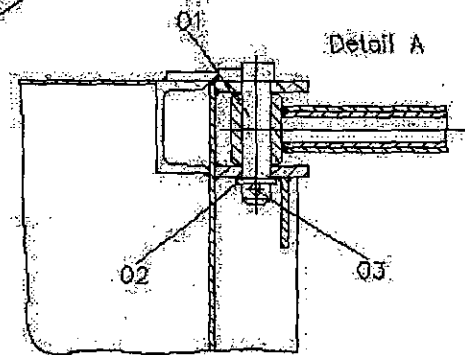
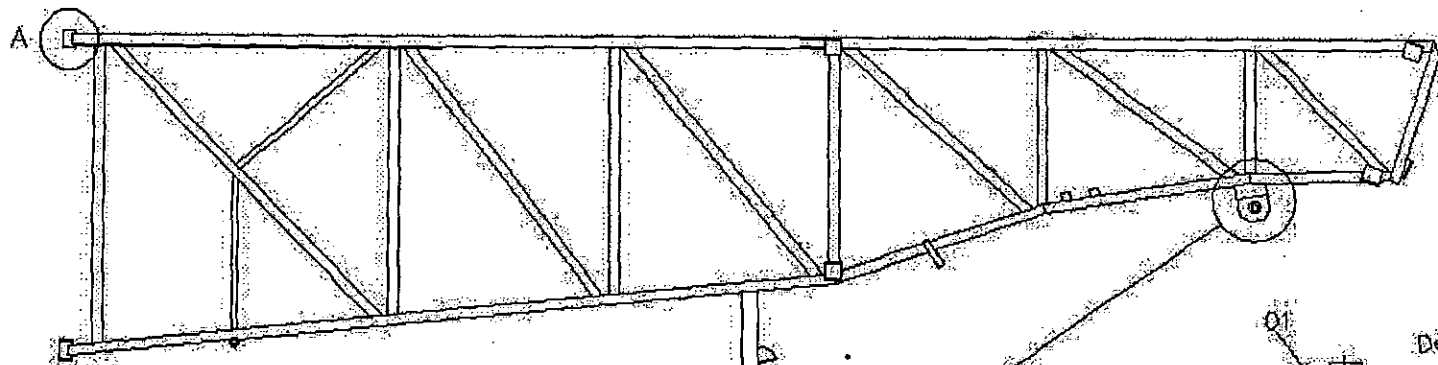
Every time the lifting cables are replaced, the rib treads of the sheaves have to be inspected with a radius gauge ( $r = 9,5\text{mm}$ ), using the light gap method. When a rib tread deviates from the contour of the radius gauge the respective sheave must be replaced as well. Tolerances are not permissible, since these can again cause deformation of the new wire rope and lead to wire breaks at an accelerated rate.





15	Splint link Nr. 60	042-09-033
14	Washer	042-09-033
13	Lock nut M 4	042-09-033
12	Screw M 4	042-09-033
11	Hook	042-09-033
10	Through the leg restraint	042-09-033
09	Büschung	042-09-033
08	Lock nut M 8	042-09-033
07	Hexagonal bolt M 8	042-09-033
06	Lock nut M 8	042-09-033
05	Exp. bar	042-09-033
04	Seat insert PU	042-09-072
03	Seat frame	042-09-033
02	Chain	042-09-033
01	Chain	042-09-033
Nr.	Benennung	Zeichnungs-Nr.

<b>ZIERER</b>		Staat der Lieferung gemäß 1.6.11.21.1.1	Datum
Name Nachname	Name	Funktion	Abteilung
Nr. 1202 1202	Datum 12.12.21	12 12	12 12
Zeichnung 042-19-06 A			4.0.11.11.12.12.12.12.12



13	Spiltted pin	042-05-036A
12	Spiltted pin	042-05-036A
11	Spilt link-Nr.60	042-05-036A
10	Bushing	042-05-036A
09	Shackle-garnitur form C1.B	042-05-036A
08	Nira-shackle	042-05-036A
07	Polyamid-bushing	042-05-036A
06	Shackle-Garnitur (form C1	042-05-036A
05	Spreader bar	042-09-018
04	S-hook	042-09-018
03	Spiltted pin	042-09-15:Bl.2
02	Waener	042-09-15:Bl.2
01	Bolt	042-09-15:Bl.2
Bezeichnung		Zeichnungs-Nr.
<b>ZIERER</b>		Nr.
Werkstoff		Stärke
72 Bohren		Stärke
nach DIN		042-19-05 B
L. 19		042-19-05 B

■ ZIERER Karussell- und Spezialmaschinenbau GmbH  
Josef-Wallner-Str. 10, D-94469 Deggendorf



Karussell- und Spezial-  
maschinenbau GmbH

**Versand-/Lieferanschrift:**

**Delivery Address:**  
Neuhausen  
Moosgasse 4  
D-94560 Offenberg

**Telefon:**

(+49) 991 91060 Zentrale  
(+49) 991 910638 Service

**Telefax:**

(+49) 991 910684 Verkauf/Sales  
(+49) 991 910683 Service  
(+49) 991 910624 Technik/  
Engineering

**E-Mail:**

info@zierer-rides.de  
service@zierer-rides.de

**Internet:**

www.zierer-rides.de

Ihre Nachricht vom: Ihre Zeichen:  
Your message dated: Your reference:

Unser Zeichen:  
Our reference:  
Wm

Tel.-Durchwahl:  
Direct Line:  
+49 991 9106-40

Datum:  
Date:  
05.08.2004

## Non destructive testing – Wave Swinger Ride

To whom it may concern!

We would like to inform that there is a new German TÜV regulation on older amusement rides which requires a special examination on safety relevant parts. To ensure the safety of the ride we highly recommend to perform this as requested.

Attached please find a „Wear inspection / Non destructive testing“ chart for the Wave Swinger ride.

This testing requirement is restricted to dynamic high stress structural components whose breakdown could endanger the passengers. It is meant to be an addition to the required regular safety checks and maintenance check list and it is by no means a complete inspection program.

The testing results are to be documented in detail and comprehensible. These testing results are to be presented to the local safety authorities, responsible for the safety of Amusement Rides, along with evaluations and statements.

If doubts about their clear identification exists, the examined structural components are to mark distinctively (e.g. punch marks, etc.) in order to avoid confusion by further prospective testings.

Attached „Wear inspection / Non destructive testing“ chart is based on the assumption, that the ride is not modified and still original.

**Remark:**

The replacement of components can sometimes be more cost-efficient than expensive test procedures.

For questions or assistance on site regarding the examination and/or assembling/disassembling work, as well for spare parts, please don't hesitate to contact us.

ZIERER Karussell- und  
Spezialmaschinenbau GmbH

Martin Weichselgartner

Tel.: (+49) 991 9106 40

Fax: (+49) 991 9106 83

E-mail: m.weichselgartner@zierer-rides.de



Karussell- und Spezial-  
maschinenbau GmbH

**Wear inspection / Non destructive testing / -- Addition to the maintenance checklist (see manual) and daily  
lubrication schedule:**

**Facility: Wave Swinger**

**Park / Road Model**

Components	Drw.-No.	Pos.	Time code	Test method code	Remark
Slewing rim of basket	042-30-01	01	Y10	A1 or A2	Clearance of slewing rim
Slewing rim of mast	042-30-02	02	Y10	A1 or A2	Clearance of slewing rim
Complete hydraulic cylinder	042-30-03	03	Y10	A1 or A2	Pressure test, check welding seam, check condition
Attachment pin basket to cable attachment	042-30-04	04	Y10	B1 or B2 or B3 or D	
Attachment pin cable attachment to cable block	042-30-05	05	Y10	B1 or B2 or B3 or D	
Cable block of lifting cables n/a	042-30-06	06	Y2	D	
Cable attachment	042-30-07	07	Y10	B1 or B2 or B3 or D	
Cable attachment	042-30-07	07	Y2	C2	Check for play
Sheave pins	042-30-08	08	Y10	B1 or B2 or B3 or D	
Sheave pins	042-30-08	08	Y2	C2	Check for wear
Upper and lower pin of hydraulic cylinder attachment as well as pins of cable attachments	042-30-09	09	Y10	B1 or B2 or B3 or D	
Pins of outriggers	042-30-10	10	Y10	B1 or B2 or B3 or D	
Pins at the locations R, S, T, Z of the lattice girder (sweep) Pins at the locations Y, Q of the lattice girder sweep)	042-30-11	11	Y10	B1 or B2 or B3 or D  B1 or B2 or B3 or D	
Upper and lower bracket of hydraulic cylinder attachment	042-30-12	12	Y10	B1 or B2 or B3	Check for cracks and deformation
Upper mast base in the area of the circulating welding seam	042-30-13	13	Y10	B3	



Lower mast base in the area of the transversal welding seams at the 12 Gussets	042-30-14	14	Y10	B3	
Cross bar in the area of welding of the seat attachment	042-30-15	15	Y10	B1 or B2 or B3	
S-hook for the chain attachment	042-30-16	16	Y10	B3 or D	
Joint weld at the boundaries of U-220 at bottom boom and joint weld at the boundaries at the bottom boom of the IPB220	042-30-17	17	Y	C1 or C2	
Joint weld at the boundaries of U-220 at bottom boom and joint weld at the boundaries at the bottom boom of the IPB220	042-30-17	17	Y10	B1 or B2 or B3	
Joint weld at the boundaries of the diagonal strut and the binding girder of base frame	042-30-18	18	Y	C1 or C2	
Joint weld at the boundaries of the diagonal strut and the binding girder of base frame	042-30-18	18	Y10	B1 or B2 or B3	
Joint weld at the boundaries of the diagonals at the base frame	042-30-19	19	Y	C1 or C2	
Joint weld at the boundaries of the diagonals at the base frame	042-30-19	19	Y10	B1 or B2 or B3	
Welding seams at the bushing of the attachment pin	042-30-20	20		B1 or B2	
Welding seams at the lower and upper polygon ring	042-30-21	21	Y	C1 or C2	
Welding seams at the lower and upper polygon ring	042-30-21	21	Y10	B1 or B2 or B3	
Joint weld at the boundaries of basket and polygon ring as well as welding seams in the area of the slew ring connection	042-30-22	22	Y	C1 or C2	
Joint weld at the boundaries of basket and polygon ring as well as welding seams in the area of the slew ring connection	042-30-22	22	Y10	B1 or B2 or B3	
Welding seams at the lattice girder (sweep) locations Y, Q	042-30-23	23	Y	C1 or C2	
Welding seams at the lattice girder (sweep) locations Y, Q	042-30-23	23	Y10	B1 or B2 or B3	
Vertical welding seams of the hydraulic cylinder attachments	042-30-24	24	Y10	B1 or B2 or B3	
Circulating welding seam at the upper mast base	042-30-25	25	Y10	B1 or B2 or B3	



Karussell- und Spezial-  
maschinenbau GmbH

Stabilization Cables	042-30-26	26	Y	C1 or C2	
Seat frame	042-30-27	27	M	C1 or C2	Check for cracks
Seat frame	042-30-27	27	Y10	B1 or B2 or B3 or D	Check for cracks
Chains, shackles, spreader bar, bolts, for seat hangers	042-30-27 042-30-28	27/28	M	C1 or C2	Check for cracks, wear and deformation
Shackle, spreader bar, bolts for seat hanger	042-30-27 042-30-28	27/27	Y10	B1 or B2 or B3 or D	



Karussell- und Spezial-  
maschinenbau GmbH

**Legend of Time code:**

- D = daily
- W = weekly
- W2 = every two weeks
- M = monthly
- M6 = every six month
- Y = yearly
- Y2 = every two years
- Y10 = first time after ten years and then every four years

**Legend of Test method code:**

- A1 = examination by manufacturer
- A2 = examination by specialized company
- A3 = accredited laboratory
- B1 = magnaflux testing (MT)
- B2 = paint penetration testing (PT)
- B3 = ultrasonic testing (UT)
- B4 = X-ray testing (RT)
- C1 = visual inspection by an expert
- C2 = visual inspection by an experienced, qualified maintenance staff
- D = replacement

Remark: Above chart is a general valid chart for the Wave Swinger Ride. There might be some slight differences to your Wave Swinger model.

Detected broken, worn or cracked parts have to be replaced and/or repaired immediately by a qualified worker or company

The test results are to be documented in detail and comprehensibly. These test results along with evaluations and statements are to be presented to the local safety authorities, responsible for the safety of Amusement Rides.

In order to avoid doubts as to their proper identification, the examined structural components should be marked distinctively (e.g. punch marks, etc.). Additionally to our "Wear inspection and NDT" requirements, the requirements of your local safety institutions have to be followed

The replacement of components can sometimes be more cost-efficient than expensive test procedures.  
The check interval dates of replaced components change, based on the date they were exchanged.

Same type components or component assemblies are subject to random check, with at least 20% but no less than two components being examined. A defect in any of these components requires a thorough check of all similar components.

*(for completeness pls. See hereunder an extract from the service manual )*

## **Maintenance Checklist**

To increase safety and extend the life of each component as well as the reliability of the whole construction the persons responsible for maintenance and attendance of the ride must be instructed to regularly and carefully inspect and maintain the entire ride according to the following check list.

For any problems you cannot solve contact the address below. Before contacting make sure all errors which caused the breakdown are written down. Did you notice any irregularities prior to this breakdown? Who is the person to contact? Under which phone number can he be reached. An address to which spare parts may be shipped if required would be very helpful as well.

Contact address:

Zierer Karussell- und Spezialmaschinenbau GmbH	
Moosgasse 4	
94560 Neuhausen / Offenberg	Phone.: +49 991/9106-0
Germany	Fax: +49 991/9106 84



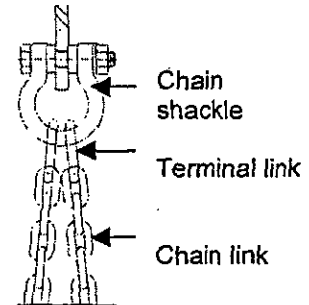
## 1.1.1 Wear Limits and Non-Destructive Testing

Material wear of 3% is to be reported to the manufacturer; components showing a material wear of 5% should be replaced. However, this is only a rough guideline and the system must be inspected and maintained on a regular basis. Unusual noises or instability occurring during operation should be reported to the manufacturer in order to make necessary adjustments or to even replace components before they reach the wear limit.

**At the end of each season** but at least **once a year** all structural components, such as sweeps, basket and mast base along with any attachments and fasteners have to be inspected thoroughly. After 3 to 5 years or when cracks in material or in welding seams appear the components should undergo non-destructive material tests.

### 1.1.1.1 Seat Chains, Seat Chain Terminal Links and Chain Shackles

After a maximum of 1200 hours of operation or semi annually a thorough check of chains and suspension has to be carried out. Chain links and terminal links worn down to a remaining strength of 3.5mm must be exchanged. The measurement has to be taken at those links, which show the most wear. It is the responsibility of the ride owner to see to these inspections being carried out. Chain shackles should be inspected together with the seat chains and have to be replaced if the remaining strength is 6.0mm (1mm wear) or less.



#### 1.1.1.1.1 Visual Inspection

Look for external failures, deformation, cracks, wear and corrosion pits. If necessary clean the chains before visual inspection. Only use cleaning agents, which do not affect the material of the chain.

#### 1.1.1.1.2 Replacement

##### Elongation caused plastic deformation

When the outside length of a chain link (terminating link) has exceeded 3% of the nominal dimension (29,35mm) due to plastic deformation, the chain (or the terminating link) has to be exchanged.

#### 1.1.1.1.3 Checking for Flaws

The chains have to undergo a special examination after maximum 3 years. The chains can be examined either by using the crack detection method, (magnetic crack detection or dye penetration test) or a load test with subsequent visual inspection.

This load test is to be performed with 1,5 times the load capacity. Subsequent to the load test the chains have to undergo another visual inspection. If deformed and damaged links are detected the respective chain has to be replaced.

## **ESSENTIAL INFORMATION FOR THE USE OF CHAINS MADE OF STAINLESS STEEL.**

Improper treatment of stainless steel chains will lead to loss of rust protection!!

If the protective layer on the chain surface is damaged the chain is no longer protected against corrosion.

Please follow the instructions below to avoid loss of rust protection:

- Do not drag the chains along steel or metal parts during installation.
- Do not do any grinding (using an angle grinder for instance) or welding jobs near the chains. Sparks too will damage the chain surface.
- Do not use tools, which are normally used for working on untreated steel (for example wire brushes, grinding wheels...)
- Always remove industrial dust by cleaning the chains regularly.
- Tempering colors as caused by welding for instance, will also result in corrosion if the stains are not thoroughly removed from the chains.

**NOTE:** Any corrosive material touching stainless steel chains may cause deterioration of the chains rust protection!

That means only correct treatment of the chains will guarantee rust-free chains. Improper handling and disregarding the above guidelines will probably lead to strong corrosion of stainless steel chains within only one year.

Neither Zierer nor the chain manufacturer will grant any warranty in case of improper treatment of stainless steel chains. Therefore please check every new stainless steel chain for any damages immediately when receiving it. Later complaints cannot be considered since inexperienced treatment and handling of the chains must be assumed.

The above guidelines for proper treatment also apply to all stainless steel parts that have been installed in attractions and ride manufactured by Zierer.

### **1.1.1.2 Shackles**

The shackles have to be checked when inspecting the seat chains. They have to be replaced when the wear measures 1,5mm - 2,0 mm.

### **1.1.1.3 S Hooks**

#### **1.1.1.3.1 Maintenance / Replacement of S-hooks**

The S-hook is a special product manufactured and supplied only by ZIERER Karussell u. Fahrzeugbau GmbH. For safety reasons it is absolute necessary to follow the instructions of the manufacturer regarding maintenance and / or replacement.

Subsequent treatment of the S-hooks by a third party is not permitted. Especially surface welding of the unit moulds (radius) leads to embrittlement of the material and can cause fractures. The S-hook has to be replaced if the wear measures more than 1.5 – 2.0 mm more on the unit moulds.

#### **1.1.1.4 Spreader Bars**

Examine together with the chains. The spreader bar needs to be exchanged if the maximum allowed wear of 1,5 - 2,0mm at the boreholes for the shackles is reached. Also check the polyamide bushing in the center for cracks and to replace it if necessary.

#### **1.1.1.5 Lifting Cables:**

In accordance with DIN 15 020, and TÜV Bayern both sets of lifting cables have to be magnaflux tested or have to be replaced at least every two years of operation

In addition, these cables have to be checked daily over the entire length for wire breaks, corrosion, abrasion, structural abnormalities or deformation and may have to be replaced at even shorter intervals if necessary.

#### 1.1.1.5.1 Wire Breaks

Wire breaks initially occur after a certain running period and then continue to occur after increasingly shorter time periods.

- a) a) The wire rope is to be replaced when the number of breaks and the wear increases to 10% and more within 0,5 meters anywhere along the cable.
- b) The wire rope is to be discarded immediately when wire break clusters appear.
- c) The wire rope is to be discarded immediately when a wire strand is fractured.

#### 1.1.1.5.2 Corrosion

Corrosion occurs particularly in corrosive environment, e.g. sea climate. Wire ropes stored outdoors for longer periods will also corrode. Corrosion of the outer wires can easily be noticed by visual inspection. Corrosion of wires not visible from the outside is difficult to detect. Both, the static breaking strength as well as the stability of the wire rope will be reduced by corrosion due to corrosion pits and reduction of the metallic cross section.

The cable must be replaced when the cable diameter in any given spot has decreased by 10% compared to the nominal size, even though no wire breaks are visible.

#### 1.1.1.5.3 Abrasion

Wire abrasion occurs as "internal abrasion" due to the movements of strands and wires against each other by bending the wire rope and as "external abrasion" due to movement between wire rope and pulley. A dusty environment increases the abrasion. Both the static breaking strength as well as the stability of the wire rope becomes reduced by abrasion, due to fretting pits and reduction of the metallic cross section.

The wire cable has to be replaced if anywhere along the cable the cable diameter is decreased by 10% compared to the nominal size, even though there are no visible wire breaks.

#### 1.1.1.5.4 Structural Changes

Strain on the wire rope during operation causes structural changes, which will reduce the rope diameter.

The cable must be replaced when over a longer stretch the cable diameter has decreased by 15% compared to the nominal size, even though there are no visible wire breaks.

#### 1.1.1.5.5 Deformation

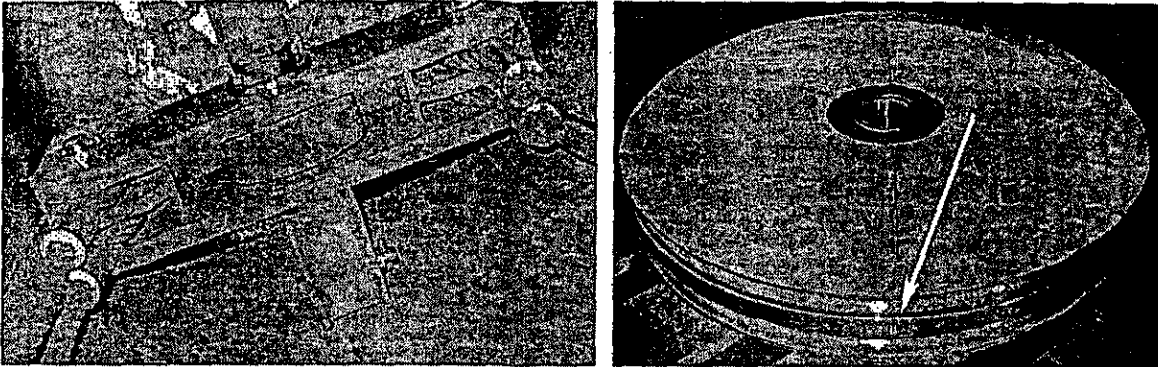
Deformations of the wire rope are visible changes in the rope structure. Deformation usually generates a destabilization of the rope structure, at least near the deformed area.

When a wire rope is visibly deformed an exchange of the lift cable sets is recommended, as the destabilization of the rope structure also means increased abrasion. The consequential damage leads to an accelerated rate of wire breaks, which are crucial for the replacement state of wear.

Please proceed as follows to exchange the cables:

- 1) Bring the ride to its load/unload position.
- 2) For manual lowering use the setup unit (see function description of hydraulic system, 4.3.5), the carrousel is lowered until it comes to rest on the basket stops and the lift cables become slack.
- 3) Slide up securing pins. The pins attaching the cables to the basket may now be removed through the basket openings by using the special tool.
- 4) Remove the top dome, the cover plate on the side of the mast and the safety clip above the pulleys

- 5) The cross-brace inside the mast is now accessible. The cable attachment bolts may now be removed.
- 6) Now the pulleys can be removed. For easier lifting and disassembly an eyebolt can be inserted into the borehole on the pulleys. Pull out the center pins



Picture 24

Special care must be taken of the nylon washers between the pulleys and the walls.

- 7) Now the cables can be exchanged.  
When inserting the new cables make sure they are not twisted.
- 8) Installation is in reverse order to the sequence of disassembly. Make sure all safety plates and safety pins are put back in place.

#### 1.1.1.6 Sheaves

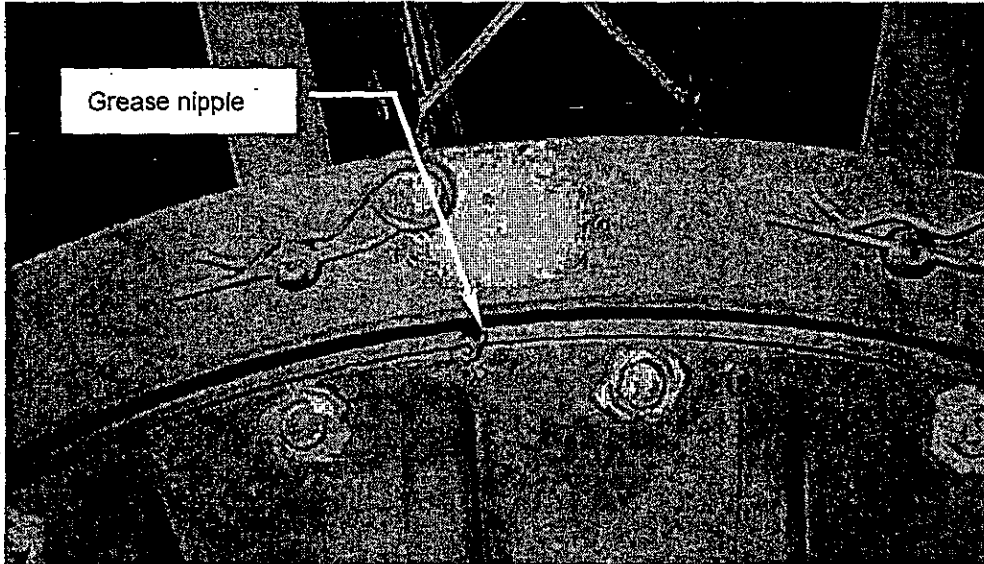
Every time the lifting cables are replaced, the rib treads of the sheaves have to be inspected with a radius gauge ( $r = 9,5\text{mm}$ ), using the light gap method. When a rib tread deviates from the contour of the radius gauge the respective sheave must be replaced as well. Tolerances are not permissible, since these can again cause deformation of the new wire rope and lead to wire breaks at an accelerated rate.

#### 1.2 Maintenance of Mechanical Parts

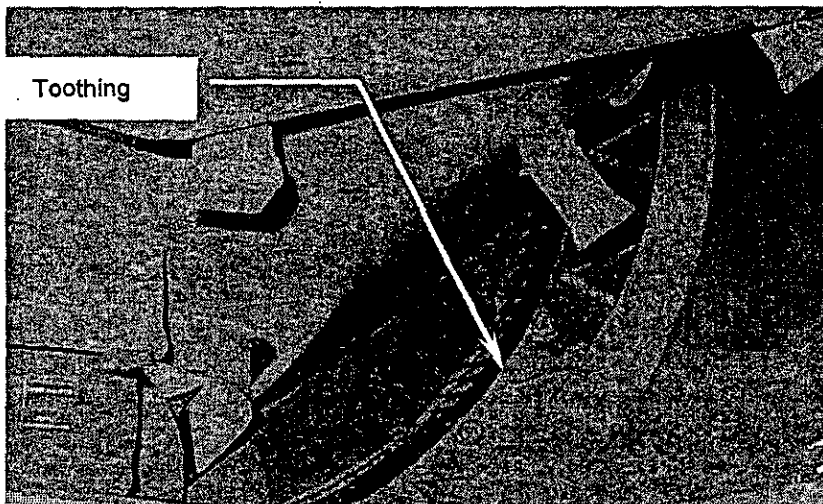
Maintenance of mechanical parts is limited to closely checking for wear and tear and the examination of the primary connecting components with their safety backups as well as the thorough lubrication of the rotating parts and contacting parts (except the slip ring assembly.) To efficiently lubricate these parts raise the carrousel about 2m to make the points of lubrication accessible.

### 1.2.1 Slewing Ring in the Basket

It is lubricated weekly at the 6 lubricating nipples (●) below the basket. The teeth of the ring gear are greased with a brush (Δ) through the oval-shaped opening in the basket from above  
**(Attention, Danger! Slip rings are live! Switch off power supply first!)**



Picture 25

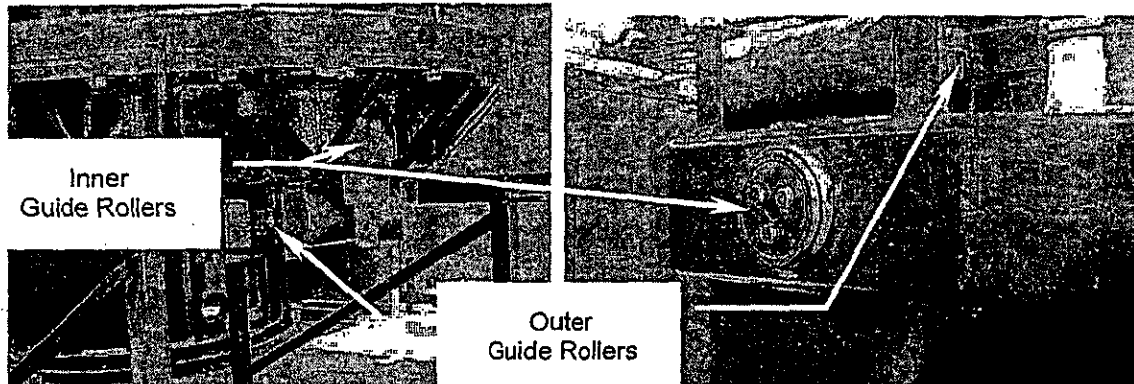


Picture 26

## 1.2.2 Guide Rollers

The guide rollers (4 rollers) running inside along the guide rail of the mast on the upper basket (2 pieces) and the lower basket (2 pieces) are to be greased daily through the lubricating nipples (●) extending to the outside of the inner basket.

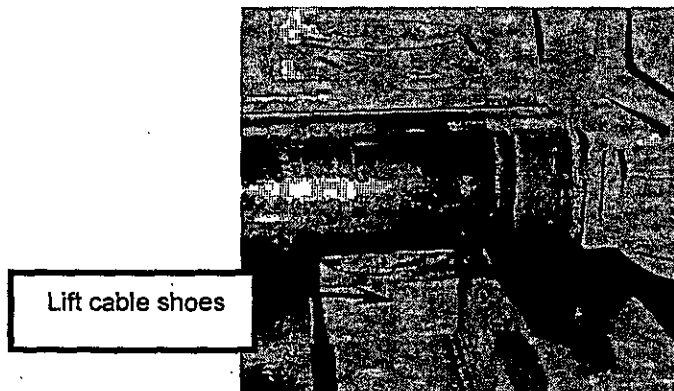
The guide rollers (4 pieces) running outside along the guide rail of the mast are to be greased daily through lubricating nipples (●) positioned on one side of the guide rollers.



Picture27

## 1.2.3 Lift cable shoes

The lift cable shoes (2 pieces) running inside the guide rail along the mast and their lubrication nipples (●) are accessible when the carousel is lifted. The lubrication nipples can then be reached from below through the guide channel of the mast. The lubrication takes place daily.



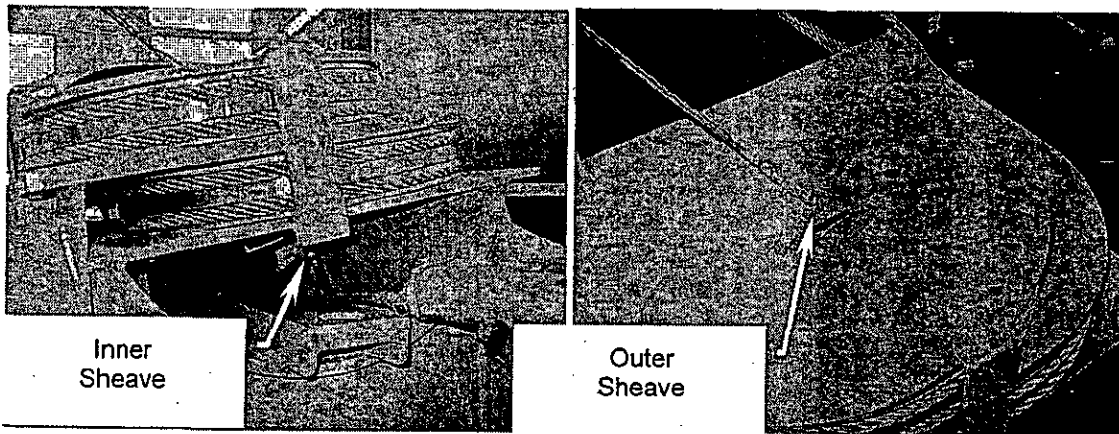
Picture 28

## 1.2.4 Guide Rail Surface

The blank spots of the surfaces of the guide rail along the mast are to be greased weekly using a brush (Δ).

### 1.2.5 Sheaves

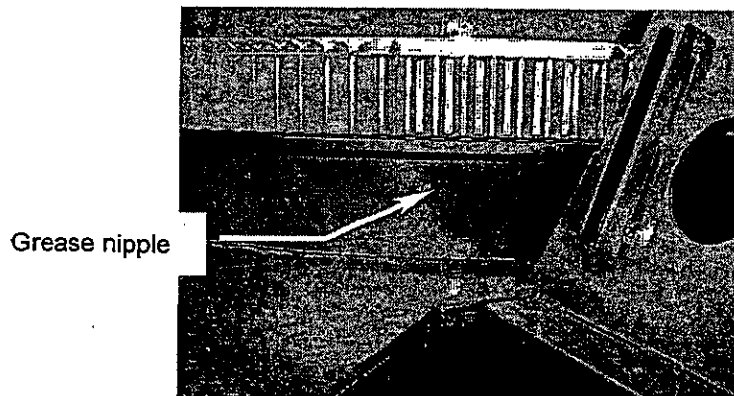
At the tip of the mast are two lubricating nipples (●) (one inside, one outside) for greasing the axles of the sheaves. They have to be lubricated ***daily***.



29

### 1.2.6 Lower ball bearing slewing rim

The lower ball bearing slewing rim is greased through six lubricating nipples (●) located all around Toothing to grease the tothing around the ball bearing slewing. (Δ).



### 1.2.7 Slide channels of mast decoration and joints of the S-Hooks

Grease from ***time to time*** with spray grease, to avoid unpleasant noise and premature wear.

