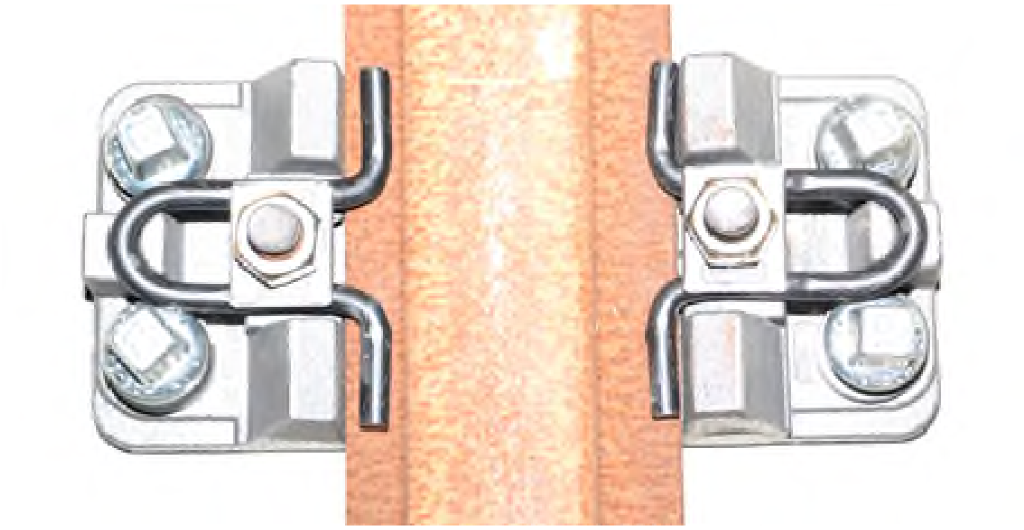
Installation and maintenance manual

for *ShimLift*® height adjustable rail fastening – type R



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1 General

This document describes the assembly, adjustment and maintenance of ShimLift rail fastening with base plates (type R) for sleepers in ballast track. This type of height adjustable rail fastener is suitable for sleepers (made of timber, concrete or plastic) with a flat upper surface.

1.1 Scope

At locations susceptible to track subsidence, such as transition zones from ballasted track to unballasted track, or at insulated rail joints, the effectiveness of ballast tamping is limited because of the memory effect of ballast. Tamping at these locations also accelerates the deterioration process of the ballast bed at these spots leading to drainage problems.

ShimLift height adjustable fasteners are used in order to adjust the track position without agitating the ballast or affecting track stability. Height adjustment of the track is corrected and voiding of sleepers is eliminated by lowering the sleeper and shimming the rail. The ShimLift system enables adjustment in steps of 1 mm up to 30 mm using shims.

Figure 1 Installation of ShimLift at a transition to a level crossing

The ShimLift adjustable fastener has been designed in such a way that rail grinding and track tamping is not obstructed. The life span is equal to that of the standard fastener. The life span of the shims is approximately 25 years.

1.2 Scope of application

The ShimLift type R adjustable fastener can be applied on sleepers in ballast track, with the following properties:

- At spots where uneven or abrupt subsidence of the sleepers is anticipated.
- All types of Vignola and grooved rails e.g. 49E1, 54E1, 54E2, 60E1, Ri59 of Ri60;
- Any rail inclination
- Flat surface sleepers adapted to steel base plates.

Figure 2 Front view of ShimLift type R rail fastening

1.3 Reading guide for this document

In chapter 2 and 3 the working principle and way of installation is clarified. Chapter 4 and 5 explain how track maintenance and adjustment of a section with ShimLift can be executed.

1.4 Declaration of conformity

ShimLift® is compliant to EN – 13 146 and EN – 13 481 (European standards for rail fastenings)

KampaBV is ISO 9001 certified (see appendix 2)

1.5 References:

1. Abrashitov, A., Semak, A., Experimental study of stone blowing track surfacing technique (Moscow State University, Elsevier 2017)
2. Bos, J., Evaluation of ShimLift Pilots (Movares, 2013)
3. Gerber, U., Fengler, W., Setzungsverhalten des Schotters, (Dresden University of Technology, Eisenbahn Technische Rundschau, ETR 2010)
4. Hyslip, J. et al, Railway bridge transition case study (8th International BCR2A'09 Conference, 2009)
5. McMichael, P., McNaughton, A., The Stone blower - Delivering the Promise: Development, Testing and Operation of a New Track Maintenance System (TRB 2003 Annual Meeting 2003)
6. Nicks, J., The bump at the end of the railway bridge (Texas A&M University, Doctoral dissertation, 2009)
7. Selig, E., Waters, J., Track Geotechnology and Substructure Management (1994)
8. Wang, H., Markine, V., Corrective Countermeasure for Track Transition Zones in Railways (Delft University of Technology, Elsevier 2018)

2 Working principle of ShimLift

The design of the ShimLift is very similar to conventional fasteners with base plates, clips and bolts. The construction of the adjustable fastener is shown in Figures 4 and 5. The connection to the sleeper is identical to the attachment of standard base plates to sleepers with a flat surface.

The main difference to standard base plate fastenings is the wide height adjustment range of the rail fastening. The normal rail pad has been replaced by a set of shims, the lower shim (base shim) has a protruding part that fits into a trough of the base plate.

Figure 3 ShimLift, base plate; right picture: including base shim, bolt and clip

The upper shim (filler shim) is available in 5 different thicknesses, each having an adjustment range of 6 mm. The rail is therefore height adjustable in increments from 1 mm up to a maximum of 30 mm. Appendix 1 shows a drawing of both shims.

The following filler shims can be supplied:

- 0 – 5 mm (included with standard delivery)
- 6 – 11 mm
- 12 – 17 mm
- 18 – 23 mm
- 24 – 29 mm

The sides facing each other have self-locking teeth that avoid sliding once the c are fastened.

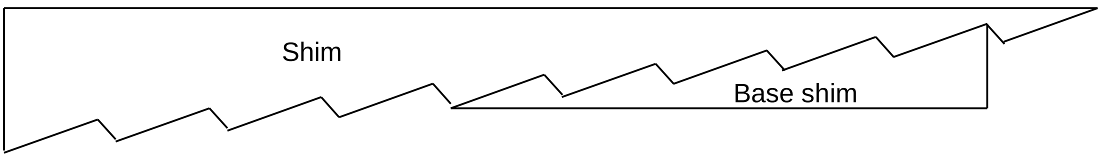

Figure 4 Longitudinal section of shims

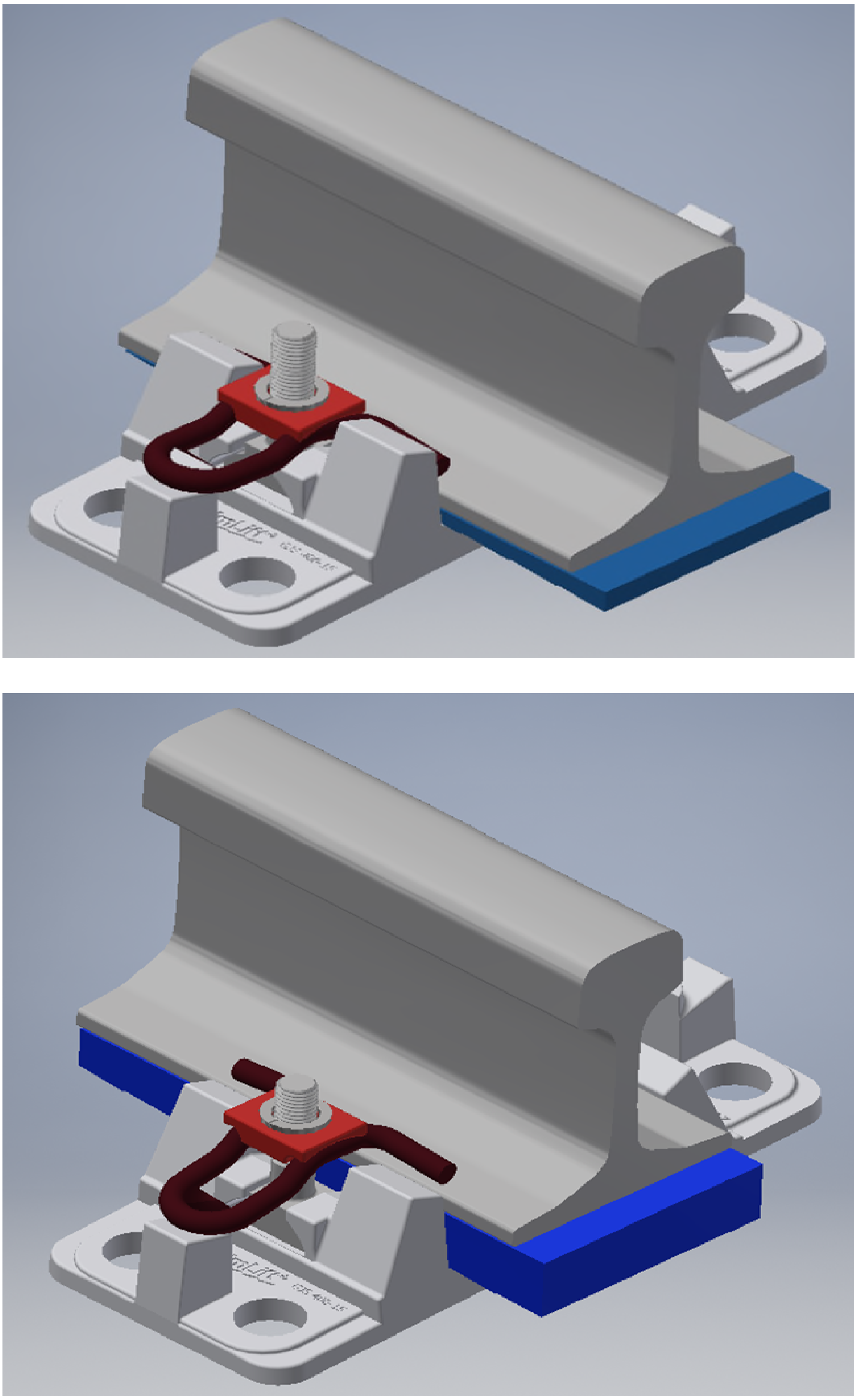

Figure 5 ShimLift R in lowest (Shim 0-5 mm) and highest position (Shim 24-29 mm)

3 Installation

3.1 General

For new work, the ShimLift base plates can be pre-installed to the sleepers. The rail will be installed in the zero position, using the thinnest filler shim (0-5 mm) in its lowest position. After installation the complete track (including the transition area) must be tamped. It is recommended to lay the sleepers on accurately levelled and compacted ballast. This will reduce settlement and the need for shimming the transition.

In existing track transitions, the standard base plates, bolts and clips are replaced by adjustable ones. Since the ballast under the sleepers has been fully settled and compacted in this case, height correction or the track is done by using the appropriate shims in the correct position. This will eliminate voiding of the sleepers.

When installing the shims, it is important that the filler shim fully covers the base shim.

3.2 Tools required

Installation of ShimLift can be done with standard equipment. A torque wrench is recommended to apply the prober torque to fasten the nuts of the clamping bolts and the collar-head bolts into the sleepers.

Overview of required tools:

- Screw machine (preferably battery powered) with socket for 36 mm nut
- 2 rail jacks
- ShimLift measuring rod (for checking the set height afterwards)
- Hammer (approx. 500 gr)
- Pliers with flat jaws (to remove old rail pads from rails or sleepers)
- Extended putty knife or narrow shovel (to remove the remains of rail pads)

A special measuring rod is available to check the position of the filler shim. It is recommend to use this to measure the protruding length of the filler shim, in order to determine the height of the shims

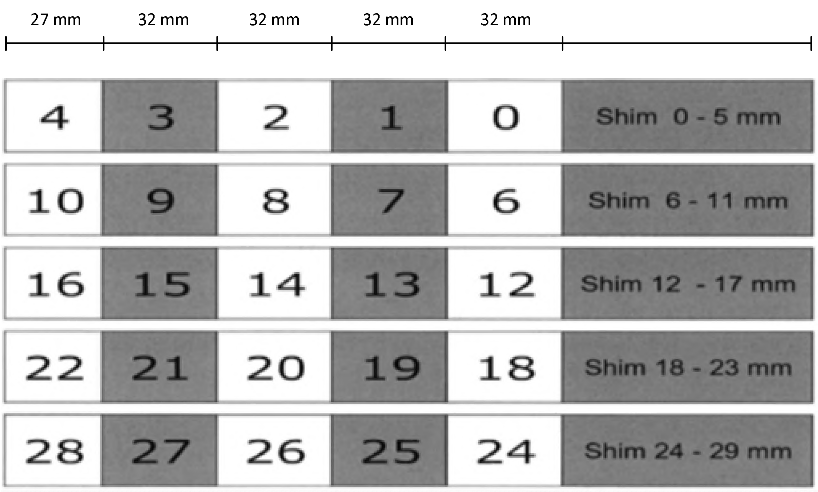

Figure 6 Measuring tool to measure the adjusted height of the rail

3.3 Applying ShimLift at existing transitions

Once the bolts are unscrewed and the clips have been removed, the rail is lifted slightly and the existing base plate is separated from the sleeper by hammering horizontally against the edge.

Figure 7 Jacking the rail

Subsequently, any ballast is removed from underneath the rail between two consecutive sleepers, so that the base plate of the sleeper can be pushed into the ballast bed. This base plate is then pulled sideways from under the rail.

Then, with a reverse movement, the new ShimLift base plate, on top of which is the base shim, can be pulled onto the sleeper. When doing so, it is important that the rubber slab below the base plate is laying on a flat and clean surface and centred around the threaded holes of the sleeper.

The ShimLift is fixed to the sleeper using the existing fasteners (e.g. collar-head bolt with spring washer). When doing so, the collar-head bolts must be tightened diagonally using the appropriate tightening moment (250 Nm, if no other value is specified).

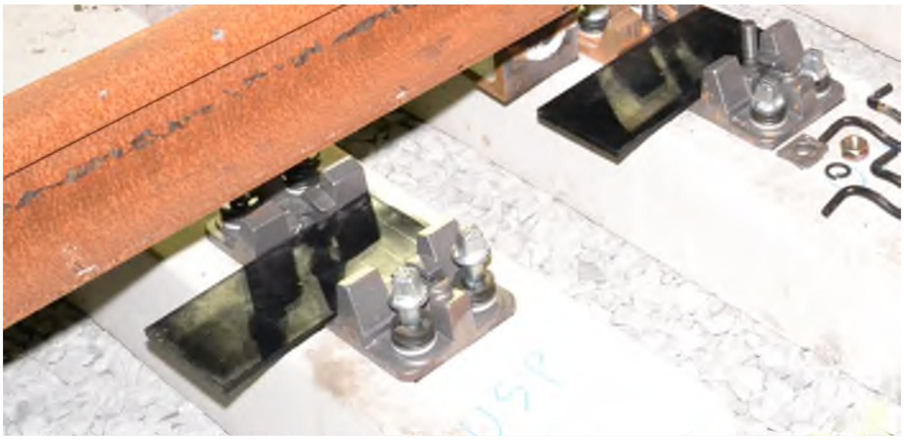

Figure 8 Fixing the ShimLift using existing bolts

After the rail is lifted to the correct height by jacking, the space between the rail and the base shim is filled using the filler shim (of the appropriate thickness) and sliding this through the opening under the rail foot. The appropriate shim can be determined by measuring the space between the highest point of the base shim and the base of the rail.

The adjustment range is given on the shims: 0 - 5, 6 - 11, 12 - 17, 18 - 23 and 24 - 29 mm.

As mentioned before, it is important that the filler shim has a complete overlap and snaps in the teeth of the base shim. This is achieved by pushing the filler shim through as far as possible until it clicks and then pull it back a little so that this rests against the stop of the teeth. To check this, the measuring rod must be held against the base plate to check the longitudinal position of the shim.

Figure 9 Checking the level of the shim

Finally the jacks are removed and the clamping bolts will be fastened using the screw machine with a pre-set torque of 250 Nm.

3.4 Introducing adjustable fasteners to transition with derailment provision

When the transition area is equipped with derailment provisions, it is still possible to apply ShimLift fastenings to eliminate voiding. However, in this case the derailment provision also must be shimmed. This can be done with standard plastic or rubber slabs with a thickness of 2 mm. It is essential that the sleepers do not hang on the guard rail, but lie firmly in the ballast.

Figure 10 Shimmed derailment provision at transition with ShimLift

3.5 Introducing *ShimLift* adjustable at locations other than transitions

ShimLift can also be used on other locations where voiding of sleepers occurs due to dynamic impact or rail joints (like expansion joints or insulated rail joints). Dynamic impact may also be caused by inhomogeneities of the subsoil like under bridges or tunnels below the track.
In this case the same procedure is followed as in paragraph 3.3.

In all cases the appropriate amount of shimming can be predetermined using the output of a measuring vehicle (like Eurail scout) or using a void meter during train passage.

After adjustment, recording of the amount of shimming on a location with ShimLift can be done filling in a table like the one that is shown in appendix 2. This gives good insight in the stabilization process of the transition due to shimming.

4 Recommendations for optimum benefit of ShimLift

To get the maximum benefit from the height-adjustable mounts, it is important to observe the steps listed below. The train load and ShimLift work hand in hand. The train load ensures that the ballast bed is compacted up to the maximum, while adjusting the shims in the correct time and manner ensures that the vertical alignment is restored. This results in minimum dynamic impact. This is in contrast to the standard tamping method where lifting and train load actually counteract each other.

The optimum way of maintaining the track is explained step by step below:

1. ShimLift is installed in new track (A) or in existing track (B) in a transition (ballast to ballastless) or, for example, under a rail joint.
2. In case A, ShimLift is mounted in the lowest (0 mm) position and the track should be adjusted in height after a few weeks and for the second time after a few months in order to remove hanging sleepers (English also: 'voiding'; German: 'Hohllage') in order to compensate for the compaction process of the ballast bed, until rapid settlement virtually is eliminated.
   In case B, voids under the sleeper are already present which is immediately comenpsated for by the shims, up to 10 or 15 mm, depending on the track condition. After shimming, virtually no maintenance is required for a longer period of time.
3. In case the track has to be realigned and tamped, the height correction at the ShimLift location will be limited, so the ballast close to fixed point of the transition is stirred as little as possible. This means that track settlement will be limited after the tamping operation.
4. If after a long time some voiding would recur, then the track must be lifted slightly with a jack and the shims should be readjusted. Where appropriate, thicker shims must be used.
5. Only when after a very long period of time the shims might reach up to 30 mm, the ShimLift location then should be tamped completely. In that case, just before tamping, the thicker shims are replaced by the thinnest and the fastening should be set to its lowest position. The tamping machine then will be able to effectively tamp the track, because new ballast stones will be put underneath the sleepers.
6. The process is then repeated from step 2 onwards.

5 Inspections of track with ShimLift rail fastenings

To determine the maintenance required for the ShimLift, the table shown below is used. The first column of the table lists the parts to be maintained. The subsequent columns list the function of the part, the possible ways in which that function could fail together with the associated causes. This information forms the basis for the maintenance activities. After all, the aim of maintenance is to prevent failure of the function of the fastening system or parts thereof.

Then the relevant maintenance rule is given: preventative maintenance based on a certain service life (maintenance dependent on usage) or a certain condition (maintenance dependent condition) or corrective maintenance (maintenance dependent on faults), the maintenance activity and the interval of that activity.
Finally, the table includes a column for the (rejection) standard during preventative maintenance, the content of the follow-up action if a standard is achieved/exceeded and a column for comments and reference to sources and possible instructions.

Because more than 1 mm of clearance under the rail may cause the filler wedge to slide away under the rail, the ShimLift rail fastening must be checked on proper clamping by regular inspections. In addition, the construction must be visually inspected (visible wear) and the stability of the track must be checked as indicated in the table below.

5.1 Maintenance table

Please note: to ensure it is legible, the table has been cut “vertically”

Part no.	1.Part	2. Function of the part	3. Possible defect	4. Mechanism of origin	5. Maintenance rule
0	Filler shim	Support of the rail	Displaced relative to the base shim	Incorrect assembly	Maintenance dependent condition
1	Hexagonal nut of the clamping bolt	Clamping the rail	Loosened by vibration	Vibrations caused by passing train	Maintenance dependent condition
2	Sleeper	Supporting the rail	Hanging sleeper (impact effect)	Settlement of the ballast bed or the bottom track	Maintenance dependent condition

Item no.	6. Maintenance activity	7. Interval	8. Standard	9.Follow-up activity	10. Source/ Referral
0	Visual inspection	Within 4 weeks after assembly	Par. 3.3	Loosen the clamping bolt, move filler shim and retighten the fastening	
1	Visual inspection	Inspection interval	Par. 3.3	Nut of the clamping bolt to be tightened to 250 Nm	
2	• Visual inspection whilst train passes • Track inspection vehicle for geometrical track position	• Inspection interval • Track inspection vehicle interval	Maintenance manual of the Infrastructure manager	Make height correction	

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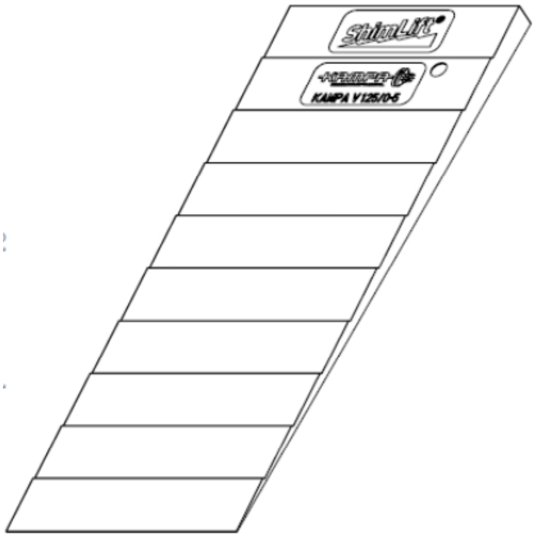
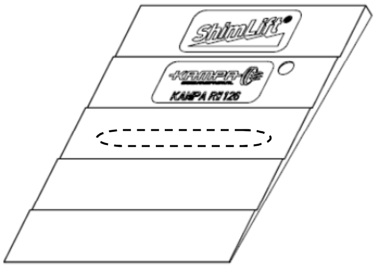
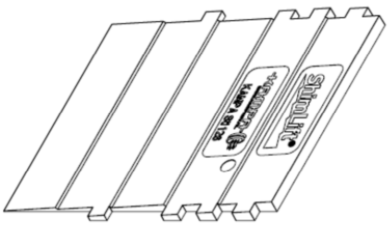
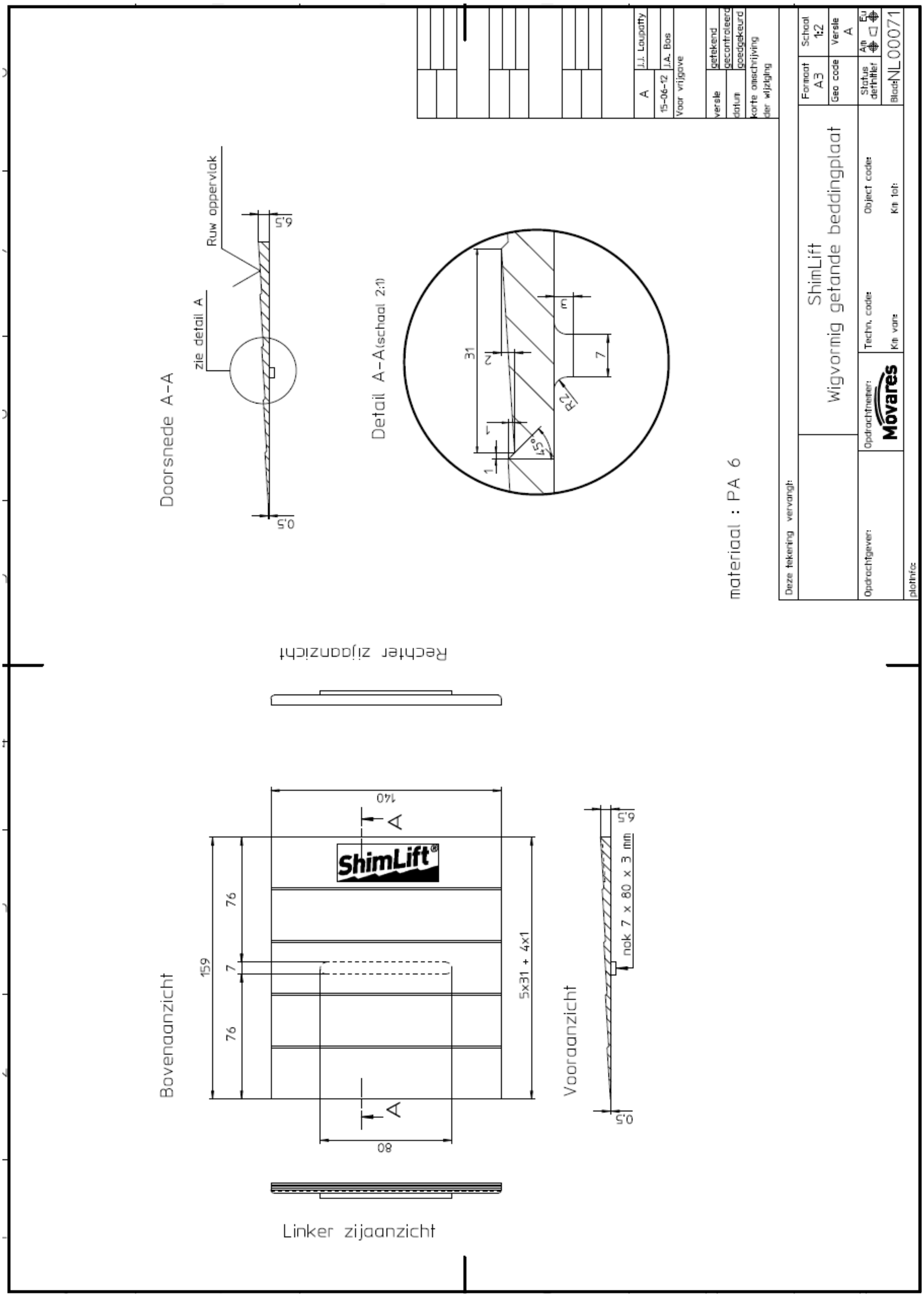
Appendix 1a: Couple of *ShimLift* shims

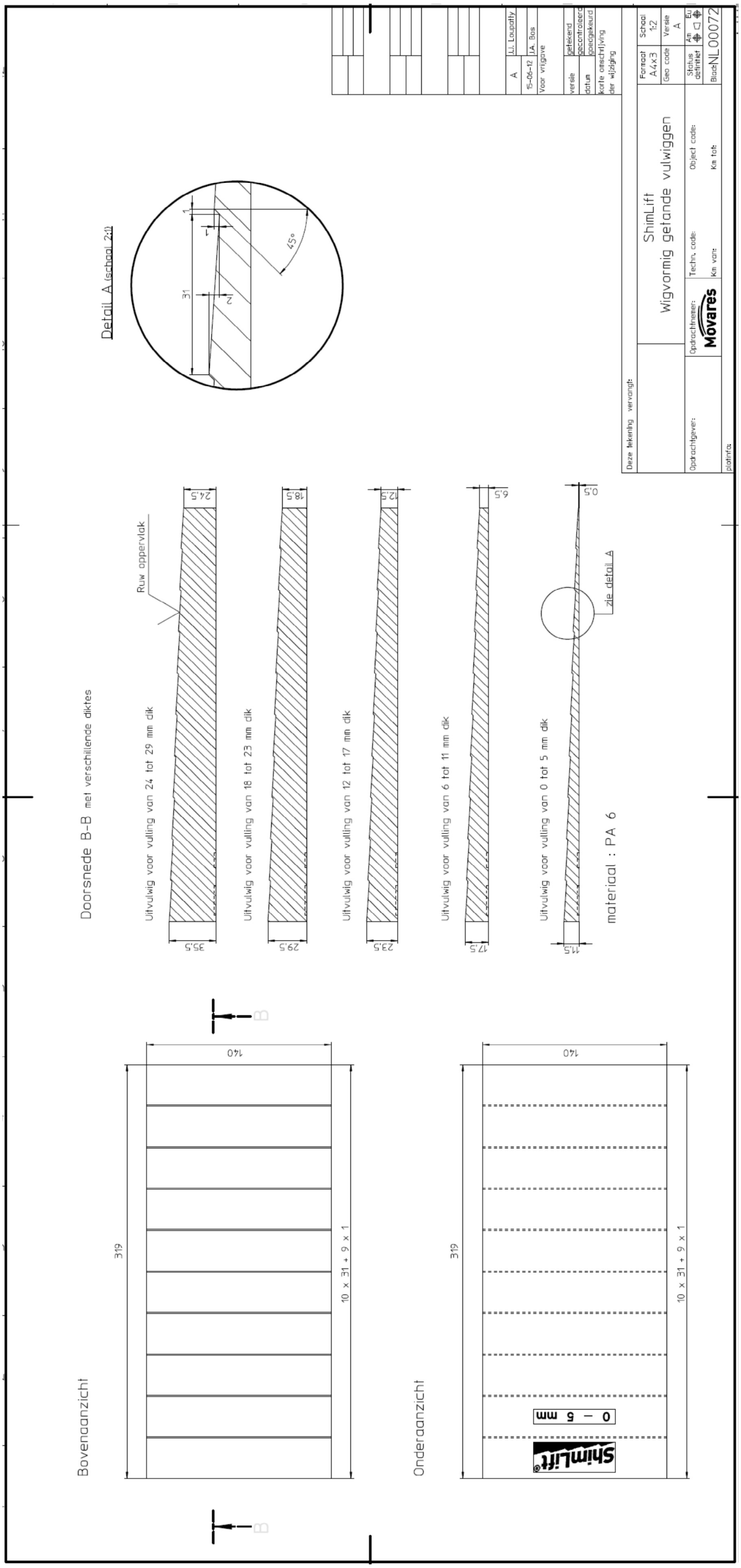




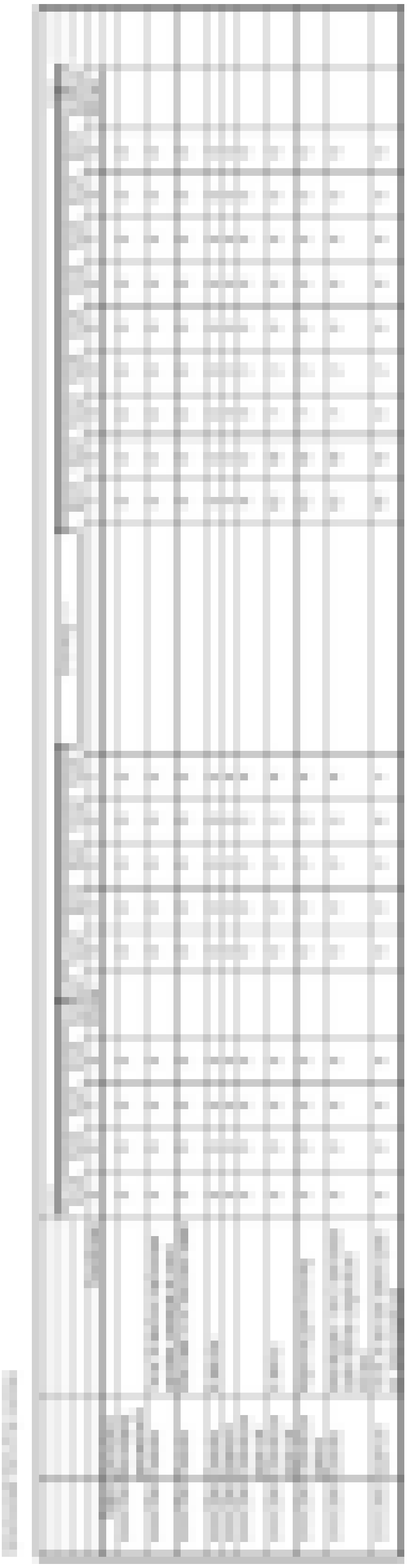


Appendix 1b Drawings of shims




Detail A (schaal 2:1)
45°
31
Doorsnede B-B met verschillende diktes
Ruw oppervlak
Uitvulwig voor vulling van 24 tot 29 mm dik
Uitvulwig voor vulling van 18 tot 23 mm dik
Uitvulwig voor vulling van 12 tot 17 mm dik
Uitvulwig voor vulling van 6 tot 11 mm dik
Uitvulwig voor vulling van 0 tot 5 mm dik
zie detail A
materiaal : PA 6
24,5
18,5
12,5
6,5
0,5
35,5
29,5
23,5
17,5
11,5
Bovenaanzicht
Onderaanzicht
140
319
10 x 31 + 9 x 1
0 – 5 mm
ShimLift
ShimLift
Wigvormig getande vulwiggen
Movares
Formaat A4x3
Schaal 1:2
Versie A
J.J. Loupatty
J.A. Bos
15-06-12
Voor vrijgave
getekend
gecontroleerd
goedgekeurd
NL00072

Appendix 2: Example of measuring table of track transition



Appendix 3: ISO 9001 certificate of Kampa BV

PLUREL TECHNIEK IN BEWEGING

a DEKRA company

Bijlage 1. ISO certificaat KAMPA

bsi.

By Royal Charter

Certificaat

KWALITEITSSYSTEEM - ISO 9001:2008

Hierbij verklaren wij dat:

KamPa B.V.
Koopvaardijweg 2
4906 CV Oosterhout
Nederland

Certificaatnummer: **QSC 753**

een kwaliteitssysteem onderhoudt dat voldoet aan de eisen van ISO 9001:2008 voor het volgende toepassingsgebied:

Inkoop en verkoop van spoor-gerelateerde producten.

Namens BSI:

Gary Fenton, Chair, Certification Body Management Committee

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