Instructions for Miniature Ball Rail® Systems
1. Safety, Cross-References and Symbols

1.1 Safety notes and their symbols
The following symbols are used to identify safety notes:

WARNING!
Risk of injury!

Caution!
Risk of damage to Miniature Ball Rail System or adjoining structure!

Caution!
Keep Miniature Ball Rail System clean!
If necessary, protect with a cover!

1.2 Cross-referencing symbols
The symbols below are used to refer to repeat or follow-on work operations:

! 3.5 See Section 3.5

! 3.5.2 See Figure 3.5.2
(Figure 2 in Section 3.5)

• Note, recommendation

1.3 Symbols

Screw
2. Overview, Miniature Ball Rail® Systems

2.1 Overview of components and accessories

Miniature Ball Rail® Systems can be assembled from the following components and accessories:

1. Guide rails with mounted rail seals
2. Guide rails
3. Wide guide rails
4. Rail seals
5. Runner blocks
6. Wide runner blocks
7. N seals
8. N seals and longitudinal seals

Each component and accessory can be individually ordered and stocked. See Miniature Ball Rail® Systems catalog for exact data and dimensions.

⚠️ These instructions will help appropriately trained experts to mount Miniature Ball Rail® Systems.

2.2 How to order components, accessories, catalogs and instructions

- For details of how to order components and accessories, see the Miniature Ball Rail® Systems catalog.
- The catalog supplements these instructions and should therefore be kept handy for easy reference.
- Please order the latest publications from your local sales partner.
3. Mounting the Guide Rails

3.1 Shipment

One-piece guide rails:

One-piece guide rails are shipped packed in a tubular polyethylene bag (1).

If a Rail Seal is also ordered, the guide rail will be shipped with the Rail Seal already clipped on.

Composite guide rails:

• Matching sections of a composite guide rail are identified by a label on the packaging.

The guide rails (2) are shipped in their own packaging, irrespective of the Rail Seal also possibly ordered.

The Rail Seal is supplied in one piece, matching the overall length, in its own packaging (3). This packaging is marked with the same production job number as the guide rail labels.

Unpacking

• Do not recycle packaging until mounting has been completed! The packaging can protect not yet mounted guide rails or Rail Seals while mounting work is in progress.

• Carefully remove guide rails from the packaging.

• Cut open the tubular polyethylene bag.
3.2 Preparing composite guide rails for mounting

- The joints (1) are numbered consecutively (2).
- All sections of a guide rail comprising three or more sections have the same number (3).
- Sort sections.

3.3 Removing the Rail Seal

Before the rails can be mounted on the base any pre-assembled Rail Seals have to be temporarily removed.

- A Rail Seal can be removed and remounted up to four times.

⚠️ Risk of injury! The Rail Seal has sharp edges. Wear gloves!
- Starting at one end, carefully ease up and remove the Rail Seal.
⚠️ Do not bend the Rail Seal!
### 3.4 Mounting the Guide Rails

- Tap holes in the supporting structure to mount the guide rails.
- Thoroughly clean adjoining surfaces for the guide rails.
- Check corner radii $r_1$, heights of fitted edges $h_1$, and supporting and reference surfaces. For size 7, an undercut (1) can be machined instead of the corner radius $r_1$.
- The end faces of the guide rails must be chamfered and free from burrs (2) to slide onto the runner blocks.
- Check supporting and reference surfaces of the guide rails.

⚠️ Contamination, out-of-flatness (material displaced by damage to the surface) or burrs are not permitted.
- Select and line up screws ready to mount the guide rails.

- Press guide rail against the fitting edge (3) and tighten screws lightly.
- Guide rails are to be aligned straight and parallel, preferably using a straight-edge.
- Tighten the screws to the appropriate tightening torque $M_A$.
- For composite guide rails, ensure flush rail surfaces at joints.

#### Table: $h_1$ and $r_1$ for Different Sizes

<table>
<thead>
<tr>
<th>Size</th>
<th>$h_1$ (mm)</th>
<th>$r_1$ (max) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1,2.0,1</td>
<td>0,1</td>
</tr>
<tr>
<td>9/M2</td>
<td>1,5.0,2</td>
<td>0,3</td>
</tr>
<tr>
<td>9/M3</td>
<td>1,5.0,2</td>
<td>0,3</td>
</tr>
<tr>
<td>12</td>
<td>2,5.0,5</td>
<td>0,3</td>
</tr>
<tr>
<td>15</td>
<td>2,8.0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>20</td>
<td>6,3.0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>9/M3 B</td>
<td>1,8.0,2</td>
<td>0,3</td>
</tr>
<tr>
<td>12 B</td>
<td>2,8.0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>15 B</td>
<td>2,8.0,5</td>
<td>0,5</td>
</tr>
</tbody>
</table>

#### Table: O3 for Different Sizes

<table>
<thead>
<tr>
<th>Size</th>
<th>O3 (ISO 4762 [DIN 912])</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>M2x5</td>
</tr>
<tr>
<td>9/M2</td>
<td>M2x6</td>
</tr>
<tr>
<td>9/M3</td>
<td>M3x8</td>
</tr>
<tr>
<td>12</td>
<td>M3x8</td>
</tr>
<tr>
<td>15</td>
<td>M3x10</td>
</tr>
<tr>
<td>20</td>
<td>M5x14</td>
</tr>
<tr>
<td>9/M3 B</td>
<td>M3x8</td>
</tr>
<tr>
<td>12 B</td>
<td>M4x10</td>
</tr>
<tr>
<td>15 B</td>
<td>M4x12</td>
</tr>
</tbody>
</table>

#### Table: $M_A$ (Nm)

<table>
<thead>
<tr>
<th>Strength class</th>
<th>$M_A$ (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2-70</td>
<td>12.9</td>
</tr>
<tr>
<td>M2</td>
<td>0.35</td>
</tr>
<tr>
<td>M3</td>
<td>1.1</td>
</tr>
<tr>
<td>M4</td>
<td>2.0</td>
</tr>
<tr>
<td>M5</td>
<td>3.9</td>
</tr>
</tbody>
</table>
3.5 Parallelism of the mounted guide rails

- Check the parallelism of the mounted guide rails before installing the rail seals.
- The parallelism offset $P_1$ causes a slight rise in the preload on one side. As long as the values specified in the table are met, the effect of this on the service life can generally be neglected.

The part numbers on the runner blocks indicate whether the runner block has clearance or a ready-adjusted preload.

- Part numbers with a "9" in sixth place (e.g. "0442-7 9 3-01") will have clearance.
- Part numbers with a "1" in sixth place (e.g. "0442-7 13-01") will have a preload.

- In Miniature Ball Rail Systems with preload, the preload is adjusted such that the clearance between the guide rail and the runner block is just no longer perceptible.

<table>
<thead>
<tr>
<th>Size</th>
<th>$\parallel P_1$ (mm)</th>
<th>Clearance</th>
<th>Preload</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td></td>
<td>0.004</td>
<td>0.002</td>
</tr>
<tr>
<td>9/M2</td>
<td></td>
<td>0.005</td>
<td>0.002</td>
</tr>
<tr>
<td>9/M3</td>
<td></td>
<td>0.005</td>
<td>0.002</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>0.008</td>
<td>0.004</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>0.017</td>
<td>0.008</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>0.025</td>
<td>0.016</td>
</tr>
<tr>
<td>9/M3 B</td>
<td></td>
<td>0.010</td>
<td>0.004</td>
</tr>
<tr>
<td>12 B</td>
<td></td>
<td>0.014</td>
<td>0.006</td>
</tr>
<tr>
<td>15 B</td>
<td></td>
<td>0.018</td>
<td>0.011</td>
</tr>
</tbody>
</table>
3.6 Vertical offset

• Check the actual vertical offsets \( S_1 \) and \( S_2 \), before mounting the rail seals.

• Provided the vertical offset is kept within the permissible limits for \( S_1 \) and \( S_2 \), its influence on the service life can generally be neglected.

**Permissible vertical offset in transverse direction \( S_1 \)**

\[ S_1 = \text{a} \cdot Y \]

<table>
<thead>
<tr>
<th>Clearance*</th>
<th>Preload*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,0 ( \cdot 10^{-4} )</td>
<td>1,5 ( \cdot 10^{-4} )</td>
</tr>
</tbody>
</table>

\( *! 3.5 \)

3.6.1

**Permissible vertical offset in longitudinal direction \( S_2 \)**

\[ S_2 = \text{b} \cdot 7 \cdot 10^{-5} \]

3.6.2

\( \text{a} = \text{distance between the guide rails (mm)} \)

\( \text{b} = \text{distance between runner blocks (mm)} \)

\( \text{Y} = \text{calculation factor} \)

• The permissible vertical offset \( S_1 \) already takes account of the tolerance for dimension \( H \) as given in the Ball Rail Systems, Miniature Version catalog, Technical Data section.

• The permissible vertical offset \( S_2 \) already takes account of the tolerance for "max. difference in dimension \( H \) on the same rail" as given in the Ball Rail Systems, Miniature Version catalog, Technical Data section.
3.7 Mounting the Rail Seal

- Thoroughly clean the mounting base and the surrounding work area.
- Thoroughly clean the guide rails.

- If necessary, re-oil the rail surface to preserve it (1).

⚠ Risk of injury! The Rail Seal has sharp edges. Wear gloves!

⚠ Do not bend the Rail Seal! Discard any bent rail seals.
- Carefully remove the Rail Seal from its packaging (2) and lay it down flat on a clean surface.

- When mounting the rail seal, start at the end of the rail where the runner block is to be slid on!
- Position the rail seal at the rounded rail end (3).
- Clip on the first 20 to 50 mm (4). Check that the seal fits snugly.
- Smooth the Rail Seal down along the guide rail. Both edges must snap into the grooves on either side of the rail (5).

⚠ Check that the seal sits tight all along the rail!
4. Mounting the Runner Blocks

4.1 Preparing for the mounting procedure

⚠️ Do not remove the mounting arbors from the runner blocks, otherwise balls may be lost!
- Tap holes in the guided load for runner block mounting.
- Thoroughly clean mating surfaces for the runner blocks.
- Check heights of fitting edges $h_2$, corner radii $r_2$, and supporting and reference surfaces.
- Select and line up screws ready for mounting the runner blocks onto the guided load.

<table>
<thead>
<tr>
<th>Size</th>
<th>$h_2$ min. (mm)</th>
<th>$r_2$ max. (mm)</th>
<th>$O_5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>2,2</td>
<td>0,3</td>
<td>M2x5</td>
</tr>
<tr>
<td>9/M2</td>
<td>2,5</td>
<td>0,3</td>
<td>M2x6</td>
</tr>
<tr>
<td>9/M3</td>
<td>2,5</td>
<td>0,3</td>
<td>M3x8</td>
</tr>
<tr>
<td>12</td>
<td>3,5</td>
<td>0,5</td>
<td>M3x8</td>
</tr>
<tr>
<td>15</td>
<td>4,5</td>
<td>0,5</td>
<td>M3x8</td>
</tr>
<tr>
<td>20</td>
<td>6,5</td>
<td>0,5</td>
<td>M4x12</td>
</tr>
<tr>
<td>9/M3 B</td>
<td>2,5</td>
<td>0,3</td>
<td>M3x8</td>
</tr>
<tr>
<td>12 B</td>
<td>3,0</td>
<td>0,4</td>
<td>M3x8</td>
</tr>
<tr>
<td>15 B</td>
<td>4,5</td>
<td>0,5</td>
<td>M4x10</td>
</tr>
</tbody>
</table>

ISO 4762 [DIN 912]

4.2 Sliding-on the runner blocks

- Clean the guide rails.
- To slide on the runner blocks, the end faces of the guide rails must be chamfered and free from burrs (1).
- Slide on runner blocks only over Rail Seal ends pre-fabricated (2) at the factory, not over ends which you have machined or cut to length yourself!
- At one end of the guide rail, the Rail Seal will be flush with the end face (3). Slide the runner block on at this end!
- Position the runner block with the mounting arbor still inserted at the head of the guide rail.
- Carefully slide the runner block onto the guide rail (4). This will push the mounting arbor out of the runner block.
- Keep the mounting arbor for later use!
- Check parallelism. ! 3.5
- Check vertical offset. ! 3.6
4.3 Fixing the runner blocks

- Position and press fitting edge (1) of the guided load (2) against the fitting edges (3) of all the runner blocks on the one guide rail (4).
- Tighten screws (5) to tightening torque $M_A$.
- Fix all the runner blocks (6) on the second guide rail (7), tightening screws to torque $M_A$.

<table>
<thead>
<tr>
<th>Strength class</th>
<th>$M_A$ (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2-70</td>
<td>12.9</td>
</tr>
<tr>
<td>M2</td>
<td>0.35</td>
</tr>
<tr>
<td>M3</td>
<td>0.50</td>
</tr>
<tr>
<td>M4</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>4.6</td>
</tr>
</tbody>
</table>

4.4 Removing the runner blocks

⚠️ Never remove a runner block from the guide rail without using its mounting arbor, otherwise balls may be lost!
- Position the mounting arbor at the head of the guide rail.
- Carefully slide the runner block off the rail and onto the mounting arbor.
5. Mounting the Accessories

5.1 Mounting the N-seals for sizes 7, 9/M2, 9/M3, 12

• Do not remove the runner block from its arbor (1), but simply shift it slightly.
• Use a screwdriver to lever off the red-brown L-seals (2) at both ends. Recycle the seals.
• Lay the black N-seals (3) down flat.
• Position the runner block on the seal from above and press it down into place.
5.2 Mounting the N-seals and longitudinal seals for sizes 15, 20, 9/M3 B, 12 B, 15 B

- Do not remove the runner block from its arbor (1), but simply shift it slightly.
- Use a screwdriver to lever off the red-brown L-seals (2) at both ends. Recycle the seals.

- Align the longitudinal seals (3) with the runner block. The sealing lips (4) must point inward.

- Press the tab of the first side sealing strip against the runner block so that the hole (5) snaps into place around the stud (6).
Mounting the N-seals and longitudinal seals for sizes 15, 20, 9/M3 B, 12 B, 15 B (cont'd)

- Press down the tab at the other end of the side sealing strip (1) so that the hole snaps into place around the stud on the runner block.
- The longitudinal seal is not yet flush with the runner block. It has a slight bulge (2).

- Smooth the longitudinal seal down until you feel the studs on its underside engage with the runner block.
- Mount the second longitudinal seal.

- Align the black N-seals with the runner block ends and press them into place.
6. Start-up

If the Miniature Ball Rail Systems used are not factory pre-lubricated, each runner block has to be individually lubricated before use!

Do not allow guide rails or runner blocks to come into contact with water-based coolants!

6.1 Lubricating equipment

A special grease-filled syringe is available on order: Part number 0419-090-01.

Sizes
7, 9/M2, 9/M3, 9/M3 B, 12, 12 B
• Use the special syringe for the lube holes. ! 6.1.1

Sizes 15, 15 B, 20
• Use a grease gun for the lube nipples at the end faces.
• Use the special syringe for the lube holes at the sides. ! 6.1.1
6.2 Individual initial lubrication with grease

We recommend a grease lubricant to DIN 51825:
- Lithium soap grease, consistency class NLGI 00 to DIN 51818
- Follow the manufacturer’s instructions.
This grease can be ordered together with a special syringe (1).
Part number: 0419-090-01
- The lubricant can be applied either at the front (2) or back (3) end of the runner block.

• Runner blocks of sizes 15, 15 B and 20 can be greased as follows:
  I. Apply the quantity of grease specified in the table to one lube nipple (4).
  II. Slide the runner block in the direction of the lube nipple used to transport grease into the interior of the runner block.
  III. Check that a film of grease is visible on the guide rail.

• All runner blocks can be greased as follows:
  I. Apply a partial quantity of grease as specified in the table to a lube hole on one side (5).
  II. Slide the runner block in the direction of the lube hole used to transport grease into the interior of the runner block.
  III. Apply a partial quantity of grease as specified in the table to a lube hole on the other side (6).
  IV. Slide the runner block in the direction of the lube hole used to transport grease into the interior of the runner block.
  V. Check that a film of grease is visible on the guide rail.

<table>
<thead>
<tr>
<th>Size</th>
<th>Quantity of grease (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>0.080</td>
</tr>
<tr>
<td>20</td>
<td>0.090</td>
</tr>
<tr>
<td>15 B</td>
<td>0.090</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>Partial quantity (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>0.025</td>
</tr>
<tr>
<td>9/M2</td>
<td>0.030</td>
</tr>
<tr>
<td>9/M3</td>
<td>0.030</td>
</tr>
<tr>
<td>12</td>
<td>0.075</td>
</tr>
<tr>
<td>15</td>
<td>0.040</td>
</tr>
<tr>
<td>20</td>
<td>0.045</td>
</tr>
<tr>
<td>9/M3 B</td>
<td>0.040</td>
</tr>
<tr>
<td>12 B</td>
<td>0.075</td>
</tr>
<tr>
<td>15 B</td>
<td>0.045</td>
</tr>
</tbody>
</table>
6.3 Individual initial lubrication with oil

We recommend oils that satisfy the minimum requirements for CLP lubricant oils (DIN 51517, Part 3) or HLP hydraulic oils (Din 51524, Part 2). These oils must have a viscosity of 100 mm²/s at 40°C.

- Follow the manufacturer’s instructions.
- Always check that the oil will be able to reach all rolling elements in any installation position!
- Apply oil until excess emerges.

⚠️ Apply the entire quantity of oil to the runner block in one shot without any interruption!

7. Maintenance

7.1 Cleaning

Dirt can settle and encrust on the guide rails, especially when these are not enclosed.

This dirt must be removed to protect the seals.

- Always run a cleaning cycle before shutting down the machine.

7.2 In-service lubrication

Initial lubrication (long-term lubrication) is sufficient for 5,000 km travel where
- \( F < 0.1 \, \text{C} \)
- \( V_m = 0.65 \, \text{m/s} \)
- 90 mm stroke
- low-friction seals

- For in-service lubrication with grease or oil, follow instructions as for initial lubrication. 6.

⚠️ The service conditions are unknown to the manufacturer. Users can only determine the in-service lubrication intervals with certainty by conducting in-house tests or by careful observation.

⚠️ The in-service lubrication intervals depend on ambient conditions, loading and type of load.

Ambient conditions include: swarf, metallic and other abrasion, solvents and temperature.
Types of load include: vibrations, impacts and tilting.