Lift Mast Rollers
For Industrial Trucks
Foreword

Economical solutions for industrial trucks

Lift masts are subjected to high dynamic and static loads as well as shocks, vibrations and oscillations. They are also heavily exposed to environmental influences such as heat, cold, moisture, dust, aggressive ambient air and contamination. The guidance arrangements of lift masts must therefore be particularly robust and have particularly high load carrying capacity.

For use in such challenging environmental conditions, Schaeffler Group Industrial has developed special lift mast rollers. These robust bearings are the solution where the guidance arrangements of lift masts must be economical and have high load carrying capacity and operational security.

Replacement for ...

This edition replaces MAI 98, issued in April 2006.

The data represent the current level of technology and manufacture as of October 2009. They reflect not only progress in rolling bearing technology but also the experience gathered in practical use.

Any information in previous publications that does not concur with the data in this Product Information is therefore invalid.
Lift mast rollers

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## Product overview

### Lift mast rollers

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double row</td>
<td>HULR</td>
<td>Lip seals on both sides</td>
</tr>
<tr>
<td>Single row</td>
<td>LRQ</td>
<td>Lip seals on both sides</td>
</tr>
</tbody>
</table>

![Double row Lift mast roller](image1)

![Single row Lift mast roller](image2)
Lift mast rollers

**Features**

Lift mast rollers HULR are double row angular contact ball bearings without filling slots, while series LRQ is a single row four point contact bearing. The rolling elements are guided by plastic cages. The bearings can support high radial forces, axial forces and moments.

The outer rings are thick-walled solid components with a crowned outside surface. The crowned surface prevents edge loads if misalignments occur.

The inner rings are of a single-piece design. This saves on fitting costs since there is no need for axial clamping of the bearings.

**Sealing and lubrication**

Lip seals on both sides of the mast rollers give reliable protection of the rolling element system against contamination and moisture.

The bearings are greased for life using a high quality lithium soap grease.

**Operating temperature**

Lift mast rollers can be used at operating temperatures from –20 °C to +120 °C.

**Design and safety guidelines**

The thick-walled outer rings of lift mast rollers can support high radial and shock-type loads.

**Contact with flat mating track**

If the rollers are in contact with a flat mating track, the outer rings undergo elastic deformation, *Figure 1*.

Compared with a rolling bearing supported in a housing bore, lift mast rollers have a modified load distribution in the bearing. This is taken into consideration in the rating life calculation using the basic load ratings $C_{rw}$ and $C_{orw}$, see dimension table.

Contact with a flat mating track leads to bending stresses in the outer ring. These are taken into consideration using the permissible radial loads $F_{rep}$ and $F_{0rep}$, see dimension table.

The bending stresses must not exceed the permissible strength values of the material.
Lift mast rollers

**Dynamic load**
For bearings subjected to dynamic load, i.e. rotating bearings, the valid parameter is the effective dynamic load rating $C_{sw}$, see dimension table.

At the same time, the permissible dynamic radial load $F_{r, per}$ must not be exceeded.

**Static load**
For bearings under static load, i.e. either stationary or with only infrequent rotary motion, the valid parameter is the effective static load rating $C_{0r, w}$, see dimension table.

At the same time, the permissible static radial load $F_{0r, per}$ must not be exceeded.

In addition to the permissible radial load on the bearing, the permissible radial load on the mating track must also be observed, see also Catalogue HR 1, Rolling Bearings, section Track rollers.

**Loading of lift mast rollers**
In industrial trucks, the lift mast is used to raise and lower loads. It comprises an outer mast, inner mast and fork carrier, Figure 2. The carrier components in the steel construction are designed as profiled sections and are movably nested within each other in a telescopic arrangement for moving the loads.

The profiled sections are guided by lift mast rollers. The rollers transmit the forces and the moments about the transverse, longitudinal and vertical axis of the industrial truck from the fork carrier into the lift mast and from there into the frame.

Most fork lift trucks have four lift mast rollers running between the inner mast and fork carrier or four lift mast rollers running between the outer mast and inner mast.

**Figure 2**
Loading of lift mast rollers

1. Outer mast
2. Inner mast
3. Fork carrier

$F_r = \text{radial load}$
$F_a = \text{axial load}$
$F_K = \text{loading of chain}$
Radial load

The vertical spacing between the lift mast rollers in the fork carrier as a function of the lift height remains constant. The radial load $F_r$ on each roller thus remains constant under the same load $Q$ and the same load centre spacing.

The radial load $F_r$ on each lift mast roller in the fork carrier taking into account the eccentricity of load $Q$ is shown in the following formula:

$$F_r = Q \cdot \left( \frac{d + c}{2a_1} \right) \cdot \frac{a_1}{d \cdot b}$$

- $F_r$: Radial load on one lift mast roller in the fork carrier (excluding fork carrier mass; vertical position of lift mast)
- $Q$: Load on fork tines
- $a_1$: Spacing between load centre and lift chain
- $b$: Vertical spacing between lift mast rollers in fork carrier
- $c$: Eccentricity of load on fork tines
- $d$: Horizontal spacing between lift mast rollers in fork carrier

Axial load

Axial loads occur when the load centre (viewed in the direction of travel) is off-centre. As a result, the induced moment about the longitudinal axis of the vehicle must be supported by the diagonally opposed lift mast rollers, *Figure 2, page 6.*

$$F_a = Q \cdot \frac{c}{b}$$

- $F_a$: Axial load on one lift mast roller in the fork carrier (excluding fork carrier mass; vertical position of lift mast)
- $Q$: Load on fork tines
- $b$: Vertical spacing between lift mast rollers in fork carrier
- $c$: Eccentricity of load on fork tines
In general, the loads on the lift mast rollers in the fork carrier are greater than those on the lift mast rollers between the inner and outer mast.

It must be noted, however, that when the lift mast is fully extended, the vertical distance between the rollers in the inner and outer mast is at its minimum value $e_{\text{min}}$, so the maximum forces occur in this condition, *Figure 3*.

If the fork tines are replaced by attachments such as pivots, crane arms, side loaders, paper roll grippers or scoops, extreme loads may occur on the lift mast rollers.
Fitting
Lift mast rollers are mounted on studs welded at an angle to the lift mast, Figure 4. In this way, the forces occurring in the longitudinal and transverse direction of the vehicle are transmitted via the lift mast into the thick-walled outer ring of the bearing.

Figure 4
Fitting of lift mast roller to lift mast

Cleanance
In order to ensure the smallest possible clearance between the lift mast roller and the profile chamber, the INA standard lift mast rollers are precisely matched to the most common standard lift mast profiles.

Clearance compensation
Axial clearance is compensated by shims on the studs.
## Lift mast rollers

Sealed

### Dimension table: Dimensions in mm

<table>
<thead>
<tr>
<th>Designation1)</th>
<th>Drawing number</th>
<th>Mass ( m )</th>
<th>Dimensions</th>
<th>Basic load ratings</th>
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<td></td>
<td>( \text{kg} )</td>
<td>( d )</td>
<td>( D )</td>
<td>( b )</td>
</tr>
<tr>
<td></td>
<td>( \text{C}_r \text{ w} )</td>
<td>( \text{C}_0 \text{ r w} )</td>
<td>( \text{F}_r \text{ per} )</td>
<td>( \text{F}_{0r} \text{ per} )</td>
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<td>2,26</td>
<td>55</td>
<td>123,3</td>
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</table>

1) Lift mast rollers are available by agreement only.

### Dimension table: Dimensions in mm

<table>
<thead>
<tr>
<th>Designation1)</th>
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<td>( \text{kg} )</td>
<td>( d )</td>
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<td></td>
<td>( \text{C}_r \text{ w} )</td>
<td>( \text{C}_0 \text{ r w} )</td>
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### Fitting example for HULR

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<th>Tolerance mm</th>
<th>Adjustment angle β °</th>
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<th>Channel width min.</th>
<th>Tolerance mm</th>
<th>Adjustment angle β °</th>
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<th>Tolerance mm</th>
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TPI 166 GB-D