

केवल कार्यालयीन उपयोग हेतु
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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS



VANDE BHARAT EXPRESS TRAINSET (V2.0) MAINTENANCE MANUAL

Volume 3 – Part I
Bogie & Coupler

IRCAMTECH/GWL/2022-23/T-18/MM/2.0
SEPTEMBER, 2022



Indian Railways
Centre for Advanced Maintenance Technology

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Bogie

- 1** Maintenance Manual / Wheel set – SMH RAIL
 Document Number: SMHRAIL/WHEEL SET/ TRAIN-44/Maintenance manual/V1.0 Date: 06/09/2022
- 2** TBU Mounting Manual - SKF Bearing
 Edition: 2019-8 Date: 2019-05-24
- 3** Installation, Removal and Maintenance Instructions for Railway Applications - TIMKEN
 Version: A-74540 – Revision: New Date: 25-11-2021
- 4** Maintenance manual Air Spring System - GMT
 Document No: WH_17305201_AirSpringSystem_en_01 Date: 2018-10-02
- 5** Maintenance Manual Bump Stop Primary Suspension - GMT
 Document No: WH_62049602_Bump Stop Primary Suspension_en Date: 2020-07-01
- 6** Maintenance manual Center Pivot Bearing- GMT
 Document No: WH_41057501_Center Pivot Bearing_en Date: 2021-11-18
- 7** Maintenance manual Lateral Buffer- GMT
 Document No: WH_62093601_Lateral Buffer_en Date: 2021-11-18
- 8** Maintenance manual Motor Suspension Bush - GMT
 Document No: WH_64064201_Motor Suspension Bush_en Date: 2020-07-01
- 9** Maintenance manual Motor Suspension Pad - GMT
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- 10** Maintenance manual Primary Suspension Bush - GMT
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- 12** Maintenance manual Stabilizer Link - GMT
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- 13** Maintenance manual Traction Rod - GMT
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- 14** Instruction Manual Performance Line type 97 - Koni
Document Number: 0100 78 00 92, Revision: B
- 15** Instruction Manual Performance Line type 02 - Koni
Document Number: 0100 78 00 94 , Revision: -
- 16** Data sheet maintenance/ Primary Spring - Axtone
Document Number: - , Revision: -

Coupler

- 17** Operating Instructions /Semi Permanent Coupler - DELLNER
Version : First / 31-01-2018

Amendment and Revisions

The correction slips to be issued in future for this report will be numbered as follows:

IRCAMTECH/GWL/2022-23/T-18/MM/2.0# XX date

Where “XX” is the serial number of the concerned correction slip (starting from 01 onwards).

Version	Date	Corrections	Remarks
1.0	AUGUST 2020	First Release	For the first and second rake of the VBE trainset manufactured by ICF.
2.0	SEPTEMBER 2022	Second Release	For 44 rakes of VBE trainset (third rake onwards).



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All technical information and guidelines are latest at the time of publishing and are subjected to change due to technology updates and requirements.

Introduction

This volume of the maintenance manual contains maintenance/ operational/ installation related document from various OEM associated with different system and components of Trainset. For ease of understanding and for simplification the document, this volume has been divided into 5 parts to divide the large document for ease of download and navigation. These are:

PART - 1

- Bogie
- Couplers

PART - 2

- Electro-Pneumatic Brakes and Air Supply

PART - 3

- Furnishing Items
- Passenger Amenities

PART - 4

- Propulsion System

PART - 5

- Train Lighting & Air-conditioning



DOCUMENT TITLE: MAINTENANCE MANUAL FOR TRAIN-44 WHEEL SET

DOCUMENT NUMBER: **SMHRAIL/WHEEL SET/ TRAIN-44/Maintenance manual/V1.0**



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Revision Control			
REVISION No.	REVISION DATE	DETAILS OF AMMENDMENT	APPROVED BY
1.0	06 th Sep 2022	First Version	

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1. INTRODUCTION

A wheelset is a pair of railroad vehicle wheels mounted rigidly on an axle such that both wheels rotate in unison. Wheelsets are often mounted in a bogie a pivoted frame assembly holding at least two wheelsets – at each end of the vehicle. Most modern freight cars and passenger cars have bogies each with two wheelsets

**THIS MANUAL IS ONLY FOR THE MAINTENANCE AND REPAIRS OF WHEELSETS PRODUCED BY
SMH RAIL INDIA PVT LTD**

These Instructions define technical parameters of wheelsets, scope of inspections and repairs, criteria of permissibility of defects and replacement or refurbishment of their parts, as well as the conditions and storage times of delivered wheels and axles.

All the above listed operations may be performed only by persons who, based on their education, experience and abilities, have received training (especially NDT tests by ultrasound and magnetic particle methods) in applicable standards, provisions of safety regulations, regulations for rendering first aid and orders of operation of the client railway.

Used for these operations must be only undamaged functional tools, measuring devices and measuring instruments duly calibrated in accordance with the Metrology Rules within the quality management system.

For replacements and assemblies, used may be only those spare parts which meet the requirements of the manufacturer’s drawings and the limiting values for refurbishment of functional surface specified therein.

Shop Schedule: a limit which may not be exceeded when performing the last wheel and axle refurbishment in a repair workshop

Running Schedule: a limit which may not be exceeded while the wheel and axle is in use.

These maintenance instructions for trailer and motor wheelsets apply only if they are fitted in vehicles used in the ICF TRAIN 44 - HIGH SPEED EMU. The vehicles may not be used on railway sidings and rail tracks where there is a danger of contact with chemicals and other substances which may have a negative impact on the wheelset’s life.

The wheelset axle load must not exceed permissible values specified in the wheelset drawings. For ICF TRAIN 18 - HIGH SPEED EMU: axle load 17t and max. cruising speed 160 kph.

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2. Technical Description

2.1 Trailer axle for ICF TRAIN 44 - HIGH SPEED EMU vehicles Dwg No.MT18Br2 001478-7

Type of transport.....Coaches
 Maximum axle load.....17 t Maximum cruising
 speed.....160 km/h



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**2.2 Solid wheel for ICF TRAIN 44-HIGH SPEED EMU Vehicles
DWG NO. MTBr2 001481-03**

Maximum axle load.....17t
 Maximum cruising speed.....160 km/h
 Wheel diameter.....952 + 0.5 mm
 Last reprofiling896 + 0.5 mm
 Worn out diameter.....877 mm
 Tread profile.....PROFIL RDSO/SK-91146 ALT.3



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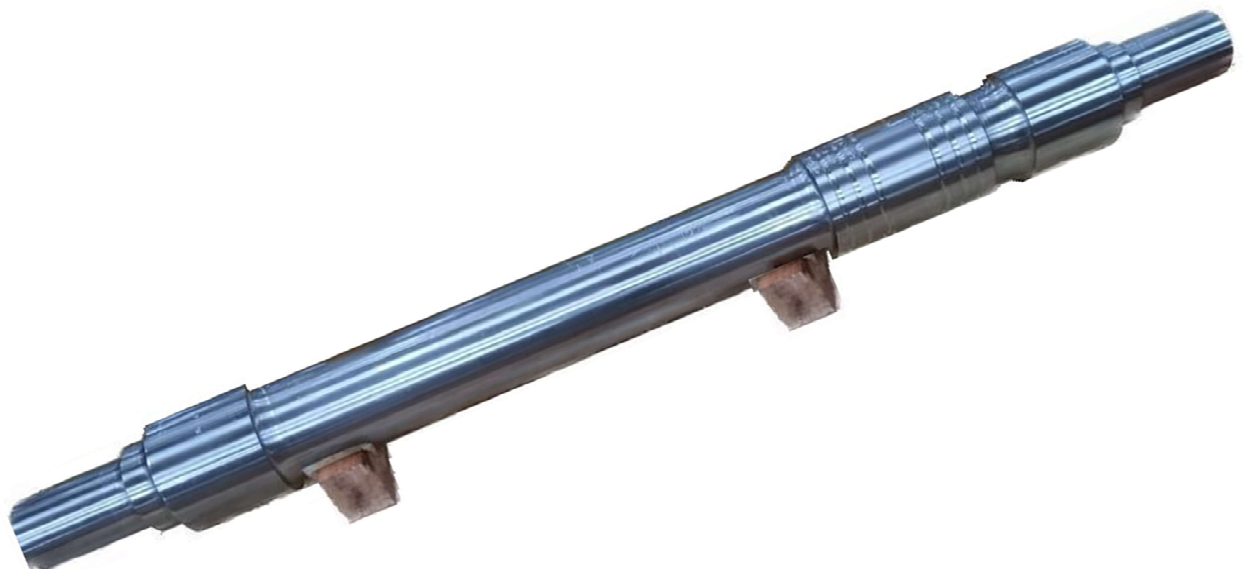
2.3 Motor axle for ICF TRAIN 44 - HIGH SPEED EMU vehicles

Dwg. No.MT18Br2 001477-8

Type of transport.....Coaches

Maximum axle load.....17 t Maximum cruising

speed.....160 km/h



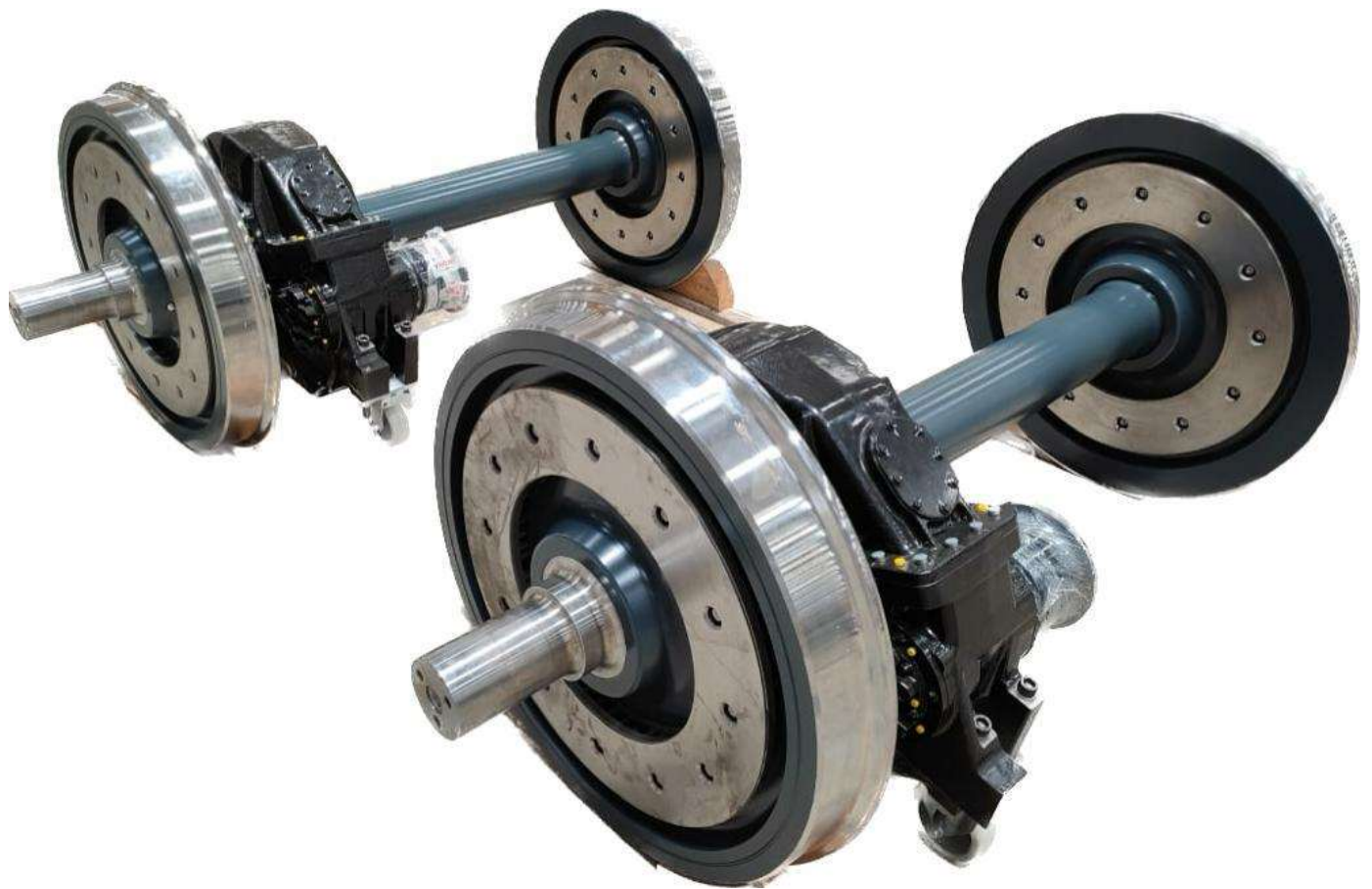
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**2.4 Trailor Wheel set For ICF TRAIN 44-High speed EMU Vehicles
Dwg No.MT18Br2 001479-4**



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2.5. Motor Wheel set For ICF TRAIN 44-High speed EMU Vehicles
Dwg No.MT18Br2 001480-4



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3.Maintenance Schedule

3.1 Maintenance interval

Schedule	Periodicity
Daily	Every Day
Trip	Every 3 days or 5000kms (whichever is earlier)
Monthly	30 Days \pm 2 Days
Quarterly	90 Days \pm 3 Days
Nine Monthly	270 Days \pm 3 Days
Shop Schedule-1 (SS-1)	18 Months \pm 5 Days
Shop Schedule-1 (SS-1)	36 Months \pm 5 Days
Shop Schedule-1 (SS-1)	72 Months \pm 5 Days

! Kilometers per day 1500 km

! The Axle Bearings, Brake discs and Gear Box shall be maintained as per the manufacturer's manual

! Reprofilng to be done depending on actual tread profile and diameter

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3.2 Inspection Plan

3.2.1 Inspection plan during wheel set's service

Part	To be checked	Inspection method	Maintenance level					Reference
			1D	1M	3M	1Y	6Y	
Wheelset	Condition of surface and its protection	visual	X	X	X	X	X	4.1.1.1
	Condition of wheel tread and rim face surfaces	visual		X	X	X	X	4.1.1.2
	Electrical resistance ($\leq 0.01 \Omega$)	measurement					X	
	Back-to-back dimension	measurement					X	4.1.3.1
	Diameter difference between wheels on the same axle $ d1 - d2 $	measurement	After reprofiling		X	X	X	4.1.3.2
	Dimensions of wheelset wheel treads	measurement			X	X	X	4.1.3.3
	Front-to-front dimension	calculation					X	4.1.3.4
	Axial and radial run-out of both wheelset's wheels	measurement					X	4.1.3.5
	NDT test of axle for presence of cracks	measurement				X	X	4.1.6.1
	NDT test of wheel tyre for presence of cracks	measurement					X	4.1.6.2

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3.2.2 Inspection plan after refurbishment of wheelset parts

Part	Operation	Reference	Inspection method	Dimensions, shapes and deviations
Axle	Refurbishment of axle seats	4.2.1	measurement	axle drawing
	Refurbishment of axle body	4.2.2	measurement	axle drawing
	Axle replacement	4.2.2	-	spare parts list
	NDT of axle by magnetic particle testing	4.1.6.3	measurement	-
Wheel	Wheel tread reprofiling	4.3.1	measurement	wheel drawing
	Wheel replacement	4.3.2	-	spare parts list
	NDT test of wheel tyre for presence of cracks	4.1.6.2	measurement	no cracks
Wheelset	Wheelset electrical resistance ($\leq 0.01 \Omega$)	4.1.2	measurement	-
	Press-fit diagram, offset, press-fitting forces, wheel integrity	4.3.2.2	-	wheel and axle drawings
	Back-to-back dimension	4.1.3.1	measurement	wheelset drawing
	Diameter difference between wheels on the same axle	4.1.3.2	measurement	wheelset drawing
	Front-to-front dimension	4.1.3.5	measurement	wheelset drawing
	Axial and radial run-out of both wheel set's wheels	4.1.3.5	measurement	wheelset drawing
	Wheel press-fitting alignment "c- c ₁ "	4.1.3.6	measurement	wheelset drawing

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3.3 Limits

3.3.1 Wheels

Part	Damage, wear and tear	Shop Schedule	Running Schedule	Reference
Wheel	Wheel paintwork	not permitted	not permitted	4.4
	Condition of wheel tread and rim face surfaces:	(Data below have been taken from EN 15313:2016)		
	- Shelling and cavities	≤ 60mm	not permitted	4.1.1.2.1, 4.3.1
	- Rolling contact fatigue - RCF		not permitted	4.1.1.2.2, 4.3.1
	- Scaling		not permitted	4.1.1.2.3, 4.3.1
	- Metal build-up		not permitted	4.1.1.2.4, 4.3.1
	- Wheel flats		not permitted	4.1.1.2.5, 4.3.1
	- Circularity defect		≤ 1.0mm	≤ 0.1mm
	- Polygonization and local wheel tread collapse	not permitted		4.1.1.2.7, 4.3.1
	- Tread material roll-over in external face	≤ 5mm	not permitted	4.1.1.2.8, 4.3.1
	- Transversal / circumferential crack in tread	not permitted	not permitted	4.1.1.2.9/4.1.1.2.10, 4.3.1
	- Wear groove and chamfer	wear groove must be always fully visible		4.1.1.2.11,4.3.2
	- Tooling marks	not permitted	not permitted	4.1.1.2.12, 4.3.2
	- Signs of damage of various kinds	not permitted	not permitted	4.1.1.2.13, 4.3.2
- Defects in wheel web holes	not permitted	not permitted	4.1.1.2.14, 4.3.2	

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	Damage, wear and tear	Shop schedule	Running schedule	Reference
Wheel	- Geometry defects in flange tip and in zone P1-P2	see reference	not permitted	4.1.1.2.15, 4.3.1
	- False flange	≤ 2 mm	not permitted	4.1.1.2.16, 4.3.1
	- Flange thickness	29.4 mm	Min.22mm, Max.	4.1.3.3 4.3.1
	- Flange Height	28.5 mm	Min.27.5mm,	
	- Flange angle dimension		6.5mm	
	- Rim thickness	130-1mm	130-3/+1mm	
	- Wheel axial run-out on wheel set	0.5mm	0.8mm	4.1.3.5 4.3.2
	- Wheel radial run-out on wheel set	0.3mm	0.3mm	4.1.3.5 4.3.1
- Cracks in rims of tread and rim face in service	Not permitted	Not permitted	4.1.6.2, 4.3.2	

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3.3.2 Axles

Part	Damage, wear and tear	Shop schedule	Running schedule	Reference
Axle	Axle paintwork	not permitted	not permitted	4.4
	Cracks in refurbished wheel seats & refurbished axle body Cracks in journals, seat of abutment (labyrinth) ring & wheel seats after simple dismantling of relevant parts with no need for their refurbishment	not permitted	not permitted	4.1.6.3 4.2.1 4.2.2 4.2.3
	Cracks (during operation)	not permitted	not permitted	4.1.6.1 4.2.1 4.2.2 4.2.3

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3.3.3 Wheel sets

Part	Damage, wear and tear	Shop Schedule	Running Schedule	Reference
Wheelset	Electrical resistance	$\leq 0.01\Omega$	$\leq 0.01\Omega$	4.1.2
	Back-to-back dimension	1600+0.8mm	1600+3mm	4.1.3.1 4.3.2.1 4.3.2.2
	Diameter difference between wheels of a wheelset	≤ 0.5 mm	≤ 0.5 mm	4.1.3.2, 4.3.1
	Front-to-front dimension	max.1659 mm	max.1659 mm min.1643 mm	4.1.3.4, 4.3.1
	Degree of wear of brake disc friction surfaces	see product documentation	see product documentation	

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4. Maintenance Instructions

By wheelset maintenance we mean ensuring that all functional surfaces and surface protection are kept intact in order to achieve the longest possible life while preserving traffic safety in view of the natural wear or defects developed by usage.

Repairs, disassembly, replacement and re-assembly or discarding the part from further use are done based on periodical inspections and NDT tests.

Maintenance levels and criteria for determining the repair extent are defined further in this document.

! Fitting wheels to an axle by supercooling the axle is prohibited.

! It is prohibited to use any welding works or spraying the wheelsets or their parts (wheels) with heated substances or adding new material to repair non-integrities in the original material.

! Cleaning products used must not damage the wheelset metal surfaces and the wheelset's parts without surface protection and surfaces protected by a coating system specified in clause 4.4.

! Before the actual inspection or a NDT test of the wheelset or its parts, all dirt must be removed to make it possible to carry out the required test and to evaluate the checked parameter.

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4.1 Wheelset

The wheelset 's functlon is to carry the railway vehicle and to keep it on the rail track, and to transfer forces between the rail vehicle and the rails. Due to the direct effect of these forces, as well as due to the heat generated in this process, the parts of the assembly lose their utility properties, functional dimensions, surface protection and sealing capabilities.

Due to the direct effect of these moments and forces, external interference and/or dismounting of some of the wheelset's components, the wheel surfaces can get damaged. When this happens, unless specified otherwise, the wheel surfaces can be refurbished.

4.1.1 Checking surface condition and surface protection

4.1.1.1 Regular inspections of surface protection

Inspections are carried out visually, checking all wheelset parts (the entire wheel surface with applied protective coating), with special focus on the surface condition and its protection of

the axle body, transition radiuses from the axle body to the wheel seats and brake disc seats (in the transition zone from the wheel web to the wheel hub and rim).

! If the inspection of the wheel surface reveals a scratch or a crack which penetrates the surface protection down to the base material (bare metal), its depth must be determined immediately, using a suitable NDT test.

If crack is found in wheel the wheel must be replaced unless it can be repaired by reprofiling.

If no crack is found underneath damaged coating specified in clause 4.4., the paintwork must be repaired.

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4.1.1.2 Regular inspection of wheel treads and rim faces

! When the wheelset is in use, a system preventing the wheels from spinning when pulling off and when braking must be always set correctly, to avoid frequent development of tread defects (e.g. wheel flats, shelling). Wheelsets must not be overloaded when pulling off and braking.

Inspections of treads and rim faces is done visually or by tests for the presence of the defects specified below. The list of defects presented in this chapter is based on **EN 15313 2016**. Limiting lengths of defects found in wheel treads are specified in Table 1.

Table 1

M		$M \leq 18$			$18 < M \leq 22,5$				$22,5 < M$		
V (km/h)		$V \leq 160$	$160 < V \leq 200$	$200 < V$	$V \leq 120$	$120 < V \leq 160$	$160 < V \leq 200$	$200 < V$	$V \leq 100$	$100 < V \leq 120$	$120 < V$
d	$1\ 000 < d$	80	60	40	80	60	50	35	X	X	X
	$840 < d \leq 1\ 000$	60	50	30	60	50	35	25	60	50	30
	$630 < d \leq 840$	40	30	25	40	30	25	20	40	X	X
	$550 < d \leq 630$	35	25	X	X	X	X	X	X	X	X
	$d < 550$	30	X	X	X	X	X	X	X	X	X

M ... axle load in tonnes (t)
 X ... reserved
 D ... actual wheel diameter

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4.1.1.2.1 Shelling, cavities

(see EN 15313:2016, Annex C.2.3, Figure C.4)

This defect is a local material loss in a limited zone of the tread surface, as shown in Figure 1.

In-service limit:

- see clause 4.1.1.2, Table 1

Remedy: Reprofilng the tread until the defect disappears see clause 4.3.1



Figure 1

4.1.1.2.2 Rolling contact fatigue – RCF

(see EN 15313:2016, Annex C .2.9, Figure C.12)

These defects are created due to the repeated fatigue loading in the plane of the tread as it rolls both along tangent track and steers around curves. Initially the damage appears as a network of fine cracks Figure 2a. As the cracks propagate, surface defects are generated as shown in Figure 2b.

Running Schedules:

- see clause 4.1.1.2, Table 1

Remedy: Reprofilng the tread until the defect disappears – see clause 4.3.1

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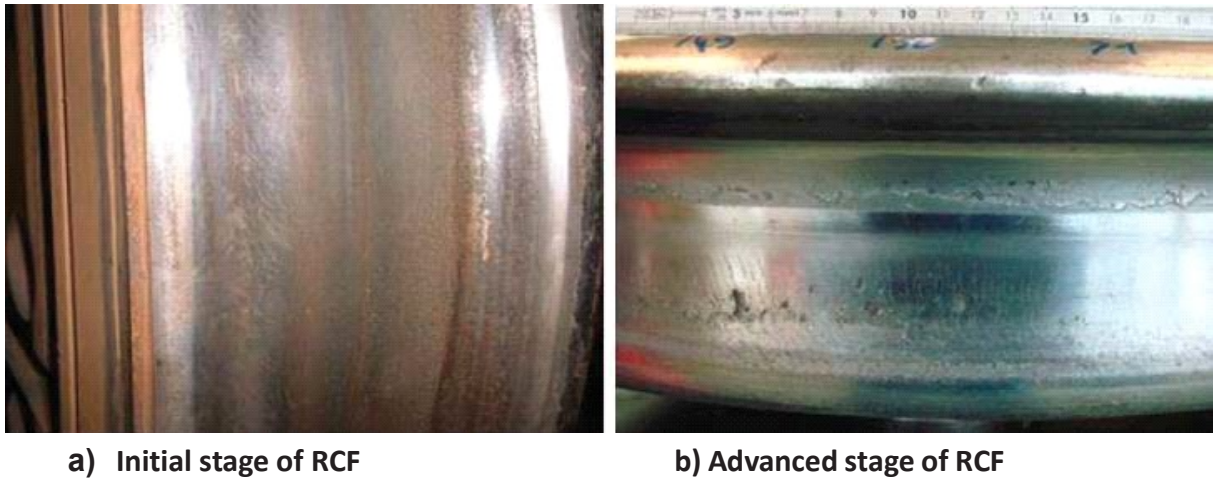


Figure 2

4.1.1.2.3 Scaling

(see EN 15313 2016, Annex C.2.4, Figure C.5)

The defect shown in Figure 3 is a laminar metal flow over the whole tread circumference. In-service limits

- see clause 4.1.1.2, Table 1

Remedy: Reprofile the tread until the defect completely disappears, see clause 4.3.1



Figure 3

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4.1.1.2.4 Metal build-up

(see EN 15313:2016, Annex C.2.2, Figure 3)

Metal build-up is shown in Figure 4.

Running schedules:

- see clause 4.1.1.2, Table 1

Remedy: Reprofile the tread until the defect completely disappears, see clause 4.3.1



Figure 4

4.1.1.2.5 Wheel flat

(See EN 15313:2016, Annex C 2.1, Figure C.1)

Wheel flats are shown in Figure 5. Flats usually develop on both wheelset's wheel at the same time. Continuing to use the wheelset without reprofiling may result in the development of shelling.

In-service limits:

- see clause 4.1.1.2, Table 1

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Remedy: Reprofilng the tread until the defect completely disappears, see clause 4.3.1



Figure 5a



Figure 5b

4.1.1.2.6 Circularity defects (ovality)

(see EN 15313 2016, Annex C.2.7.1, Figure C.8)

The circularity defect includes all in-service permanent changes to the shape of the tread contact zone of the wheel (e.g. polygonization with one or more defects around the circumference of the wheel, local tread collapse, etc.). The reference plane is taken on the running circle and includes point D_0 shown in Figure 11. The general circularity defect is shown in Figure 6.

Running schedules:

- see Table 2 below (informative) and clause 4.1.1.2, Table 1

Shop Schedules:

- $\Delta r \leq 0.1 \text{ mm}$

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Table 2

Wheel diameter Speed range	Permissible circularity defects (Δr)
$d > 840$ mm <ul style="list-style-type: none"> • $v_{max} \leq 60$ km/h • $60 \text{ km/h} < v_{max} \leq 160$ km/h • $160 \text{ km/h} < v_{max} \leq 200$ km/h • $v_{max} > 200$ km/h 	1.5 1.0 0.7 0.5
$380 < d \leq 840$ mm <ul style="list-style-type: none"> • v_{max} • $v_{max} > 200$ km/h 	0.7 0.5
$d \leq 380$ mm	0.3

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Remedy: Reprofilng the tread until the defect completely disappears, see clause 5.3.1

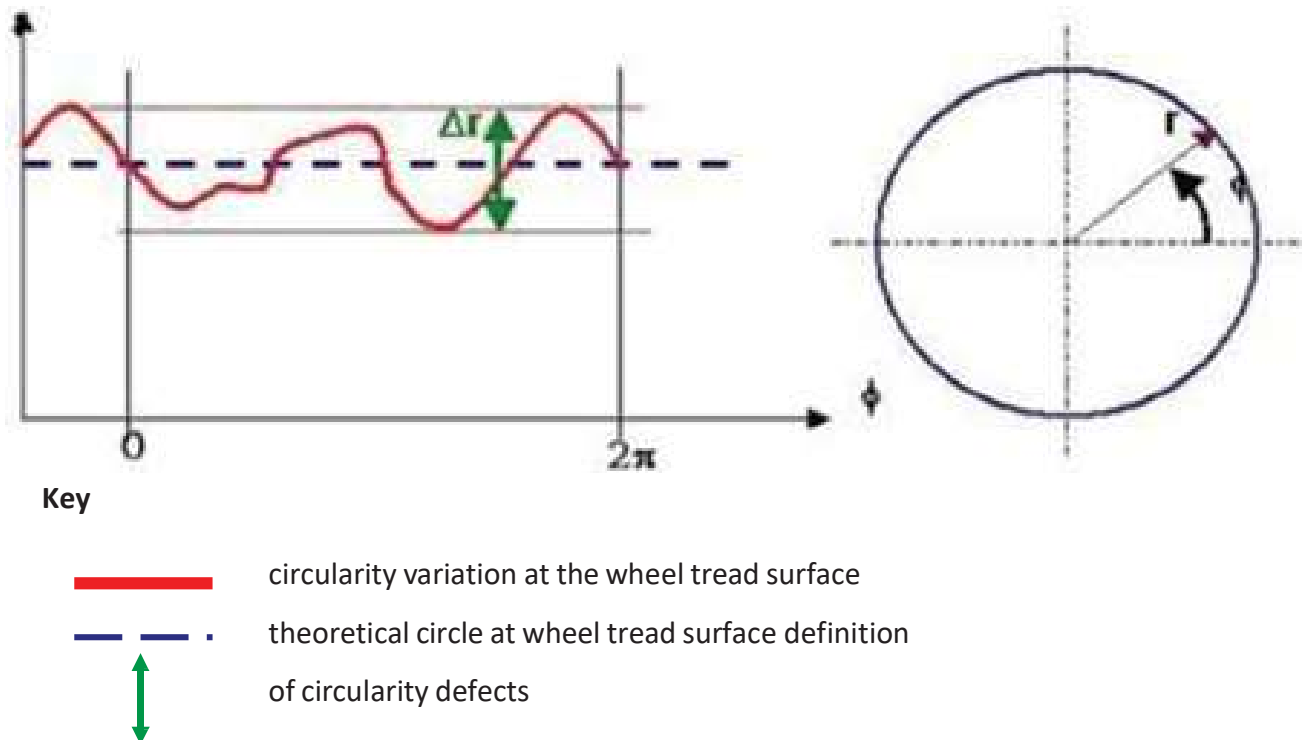


Figure 6

4.1.1.2.7 Polygonization and local tread collapse

(See EN 15313 2016, Annex C.2.7.3, Figure 10)

Polygonization is shown in Figure 7a.

A local tread collapse is shown in Figure 7b.

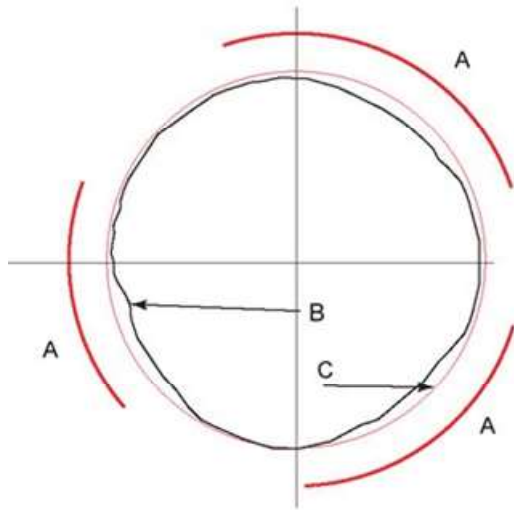
Shelling in the Centre of a local tread collapse is shown in Figure 7c.

Running schedules:

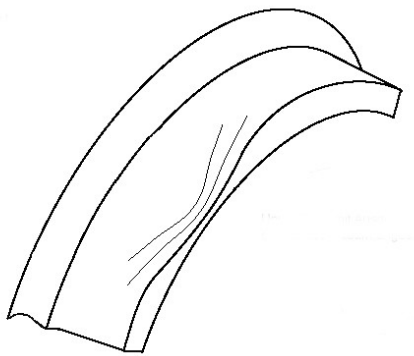
- see clause 4.1.1.2.6, Table 2

Remedy: Reprofilng the tread until the defect completely disappears, see clause 4.3.1

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**Key**

- A** designates the circularity defect zone
B designates the actual tread shape
C designates the reference wheel tread

Figure 7a**Figure 7b****Figure 7c****4.1.1.2.8 Wheel tread corner roll-over**

(See EN 15313 2016, Annex C. 2.11, Figure C15)

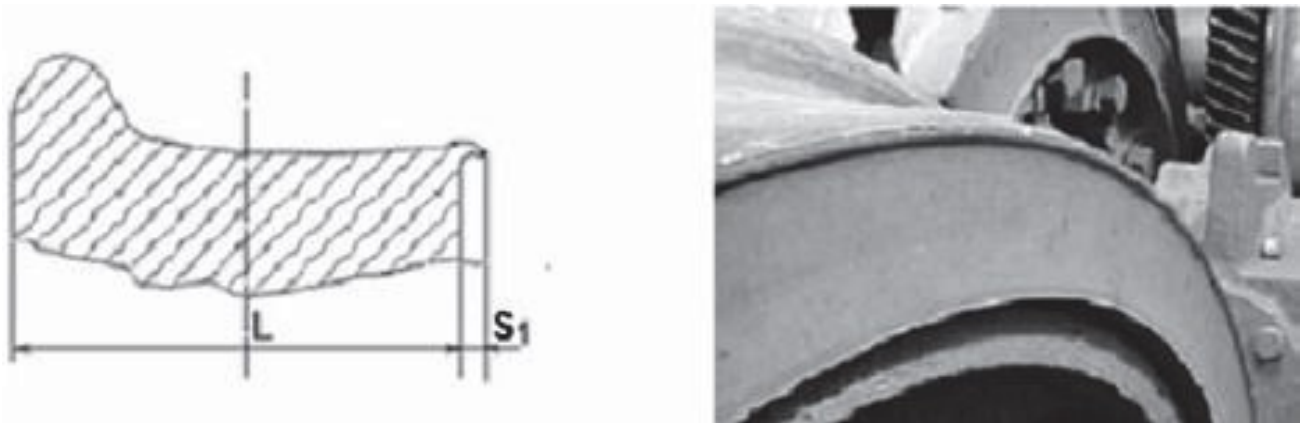
The wheel tread roll-over of dimension S1 is a continuous defect around the wheel tread corner circumference. This defect is shown in Figure 8.

Running schedules:

- $S_1 \leq 5 \text{ mm}$

Remedy: Reprofile the wheel tread until the defect completely disappears, see clause 4.3.1

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**Key** L rim width S_1 dimension of wheel tread corner roll-over**Figure 8****4.1.1.2.9 Transversal cracks in wheel tread surface**

These are cracks orientated under an angle of about 90° relative to the wheel's circumference. They usually appear individually on the wheel tread surface, but can be also spread in larger numbers along the wheel's circumference. They usually start developing from flats or spots of shelled material from the wheel tread. They might also appear after reprofiling done to remove shelling and scaling, or as heat cracks developed as a result of using block brakes.

In-service limits **not permitted**

Remedy: Reprofile the wheel tread until the defect completely disappears, see clause 4.3.1

4.1.1.2.10 Circumferential cracks in wheel tread surface

These are cracks orientated in the direction of the wheel tread. Can be straight or curved. Transversal cracks might initiate from circumferential crack ends.

In-service limits **not permitted**

Remedy: Reprofile the wheel tread until the defect completely disappears, see clause 4.3.1

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4.1.1.2.11 Wear groove and chamfer

(See EN 15313 2016, clause 6.2.1.7, 6.2.1.8, 6.2.1.9)

The main dimensional and installation characteristics of the groove are as follows

- dimensions

The dimensional characteristics of the groove are shown in Figure 9.

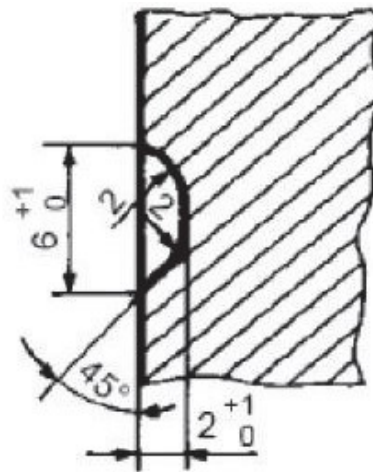


Figure 9

- groove location

The groove location must take into consideration the location of point I which is specified in EN 13715.

A section of the tread profile is given in EN 15313 2016, Ch.6.2.1.7 in Figure 10;

The wear groove, when mandatory, shall always be fully visible after reprofiling or in service. The decision criteria are shown in Figure 10.

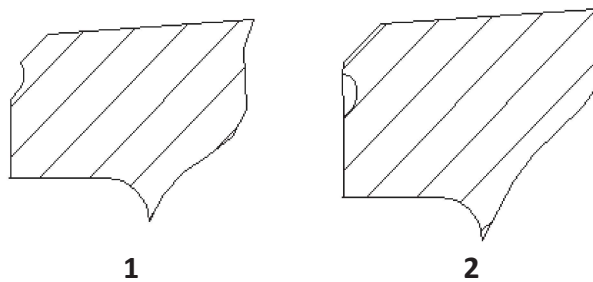


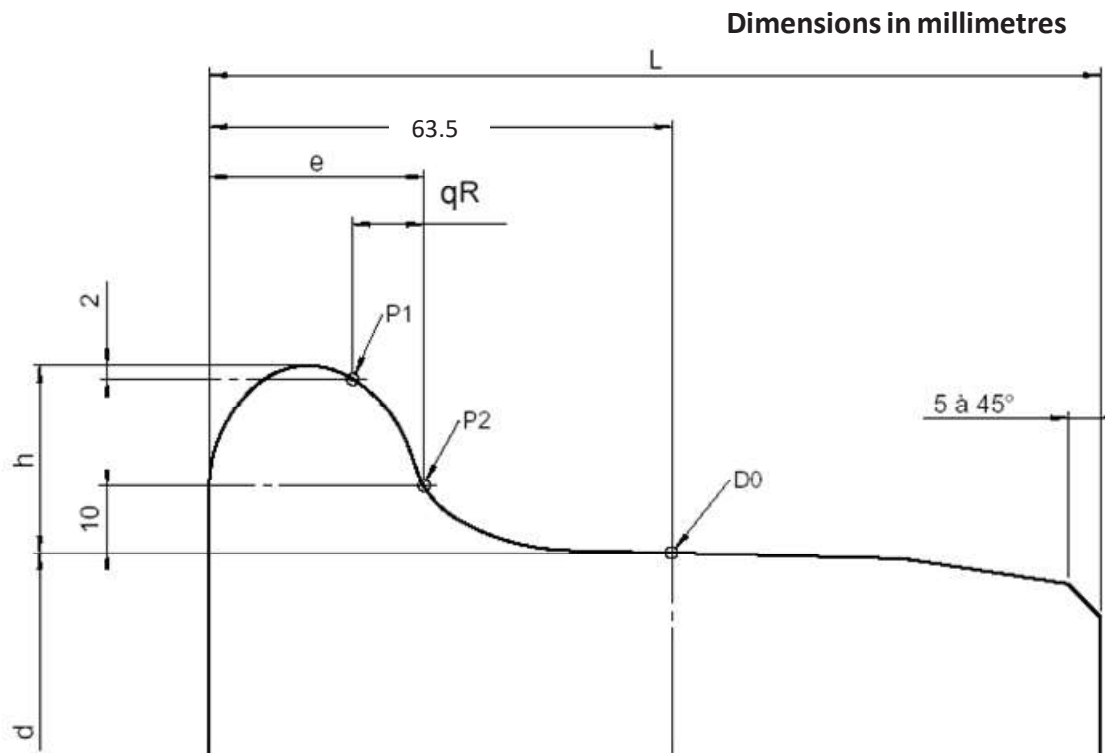
Figure 10

Key

- 1 not permitted
- 2 permitted

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The chamfer is defined in Figure 11. The nominal dimensions are 5 mmx5 mm.



Key

- d wheel diameter
- D_0 position of wheel tread
- h flange height
- L rim width
- qR flange angle dimension between P1 and P2

Figure 11

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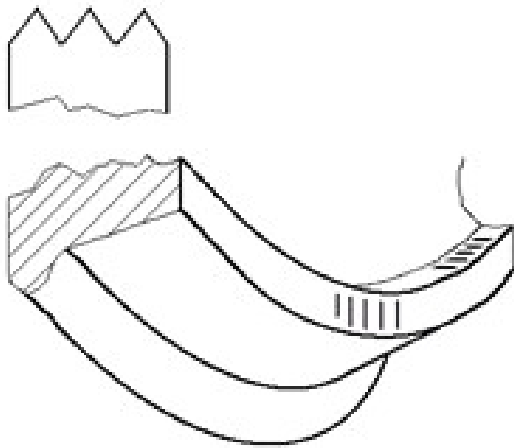
4.1.1.2.12 Tooling marks

(See EN 15313 2016, Annex C.2.18, Figure C.25)

The various types of dangerous tooling marks are shown in Figure 12.

Running schedules: **not permitted**

Remedy: Replacing the wheel or, provided the drawing tolerances allow it, machining until the defect is completely gone.



a) Tooling mark



b) Marks left by lathe chuck jaws

Figure 12

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4.1.1.2.13 Damage marks of all types

(see EN 15313 2016, Annex C.2.19, Figure C.26 and C.27) The main types of damage marks are as follows

- sharp-edged circumferential defects on the web or wheel center as shown in Figure 13.

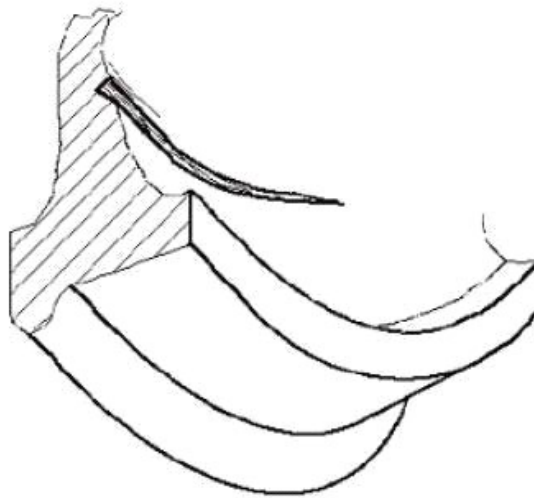


Figure 13

- sharp-edged radial marks on the internal face of the wheel. This type of defect is shown in Figure 14.



Figure 14

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- sharp-edged radial defect on the web. This type of defect is shown in Figure 15

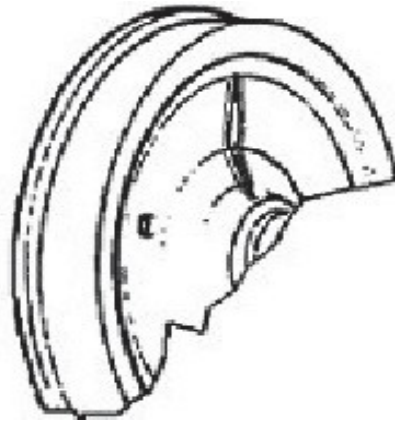


Figure 15

Running schedules: **not permitted**

Remedy: Replacing the wheel or, provided the drawing tolerances allow it, machining until the defect is completely gone.

4.1.1.2.14 Wheel web hole defects

(see EN 15313 2016, Annex C. 2.21, Figure C. 28) Wheel web

hole defects are shown in Figure16.

Running schedules: **Not permitted**

Remedy: Wheel replacement



Figure 16

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4.1.1.2.15 Geometric defects at the flange tip in zone P1-P2

(See EN 15313 2016, Annex C.2.15, Figure C.22)

Zone P1 – P2 (active face of the flange) is shown in Figure 11.
Defects of this type, continuous or not, are shown in Figure 17.

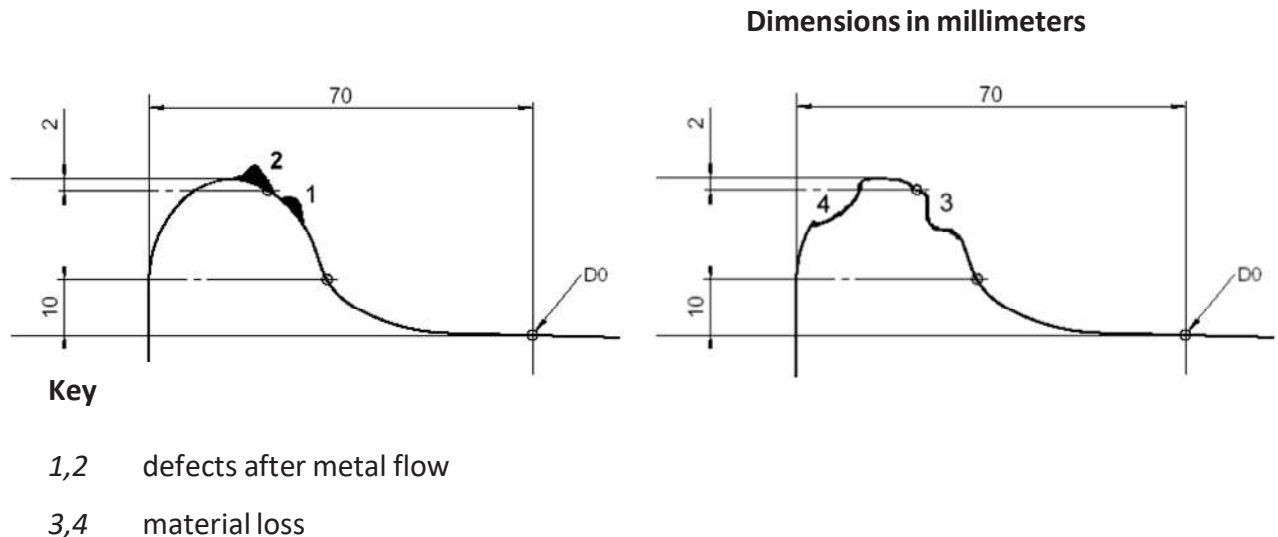


Figure 17

Running Schedule

- Material flow in the P1 zone – the flange tip, defined in Figure 11, is permissible provided the representative dimension qR is greater than 6.5 mm.
- Defects, sharp edges or burrs, number 1, 3 or 4, defined in Figure 19, are not permitted.

Remedy: Reprofile the wheel tread until the defect completely disappears, see clause 4.3.1

4.1.2.16 False flange

(see EN 15313 2016, Annex C.2.14, Figure C.19 and C. 20)

False flange is formed when the rim-face side of the tread is raised above the nominal tread running band. A false flange can be formed when significant tread wear is concentrated at the running band (see Figure 18).

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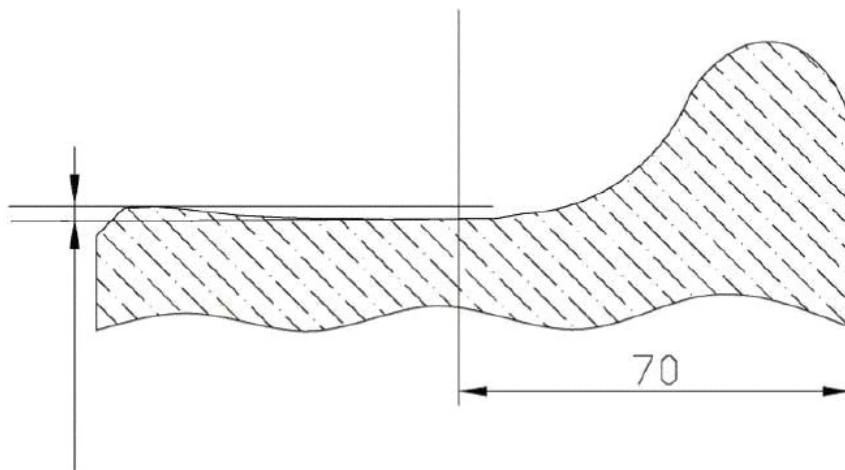
Running schedule

- ≤ 2 mm

Remedy: Reprofilng the wheel tread until the defect completely disappears see clause 4.3.1



a) Picture of false flange



b) Definition of false flange

Figure 18

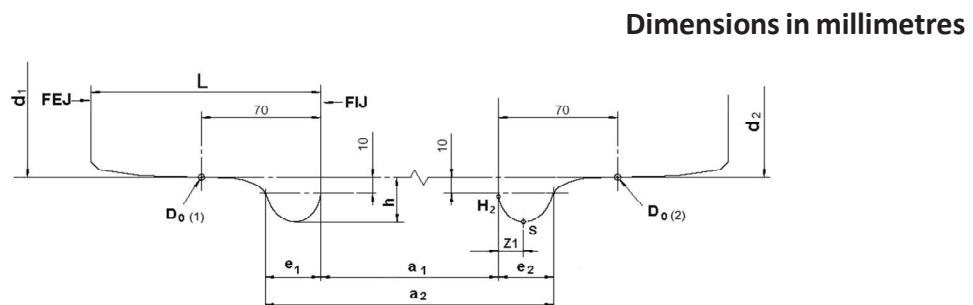
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4.1.2 Verification of wheelset electrical resistance

Electrical resistance is verified after wheelset refurbishment, with a measuring device (ohmmeter). Voltage must be between 1.8 V and 2.0 V DC. The ohmmeter electrodes must be attached to the rim of both wheels. The wheelset must be either removed from the bogie or electrically isolated from it, as well as from the rail, at least one wheel. Electrical resistance of the wheelset after a wheel replacement and refurbishment of the contact surfaces of the press-fitted joint must not be greater than 0.01 Ω

4.1.3 Checking wheelset dimensions

The essential dimensional references of the interface are defined in Figure 19.



Key

a_1 back-to-back dimension

a_2 front-to-front dimension ($a_1 + e_1 + e_2$)

D_0 position of wheel tread (1) wheel 1, (2) wheel 2

e_1, e_2 flange thickness

h flange height

H_2 transition point between internal face of the rim and the flange

L rim width

z_1 internal zone of flange ($H_2 - s$)

FEJ internal face of the rim FIJ

external face of the rim S

flange tip

d_1, d_2 wheel diameters

Figure 19

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4.1.3.1 Checking back-to-back dimension of a wheelset

The distance is checked by direct measurement of the distance between internal faces of the rims of both wheels with a measuring device of a minimum measurement accuracy (scale resolution) 0.1 mm.

The back-to-back dimension of a wheelset are measured at three points at 120° intervals (a_{11}, a_{12}, a_{13}), between internal faces of the rims of both wheels, at $a_{60} \pm 5$ mm flange tip.

$$a_1 = (a_{11} + a_{12} + a_{13}) / 3$$

Running schedule: (S_R)

- $a_{1\min} = 1597$ mm, $a_{1\max} = 1603$ mm (under load)

Shop schedule: (S_R)

- $a_{1\min} = 1599.2$ mm, $a_{1\max} = 1600.8$ mm (without load)

4.1.3.2 Checking diameter difference between wheels of a wheelset

The check is carried out by direct measurement at the point of running circles of both wheels, i.e. 70 mm from the internal face of rim, with a measuring device of a minimum measurement accuracy (scale resolution) 0.01 mm, in planes I and II which are perpendicular to each other, with the diameter of the two wheels:

$$d_1 = d_{1I} + d_{1II} / 2 \quad \text{and} \quad d_2 = d_{2I} + d_{2II} / 2$$

Running schedule:

- $|d_1 - d_2| \leq 0.5$ mm (see EN 15313:2016, clause 6.4.2, Table 8)

Shop schedules:

- $|d_1 - d_2| \leq 0.3$ mm (see EN 13260:2020(E) table:3)

Remedy (if the limit has been exceeded): reprofiling the wheel tread, see clause 4.3.1

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4.1.3.3 Checking wheel tread sizes and rim width of both wheels

The check is carried out by direct measurement made on the wheel treads and rims of both wheels with a special measuring device of accuracy 0.01 mm which allows the following parameters to be measured simultaneously (see EN 15313:2016):

Running schedules:

- Flange thickness (S_d): $e_{min.} = 22$ mm, $e_{max.} = 33$ mm (see EN 15313:2016, clause 6.2.1.3, Table 2)
- Flange height (S_h): $h_{min.} = 27.5$ mm, $h_{max.} = 36$ mm (see EN 15313:2016, clause 6.2.1.2, Table 1)
- Flange angle dimension: $qR \geq 6.5$ mm (see EN 15313:2016, clause 6.2.1.4)
- Rim width: $L_{min.} = 127$ mm, $L_{max.} = 131$ mm with no tread material roll-over in the external face plus tolerance

Wheel treads after reprofiling are usually checked with the wheel still on the reprofiling lathe. If not, then the check is carried out using a special profile measuring device or profile shape gauge. When the latter is used, assessed is the difference between the reprofiled profile and the new profile.

Shop schedule (after reprofiling):

- Shape deviation from the gauge: ≤ 0.2 mm

Remedy (if the limit has been exceeded): reprofiling the wheel tread, see clause 4.3.1

4.1.3.4 Checking front-to-front dimension

The check is carried out by calculating (adding) measurement readings of the flange thickness of both wheels and an average value of the back-to-back dimension $a_1 = (a_{11} + a_{12} + a_{13})/3$

The calculated front-to-front value (a_2) or (S_R) is obtained from the formula: $a_2 = e_1 + a_1 + e_2$, measured as described in clause 5.1.3.1 and 5.1.3.3.

Running schedule:

- $a_{2min} = 1643$ mm, $a_{2max} = 1659$ mm (loaded)

Measurements of wheelset 's front-to-front dimension are usually done straight in the press-fitting press after new wheels have been press-fitted, or straight after reprofiling of wheel treads on the reprofiling lathe. If not, the check of front-to-front dimension is carried out by direct measurement using a special measuring device with a dial indicator of a minimum accuracy 0.1 mm.

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Wheelset 's front-to-front dimension is measured at three points at 120° intervals (a_{21} , a_{22} , a_{23}) around the wheel 's circumference.

Shop schedule:

- $a_2 = \text{max.1659 mm (unloaded)}$

4.1.3.5 Checking axial and radial run-out of wheelset's wheels

The check is usually carried out straight in the press-fitting press after new wheels have been press-fitted, or straight after reprofiling of the wheel treads on the reprofiling lathe. If not, axial and radial run-out is checked using a suitable measuring device or directly by using a dial indicator of a minimum accuracy 0.01mm, mounted on a stable stand. The stand must not transfer vibrations from the surroundings to the measuring device. The reference basis for the run-out measurements are the axle bearing journals.

The check is always carried out with the wheels rotating, unloaded, or on a wheelset removed from the bogie.

Axial run-out is measured on the internal face of rim at a point $60 \pm 5 \text{ mm}$. Radial run-out is measured on the wheel tread at the point of wheel running circle, i.e. 63.5 mm from the internal face of rim.

Running Schedule:

- axial run-out: $\rightarrow \leq 0.8 \text{ mm}$ (see EN 15313:2016, clause 6.4.4, Table 10)
- radial run-out: $\uparrow \leq 0.3 \text{ mm}$ (see EN 15313:2016, clause 6.4.3, Table 9)

Shop Schedule:

- axial run-out: $\rightarrow \leq 0.5 \text{ mm}$ (see EN 13260:2009+A1:2010)
- radial run-out: $\uparrow \leq 0.3 \text{ mm}$ (see EN 13260:2009+A1:2010)

Remedy (if the limit has been exceeded): dismantle the wheelset, see clause 4.3.2.1

4.1.3.6 Checking alignment of wheelset's press-fitted wheels dimension "C - C₁"

The check is carried out by direct measurement using a dial indicator of minimum accuracy 0.01 mm, mounted on a stable (magnetic) stand, which must not transfer vibrations from the surroundings to the measuring device.

Dimension "c - c₁" is the difference in distances between the reference plane of the axle and

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the rim internal face of the press-fitted wheel, applicable always to the same side of the wheelset. The measurement is carried out on the internal faces of the rims, 60 + 5 mm below the flange tip.

The check must be carried out every time new wheels have been press-fitted to an axle, without axle bearings and their components.

Off-vehicle limits (after reprofiling):

- $c - c_1 \leq 1 \text{ mm}$ (see EN 13260:2009+A1:2010)

Remedy (if the limit has been exceeded): dismantle the wheelset, see clause

4.1.4 Wheel axial and rotational displacement

(See EN 15313:2016, Annex C. 6.3.1, Figure C. 43)

Axial displacement is the axial movement of a component relative to its bearing surface. This type of defect is shown in Figure 20, that illustrates the example of a wheel.

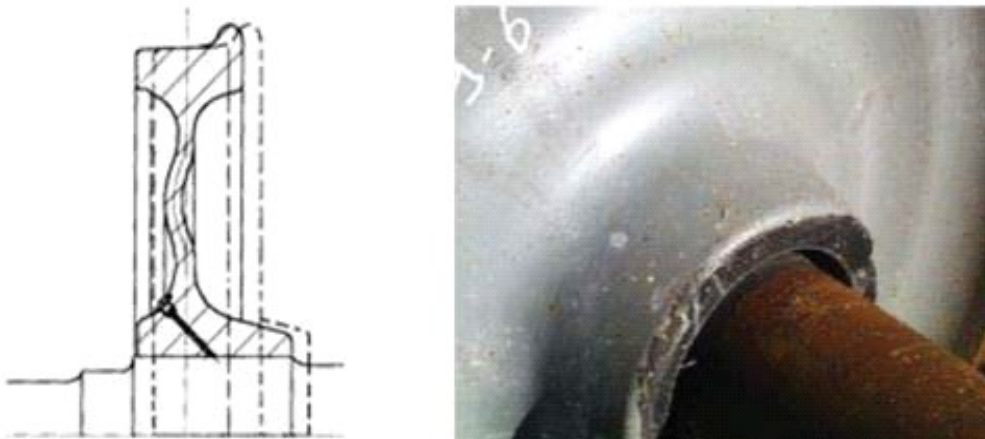


Figure 20

Rotational displacement results from a rotation of a component relative to its bearing surface. This type of defect is shown in Figure 21 that illustrates the example of a wheel.

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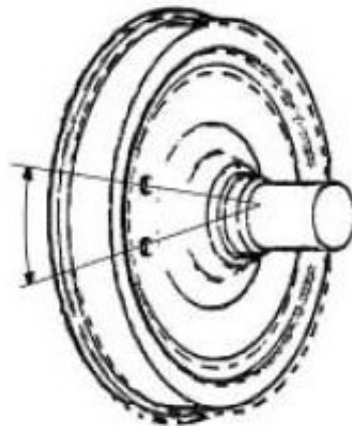


Figure 21

Running schedule

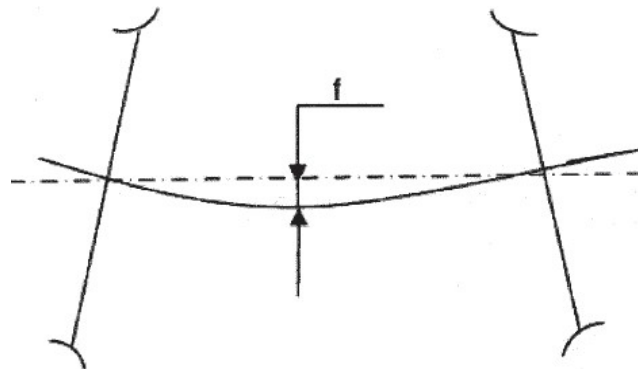
- Neither type of a defect is permissible

Remedy: Wheel replacement, see clause (alternatively refurbishment or axle replacement, see clause 4.2.1.

4.1.5 Bent axle

(see EN 15313 2016, Annex C. 6.4, Figure C. 45)

The deformation of an axle is indicated by its non-linearity as shown in Figure 22, with the sag "f" relative to the position of the original symmetrical axle.



Key

f sag relative to the position of the original symmetrical axle

Figure 22

In-service limits

- not permitted

Remedy: Axle replacement

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4.1.6 Wheelset NDT testing

NDT testing of worn or defective spots on any part of the wheelset must be always carried out in dangerous cases (see clause 5.1.1.1) in accordance with the client railway's regulations.

Before the actual testing can commence, the surface to be tested must be cleaned from any sediments of dirt and dust.

4.1.6.1 Ultrasonic testing of axles for presence of cracks

Ultrasound testing of solid axles is carried out from the axle's end faces, using angle probes. Unless the testing method is stipulated by the test regulation of the client railway to which the wheelset is intended, followed must be the procedure and used must be equipment specified by the axle manufacturer's standard.

4.1.6.2 Ultrasonic testing of wheel rims for presence of cracks

Wheel rims are tested for the presence of cracks by the ultrasound method in accordance with the regulation of the client railway for which the wheelset is intended. As a rule, the test is carried out after the first trimming cut before the wheel reprofiling. After the reprofiling, the wheel tread surface must be checked by magnetoscopy (MPT) for the presence of cracks which might have originated in an inadequately remedied defect.

4.1.6.3 Magnetic particle testing of axles

The test must be carried out in accordance with the regulation of the client railway for which the wheelset is intended. The test is carried out on the axle's wheel seats and on the seats of abutment (labyrinth) rings after the appropriate parts have been dismantled, making the actual surface (of the wheel, the inside bearing rings, etc.) accessible.

The testing must be carried out after refurbishment of the contact surface of wheel's or axle body's seat

4.2 Axle

Axle is a rotating part with seats for fitting wheels, axle bearings, labyrinth rings, axle brake discs and, in case of a power wheelset, axle gearbox.

Axle provides mechanical and electrical bond between the two wheels; imposed upon the axle are bending and braking moments.

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Direct effects of these moments, external interferences or dismounting of one of the parts fitted to the axle may damage the axles seats. If this happens and unless stipulated otherwise, the axle seats detailed below can be refurbished (renovated).

4.2.1 Refurbishing axle wheel seats

Axle wheel seats are refurbished by reducing the nominal diameter of the cylindrical surface of the axle seat, including the tapered transition of this seat, with the aim of achieving

dimensional, shape and positional deviations and surface roughness which are within the tolerances specified in the manufacturer's drawing

By axle wheel seat are understood the below cylindrical surfaces (including tapered transition)

Wheel seat diameter[mm]^	
Manufacturing tolerance Motor axle	Ø 212 v6
Minimum (Motor axle)	Ø 209 v6
Manufacturing tolerance Trailer axle	Ø 190 v6
Minimum (Trailor axle)	Ø 187 v6

^ Motor axle, drawing number MT 18Br2 001477-8

Trailor axle, drawing number MT 18Br2 001478-7

! Refurbishment must be done to an identical nominal diameter of both axle seats, even if one of them shows no signs of damage or defect.

4.2.2 Refurbishing axle body

Axle bodies is refurbished by reducing the nominal diameter of the cylindrical surface including tapered transitions, with the aim to achieve dimensional, shape and positional deviations and surface roughness which are within the tolerances specified in the manufacturer's drawing

Axle body diameter[mm]^	
Manufacturing tolerance	Motor axle Ø179+2 Trailer axle Ø160+2
Minimum	Ø179, Ø160

^ Motor axle, drawing number MT 18Br2 001477-8

Trailor axle, drawing number MT 18Br2 001478-7

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Local axle body repairs are permitted. The place of such repair must be at least 50 mm away from the seat edge. The repair must be carried out by grinding off the defect to a maximum depth 0.6 mm, with a transition radius from the repaired area being at least R75. The length of the repaired section in the axial direction must not exceed 50 mm. Transition to cylindrical sections must be gradual and free of any edges. Maximum permissible surface roughness must be $R_a = 1.6 \mu\text{m}$.

After the refurbishment, the axle body surface protection must be restored in accordance with instructions of the manufacturer of the coating material used on the axle.

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4.2.3 Replacing the axle

Axles are replaced when the degree of wear or the extent of a defect exceeds the running schedule set forth by these Instructions or the regulations of the client railway for which the axle is intended.

Axle replacement requires all components to be dismantled. Wheels are dismantled as described in clause 4.3.2.1 herein.

Axle bearings are dismantled In accordance with the axle bearing manufacturer's product documentation.

Axle brake discs are dismantled In accordance with the brake disc manufacturer's product documentation.

4.3 Wheel

Wheel is a body of a rotational shape, shape-wise divided into a hub with a machined hole for fitting onto an axle, a wheel web and a wheel rim with a tread and flange.

Wheels are cold press-fitted to an axle as part of a wheelset whose function is to keep the railway vehicle on the rail track, to transfer traction and braking moment as well as axial forces, imposing loads mainly on the wheel flange (driving in curves and through rails crossings). Direct imposition of these forces and moments, external interferences or dismantling of one of the parts fitted to the axle can lead to some of these parts (functional surfaces of the wheel) getting damaged. If this happens and unless stated otherwise, the below defined wheel surfaces can be refurbished (renovated).

4.3.1 Reprofilng wheel tread

Wheel tread is reprofiled by machining the tread surface around the entire surface of the rim including flange, by reducing its nominal outside diameter measured at the point of the wheel running circle.

Reprofilng must achieve dimensional, shape and positional deviations, including surface roughness, to be within the tolerances specified in the wheel manufacturer's drawings.

Running circle diameter [mm] ^	
New wheel	Ø 952+0.5
Last reprofilng	Ø896+0.5
Shop schedule	Ø877

^ monobloc wheel, drawing number MT18Br2 001481-03

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! Refurbishment must be carried out to an identical nominal diameter of both wheel treads, even if one of them shows no signs of damage or defect.

! Nominal diameter of the wheel tread after reprofiling must not be smaller than the limiting nominal diameter specified in the wheel drawing. If the drawing does not specify a last reprofiling diameter, a rule applies that the last reprofiling diameter is determined by the diameter of the wear groove. After the operation, a full section of the wear groove must be visible.

After the wheel has been reprofiled, a series of measurements specified in clauses 4.1.3.2 to 4.1.3.5. must be repeated.

4.3.2 Wheel replacement

Wheel replacement is carried out when the degree of wear or the extent of a defect has exceeded the in-service limit set forth by these Instructions or by the regulation of the client railway for which the wheel is intended.

4.3.2.1 Dismounting wheel from axle

! It is prohibited to heat the wheel hub with a welding torch or with any other source of heat to dismount the wheel from the axle.

Wheels are pulled off the axle on a hydraulic press equipped at least with a pressure gauge to register the pulling force. To avoid damaging the axle seat and the wheel hub hole, before pulling force is applied, it is necessary to release the bond between the press-fitted joint's contact surfaces by injecting pressure fluid through the G1/4 injection hole in the wheel hub leading to a distribution groove in the wheel hub's hole.

The pressure fluid is generated in a high-pressure injector capable of developing at least 250 MPa pressure.

! When using the high-pressure injector, the equipment manufacturer's user instructions must be followed.

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An indicator to stop increasing the injector pressure is when the pressure fluid starts flowing out of the press-fitted joint on both sides, ideally around the entire hub circumference. When this happens, continue injecting the fluid for about 30 seconds to ensure that it penetrates the

entire circumference of the press-fitted joint. Then you can start applying the dismantling force upon the inner face of the wheel hub.

Unless the wheel is during the dismantling operation centered, hung or propped up under the wheel tread, a dismantling case attached to the journal must be used to place the wheel in.

The outside diameter of this case must match the diameter of the hub hole less a 0.5 mm insertion allowance.

4.3.2.2 Press-fitting wheel to axle

Wheels are press-fitted on a hydraulic press equipped with a pressure gauge and a registration device for graphical recording of the pressing force curve as a function of the press-fitting track (a press-fit force displacement diagrams).

The pressure sensors on the press must be sufficiently accurate to allow the press-fitting force to be determined with a minimum accuracy of 10 kN.

The pressure gauge, the registration device and the conformity of the pressure gauge values with those in the press-fit diagram must be checked on a regular basis according to a Metrology Rules as part of the quality management system. Maximum deviation must not exceed 5 kN.

The press-fitting force recording in the diagram must allow the press-fitting forces to be read off the diagram with a 25 kN accuracy.

The length ratio between the “diagram length” to “press-fitting” must be at least 1:2.

The magnitude of the press-fitting force reached at the end of the press-fitting operation and the lubricant used must meet the requirements specified in the wheelset manufacturer’s drawing.

The press-fitting speed and the shape of the press-fit diagram must meet the requirements specified in technical conditions and values specified in the wheelsets manufactures drawing.

For each press-fitting joint must be available a corresponding press-fit diagram with the following information added

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- a) Logo of the organization who did the press-fitting.
- b) The press-fit diagram sequence number.
- c) Unique identification of the press-fitted wheel and axle.
- d) Dimensions of the wheels and axles relevant contact surfaces
- e) An offset determined from measured dimensions of the contact surfaces.
- f) Type of the lubricant used to lubricate the contract surfaces during the press-fitting operation.
- g) The press/fitting force reached at the end of the press-fitting operation in kN.
- h) The press-fitting date.
- i) Signature of the press operator.

If the press-fit diagram fails to meet the criteria specified in technical conditions and values specified In the wheelset manufacturers drawing, it is possible (provided the technical conditions allow it) to perform an integrity test of the press-fitted joint.

The test is carried out 48 hours after the wheel was press-fitted to the axle by applying a force equal to 1.2-times the minimum pressing force specified in the wheelset manufacturer's drawing.

The imposed test force must be of an opposite direction to the press-fitting force, and be applied for at least 30 seconds. The press-fitted joint must not fail during the test. This can be verified by checking the press-fit diagram (provided the press when working in the opposite direction allows it), or by attaching a measuring device (of a minimum accuracy 0.01 mm) to the wheel rim before the test.

After the wheel has been press-fitted to the axle, the wheelset dimensions must be checked and the measurement readings recorded in the wheelset's measurement sheet.

Checked are the dimensions defined in the following clauses:

- 4.1.3.1 Checking back-to-back dimension
- 4.1.3.2 Checking diameter difference between wheels on the same axle
- 4.1.3.3 Checking dimensions of wheel treads and rim width of both wheels
- 4.1.3.5 Checking axial and radial run- out of wheelset's wheels
- 4.1.3.6 Checking press-fitting alignment of wheelset's wheels (dmlenslon "c - c1 .")

4.4 Repairing wheelset (wheel and/or axle) paintwork

Wheelset parts whose surface protection is defective must be first degreased with a degreasing product and any dirt stuck to the surface from use must be removed.

! Any degreasing, cleaning and lubrication products used, including for degreasing flanges, must not damage metal surfaces without protection, surfaces with a protective coating system or sealing mastics. These products must meet the clint's technical specification.

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The degreasing product is applied with a brush with plastic bristle and let for about 5 minutes to take effect. After rinsing and drying, any non-adhering paint surrounding the damaged spot is removed with a steel scraper.

4.4.1 Removing old paint

4.4.1.1 Local repairs

Marked spots of local damage are smoothed with a sand paper of minimum granularity P80. For fine smoothing of transition zones is used sand paper of granularity up to P400. The transition between the steel surface of the wheel set part and the original paintwork must be smooth and continuous.

4.4.1.2 Complete removal of old paint

If when removing non-adhering paint from around a defect, more than 50% of the paint has been removed or peeled off, the paint must be removed from the part completely. This is done using a paint removal. The entire surface is roughened with sand paper of minimum granularity P80.

4.4.2 Degreasing wheel set (wheel) parts before applying new coating

Final degreasing is done with a degreasing product approved by the coating system's manufacturer. The degreasing product is applied by brush with plastic bristle and let for approx. 10 minutes to take effect. After rinsing, the surface is dried with compressed air or a dry cloth which does not release fluff.

! Application of the coating system must commence within 4 hours after the part or the damaged spot to be repaired has been degreased (applies in ideal conditions for applying the coating system).

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4.4.3 Selecting coating system

For paintwork repairs is used a two- layer MÄDER coating system.

Coating system specification for wheel and axle	
Primer	ARKOTE 31 NDFT 75-90 μm
Top coat	Arkote 31, RAL 7016, BR 40-70 NDFT 110μm

For painting repairs, the same coating system must be used as the one used on the new wheel set

Painting works can be performed only when the axle (wheel) temperature is at least 3 C above the dew point. Relative humidity must be between 30 and 70%. These values must be checked before the actual application of the coating system, using a suitable measuring instrument.

4.4.3.1 Paint preparation

Base	ARKOTE 31 PRIMER		ARKOTE 31 TOPCOAT	
Hardener	Durcisseur ARKOTE 31		Durcisseur ARKOTE 31	
Thinner	DILUANT T2506		DILUANT T2506	
%	Volume (ml)	Weight (g)	Volume	Weight
Base	3	100	3	100
Hardener	1	23	1	23
Thinner	0 - 1	0 - 20	0 - 1	0 - 20
Viscosity B4 Ford cup	30 ± 4 Sec @ 30°C		30 ± 4 Sec @ 30°C	

Preparing the paint for application:

- check whether the paint is not past the expiration date shown on the label; allow the components to reach ambient temperature;
- stir the paint thoroughly,
- adjust the viscosity to match the application technology to be used; if
- there is any dirt in the paint, filter them off through a sieve.

! All works must be performed in accordance with the paint manufacturer's instruction and paint technical sheets

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4.4.4 Paint application and drying

The ARKOTE 31 PRIMER can be applied on the in-advance prepared surface with a brush or by air or airless spraying in a single layer or, if the specified minimum thickness has not been achieved, in two layers, with a 90-minute time break between the two coats.

The ARKOTE 31 TOP COAT top coat can be applied with a brush or roller, or by air or airless spraying, if necessary, in multiple layers. Allow at least 12 hours between coats.

Weather conditions when applying the coating system must meet the recommendations of the paint system's technical sheet

An exact consistency and workability time must be adhered to as specified in the coating system's technical sheet. With an increasing temperature the paint workability time decreases. The mixture's viscosity can be as required by adding solvent in the ratio specified in the coating system's technical sheet.

Current thickness of a wet layer can be measured at random using a comb. Current thickness of a dry layer can be measured only if the layer is sufficiently dry (non-sticky), using a special magnetic flow-based instrument in accordance with EN ISO 2808.

Base	ARKOTE 31 PRIMER	ARKOTE 31 TOPCOAT
Application	1 - 2 layers (5 mins b/w each coating)	2 - 3 layers (5 mins b/w each coating)
WFT Spec	110-130 μ	130 - 170 μ
DFT Spec	45 - 55 μ	60 - 80 μ
Over coating - Air Dry	10 hrs	10 hrs
Force Dry	30 mins Flash off - > 60 mins @ 60° C EMT	30 mins Flash off - > 60 mins @ 60° C EMT
Nozzle Size	1.2 to 1.4 mm	1.2 to 1.4 mm
Appl. Temperature	15° - 35° C	15° - 35° C
Humidity	< 70%	< 70%
Pressure	2 to 4 bar (Preferable 2-3 bar)	

4.4.5 Checks and records

The worker who has done the repair must record the following information

- a) Place of repair, worker's name,
- b) Bogie number,
- c) Date of old paint removal, degreasing and new coat application,
- d) Air temperature inside the hall, air humidity, axle temperature and dew point.

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Checked must be also an overall appearance of the applied coating system (no wrinkles, runs, blisters, etc.) and, provided the paint is sufficiently dry, a random check of the paint layer thickness is made with an ultrasound thickness meter.

5. Transportation and Storage

5.1 Transportation and handling

The wheelsets are transported either on road trucks or in enclosed railway wagons or in closed containers. A manipulation unit is a single wheelset placed on a special transportation palette designed for handling by a forklift. The wheel treads, rim faces and hubs including the wheel hole, must be protected by temporary conservation.

Handling must be done exclusively by crane, with the wheelset suspended on ropes which must not damage the wheelset surfaces or its paintwork. It is prohibited to handle the wheelsets by painted surfaces, especially by the axle body.

If the wheelsets are transported without axle bearings, then journals and seats of abutment rings must be protected by at least temporary conservation and protected against mechanical damage.

! It is prohibited to handle wheelsets and their parts with electromagnetic equipment and steel cables.

Wheelsets and/or their parts must be stowed in the transportation vehicle or container in such a way that they cannot move relative to the vehicle or container or relative to each other. The wheelsets must be secured on the stowage surface against movement with wooden blocks or frames.

Secure the wheelsets against moving on the stowage floor of the transportation vehicle or container with wooden blocks or frames. Transportation palettes containing wheels must be adequately secured against moving on the stowage floor of the transportation vehicle or container with fastening belts.

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5.2 Storage

Wheelsets and their parts must be stored in covered, dry, clean and ventilated premises, protected against the effects of atmospheric conditions and chemicals. Immediately after delivery, a check must be made whether their protection against corrosion and mechanical damage is intact.

Wheelsets protected by a conservation product can be stored in clean and covered premises for not longer than one year, provided their original packaging is intact, and for not more than six months if the packaging has been removed but the integrity of the protective conservation product film has not been disturbed.

In order to guarantee long term protection by conservation, the client must check the conservation condition on a regular basis and, if it is necessary, renew the protection. A written record must be made of the renewed conservation. A safe distance between axle ends of stored wheelsets is 50 mm.

If the conservation product film has been disturbed, or if the conserved parts are to be stored for a protracted period of time, the conservation film must be checked and renewed. We recommend to carry out these checks at least once a month.

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Complete wheelsets with axle bearings fitted must be protected against inclement weather conditions and other harmful factors. The bearings containing contact seals must be placed preferably in covered premises.

Bearings with labyrinth seals must be stored in covered premises, always with a final arrangement of the bearing casing, or with provisional protection provided by the axle bearing's manufacturer.

Putting axle bearings into hermetically closed plastic bags is prohibited, as condensation may develop inside the bag.

Bearings fitted to wheelsets with bearing chambers must be stored in covered premises (if possibly enclosed), protected against the effects of unfavorable weather. Complete axle bearings stored for longer than 24 months without being fitted to a bogie must be checked by taking samples before they are used. If you need further details, please contact your local technician of the axle bearing manufacturer.

Axle bearings fitted to wheelsets in bogies or under vehicles must be rotated at least once every six months to prevent their oxidation on the orbital contact due to inaction. If the bearing cannot be turned or if the fitted wheelsets have been stored for more than 18 months, the bearing condition must be checked by disassembling a selected bearing sample. For more information, please contact your local technician of the axle bearing manufacturer.

The same applies reasonably also when a whole locomotive is stored (or taken out of use for a protracted period of time), or its bogies, etc.

5.3 Cleaning

When cleaning a vehicle/bogie/wheelset, care must be always taken that the water nozzle is not aimed at gearbox and bearing system seals. Moisture inside the bearing/gearbox reduces the effectiveness of the lubrication grease and causes the bearing steel oxidation which in turn will lead to bearing defects. Watch this especially if you use for washing high pressure water nozzles.

Unless specified otherwise, the maximum permitted water pressure is 30 bar. With higher pressure, the water might penetrate through the seal or disturb the anticorrosion protection (coating system, sealing and other kind of conservation) of the wheelset parts.

It is prohibited to use abrasive and/or corrosive substances and solvents which might disturb or damage the anticorrosion protection or the coating system.

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6. Special Tools and Measuring Instruments

6.1 Workshop measurements

6.1.1 Wheel tread shape gauge

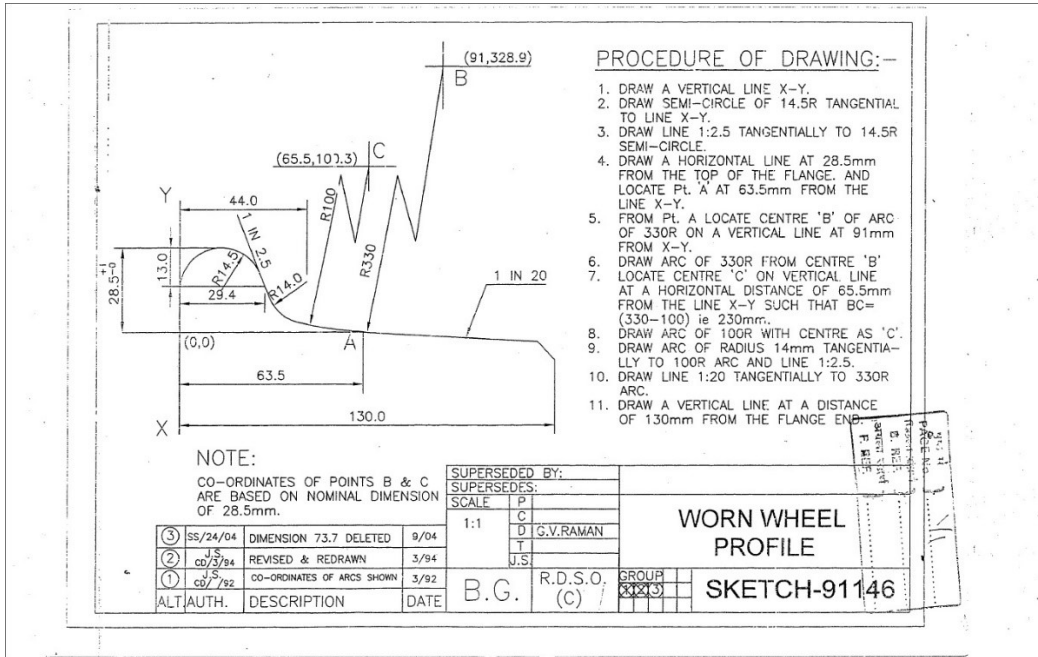
If it is necessary to check a wheel tread (e.g. if it is not possible to check the wheel tread after reprofiling on the reprofiling lathe, or when the wheelset is to be checked after press-fitting), the tread is checked with a special shape gauge.

Measurements can be carried out either on a wheelset removed from the bogie or on a wheelset installed underneath a vehicle. An output is a visual check of the refurbished wheel fit against a shape gauge placed perpendicularly to the wheel thread.



Wheel tread shape gauge should be as per RDSO "SKETCH-91146"

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6.1.2 Wheel diameter

The gauge is used to check the diameter of the wheels running circle, and to identify any difference in these diameters between the wheels press-fitted to the same axle

Measurements can be carried out on a wheelset removed from the bogie. An output are measurement readings of diameters d_1 , d_2 (by adding the value of the wheel diameter set on the gauge with caliper's or an etalon, and maximum indicator deviation) and the calculated value of their difference $|d_1 - d_2|$.



Wheel diameter gauge Paragon Instruments Engineers model "PIE WD-1(M)"

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6.1.3 Device for measuring back-to-back dimension

The measuring device is used to check whether the distance between the wheel's internal faces of rims is correct and also, if used as an in-service check, to measure the back-to-back dimension of a wheelset.



Measured with Mitutoyo make Stick Micrometer (137-204)

Measurements can be carried out on a wheelset removed from the bogie. An output is a measurement reading of the back-to-back dimension a_{12} , a_{12}^* , a_{13} , and from them calculated value " a_1 ".

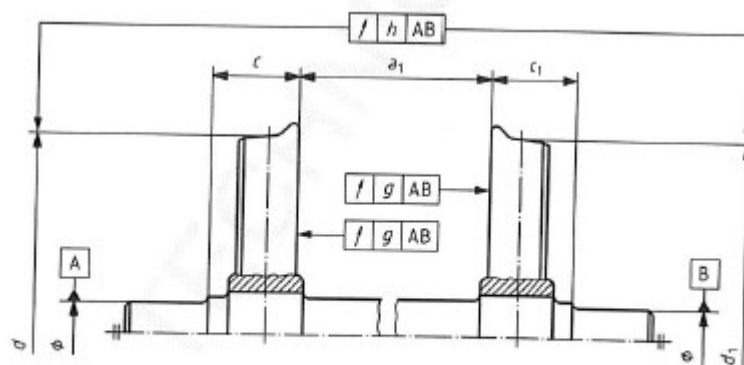
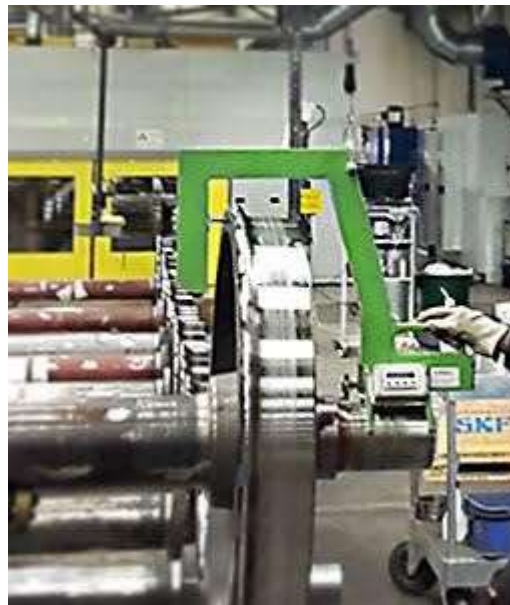
This measuring device is not required if the wheel fitting press has a device for measuring the back-to-back dimension.

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6.1.4 Measuring device for checking alignment of press-fitted wheels (dimension “c - c₁”)

The measuring device is used to check if the wheels press-fitted to an axle are in the correct position.

Measurements can be carried out on a wheelset removed from the bogie and without a bearing system. An output is the difference in maximum values “c-c₁” read off the indicator



Measuring Internal face of the wheel and plane of the journal side defining the corresponding collar bearing surface

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6.1.5 Device for checking axial and radial run-out of wheelset wheels

The device comprises of a magnetic stand and a dial indicator.

Measurements can be carried out either on a wheelset removed from the bogie, or on a rotating wheelset installed underneath a vehicle. An output is a measurement reading of an axial and radial run-out (maximum deviation read off the indicator).

This instrument is not required if the wheel fitting press includes a run-out measuring device.
The Dial gauge range Mitutyo

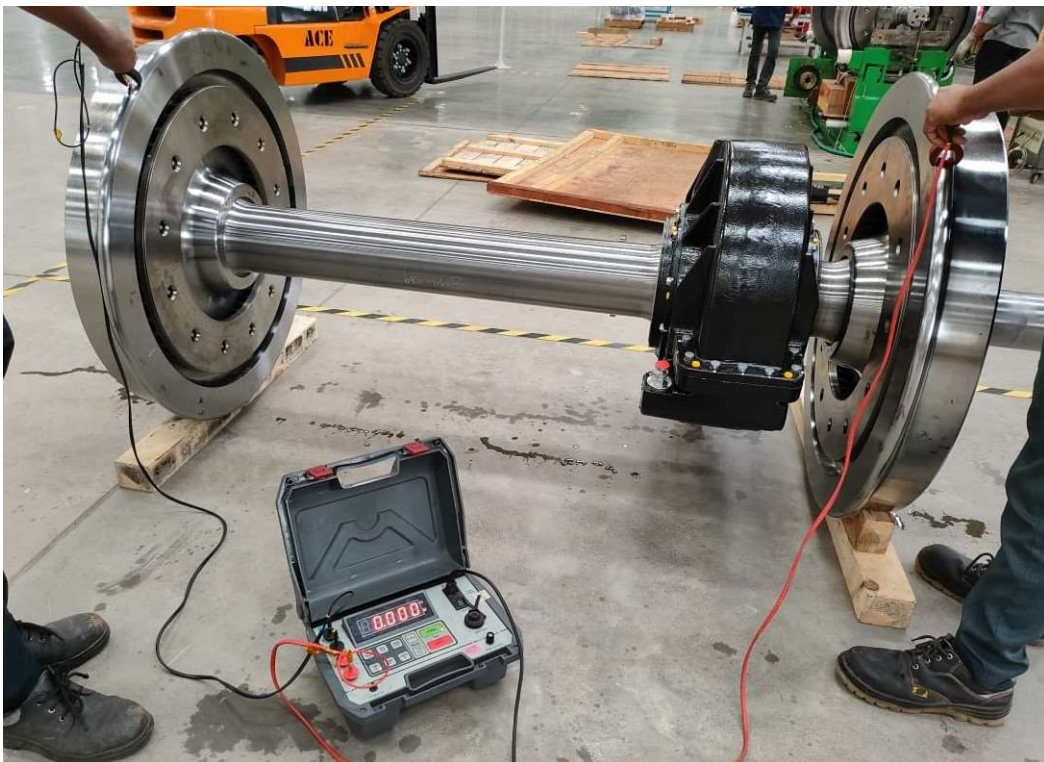


Measured with Mitutoyo Plunger Type Dial Gauge L.c-0.01mm range 0-10mm (2046A) with magnetic stand

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6.1.6 Verification of wheelset electrical resistance

Electrical resistance is verified after wheelset refurbishment, with a measuring device (ohmmeter). Voltage must be between 1.8 V and 2.0 V DC. The ohmmeter electrodes must be attached to the rim of both wheels. The wheelset must be either removed from the bogie or electrically isolated from it, as well as from the rail, at least one wheel. Electrical resistance of the wheelset after a wheel replacement and refurbishment of the contact surfaces of the press-fitted joint must not be greater than 0.01Ω



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7. Spare Parts

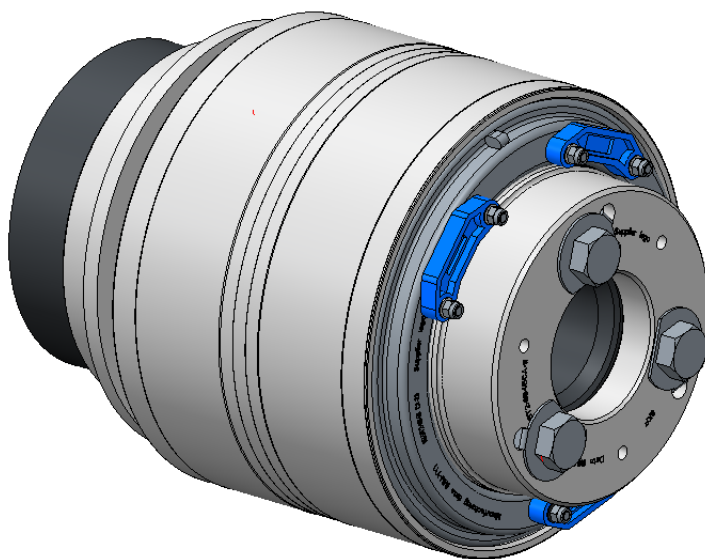
7.1 Spare parts list

- Trailer axle (Dwg No.MT18Br2 001478-7)
- Motor axle (Dwg. No.MT18Br2 001477-8)
- Monobloc wheel (DWG NO. MTBr2 001481-03)

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RAILWAY PRODUCTS TBU MOUNTING MANUAL

Classic outboard applications



SKF Industrie S.p.A

A company belonging to the SKF Group

Site: Villar Perosa

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(TO), Italy

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RAILWAYS PRODUCTS

SKF TBU Mounting Instructions

Date	2019-05-24
Location	Villar Perosa, Italy

Tapered roller bearings are high precision products. Bad handling, mounting and dismounting can affect bearing life, leading to early failures. This manual is intended as a guide to correct handling, mounting and dismounting of SKF tapered roller bearing units. For convenience, only the term TBU is used in this document since all the instructions given in this manual are valid for both TBU and CTBU (see “*Terms and Definitions*” section).

Project: Medha Train 18

Product: BT2-8555 CA

Customer: Medha Servo

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	Department	Date	Name	Signature
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Checked by:	SKF – PE - TBU			
Approved by:	SKF – PE - TBU			

We thank you for your interest in SKF products.

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STRUCTURE OF THE MANUAL

This section describes the general organization of the TBU mounting manual. The user will find details about conventions and symbols used in this guide as well as the statements which detail the rights and obligations that may be exercised and enforced by parties in a legally-recognized relationship.

Overview

The manual contains the following:

- **Disclaimer**
Statement of responsibilities between SKF and the Recipient, in order to make the Customer aware of the legal risks involved in ignoring or not respecting the SKF procedures provided in this manual.
- **General Conditions**
The General Conditions for the technical assistance, advice and other consultancy type services between SKF and the Recipient are reported.
- **Terms and Definitions**
Definitions of the terms used and how and where to find more information and advice on the drawings.
- **Operation of TBU**
This chapter describes the maintenance plan and the re-greasing details (if needed) for the TBU in the application.
- **Handling and storage of TBU**
Describes the general precautions to be taken in order to prevent injury and to preserve the reliability and performance of the TBU in service by means of a correct storage and handling. The steps the user must follow to prepare the workbench in order to guarantee correct mounting and dismounting operations can be found at the end of the section.
- **Journal control before TBU mounting**
Describes rules and procedures to be followed when checking the journal.
- **TBU mounting instructions**
Describes the operations necessary for mounting the TBU on the journal.
- **TBU dismounting instructions**
Describes the operations necessary to dismount the TBU from the journal.
- **Control of the axlebox**
Describes the rules and procedures to be followed when checking the axlebox before it is remounted on the TBU.
- **Additional sections**
Sections which may be added, depending on the applications.

List of symbols



WARNING: Information useful for preventing damage to components and people when trying to complete a task.

SAFETY RELATED TASK: a task that, if missed or not properly performed, can generate risks in service.



CONTACT US: Refers to the sources for additional information and for product and equipment updates.



FOCUS: examples that allow a better understanding of the topic.

Where to find more information

Refer to the following sources for additional information:

- **SKF resources**
If the bearing has to be returned to the bearing manufacturer, please contact the local SKF engineer or sales representative.
- **Optional documentation**
The product package may include optional documentation, such as drawings reporting technical information. The TBU drawings and customer drawings are always available at the SKF Sales Unit.

DISCLAIMER

Accuracy of the Contents

The SKF declines any responsibility for errors in the printing of the present manual. All the information is intended updated at the date of the manual indicated above.

Although care has been taken to assure the accuracy of the information in this manual, SKF provides this information "AS IS" and DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. You acknowledge that your use of this information of the manual is at your sole risk and that SKF shall not be liable for any direct, incidental, consequential, or indirect damages of any kind arising of use of the information of this manual.

Any warranties and representations for SKF products or services that you purchase or use will be subject to the agreed upon terms and conditions in the contract for such product or service.

In case SKF provides to you technical assistance and / or advice, you acknowledge that the rendering of such technical assistance and advice is subject to the SKF General Conditions for technical assistance and advice, which read as follows:

- SKF -

General Conditions for technical assistance and advice
valid from 2010-01-01

A complete understanding of the contents of this manual is fundamental to ensure not to damage people and products. Therefore, for any questions, doubts or concerns, it is strongly recommendable not take autonomous decisions, but to contact SKF that will provide adequate support.

Updated Technical Information

The Customer must be sure that, every time the product is to be mounted, they have the latest edition of the manual and of the required assembly and component drawings (drawings in the Manual are just for reference). SKF recommends the Customer to verify with the local SKF Sales Unit Application Engineer to have the most up to date technical information, the latest edition of the drawings and of the assembly drawings.

Product Modifications

PRODUCT MODIFICATIONS AND CHANGES AFFECTING SAFETY IN SERVICE ARE FORBIDDEN WITHOUT SKF AUTHORIZATION. The SKF keeps the right to apply any modification required to develop and evolve their products.

If customer identifies obvious differences between the product he has bought and the product as described in this document, the customer should inform SKF immediately.

Infringements of Prescriptions

ALL ACTIONS CONTAINED IN THIS MANUAL ARE SAFETY RELATED. In the interest of safety, each person authorized to perform SKF product mounting and dismounting must be fully aware of the contents of this manual.



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The infringement of the prescriptions reported on this manual can result in serious damages to people and goods, causing the warranty to expire. In this case SKF declines every responsibility. SKF is not responsible for damage to their product caused by misuse or non-observance of the rules stated in this manual.

Mounting and Dismounting

Only trained and skilled SKF people are authorized to perform mounting and dismounting of SKF products. In case of difficult mounting and dismounting, doubts or uncertainty, do not take actions. Contact SKF, which will provide adequate support.

Tooling

SKF shall supply mounting and dismounting tools. If the customer decides to use their own tooling, it is their responsibility to guarantee an appropriate mounting.

GENERAL CONDITIONS FOR TECHNICAL ASSISTANCE AND ADVICE

Applicability

These General Conditions shall apply in full on technical assistance, advice and other consultancy type services (including engineering consultancy services or application engineering services) (“Advice”) provided by SKF to a third party (“Recipient”) unless otherwise explicitly agreed in writing by SKF. No other provisions shall be applicable, regardless of whether they were explicitly rejected or not in any individual case. The services to be performed by SKF hereunder shall be conclusively deemed to be subject to these General Conditions, which shall supersede any provisions, terms and conditions contained in Recipient’s purchase order or other communication from recipient to SKF. SKF’s performance is expressly conditioned upon Recipient’s acceptance of these General Conditions without modifications.

Scope of the Advice

The scope, purpose and the intended use of the results of the Advice shall be determined by SKF, unless otherwise is agreed in writing. SKF shall incur no liability or obligation to the Recipient arising out of any other use or application thereof by the Recipient.

Term of provision of Advice/Fee and payment terms

Dates or periods for the provision of the Advice are approximate and are given for information purposes only. A delay in provision of the Advice, including completion of the Advice later than the date or dates provided by SKF, shall not constitute a breach of contract and shall not entitle the recipient to any remedy unless SKF has guaranteed a date for completion of the advice in a written warranty which expressly modifies the provisions of these General Conditions. Fees and payment terms shall be agreed separately.

Confidential Information

Each party undertakes for itself and for its employees, agents and representatives to treat the other party’s Confidential Information (“Confidential Information” shall mean any and all information related to the processes, product range, internal affairs and/or business of the parties (and their affiliates) – including but not limited to technical, practical and commercial information- that a party may disclose to the other party directly or indirectly in writing, orally, or otherwise) as strictly confidential and not disclose or communicate such Confidential Information to any third parties. Confidential Information may be disclosed only to those representatives and employees of a party to whom such disclosure is necessary for the purpose of the Advice. SKF shall, however, be entitled to communicate the Recipient’s Confidential Information to another company within the SKF group. SKF shall see to it that such company adheres to the provisions in these general conditions.

Neither party may use the other party’s Confidential Information for any other purpose than the intended use of the result of the Advice (see section 2 above). No obligation of use, disclosure or confidentiality shall apply to information which (i) was known by the receiving party (or an affiliate of the receiving party) prior to receipt from the other party; (ii) was known to the public prior to receipt by the receiving party from the other party or which becomes to the public subsequent to receipt from the other party through no fault of the receiving party or the receiving party’s employees, agents or representatives; (iii) subsequent to receipt by the receiving party from the other party, is made available to the receiving party (or an affiliate of the receiving party) by a third party which is legally entitled to do so; (iv) if such disclosure is required by law, court order or stock regulations or



RAILWAYS PRODUCTS

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Villar Perosa,
Italy

(v) is developed by the receiving party (or an affiliate of the receiving party) independently of the other party's Confidential Information. Each party shall provide proper and secure storage for the other party's written Confidential Information. All copies of the other party's Confidential Information will be returned to the other party immediately upon the request of the other party, unless such documents are required as a part of a party's internal decision making process or maintenance of company records.

Intellectual Property

SKF shall retain control and ownership of all inventions, designs and copyright and any other intellectual property owned, controlled or possessed by SKF. The Parties agree that SKF shall own at all right, title and interest in and to all results ("results" shall mean any ideas, inventions, discoveries, know-how, data, documentation, reports, materials, writings, designs, computer software, processes, principles, methods, techniques and other information, recorded in any form, that are discovered, conceived, reduced to practice or otherwise generated as a result of or in connection with any Advice performed under general conditions by or on behalf of SKF or the Recipient, and any patent, trade secret, copyright or other intellectual property rights pertaining to any of the foregoing). The Recipient shall make full disclosure of all results. If and to the extent the Recipient has generated results, the Recipient hereby assigns and transfers, without additional consideration, to SKF all right, title and interest in and to such Results. The Recipient shall, and shall cause its employees and agents to execute, or cause to be executed, all papers necessary to effect the foregoing, including assignments as necessary or useful to vest all right, title and interest in and to the Results in SKF, without additional consideration.

Recipient's Warranty

The Recipient warrants that use by SKF of designs or instructions provided by Recipient or on behalf of the Recipient shall not cause SKF to infringe any patent, registered trademark, copyright, design right or similar rights protected by law. Recipient shall defend, hold harmless and indemnify SKF against any claims of infringement and resulting damages and expenses (including, without limitation, attorney and other professional fees and disbursements) relating to the Advice covered by this Agreement.

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RAILWAYS PRODUCTS
SKF TBU Mounting Instructions

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TERMS AND DEFINITIONS

This chapter provides definitions of specific terms used in the following manual and in the Railway segment.

Abutment

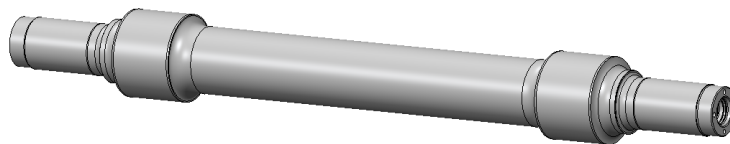
A flat surface between the axle collar diameter and journal. Usually the backing ring leans on the abutment.

Axial clearance

The internal axial clearance of a bearing is the total possible displacement between its rings in the axial direction. Usually the axial clearance of an unmounted bearing is higher than the one of a mounted bearing. This difference is due to the mounting with interference between the bearing and the journal.

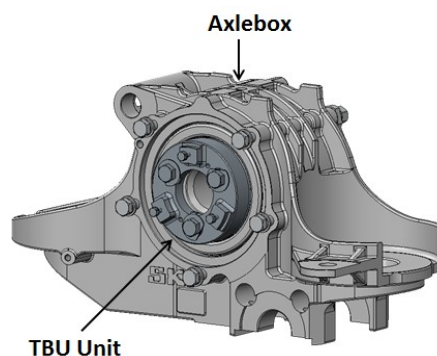
Axle

An axle is a shaft for a rotating wheel. On railway vehicles the axle is fixed to the wheels, rotating with them. Bearings are provided at the mounting points where the axle is supported.



Axlebox

The journal box of the railway axle that hosts the TBU bearing unit. It is the linking element between the rotating wheelset and the quasi-static bogie frame or running gear of a railway vehicle.



Cage (EN 12080:2011-01)

Component which partly surrounds the rolling elements and moves with them. It can be made in steel or in polymeric material.

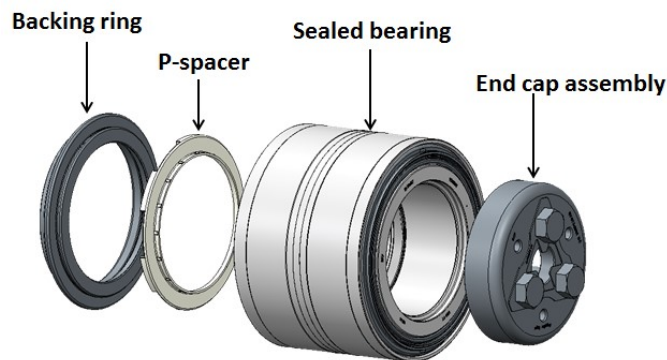


Cartridge bearing (EN 12080)

Rolling bearing with two or more rows of rolling elements within a single outer ring, greased and equipped with integral seals.

Compact Tapered Rolling Bearing Unit (CTBU)

Pre-lubricated, sealed bearing and ready-to-mount units with a predefined axial clearance. CTBU assembly is made by sealed bearing, the backing ring, the grease and additional components can vary from application to application. Examples of additional components are: the polymer spacer, the end cap, the impulse wheel, etc.



Customer (EN 12080)

Railway undertaking, manufacturer or buyer of railway rolling stock or subassemblies, or they representative.

EN 12080/12081/12082

Set of European norms providing prescriptions for bearing manufacturing and storage, grease manufacturing and storage, bearing homologation testing.

Final Seating Force

The final seating force is an extra force that must be applied at the end of the mounting phase to guarantee an optimal seating of the bearing. The maximum values of the final seating force are reported on SKF TBU drawings. The bearing unit may be damaged if these values are exceeded.

Fretting corrosion

Fretting is a complex phenomenon which takes place whenever two mating surfaces are subjected to cyclic loading. The cyclic loading causes micro slips at the interface which, ultimately, lead to fretting corrosion. Fretting corrosion can develop fatigue cracks which propagate through the material. At a later time, the crack will cause premature component failure. Fretting is a common source of failures in bearing, in particular, it forms on the spacers and at the bearing / shaft interface. Fretting is influenced by: displacement amplitude, applied load, temperature, surface roughness, surface hardness and frequency.

Grease (EN 12081)

Semi-solid lubricant, that consists of a thickener and additives dispersed in lubricating oil.

Grease batch (EN 12081)

Entire content of a single production of grease from a finishing vessel.

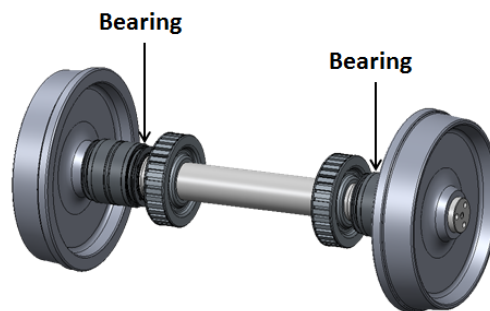
Inner ring assembly

The assembly composed by inner ring, cage and rollers.



Inboard layout

Layout of the wheelset in which the bearings are mounted on the inner side of the wheels.



Journal

Part of the axle where the bearing is mounted.

Maintenance interval

The frequency in time or kilometers at which the TBU must be refurbished.

Metric ton

The metric ton or tonne is a non-SI metric unit of mass equal to 1,000 kilograms. Although not part of the SI, the tonne is "accepted for use with" SI units and prefixes by the International Committee for Weights and Measures. The S.I. symbol for the metric ton is t.

1 metric ton = 1,10231 short ton.

The tonne gave rise to a force unit of the same name, the tonne-force, equivalent to the force produced by a mass of 1000 kg. One unit of tonne-force is equivalent to 9810 N.

For example, a final seating force of 45t is equivalent to 441,45 KN.

Network (EN 12080)

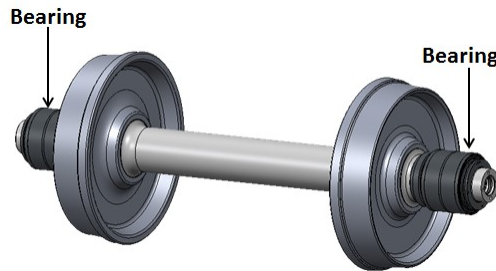
Infrastructure, on which any railway undertaking can operate rolling stock.

OEM

Acronym of Original Equipment Manufacturer. It is a term used when one company makes a part or subsystem that is used in the end product of another company.

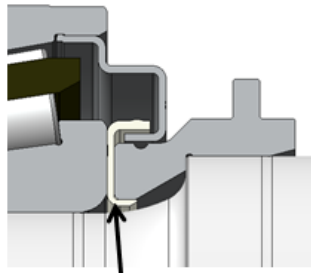
Outboard layout

Layout of the wheelset in which the bearings are mounted on the outer side of the wheels.



Polymer seal

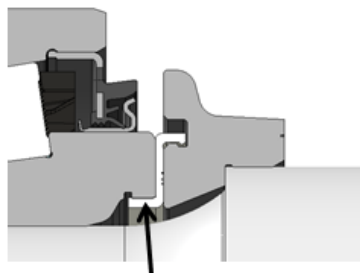
Polymer component placed between the backing ring and the inner ring to reduce fretting corrosion and retain backing ring. The polymer seal, as the name suggests, has also a sealing function when combined with labyrinth seals.



P-seal

Polymer spacer

Polymer component placed between the backing ring and the inner ring to reduce fretting corrosion and retain backing ring. The polymer spacer has no sealing function.



P-spacer

Railway undertaking (EN 12080)

Organization or its representative, whatever status it has, which is responsible of the registration of the rolling stock.

Raceway

The part of the bearing rings that is in contact with the rolling elements, tapered rollers in case of TBU.



Refurbishment

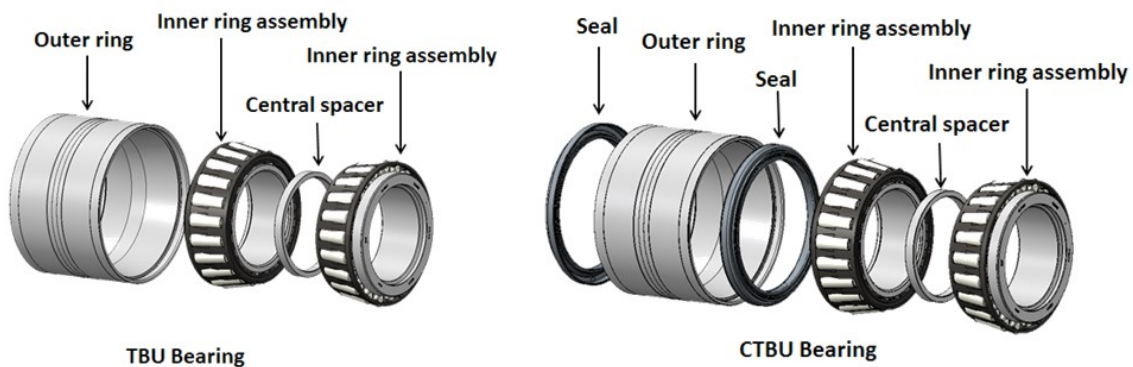
Activity of bearing reconditioning. The bearing is dismantled, cleaned, inspected. The parts which are no more suitable for service are substituted by new ones. Bearing is then reassembled, greased and its axial clearance is measured. Finally, it is packaged and shipped to the customer for reuse.

Relubrication

An optional operation to increase the life of the TBU, which consists of pumping fresh grease into the bearing unit (regreasing).

Rolling bearing

A rolling bearing is a bearing which carries a load by placing rolling elements (such as balls or rollers) between two rings and guarantees the relative motion between rotating and static parts. SKF has two types of bearings: TBU-Bearing and CTBU-Bearing. Both of them are composed of inner and outer rings, rollers, cage, grease and central spacer. The CTBU bearing also includes the seals.



Sand blasting

Abrasive blasting is the operation of propelling a stream of abrasive material, under high pressure, against a surface in order to smooth a rough surface, roughen a smooth surface, shape a surface, or remove surface contaminants.

A pressurized fluid, typically air, or a centrifugal wheel is used to propel the blasting material. When performing sand blasting the worker must wear full protective equipment in order to be protected by particulate.

Seal

Component that prevents water and dust from entering the bearing and retains the grease in the rolling bearings. Seals can include sensors, typically for speed and temperature mapping.

Service life

Maximum life (in kilometers) of the bearing in service. When service life is reached, the bearing must be scrapped and substituted by a new one. Typically, service life is a multiple of maintenance interval.

Short ton

The short ton is a unit of weight equal to 2,000 pounds (907.18474 kg), that is most commonly used in the United States where it is known simply as the ton.

1 short ton=0,90718 metric ton

The short ton can be also used as a unity of force. For example, a final seating force of 45 ton is equivalent to 400,474 KN.

Shot peening

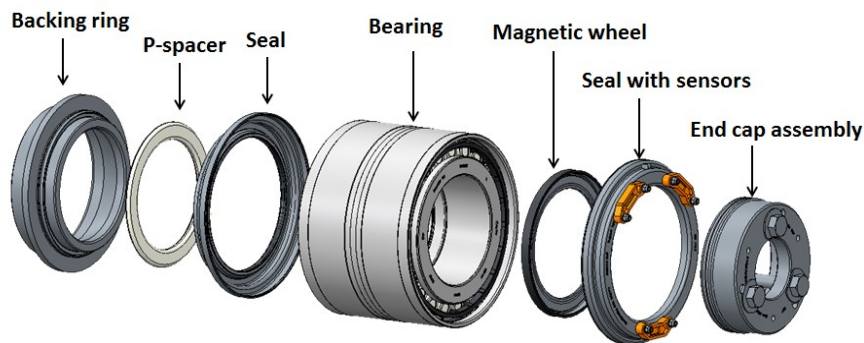
A cold working process used to produce a compressive residual stress layer and modify mechanical properties of metals. It consists in impacting a surface with shot (round metallic, glass, or ceramic particles) with force sufficient to create plastic deformation.

Supplier (EN 12080)

Suppliers of axlebox rolling bearings manufactured under his responsibilities.

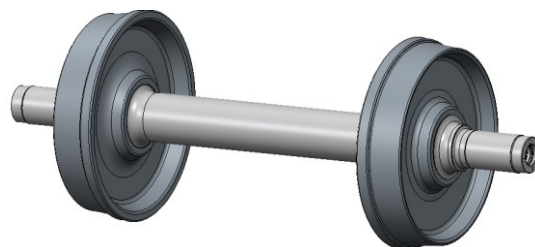
Tapered Rolling Bearing Unit (TBU)

Pre-lubricated, sealed bearing and ready-to-mount units with a predefined axial clearance. TBU assembly is made by the bearing, the seals, the grease, the backing ring and some additional components that can vary from application to application. Examples of additional components are: the polymer spacer, the end cap, the impulse wheel, etc.



Wheelset

The wheelset is the wheel-axle assembly of a railroad vehicle.



OPERATION OF TBU

TBU/CTBU maintenance is a delicate operation which, if not correctly performed, can lead to failures in service, resulting in damages to people or goods and liability issues. For these reasons, it should be always performed by SKF or in certified refurbishment centres. Responsibility of maintenance process lies with the Customer whenever he decides to perform this operation autonomously in a workshop not certified by SKF. The maintenance interval for this application is:

Maintenance interval
1.4 Millions of Km or 3 years whichever comes first.



SKF bearings have to be completely overhauled every time they are dismantled from the axle for any reason (i.e. change brake disk, etc.) even if they have not reached the maintenance interval. It is always necessary to replace both the TBUs on an axle when one of these TBU is dismantled before having reached its maintenance interval. The warranty on the TBU will expire when it is dismantled from the axle. The polymer cage must be replaced every 12 years for high speed bearings and every 16 years for bearings in other applications. Contact SKF for further details.

The Service Life for this application is:

Service Life
4.2 Millions of Km or 9 years whichever comes first.



SKF bearings must be scrapped when the service life is reached.

The maintenance plan for this project is the following:

Maintenance Plan	
Type of Operation	Frequency
1 st Overhaul	1.4 Million Km or 3 years
2 nd Overhaul	2.8 Million Km or 6 years
Scrap of the bearing	4.2 Million Km or 9 years

For this application relubrication must be performed according to the table below:

Relubrication in service			
Grease type	Mileage [Million of km]	Relubrication quantity [g]	Tolerance [g]
See TBU drawing	Not Applicable		



Relubrication and overhaul are a safety related tasks because missed or badly performed operations can lead to TBU failure in service.

HANDLING AND STORAGE OF TBUs

This chapter describes the precautions to be taken when preparing a correct working environment and workbench.

The general rules for a correct handling and storage are also provided: such rules are mandatory to ensure reliability and durability of the components.

Safety information

The TBU is designed and manufactured according to high technical and safety standards. Despite this, safety issues may arise if the TBU is not correctly fitted, used or maintained by competent personnel. The mounting of the bearings and axlebox requires that the rules in force for heavy components handling are respected.



General and Local Health and Safety Regulations must be observed.

Where auxiliary products are used (hydraulic press, chemical products, etc.) refer to the safety rules stated by their suppliers.

Cleanliness of the workplace

It is responsibility of the customer to ensure the workplace where the SKF product will be stored, mounted and dismantled is ordered, clean, dry and sufficiently lit. Rooms where welding and metalworking operations are carried out are not suitable for storing, mounting and dismantling the bearings.

Handling of chemicals, lubricants and cleaning materials

In general, the lubricants (oil and grease) and solvents used for cleaning and mounting can generate skin irritations or can cause infections to small cuts or grazes present on the skin.

Some people are more sensitive to this aspect or can be allergic to the substances within such products. For these reasons, the lubricants and solvents must not come into direct contact with the skin.

The use of protective gloves and appropriate tools (grease gun, oil-can, etc.), which are in good conditions, is mandatory when handling these products. Toxic solvents must not be used for cleaning or removal of the grease. In general solvents are highly flammable, therefore they must not be used in places where naked flames or sparks are produced.

Chemicals which have a corrosive effect on bearings (acids, mists or aerosols of acids, ammonia, chlorinated lime, alkaline solutions, salts, etc.) must not be stored in the same room.

Heavy parts and equipment

During transportation, mounting and dismantling of heavy TBUs, proper tools in good working conditions must be used.

Special care must be taken when handling such items in order to avoid damage to people and objects. If cranes are used, the general rules for suspended loads must be observed and the personnel must be equipped with protective clothing.

Packing and storage

Two situations must be considered: handling of TBU not mounted on the wheelset and the handling of TBUs mounted on the wheelset. The following table summarizes the storage conditions for these two situations.

TBU Storage Conditions			
Item	Location	Storage Time	Notes
TBU in pallet box	Indoor -5°C÷+40°C	24 months	Outside of these 24 months, a maximum period of 12 months shall be at the bearing manufacturer.
TBU mounted on Wheelset	Indoor/outdoor (covered area)	12 months	Rotate outer ring every 4 months. Minimum 20 rotations.

Table with storage conditions for TBUs

Storage, transportation and handling of TBUs not mounted on wheelset



“Whether delivered in bulk or singly, all rolling bearings shall be effectively protected by appropriate packaging such that they can be transported, handled and stored without any damage.

The packaging shall permit a minimum storage time of two years under normal storage conditions and provided that the original packing has not been opened. For rolling bearings delivered pre-lubricated, the storage time from manufacture to mounting the bearing on the axle is limited to 24 months indoor between -5°C and +40°C. Outside of this 24-month period, a maximum of 12 months shall be at bearing manufacturer’s premises.” [EN 12080]

If the storage time limit is exceeded, do not mount the TBU but contact SKF. The storage temperature should remain as constant as possible in order to avoid condensation. Pallet boxes containing TBUs must not be stored being exposed to direct sunlight.



TBUs not mounted on wheelset and stored by the Customer, must be handled with care: incorrect transportation can cause vibrations or impacts. If the boxes have fallen or they have come in contact with water, the bearings are not suitable for use: contact SKF for instructions.

The bearings, axlebox and accessories must be protected against moisture and dirt before and during mounting. TBUs, when stored, must remain sealed inside their pallet box until immediately prior to mounting. If any undesired condition is found on TBU when opening the pallet (condensation, sign of damage, missing components, etc.) do not use any TBU in that box, but contact SKF for further instructions.



Pallet boxes containing TBUs

Storage, transportation and handling of the TBUs mounted on a wheelset.



Following fitment on a cartridge bearings or axlebox bearings charged with grease, to the new, overhauled, repaired or otherwise serviceable wheelset, the wheelset should be used in traffic within 12 months.

Within this storage level, the grease contained in the bearing arrangement shall be agitated periodically to prevent oxidation. This may be undertaken by rotating the outer race of the bearing or the axlebox several times, or rotating the wheelset whilst the bearing outer races or axlebox are stationary, 20 rotations minimum. The latter may best suite wheelsets fitted within bogies. It is recommended that this redistribution of grease is undertaken at least every 4 months.

In case rotation is not undertaken and in any case after 12 months of mounted wheelset storage, it is necessary to dismount some units by sampling in order to check the condition and to take decision on the rest of the fleet. Sampling and conditions need to be agreed between the parties.

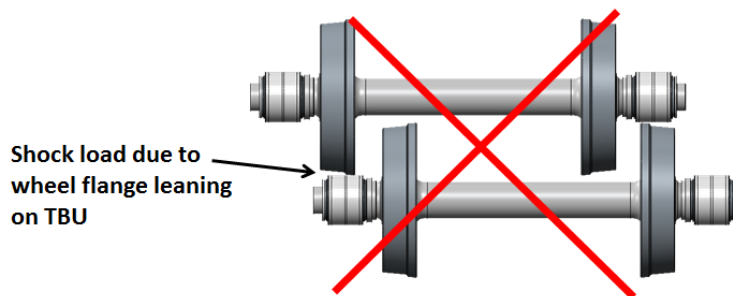
Unless otherwise documented, the elapsed time will be counted from the manufacturing date stamped on the TBU outer seal front side.



Extreme care must be taken during handling and transportation of the wheelsets, in particular (but not only) without axlebox. This in order to completely avoid shock loads on the bearings, which are extremely detrimental to the integrity of the product.

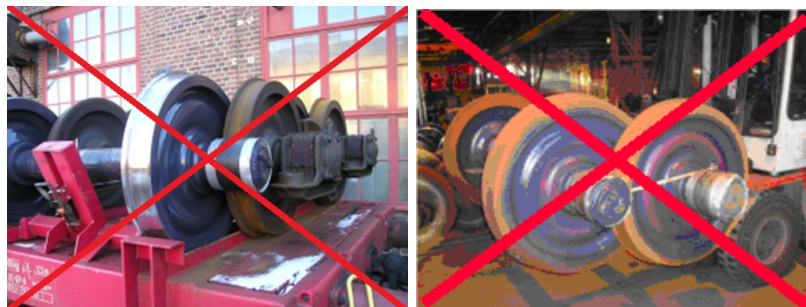
Staggering with the wheel flange in contact with the TBU is a wrong and dangerous way of storing/transporting the wheelsets because shock loads on the TBU can occur, damaging it.

Wrong Staggering



Wrong staggering, shock load on TBU

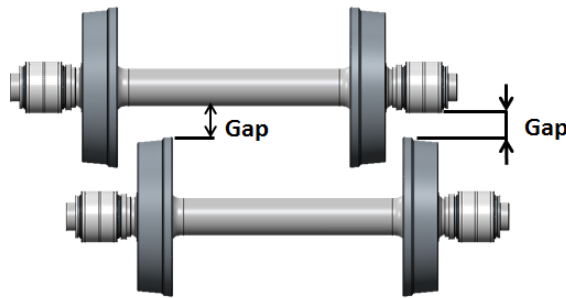
Figures below show some examples of wrong staggering while transporting wheelsets:



Incorrect wheelset transportation (wrong staggering)

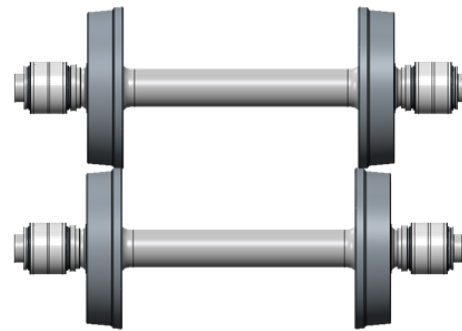
Aligning is that correct way to store/transport the wheelsets since each wheel flange is directly leaning on the flange of the other wheel. This will not cause any shock load to the TBUs. It is also allowed to have staggering during storage and transportation in order to save space, provided that there is no contact between the two wheelset. Customer is free to adopt any solution to prevent contact between staggered wheelsets.

Correct Staggering



Gap between wheel flange and TBU and wheel flange and axle: no shock load on TBU and axle.

Aligning



Wheel to wheel contact. No shock load on TBU.

Correct ways of storing and transporting wheelset

A complete wheelset, mounted with SKF products, must be stored in a covered area, not exposed to direct sunlight and must be protected from bad weather conditions and other damaging agents. If water has entered in the TBUs during the storage and transportation of the wheelsets or if any other signs of bearing damage are detected, the TBUs are not suitable for use. Dismount them from the wheelset and contact SKF for further details. Bearings with labyrinth seals shall be with the final arrangement of the axlebox or with provisional protection approved by SKF.



Sealed plastic bags (like the ones shown below) wrapped around SKF TBUs are forbidden, as they promote condensation.



Plastic bags and staggering: not acceptable



Particular care has to be taken during transportation by ship. Vibrations at low frequency can occur, leading false brinelling on the outer ring and inner ring raceways through the rollers. In this case the main recommendations are:

- Lift the wheelset or bogie in order to avoid the wheels being in contact with the deck of the ship.
- Apply an anti-vibration component (such as wood or rubber) between the axle or bogie and the deck of the ship so that it can absorb this vibration. An important point is that the axle or bogie has to be firmly secured to the anti-vibration system in order to avoid any movement, in axial direction, of the complete assembly between axlebox body and bearing inside it.
- Store in closed containers and the axles/bogies must not come into direct contact with water. It is recommended that they are protected with an air permeable fabric.

Cleaning of the vehicles

The vehicles can be cleaned mainly using water, sand blasting and shot peening. Precautions must be taken with all methods in order to avoid damaging the TBU. The following sections deal with each cleaning method in detail.

Cleaning with water and detergents



It must be absolutely ensured that no water or solvents enter in the bearing arrangement. If these liquids enter the bearing, they destroy the lubricating effect of the grease and oxide the bearing steel, leading to bearing failures. When the vehicles/bogies are washed, the water jet must not be directed onto the seals. High pressure washing is forbidden when labyrinth sealing system is used on the rear side. The maximum allowed water temperature is 70 °C. Detergents used together with water may damage TBU components: in case of doubts, please contact the Sales Unit and the Application Engineering.

Cleaning with sand blasting



Sand blasting and shot peening destroy the seals and the phosphate coat on the inner, outer seals and on the outer ring. When using one of these cleaning methods it is therefore absolutely necessary to avoid that these particles come into contact with the bearing.

Electro welding on vehicles or bogies



If welding operations are carried out on the vehicle bodywork or the bogie, all precautions must be taken to prevent the passage of electric current through the bearing.

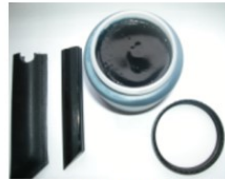
Ultrasonic control of the axle



When ultrasonic control is carried out on the axle, it must be ensured that no oil, or any other fluid used for UT, enters inside the bearing unit.

JOURNAL CONTROL BEFORE TBU MOUNTING

This chapter describes the steps to be followed to check the correct functionality of the journal. To obtain reliable measurements, the journal shall have the same temperature as the measuring instruments, approximately 20°C. The following tools must be available:



Prussian blue



Thermometer



Ruler



Cloth



Stirrup gauge



Honing stone/Emery paper

Tooling for journal control

The journal must be checked immediately before the bearing mounting in order to minimize the risk of damaging the bearing.

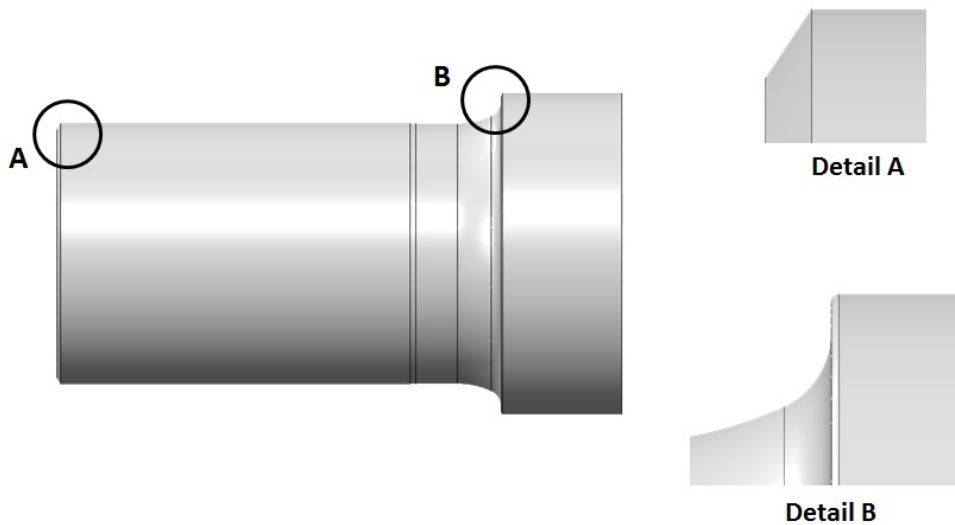
The procedure to perform a correct check of the journal is reported here below.

- 1) Clean the journal and measure the superficial temperature as illustrated below



Cleaning and temperature measurement of the journal

- 2) Examine the surface of the journal where the bearing will be fitted, fillet "A" and the vertical abutment "B" for the sealing collar: remove any burrs, scratches or dents. Check that the edge of the journal bearing is not sharp.
A chamfer must be present and its edges must be smoothed. The journal shoulder must be free from pre-existing paint and/or antirust coating. Ensure that the threaded holes for the end cap screws are clean and not burred. Clean the holes by blowing compressed air into them.



Journal detail

- 3) If some edges are protruding outside the journal cylindrical shape where the bearing will be fitted, these must be carefully removed. In this case, a honing stone or emery cloth is recommended. Sometimes, in workshops, sandpaper is used to clean-up surfaces that have been affected by fretting corrosion or any other kind of surface change. In many cases, the result is that the correct diameters are change as too much material is removed. In order to prevent this type of damage, SKF recommends using sandpaper with the correct grit size, according to the following table.

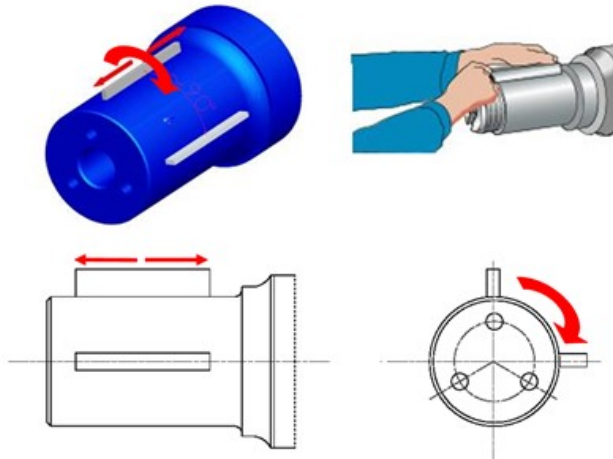
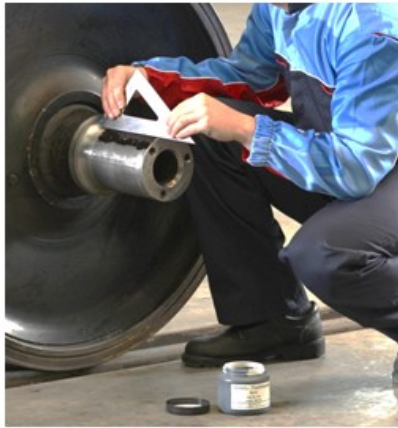
Grit size table			
General Grits Dimensions	ISO/FEPA Grit Designation	CAMI Grit Designation	Average particle diameter relative to FEPA Designation (μm)
MACROGRIT	P220	220	68.0
MICROGRIT	P320	240 or 320	46.2

Table with grit size recommended by SKF

Different standards have been established for the grit size. The two most common are the United States CAMI (Coated Abrasive Manufacturers Institute) and the European FEPA (Federation of European Producers of Abrasive) "P" grade. The FEPA system is the same as the ISO 6344 standard.

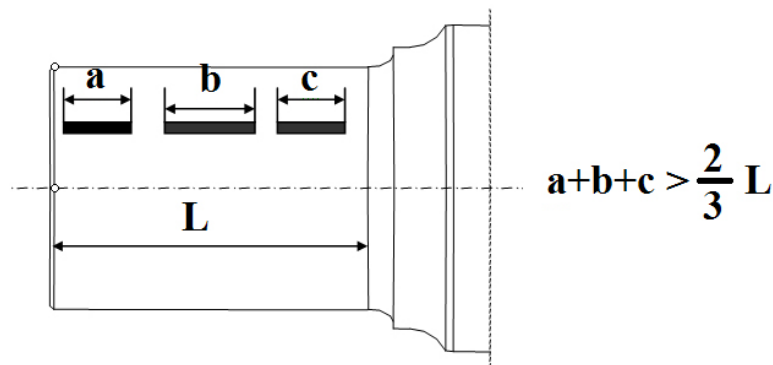
The following procedure must be applied to remove edges using sandpaper:

- Firstly the coarser sandpaper (grit size P220 or P320) is passed to remove greater surface indentations.
 - Secondly the finer sandpaper (grit size P400 or P800) is wiped to obtain a is polished and smooth surface of the journal.
- 4) The journal must not have waves on its surface. This aspect can be checked by mean of a metal ruler smeared with Prussian blue by moving it forwards and backwards on the journal in the axial direction, several times. This inspection shall be carried out at least in two planes at 90° as showed in figure below.



Procedure to control journal

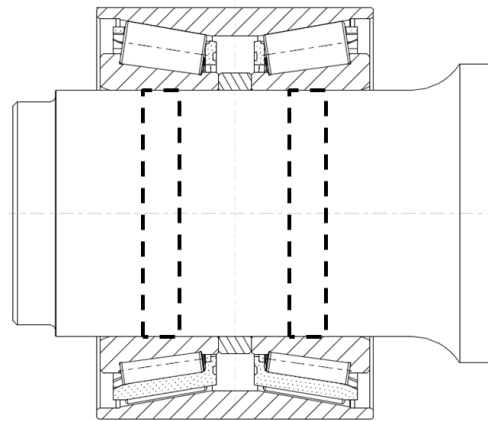
If there is an unbroken line on the surface plate, the journal is good and suitable for use. If a dashed line is left on the journal, as shown below, and the length of its parts is less or equal than $\frac{2}{3}$ of the total length, **the journal must be repaired or scrapped**. The following rule shall be respected:



Acceptance criteria for journal scratches

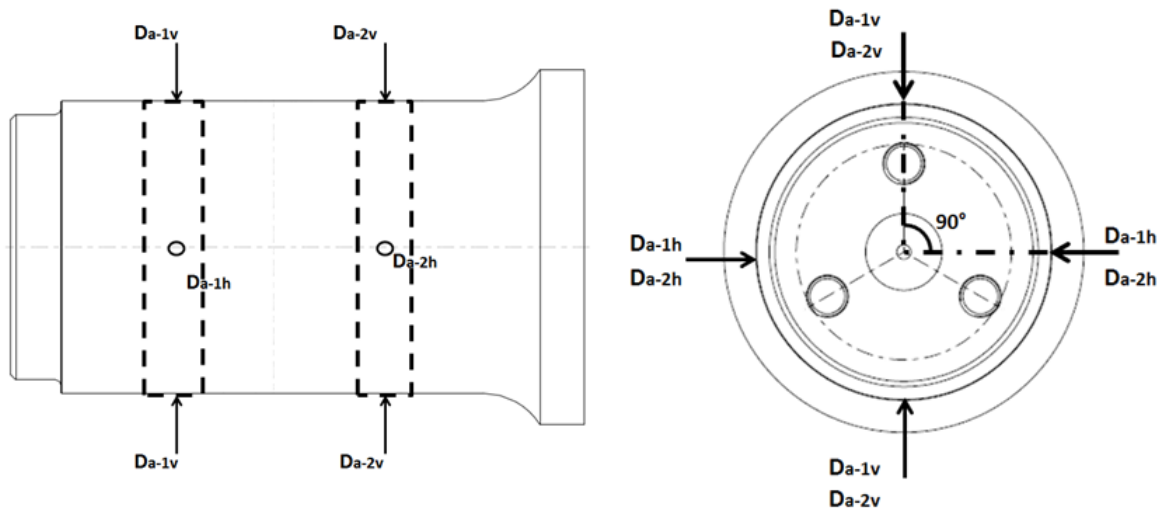
If several short undulations are detected on the journal, the surface where the bearing will be fitted must be reground over its entire length. The reground journal must be within the specified tolerance limits.

- 5) Verification of diameters D_a and D_b .
Diameter D_a is the diameter of the journal at which the bearing bore is fitted.
" D_a " should be measured in two planes at 90° each other, approximately where the middle of the two inner rings will be placed (dashed lines):



Bearing seat diameter

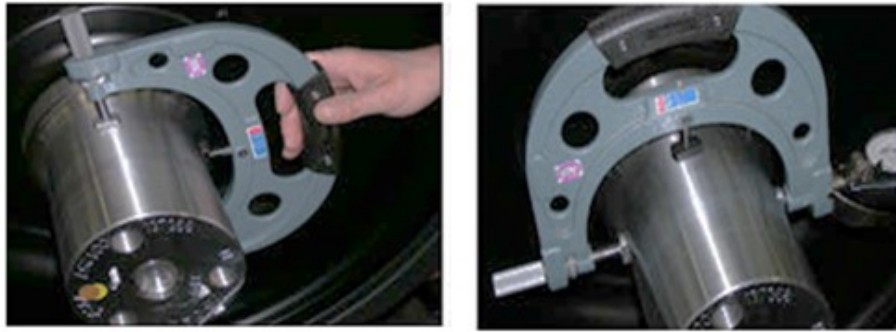
Values D_{a-1v} and D_{a-2v} are the values of D_a measured in the vertical position while D_{a-1h} and D_{a-2h} are the values of D_a measured in the horizontal position (i.e. measured in a plane rotated of 90° with respect to the one in which D_{a-1v} and D_{a-2v} are measured). These values must be within the tolerance prescribed for the journal.



How to measure D_a

It is strongly recommended to measure D_a by mean of a stirrup type gauge with three points.





Stirrup gauge with three points used to measure D_a

Once the diameters have been measured, the verification of the journal deviations of conicity and ovality must be verified. Ovality is evaluated in the sections of the journal where inner rings are fitted:

$$\text{Ovality}_1 = |D_{a-1v} - D_{a-1h}|$$

$$\text{Ovality}_2 = |D_{a-2v} - D_{a-2h}|$$

Conicity is measured both on the vertical and on the horizontal planes:

$$\text{Conicity}_v = |D_{a-2v} - D_{a-1v}|$$

$$\text{Conicity}_h = |D_{a-2h} - D_{a-1h}|$$

The deviations of journal diameter (ovality, conicity) must not be greater than the tolerance of ISO class 5, unless otherwise specified by the Railway Network. The table below provides the most common ISO tolerance classes for linear dimensions from 50 to 250 mm:

Basic size [mm]		Standard tolerance classes						
		IT4	IT5	IT6	IT7	IT8	IT9	IT10
Above	Up to and including	Tolerances [μm]						
50	80	8	13	19	30	46	74	120
80	120	10	15	22	35	54	87	140
120	180	12	18	25	40	63	100	160
180	250	14	20	29	46	72	115	185

Table with ISO IT tolerance classes



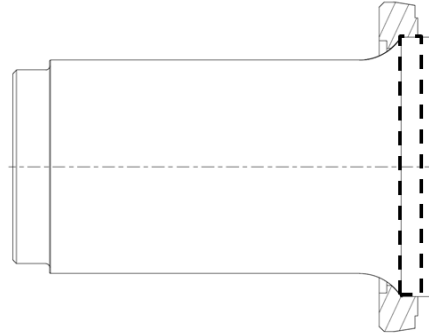
Example:

A journal with diameter 120 mm is given. If no other specifications are prescribed by the Railway Network, the deviations of ovality and conicity must not be greater than ISO class 5. It can be seen from the table above that the class 5 tolerance is 15 μm for diameter of 120 mm. This means:

- $\text{Ovality}_1 \leq 15 \mu\text{m}$
- $\text{Ovality}_2 \leq 15 \mu\text{m}$
- $\text{Conicity}_v \leq 15 \mu\text{m}$
- $\text{Conicity}_h \leq 15 \mu\text{m}$

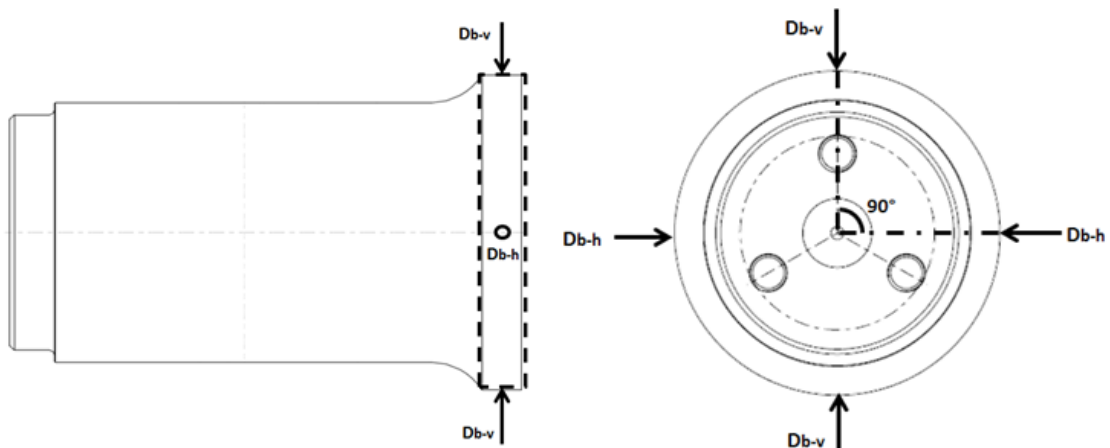
Diameter D_b is the Backing Ring Seat Diameter, i.e. the diameter of the journal at which the backing ring is fitted.

" **D_b** " must be measured in two planes at 90° each other, approximately where the middle of the backing ring will be placed (dashed line), and it must be within the values prescribed for the journal:



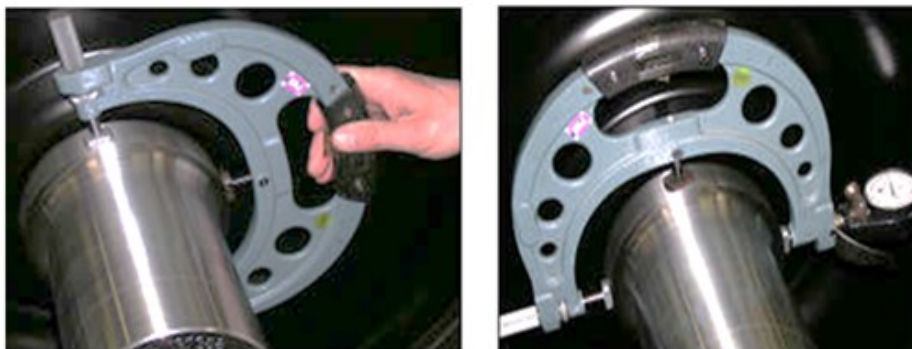
Backing ring seat diameter

Values D_{b-v} and D_{b-h} are the values of D_b measured in the vertical and in the horizontal position (i.e. measured in a plane rotated of 90° with respect to the one in which D_{b-v} is measured).



How to measure D_b

Again, it is strongly recommend to measure the backing ring seating diameter using a stirrup type gauge with 3 points.



Stirrup gauge with three points used to measure D_b

Once the diameter values have been measured, the ovality must be verified. Ovality is evaluated in the section of the journal where backing ring is fitted:

$$\text{Ovality} = |D_{b-v} - D_{b-h}|$$

Ovality must not be greater than the tolerance of ISO class 5, unless otherwise specified by the Railway Network.



Example:

The tolerances of ISO class 5 for diameter 120 mm is IT5 = 15 µm. If no other specifications of the Railway Network are prescribed, ovality of the backing ring seat diameter must be smaller than 15 µm. This means:

$$\text{Ovality} = |D_{b-v} - D_{b-h}| \leq 15 \mu\text{m}$$

- 6) Magnetized axles must be demagnetized before mounting the SKF bearings.

TBU MOUNTING INSTRUCTIONS



The procedure described in this chapter is applicable to the mounting process in which SKF tools are used. Nevertheless the safety instructions as well as the technical prescriptions are also applicable when mounting with other tools, e.g. when the reaction to the press force is obtained by a bar passing through the journal.

After the dimensional controls and geometric verifications of journal and axlebox, proceed with the assembly of the SKF bearing. Before mounting the TBU by press, verify that all the necessary tooling is available as shown in figure below:



Lubricant agent



Torque wrench



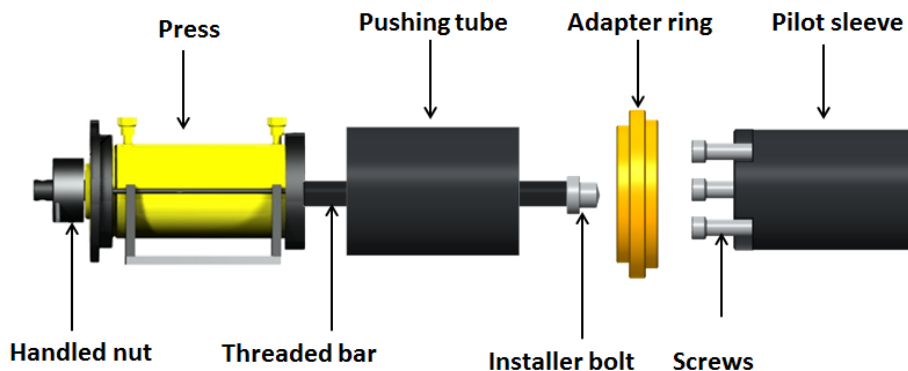
Axial clearance measurement tool



Mounting press

Tools for TBU mounting

The mounting press supplied by SKF includes the following components:



SKF mounting press

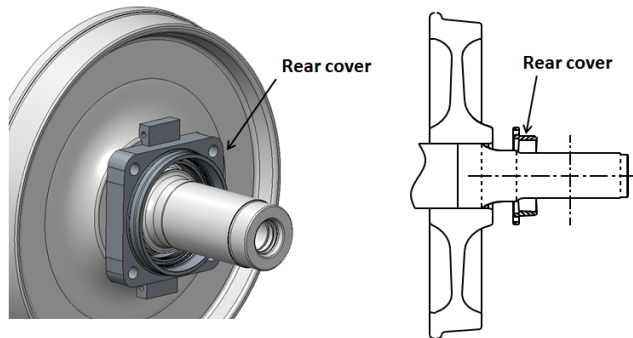
The TBU mounting procedure is divided in the following steps:

- Mounting of the TBU on the journal
- Mount of the end cap on the TBU
- Measurement of axial clearance

Mounting of the TBU on the journal

The following operations must be followed:

- 1) When the backing ring of the TBU is mounted together with the TBU bearing using the press, make sure to place the rear cover, if present, on the journal before the mounting of the TBU, as figure below shows:



Rear cover mounting



The provisionally placed rear cover must not interfere with bearing mounting.

- 2) Mount the pilot sleeve onto the journal with the screws, in order to hold and guide the TBU during the mounting.



Pilot sleeve

Pilot sleeve mounting

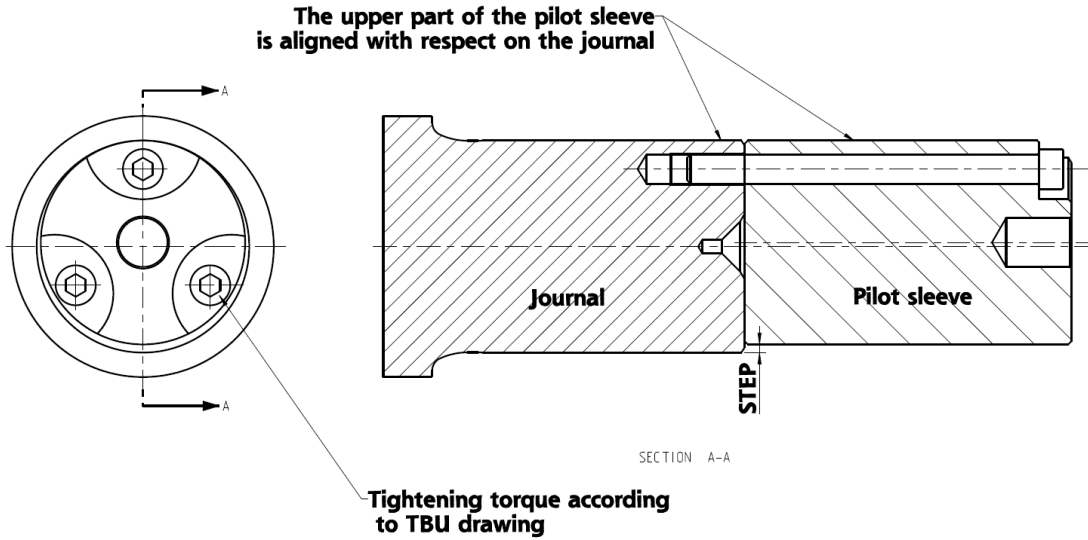


Tighten the screws with the tightening torque specified in the TBU assembly drawing for the end cap screws; if it is not indicated, please contact SKF.

The operator must be sure that the female thread of the journal is able to withstand, without damage, the effects of the force generated by the screws plus the final seating force.

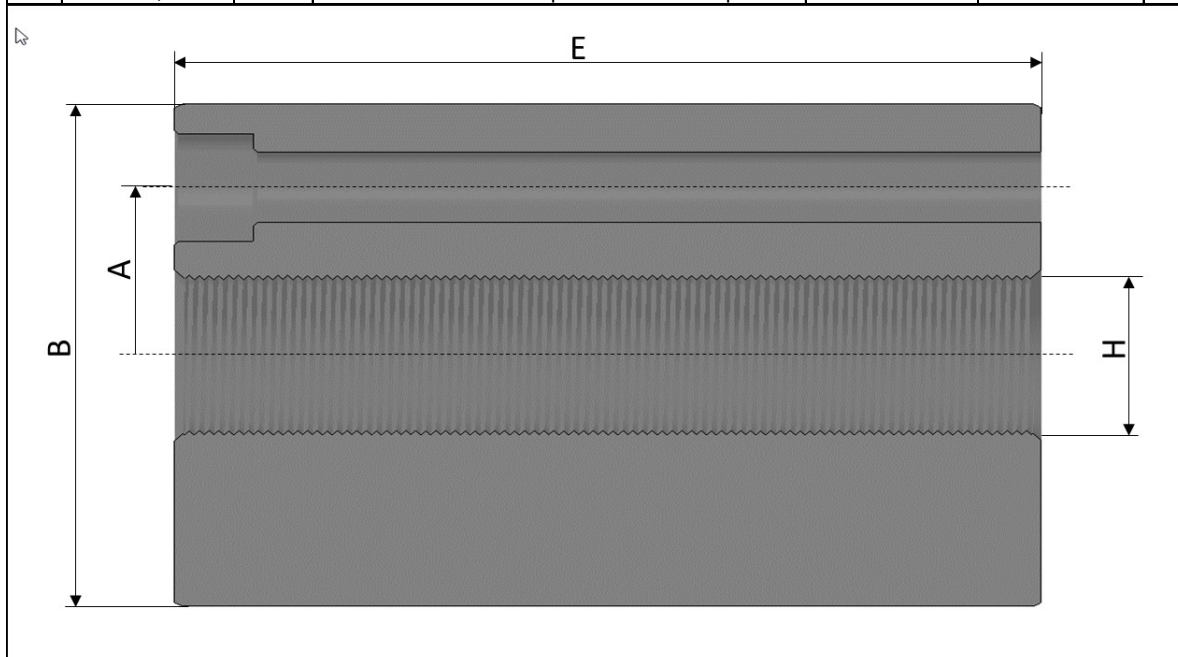


The pilot sleeve must be mounted in a way that its upper part is aligned with the journal. The step must be located in the lower part in order to avoid possible damages to the TBU and journal.



Pilot sleeve alignment

TBU size	outer diameter B (0 / +0,1)	length E	Material	pitch diameter A	no. Holes at 120 °	through hole H
90	89,7	150	39NiCrMo3 UNI 7845 quenched and tempered	60	3	M30x2
100	99,7	170	39NiCrMo3 UNI 7845 quenched and tempered	60	3	M30x2
120	119,7	200	39NiCrMo3 UNI 7845 quenched and tempered	80	3	M48x3
130	129,7	220	39NiCrMo3 UNI 7845 quenched and tempered	90	3	M48x3
150	149,7	220	39NiCrMo3 UNI 7845 quenched and tempered	100	3	M48x3



Example of pilot sleeve dimensions and material

- 3) Check the alignment of the upper part of the pilot sleeve with the journal using a ruler and by measuring it at 0° (12 o' clock). No step must be detected in the upper part.



Alignment control

- 4) When present, mount the installer bolt on the pilot sleeve.



Installer bolt

Installer bolt detail

- 5) Apply a thin and uniform layer of the most suitable lubricant agent to the journal and to the collar journal.



Coating with lubricant agent



The layer of the agent must be very thin and applied with a paint brush/cloth. High quantity of agent is detrimental for smooth mounting.

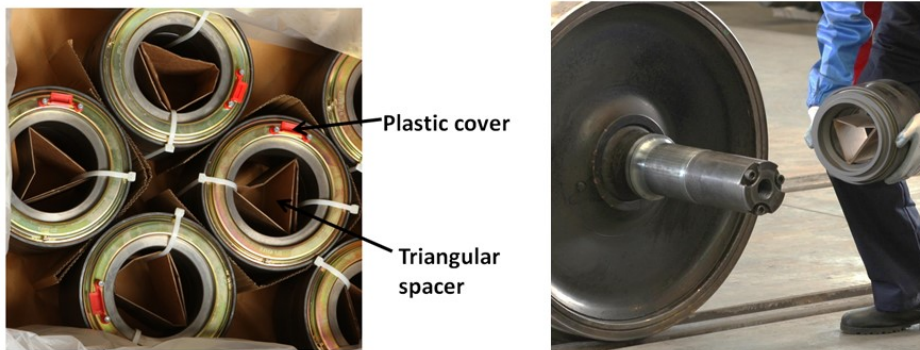
SKF recommends followings agents:

- Molikote DX
- Molikote G-n plus

Possible other agents:

- Thick mineral oil (SAE 30)
- Oil and molybdenum disulphide mixture (70%-30%)
- Anti stick-slip oil

- 6) Pick up the TBU from the pallet box; do not remove the triangular retainer placed in the TBU bore in order to avoid any movements of the central spacer. If the TBU is a sensorized one, do not remove the protecting plastic cover on the end cap side.



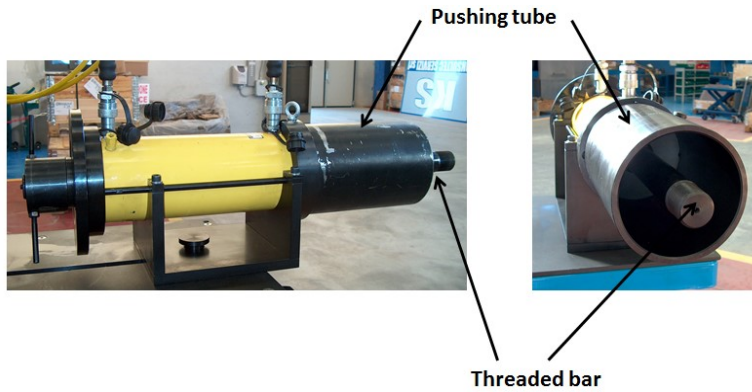
TBUs with plastic retainer and plastic cover

- 7) Place the TBU on the pilot sleeve by hand. The retainer will be automatically pushed out, as shown in figure below (left). After the removal of the retainer, the TBU placed on the pilot sleeve looks like the one in figure below (right).



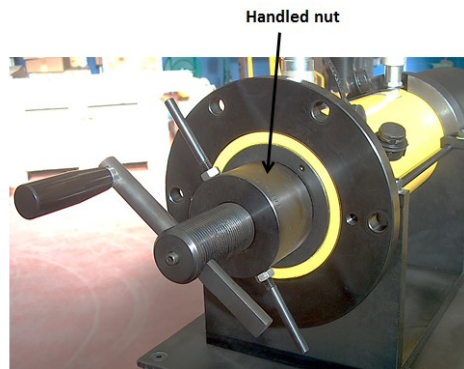
Placement of the TBU on the journal

- 8) Assemble the threaded bar and the pushing tube with the press



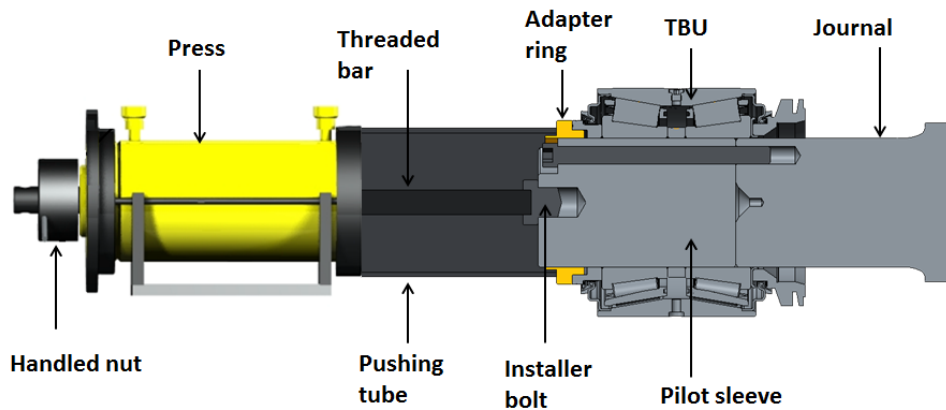
Threaded bar assembling

- 9) Lock the hydraulic press against the threaded bar using the handle nut.



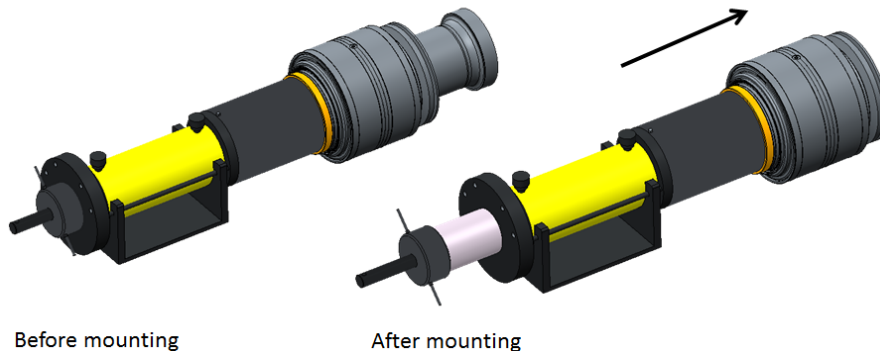
Handle nut assembling

Proceed by fixing the press assembly to the pilot sleeve. The assembly of all the components in shown below:



Mounting press and TBU assembly

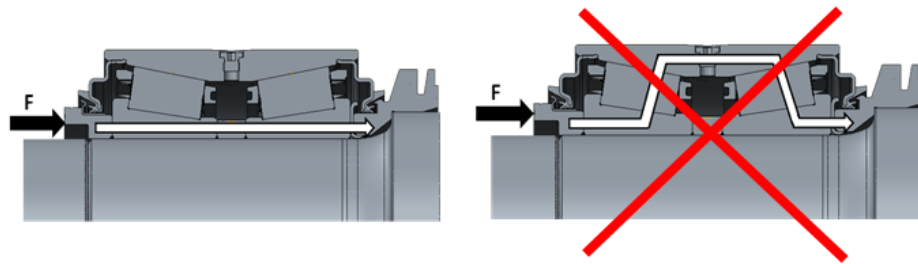
- 10) The TBU is now ready to be mounted. Switch on the hydraulic press: the TBU starts to slide along the journal as a consequence of the applied hydraulic force.



Mounting scheme



The mounting force should be transmitted via inner rings and not via the roller set. It is forbidden to mount the TBU by applying the mounting force on the outer ring.



Transmission of mounting force inside TBU

To verify that the load is properly transmitted, the outer ring must be free to rotate during all the mounting phase. As a consequence, the outer ring must be kept in rotation during mounting. If it jams, discontinue the operation, dismantle the bearing and contact SKF for inspection.



If the TBU is equipped with p-spacer, it must not be detached and mounted separately. It must be mounted together with the TBU. No components must be detached.

In case, during mounting, some components are detached (for example the backing ring from the bearing, etc.), the mounting process must be stopped and the TBU dismantled. Then contact local application engineer on how to proceed.

Stick-slip phenomenon is not normal during mounting as it can damage the TBU and the journal. If stick-slip occurs, stop the operation and contact the local application engineer on how to proceed.

Keep under control the dial indicator of the manometer in order to get the right seating force. During the mounting pressure will slowly increase. At the final seating phase, when the backing ring gets in contact with the journal abutment, a very quick pressure increase will be noted. The final value of pressure the dial indicator corresponds to the "final seating force" (see SKF drawing). Keep the press force applied for few seconds.



The correct final seating force is indicated on the TBU assembly drawing. Please contact the SKF Sales Unit Application Engineer if such indication cannot be found on the drawing. If the final seating force exceeds the maximum limit it is possible that some TBU components are permanently damaged, e.g. the polymer spacer. In this case it is strongly recommended to contact SKF. It is also recommended to use a press with a pressure relief valve which acts whenever the final seating force is exceeded.

- Once the bearing is mounted, release the pressure until the adapter ring comes free, unscrew the handled nut, roll the hydraulic press away, remove the threaded bar, the installer bolt and dismount the pilot sleeve.

Mounting of the End Cap

- Once the bearing is mounted and the pilot sleeve dismantled, place the end-cap in position.



End cap assembling

- Place the locking plate in front of the end-cap and then insert the screws.



Locking plate and screws assembling

- Tighten the screws at the tightening torque specified in the assembly drawing, using a torque wrench. If tightening torque is not indicated in the drawing, contact SKF.



The screws shall be tightened in two loops:

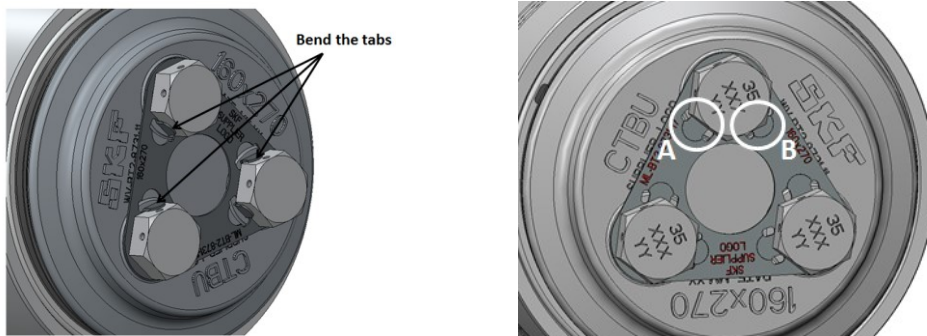
- 1st loop: 50% of the final torque
- 2nd loop: final torque

If the end cap has four screws, in addition to the above mentioned instructions, it is recommended to tighten them following a crossed sequence, as shown in the figure below:



Correct sequence for tightening screws

- 4) Bend the tabs of the locking plate against the screws in order to avoid unscrewing:



Bending of locking plate tabs

It is possible that the screw head faces are not aligned with the locking plate tabs after the screw is tightened. Locking plates are manufactured to have at least one tab that can be almost aligned with one face of the screw head. In this case it is sufficient to bend this tab. Consider the situation showed in the figure above (right): after screw tightening, the tab B is on the edge of two faces of the screw head, therefore it is difficult to bend. In this case, tab A must be bent because it is the one better aligned with screw head face.

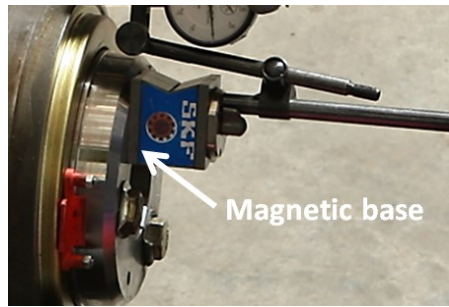
Measurement of internal axial clearance



The internal axial clearance must only be measured when the bearing is completely mounted, with end cap fitted and tightened screws.

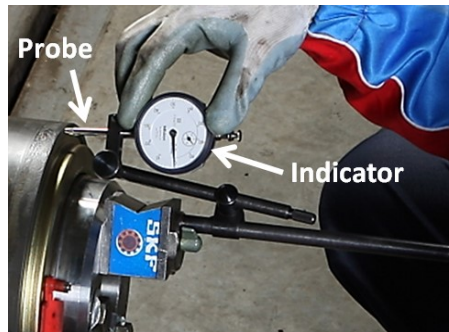
The procedure to measure axial clearance is reported below:

- 1) Apply the magnetic base of SKF tool on the end-cap face.



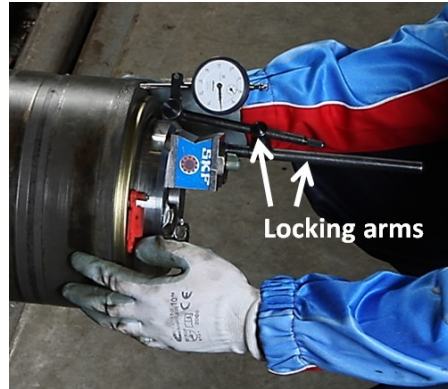
Detail of SKF tool for axial clearance

- 2) Place the probe on the flat face of the outer ring so to measure axial movements.



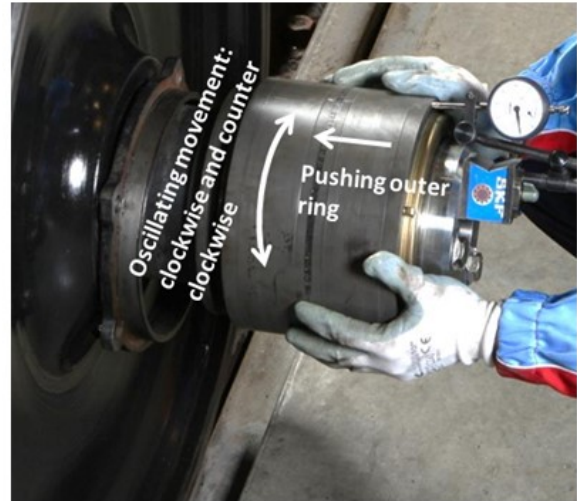
Detail of SKF tool for axial clearance

- 3) Secure the probe position through the locking arms.



Detail of SKF tool for axial clearance

- 4) Check the internal axial clearance of the TBU moving the outer ring (cup) by hand. In this operation, apply an oscillating movement to the outer ring during the pushing as well as during the pulling phase. The excursion between maximum and minimum value measured is the axial clearance and can be read on the indicator. See picture below:



Movements to be applied to the outer ring to check the axial clearance correctly

- 5) The value of the theoretical residual axial clearance of the TBU is indicated on the drawing. It may happen that, due to the grease thickness and the applied method itself, the actual value measured is lower than the one indicated on the drawing. In this case contact SKF. Free rotation of the TBU outer ring must be guaranteed at any time.

TBU DISMOUNTING INSTRUCTIONS



The procedure described in this chapter is applicable to the dismantling process in which SKF tools are used. Nevertheless, the safety instructions as well as technical prescriptions are applicable also to dismantling operations performed with other tools.

The following tools are needed to correctly dismantle a TBU:



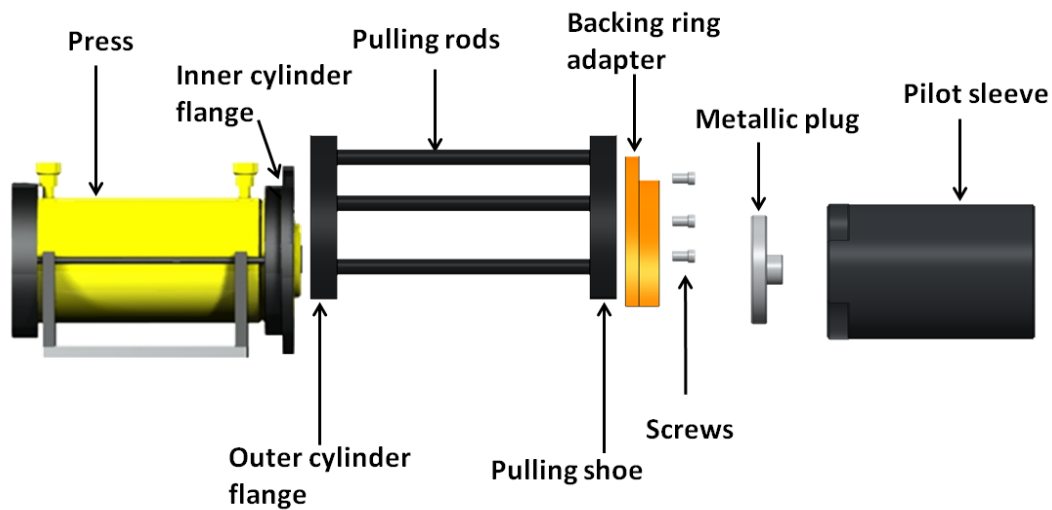
Dismounting press



Dead-blow hammer

Tools for TBU dismantling

The SKF press in dismantling configuration has the following components:

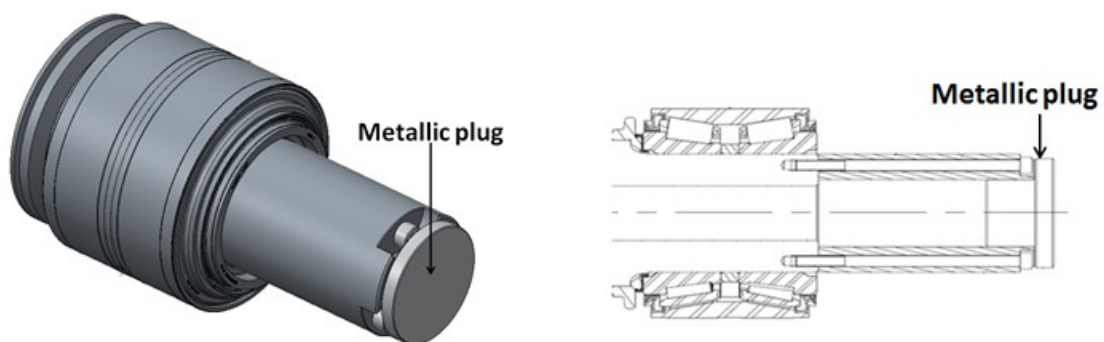


SKF dismantling press

In order to perform a correct dismantling, follow the procedure below:

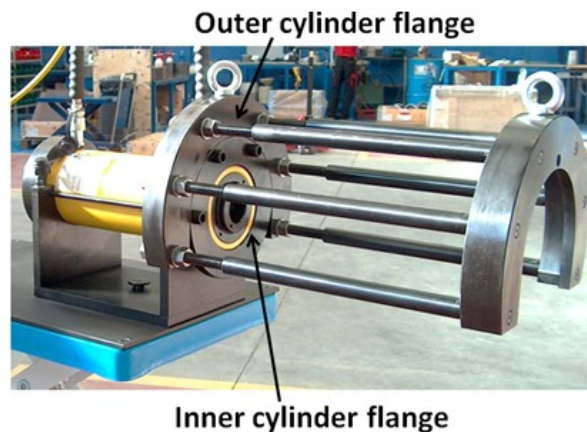
- 1) Dismount the outer additional equipment (e.g. shock absorber, axlebox, sensors, etc). A dead-blow hammer can be used if needed.
- 2) Make sure the surrounding TBU components have been cleaned to avoid contamination in the bearing arrangement.
- 3) Unlock the locking plate. Dismount the screws and remove the end-cap.
- 4) Mount the pilot sleeve: this is needed to support the TBU preventing it from falling to the ground once it is dismantled from the journal.

Mount the metallic plug (when delivered by SKF) onto the pilot sleeve. It will be the interface of the press piston during the dismantling.



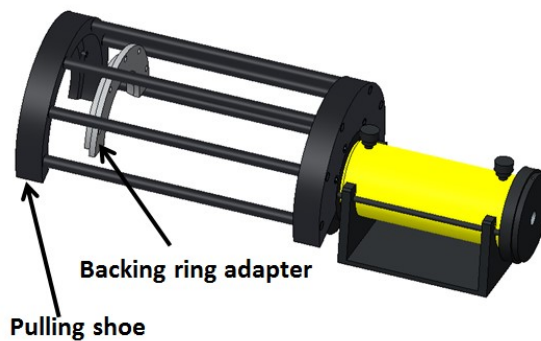
Metallic plug assembling

- 5) Assemble the pulling shoe on the press using a crane, as figure below shows. The distance between the pulling shoe and the outer cylinder flange ram side is obtained by the position of the pulling rods. This position must be strictly the same for all the pulling rods.



Pulling shoe assembling

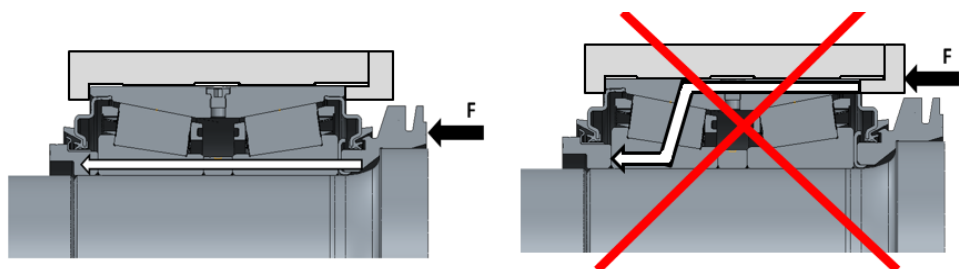
- 6) Align the press so that the pulling shoe is over the back side of the backing ring of the TBU, then lock the pulling flange just behind the backing ring. In some cases an adapter (depending on the TBU size) can be mounted on the pulling shoe in order to guarantee a correct matching with the backing ring, see figure below:



Backing ring adapter

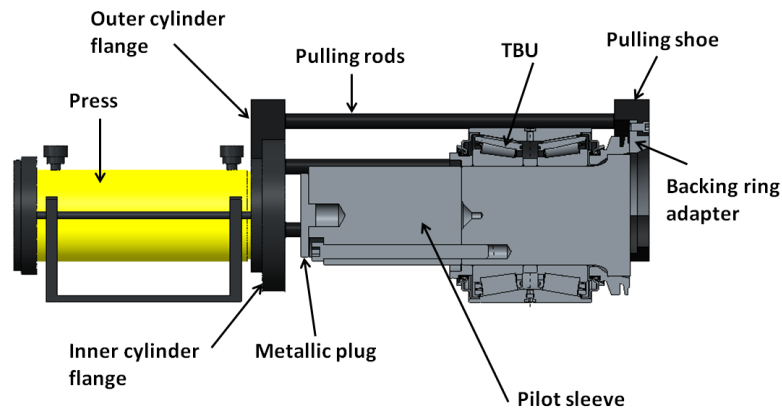


The pulling shoe must engage only the backing ring and must not touch the rear cover or the housing, when present. This condition is necessary to ensure the dismounting force is transmitted via inner rings and not via the roller set



Transmission of dismounting force inside TBU

Figure below shows the final assembly configuration of the dismounting tool:



Dismounting press and TBU assembly

- 7) With the pulling shoe in position, apply the pressure. The pressure of the piston will be applied through the metallic plug to the end of the pilot sleeve and will allow the removal of the TBU.



Before dismounting After dismounting

Dismounting scheme



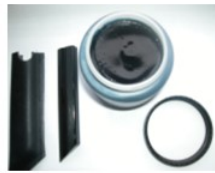
Maintain the manometer of the press under control during all the operations.

CONTROL OF THE AXLEBOX

In the case of any disassembly of the bearing from the wheelset after one or more periods of service, it is essential to have an accurate control of the axlebox before it is reassembled and put into operation. The axlebox control is divided into four steps:

- Rust removal
- Visual control
- Dimensional control
- Check of housing integrity

In order to perform a correct check, the following instruments are needed:



Contrast liquid



Abrasive flap wheel



Ruler



Solvent

Tools for axlebox control

Rust removal

After one or more periods of bearing service, when dismantled from the wheel-set, the railway axlebox looks like the one in figure below. The housing bore is covered with "fretting corrosion" caused by the hammering of the outer ring of the TBU against the housing bore. It is important to clean the contact areas affected by the fretting corrosion (mainly the housing bore, but also other parts of the axlebox) before making the further controls.



Fretting corrosion on an axlebox back from service

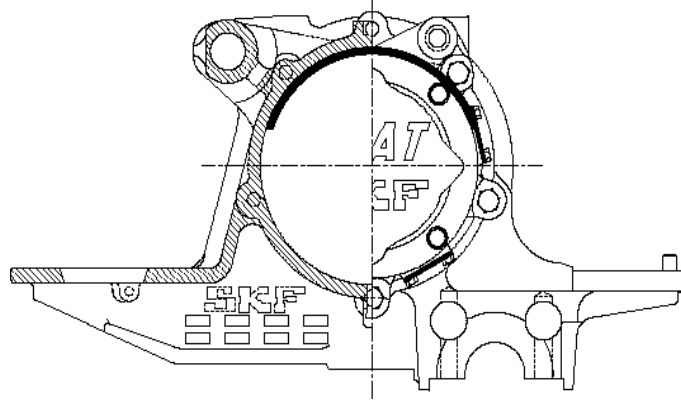
The procedure for cleaning the axlebox is reported below:

- 1) Clean the housing and the axlebox components (covers and other elements) by washing. After washing, remove any rust particles detached and traces of washing liquid with rags and air. Remove the "rust of contact" from the cover faces in contact with the covers. Clean the holes of the covers.



Please note: when you do not proceed immediately to the next step, protect the axlebox housing and components from possible oxidation (by using for example, Dinitrol 41 or equivalent)

- 2) Proceed with the mechanical removal of the "fretting corrosion" in the bore of the housing where the bearing is fitted. Typical areas affected by the "fretting corrosion" are shown below (thick black line):



Area of concentration of fretting corrosion

It is recommended to place the housing with the loaded area on the bottom, since the fretting corrosion is more evident in the loaded zone:



Removal of fretting corrosion

The "mechanical cleaning" from the fretting corrosion can be carried out using a "flap wheel" or rotating brush mounted on a mandrel machine. Utilize grit size correspondent to sand paper with "grit size" 180-200. Alternatively, the cleaning can be executed with sand paper, grit size 180-200.

- 3) Protect the axlebox and its components from a possible oxidation using a solvent (Dinitrol 41), as shown below. Compressed air shall be used to clean the screw holes and regreasing holes of the housing.



Use preferably a solvent in connection with the cleaning surfaces



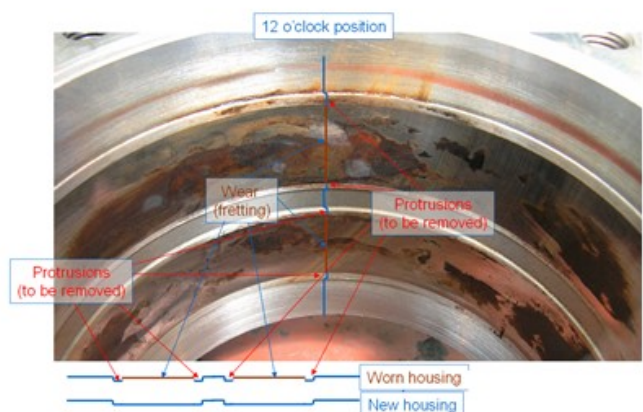
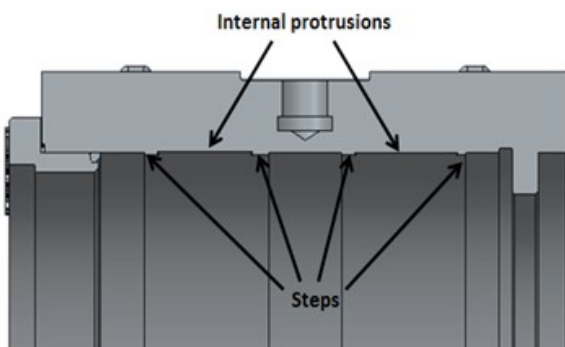
Wipe dry thoroughly all around the bore.

Application of anti-oxidation solvent

Visual Control

The visual control is fundamental to ensure that the axlebox, even if already used, will guarantee a performance of the TBU as if it was new. The procedure to perform a proper visual control is the following:

- 1) Check of the housing.
The bore of the housing must be completely free from steps, ridges, internal protrusions of material in respect to the bearing seat, and other localized defects that could have been created by the use of the axlebox in service. In the rest of the document, all these defects will be called "steps". Check carefully for any "dimples" and steps on the axlebox housing, especially in the proximity of the contact areas such as central recesses of the TBU outer ring and outer ring "end-drops". Here below an example of possible housing wear and steps (the picture does not exhaust all the possible cases, anyway it offers a good example; it remains the operator's duty to foresee similar situations)



Examples of steps and internal protrusions



If these defects are not removed before the re-mounting of the "used" axlebox, they may come in contact with the outer diameter of the TBU bearing and generate localized stresses and deformations at very high level which may lead to failure of the outer ring itself.

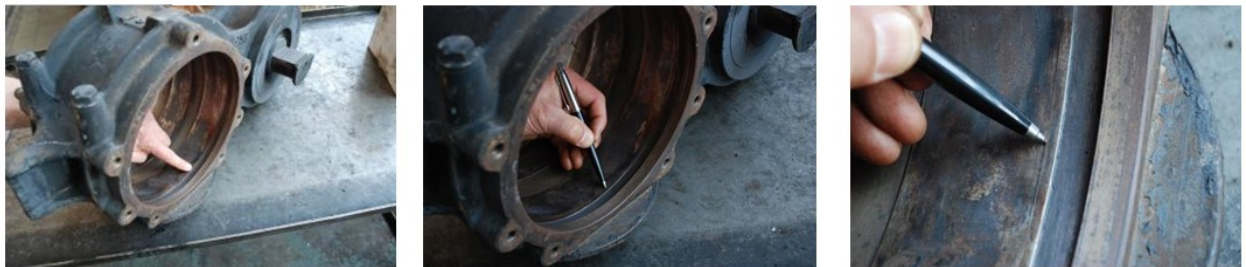
The steps, when present, are more pronounced at “12 o’clock” position, where the vertical loads are highest. The following is an example of used housing, where the area with fretting corrosion, wear and steps (ridges, internal protrusions) are present:

In order to proceed at the identification of the steps, the room must be adequately lit. Dedicated lighting must be available for the inspection of the housing bore surface, in the area of maximum vertical load.

The following methods are recommended:

- combined visual and tactile control
- control with a "ruler" (template) with built-in light
- control with “contrast liquid” (Prussian blue)

The combined visual and tactile inspection is done by passing a small needle over the area with the supposed step. If the step is felt to at the touch, it must be repaired.



Tactile inspection with a needle

The comparison with a "ruler" with built-in light it can be done by passing it, with circular motion, in the area at 120° across the area of maximum vertical load. If the light highlights steps at the edges of the contact area (light filters in the area adjacent to the step), they must be repaired.

The check with “contrast liquid” is carried out by by "smearing" the area of the housing bore in contact with the outer ring of the TBU bearing along an arch on the area of maximum vertical load: the “ruler” will then be passed on the bore surface and it must be carefully observed if the trace left has revealed steps. If so, the steps must be repaired.

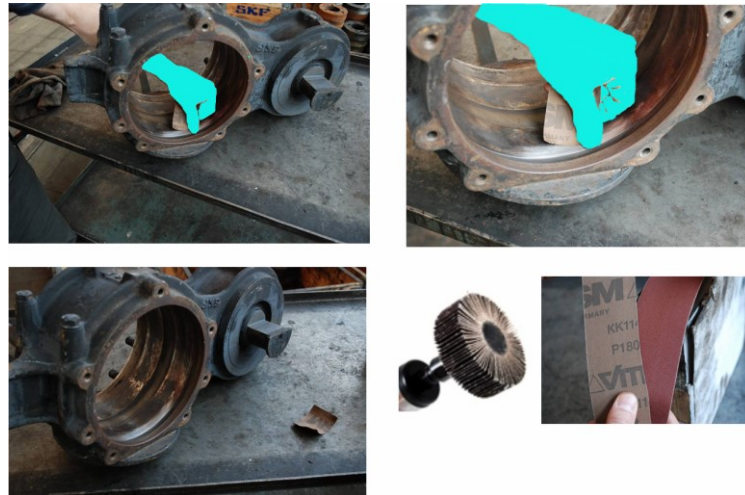


Inspection with ruler (left) and with contrast liquid (right)



The controls above are complementary. If housing steps were found with the above controls, it is necessarily to have them removed by repairing the housing bore.

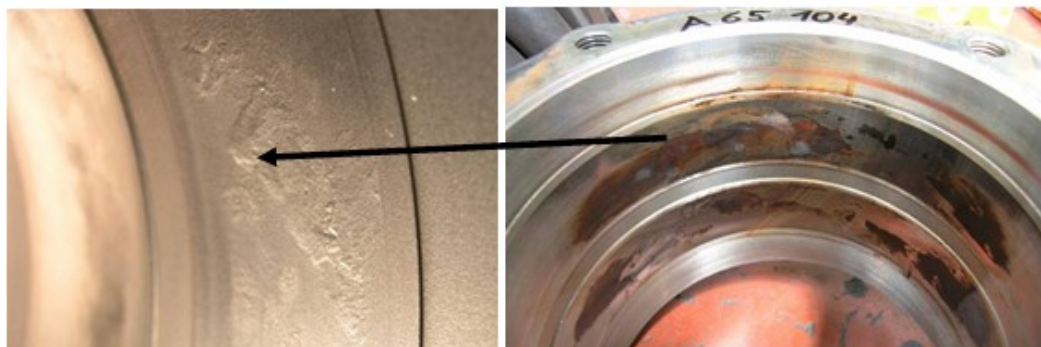
The repair can be done using abrasive stones or emery cloth, by hand or with rotary elements using a “flap wheel” or “rotating brush” mounted on a mandrel machine (utilize grit size correspondent to sand paper with “grit size” 180-200) and must completely remove the step. However, the operation must not compromise the structural integrity of the axlebox and must not produce defective geometry:



Repair of axlebox

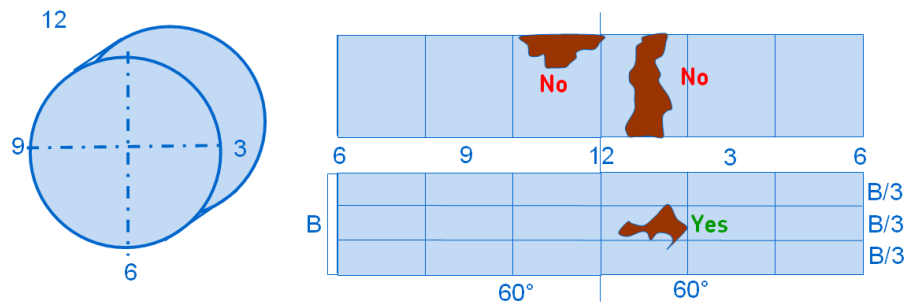
When the fretting corrosion that is present in the housing bore is significant, it is possible that its mechanical removal will leave evident dimples and irregular valleys in the area facing the outer ring of the TBU bearing.

One example is shown here below shown:



Dimples and irregularities due to fretting corrosion removal

If the area affected by these depressions is wide, the outer ring of the TBU will work with a highly irregular surface, which again leads to stress and deformations on the outer ring that can lead to its failure. It is therefore necessary to assess the entity and the position of these depressions and dimples carefully. Acceptance/rejection criterion is indicated here below (the depression areas are in brown colour):



Examination of area from -60° to $+60^\circ$ from 12 o'clock
 For depths > 0.2 mm : not acceptable across "B"
 For depths > 0.2 mm : not acceptable at the edge of "B"
 For depths > 0.2 mm : acceptable within the central "B/3"

Being "B" each bearing row axlebox seating

Acceptance criteria for surface irregularities

2) After the bore of the housing the following areas must be controlled:

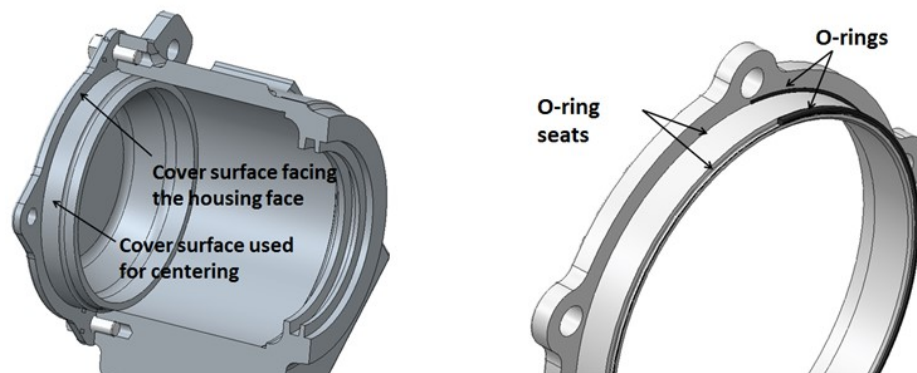
- the area connecting the boogie frame
- One or more areas of support for primary suspension
- One or more areas connecting dampers
- Connection with covers

All these areas must be checked visually on 100% of the axlebox. A well-lit room is necessary for this visual inspection. All checked areas must be free from cracks, breaks, deformations, dents and other defects.

Whenever a doubt persists that a possible crack is found, it is necessary to use the most appropriate NDT technique (see related paragraph). Only some of the axlebox, the number is agreed between customer and supplier, must be checked with technical NDT anyway.

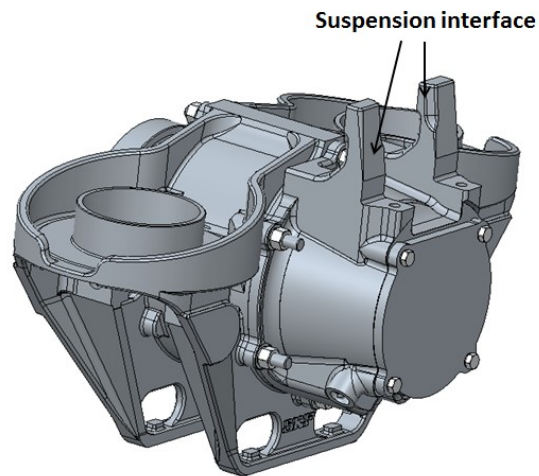
3) Control of the covers (front cover, back cover).

Remove any rust or fretting corrosion from all the cover surfaces facing the housing face and housing centring by using sand paper grit 180-200. Smooth any burrs which may appear. Make sure that the covers do not show cracks, breaks, deformations, dents and various damages. Check that the seat for the O-ring seat is not damaged. If the covers are made of aluminium material, use cloths for cleaning and not sand paper as it could remove the anodizing treatment.



Control of the covers

If the cover has a zone of connection with suspensions, shock absorbers or “lifting truck” (see picture below), check that these areas do not show cracks, breaks, deformations, dents and various damages.



Control of suspension interface of the cover

Whenever a doubt persists that a possible crack is found, it is necessary to use the most appropriate NDT technique (see related paragraph). If necessary, replace it. Make sure the threads for the screws for the front cover and that screw studs for the connection of the back cover are not damaged. Check mounting centring diameters and external devices seating, measure diameters at least on 2 angular positions: circularity and ovality, normally have not to exceed 0,1 mm.

- 4) Control of end cap.
Verify that the end cap does not present cracks, breaks, deformations, dents and various damages. Whenever a doubt persists, it is necessary to use the most appropriate NDT technique (see related paragraph). Examine with care the appearance of the surfaces in contact with the axle and the bearing. Remove any heavy marks of contact corrosion with smooth glass paper and smooth any burrs which may appear. Make sure that the threads of any middle hole are not damaged.
Make sure the threaded holes for connecting the current return plate are not damaged. In this case, replace the component.
Verify that the force application surface of the screws is not permanently deformed or cracked.
- 5) Verify screws, washers, locking plates and other components, the spring washers (of the screws).



The locking plates and the O-rings must always be replaced by new ones.

Control the threaded surfaces of the nuts and the screws carefully before reusing; if they show damages or dents, scrap them. The nuts and the screws surfaces have not to be oiled. Strictly respect tightening torques of the screws recommended on the assembly drawing. Close them in a progressively, crossed way.

- 6) Control the contact plates for Earth return. Examine the contact surface with care, check that the wear is not too deep and extended. The brush furrows must not exceed 0.2 mm.

Dimensional Control of the housing bore

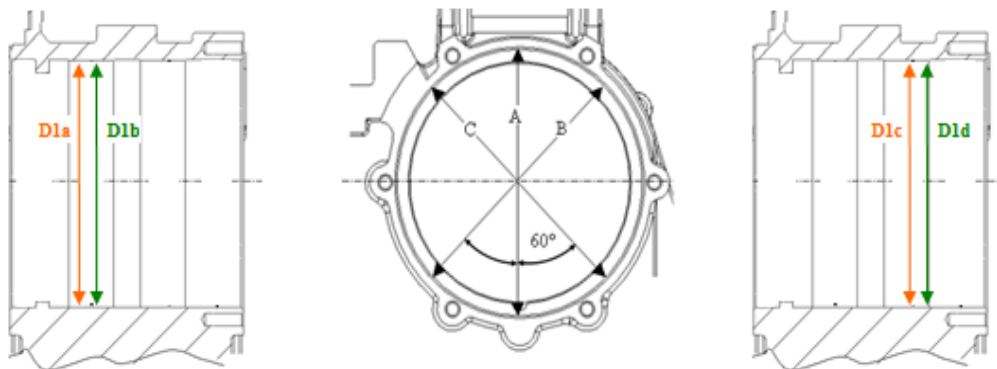
After completing all the visual controls, the axlebox considered serviceable and those ones that have been repaired are ready for dimensional control. The dimensional control is critical to ensure that the axlebox, even if already used, will enable the performance of the TBU like if it was new. The following parameters must be verified:

- Geometric tolerance of the housing bore
- Ovality of the housing bore
- Cylindricity for each housing bearing seat
- Concentricity of the housing bearing seats

The Customer can choose the tools considered most suitable for a correct measuring of the abovementioned parameters.

The procedure for dimensional control is the following:

- 1) Measure the average housing bore diameter. Measure it in two points along each bearing housing seat, both for the inboard side (D_{1a}, D_{1b}) and for the outboard side (D_{1c}, D_{1d}). These two points should be chosen close to the extremities of the bearing seat. Each average diameter is an average between the values of diameter measured in three different positions A, B and C, at 60° from each other.



Measurement of average housing bore diameter



Example:

D_{1a} is the average of the diameters calculated in three positions at 60° from each other, A, B and C. Let us suppose that the values measured in these three positions are D_{1a_A} , D_{1a_B} , D_{1a_C} . D_{1a} is calculated as:

$$D_{1a} = \frac{D_{1a_A} + D_{1a_B} + D_{1a_C}}{3}$$

The same for the other average diameters:

$$D_{1b} = \frac{D_{1b_A} + D_{1b_B} + D_{1b_C}}{3} \quad D_{1c} = \frac{D_{1c_A} + D_{1c_B} + D_{1c_C}}{3}$$

$$D_{1d} = \frac{D_{1d_A} + D_{1d_B} + D_{1d_C}}{3}$$

- 2) Measure the ovality of each housing bearing seat.
First of all, calculate the ovality for each diameter D1a, D1b, D1c, D1d, as the difference between their maximum and minimum value.

Then, for each of the two bearing seats, the biggest value is taken; The acceptable tolerances will be provided in later in this manual.



Example:

Calculation of the maximum ovality of the housing bearing seat on the inboard side. The first step is to calculate the ovality of the two average diameters D_{1a} and D_{1b}.

$$OVALITY_{D_{1a}} = MAX(D_{1a_A}; D_{1a_B}; D_{1a_C}) - MIN(D_{1a_A}; D_{1a_B}; D_{1a_C})$$

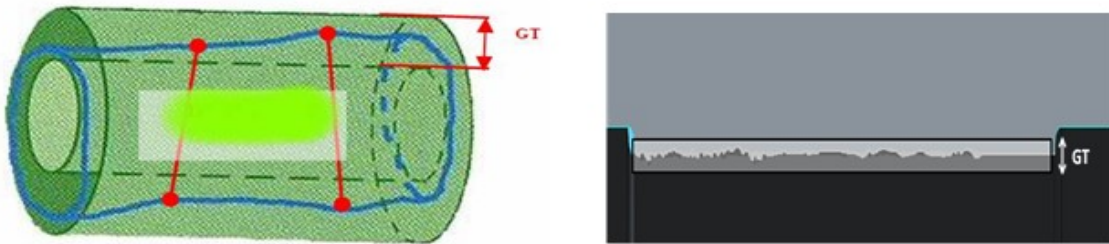
$$OVALITY_{D_{1b}} = MAX(D_{1b_A}; D_{1b_B}; D_{1b_C}) - MIN(D_{1b_A}; D_{1b_B}; D_{1b_C})$$

The ovality on the housing bearing seat (inboard side) is the maximum between the two values of ovality calculated before:

$$OVALITY_{bearing\ seat} = MAX(OVALITY_{D_{1a}}; OVALITY_{D_{1b}})$$

The same procedure is used to calculate the ovality of the housing bearing seat outboard side.

- 3) Check the cilindricity
For each housing bearing seat, it is possible to define two cylinders coaxial with two different diameters:

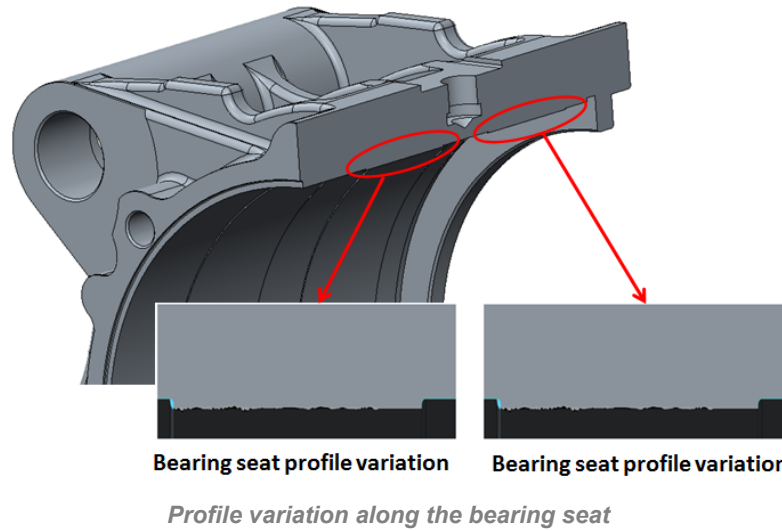


Cilindricity error

The real profile of the housing bore (blue line in figure above left) is contained within these two coaxial cylinders. The difference of the radii of the two coaxial cylinders is the error of cylindricity admitted.

Cilindricity must be evaluated at 12 o'clock, i.e. in the axlebox most loaded zone:

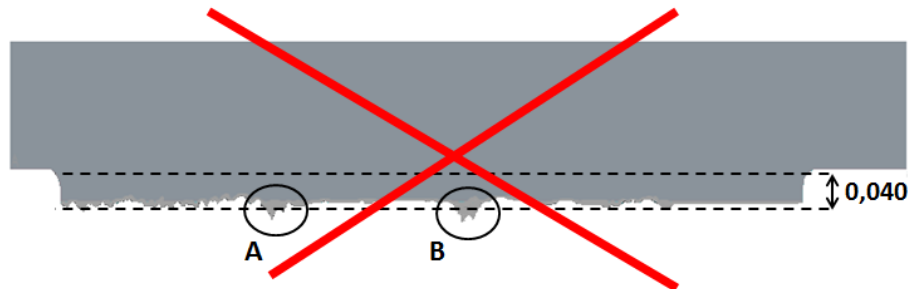
Measure the variation of the profile along all of each bearing seat.



The variation of the profile, **measured along all the housing bearing seat**, must be inside the acceptable tolerance GT.



Example:
With the assumption that the maximum error of cilindricity admitted is 0,040 mm, if the variation of the profile along all the bearing housing exceeds 0,040 mm (areas A and B), the result cannot be accepted.



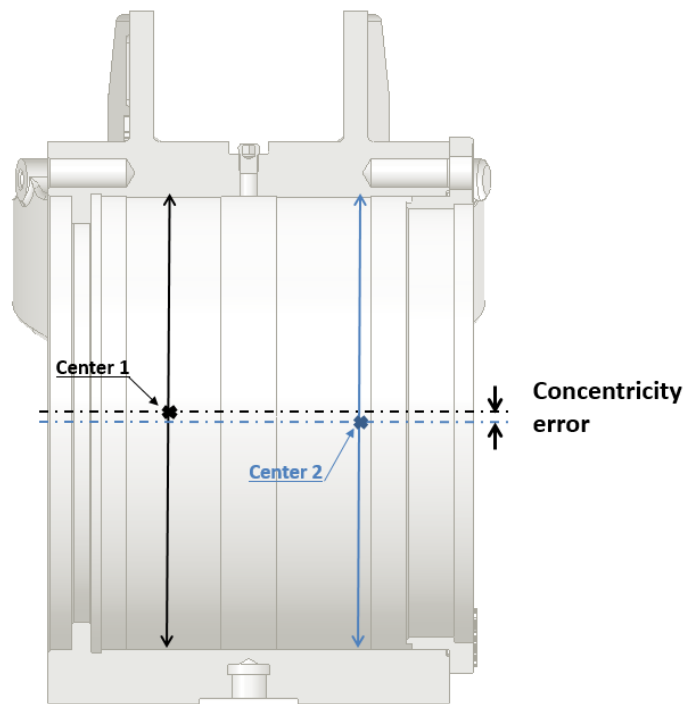
Example of a profile exceeding the limits of cilindricity

If the variation of the profile along all the bearing housing does not exceed 0,040 mm (areas A and B), the result is accepted.



Example of a profile in the limits of cilindricity

- 4) Concentricity of the housing bearing seats.
Measure the position of the center of each bearing seat using a proper device:



Concentricity measurement

The concentricity error is the distance between the two centres, as figure above shows.

- 5) Verify that the measured values are in the range of admissible values for housing bore shape errors. **The extra tolerance admissible for the bore of the housing must be within two IT classes (for example, if the new housing is IT7 up to IT9 is allowed for a used housing).** However, this tolerance must be viewed together with the ovality error, which is mentioned below.

Table below shows the ISO tolerance classes according to the housing diameters:

Basic size [mm]		Standard tolerance classes						
		IT4	IT5	IT6	IT7	IT8	IT9	IT10
Above	Up to and including	Tolerances [μm]						
50	80	8	13	19	30	46	74	120
80	120	10	15	22	35	54	87	140
120	180	12	18	25	40	63	100	160
180	250	14	20	29	46	72	115	185
250	315	16	23	32	52	81	130	210

ISO tolerance class values

Here below the maximum allowed values for shape errors:

Geometric tolerance	Admissible value (mm)
Ovality	0.050
Cylindricity	0.040
Concentricity	0.040

Tolerance values for shape errors



Example:

Consider a new axlebox with IT7 tolerance, for example 230 H7. This means a minimum diameter of 230,00 mm and a maximum diameter of 230,046 mm.

For the used axlebox we can accept an increase of the tolerance field of two IT classes. In this case it means we can consider an increase of tolerance class up to IT9. Therefore, we can accept a used axlebox with diameter 230 H9, meaning a minimum diameter of 230,00 mm and a maximum diameter of 230,115 mm.

Control of the Housing integrity

Non-destructive testing (NDT) is a wide group of analysis techniques used in industry to evaluate the properties of a material, component or system without causing damage. The NDT controls allow putting in evidence with good reliability the presence of cracks and fissures. Two examples of NDT used in the railway industry are:

- *Dye Penetrant Inspection (DPI)*, also called *Liquid Penetrant Inspection (LPI)* or *Penetrant Testing (PT)*, used to detect casting, forging and welding surface defects such as hairline cracks, surface porosities and leaks in new products, and fatigue cracks on in-service components.
- *Magnetic Particle Inspection (MPI)*, used to detect surface and slightly subsurface discontinuities in ferromagnetic materials



The user must refer to dedicated guidelines to apply in the best way the proper DPI technique.

The NDT are very useful to detect defects in the surface and/or sub-surface of axlebox, in particular in the most stressed areas, such as:

- Areas highlighted by the FEM (Finite Element Method) analysis with critical stress concentration
- The areas connecting the housing body to the bogie frame
- One or more areas of support for primary suspension
- One or more areas connecting dampers
- Areas of interface with rod link

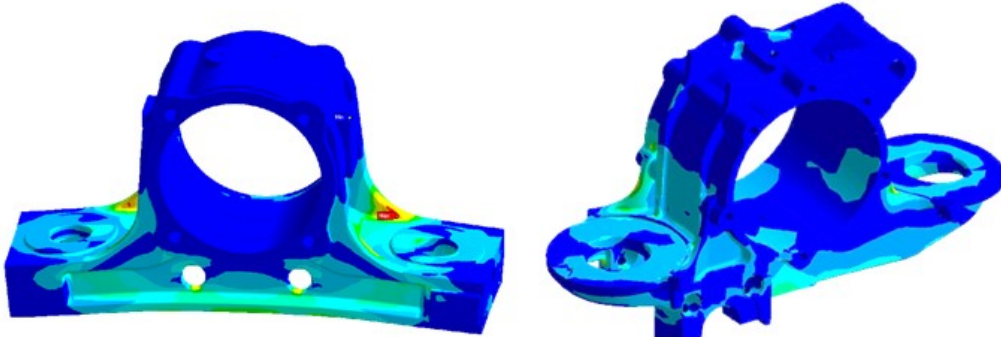


The housing is whole a safety item therefore in case of detection of any type of defect related to material integrity, it must be checked with NDT techniques also if the defect is not included in the critical area.

Areas of particular stress are usually indicated by the axlebox manufacturers. In case of doubts regarding their location, please contact the axlebox supplier.

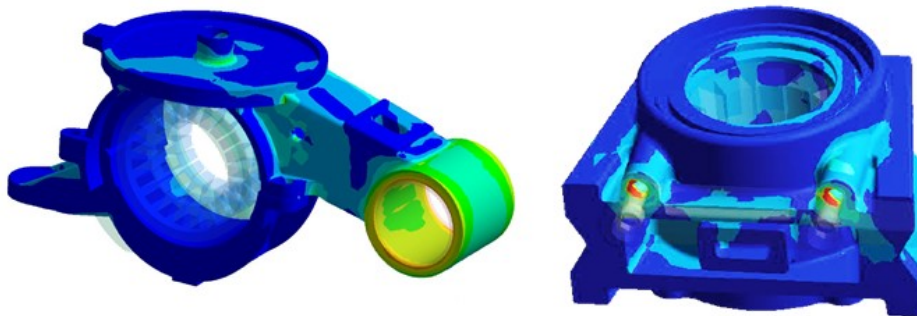
The following figures show some examples of critical areas highlighted by FEM analysis, for different types of Axlebox.

Example of critical areas (Von Mises stress) in a Y25 and a two plates axlebox body



Critical areas highlighted by FEM

Example of critical areas (Von Mises stress) for a link arm and a Chevron axlebox:



Critical areas highlighted by FEM

Contacts



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**INSTALLATION,
REMOVAL
AND MAINTENANCE
INSTRUCTIONS FOR
RAILWAY
APPLICATIONS**

TIMKEN

**130MM AP2 CARTRIDGE
JOURNAL BEARING
ASSEMBLY**

**TRAINSET 44
MEDHA**

TIMKEN

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TIMKEN CARTRIDGE BEARINGS

XXXXXXXXXXXXXXXXXXXX

**INSTALLATION AND REMOVAL INSTRUCTIONS
FOR RAILWAY APPLICATIONS**

XXXXXXXXXXXXXXXXXXXX

130MM CARTRIDGE TYPE JOURNAL BEARING ASSEMBLY

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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Issued: November 2021

Maintenance manual number: A-74540**Revision status: - New****ESR number: - 527740**

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Revision	Rev.No.	Prepared by	Checked by	Date
New	-	Kiran Ambi	Suresh Kumar	25 th Nov 2021

FOREWORD

This instruction book represents the installation, removal and maintenance recommendations of The Timken Company for the cartridge bearing assembly as shown on drawings E-59773

It is a guide to the proper care and procedure that should be followed for the installation, lubrication, and maintenance of Timken Cartridge bearings as applied to railway equipment.

A Timken Cartridge bearing correctly applied and properly lubricated will give reliable, trouble-free service.

The periodic attention recommended should be scheduled for convenience, with other phases of equipment maintenance.

As a part of continuing improvements in services that we offer to our customers, we can provide bearing overhaul services. Please contact our Timken representative for more details.

XXXXXXXX

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GENERAL INFORMATION

GENERAL INFORMATION

INTRODUCTION

This Timken cartridge bearing is a self-contained, preassembled, preadjusted, prelubricated, enclosed tapered roller bearing unit. It is applied to and removed from the axle using tools specifically designed for the purpose, without exposing the bearing elements, or lubricant to contamination or damage.

The preassembled cartridge bearing reduces the number of separate parts to be applied to the axle assembly to a minimum.

This manual covers the installation and removal instructions for the NP737217FSA-90020 bearing assembly.

The contents of this manual include Timken recommendations for the method of installation, removal, maintenance, inspection and storage of Timken cartridge bearings and associated parts.

Following the instructions in this manual will help ensure the Timken cartridge bearing gives reliable and trouble-free service.

The maintenance or inspection intervals for the bearing and associated parts should be planned appropriately in such a way that they coincide with other planned phases of the vehicle maintenance.

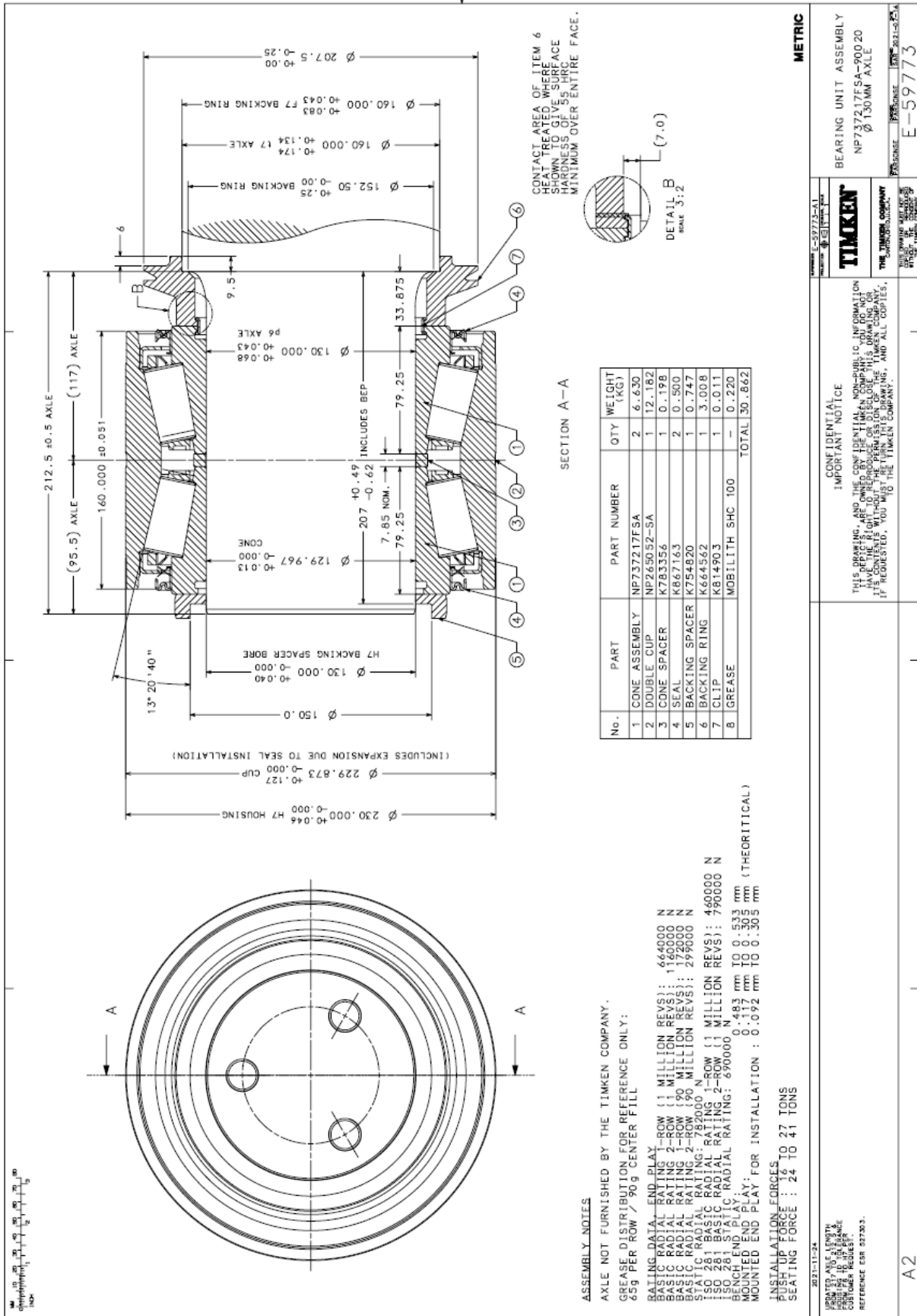
Tools and devices for mounting, dismounting and maintenance of Timken tapered roller bearings can be manufactured according to designs which are available from the Timken Company.

CAUTION

Failure to follow these cautions may result in property damage.

The products catalogued in this manual are application specific. Any use in applications other than those intended could lead to equipment failure or to reduced equipment life. Use of improper bearing fits may cause damage to equipment.

Figure GI-1 Bearing unit assembly – E-59773



BOM DETAILS – NP737217FSA-90020 – REFER FIGURE GI-1

REF	DESCRIPTION	QTY	PART NO	WEIGHT/ UNIT (KG)*
1	CONE ASSEMBLY	2	NP737217FSA	6.630
2	DOUBLE CUP	1	NP265052SA	12.182
3	CONE SPACER	1	K783356	0.198
4	SEAL	2	K867163	0.500
5	BACKING SPACER	1	K754820	0.747
6	BACKING RING	1	K664562	3.008
7	CLIP	1	K814903	0.011
8	GREASE	1	MOBILITH SHC100	0.220
			TOTAL	30.862

* WEIGHT BASED ON NOMINAL COMPONENT DIMENSIONS

BENCH END PLAY: 0.483mm – 0.533mm

MOUNTED END PLAY: 0.117mm – 0.305mm (THEORITICAL)

MOUNTED END PLAY: 0.092mm – 0.305mm (INSTALLATION)

**BEARING - INSTALLATION
AND REMOVAL**

BEARING INSTALLATION AND REMOVAL

EQUIPMENT

Bearings may be installed or removed with a bearing press, wheel press, or with portable jacks, depending on requirements and availability of equipment. A description of how to use Timken's portable press is included in Appendix 1.

Bearing maintenance operations should be carried out in a dedicated location using machines and tools designed for roller bearing installation and removal.

BEARING OR WHEEL PRESSES


Where the bearing is applied by a bearing press or wheel press a guide tube is fastened to the end of the axle and a separate assembly sleeve is to be used as shown in figure BIR – 1. The details of the assembly sleeve will be provided in Appendix 2. However, the design of all parts shown should be reviewed for suitability for the specific press equipment in use and modified where required.

To ensure that bearings are properly seated, bearing or wheel presses should be equipped with a calibrated pressure gauge so that the specified pressure can be maintained for a short period, otherwise bearings may not be properly seated.

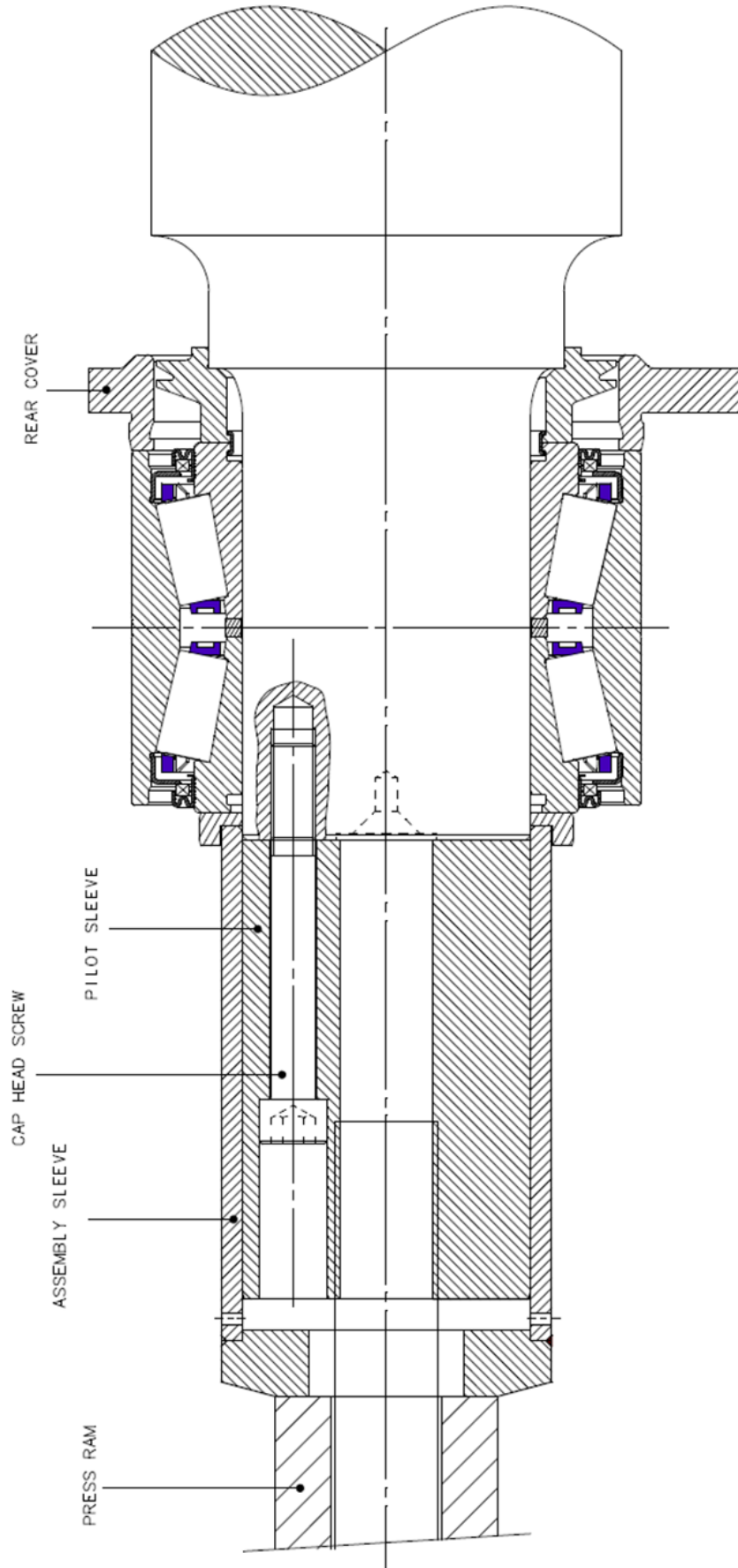
Bearing presses or wheel presses should be checked with a load cell to be sure that the ram pressure, as indicated by the gauge, is correct in the tonnage range and for the piston travel required for applying cartridge bearings to axles.

When bearing or wheel presses are used for bearing removal, the equipment shown in Figure BIR-2 should be used. Again, this typical arrangement is based on a Timken designed press and the details of the pulling shoe insert are shown in Appendix 2. The withdrawal plate and puller rods required to attach the fixture to the bearing press should be designed to suit the specific press equipment in use and the available space due to the wheelset design conditions.

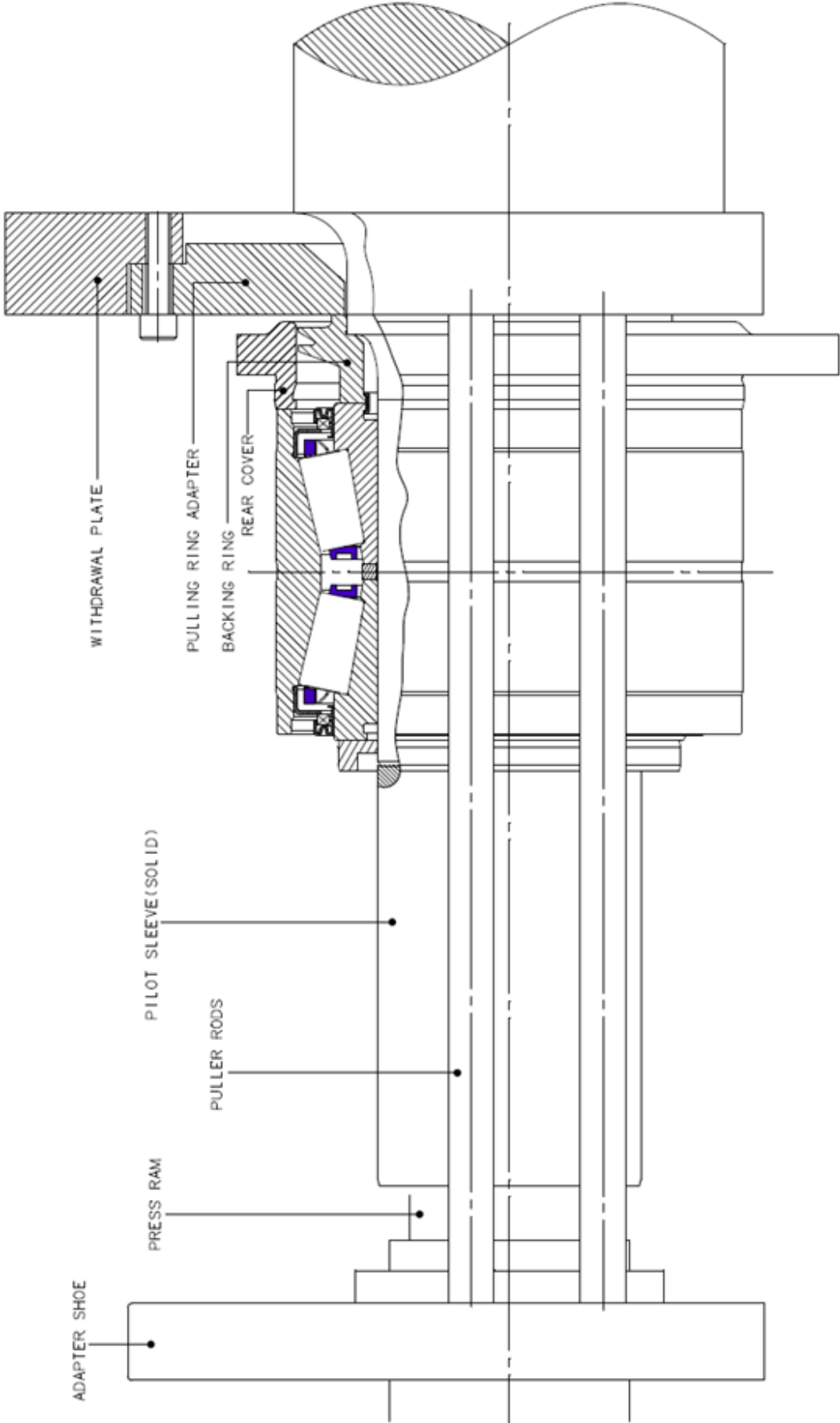
<p>CAUTION <i>Failure to follow these cautions may result in property damage.</i></p>
<p>Use of improper bearing fits may cause damage to equipment. Do not use damaged bearings. The use of a damaged bearing can result in equipment damage.</p>

<p> Warning <i>Failure to follow these warnings may result in property damage.</i></p>
<p>Tensile stresses can be very high in tightly fitted bearing components. Attempting to remove such components by cutting the cone (inner race) may result in a sudden shattering of the component causing fragments of metal to be forcefully expelled. Always use properly guarded presses or bearing pullers to remove bearings from shafts, and always use suitable personal protective equipment, including safety glasses.</p>

BEARING INSTALLATION - Figure BIR-1 TYPICAL ARRANGEMENT



**BEARING REMOVAL - Figure BIR-2
TYPICAL ARRANGEMENT**



PORTABLE JACKS

Portable jacks consisting of an assembly sleeve, withdrawal plate, puller rods, and a pulling ring adapter, may be used for bearing installation and removal using similar tooling arrangements to that used with bearing/wheel presses, illustrated in Figures BIR-1 and 2. Details of the parts are shown in Appendix 2.

These jacks can have hand or electrically operated hydraulic pumps, which are available commercially to suit production requirements.

The hydraulic ram or jack used should have sufficient travel to install or remove the bearings in one operation without the use of intermediate blocking.

Portable fixtures may be supported on a "dolly" or shop truck.

AXLES

Before proceeding with the bearing installation, the axles should be checked under uniform conditions of temperature to make sure that the bearings can be applied without difficulty and that the axle is to specification.

Axles should be checked on the bearing seat diameters, shoulders and radii with proper gauges to determine that finished axle dimensions are within prescribed tolerances, see Figure BIR-3 to obtain proper fit of the cone assembly, backing ring etc.

Micrometers used to measure the bearing seat diameters of axles should be checked for accuracy with a disc micrometer standard.

Micrometers and disc standards should be of the same temperature as the axle. Axle diameters should not be checked while the axles are heated due to machining.

Axle bearing seat diameters, shoulders, and radii should have a smooth machined and rolled, or ground finish, and must be free from sharp corners, burrs, nicks, tool marks, scratches, or corrosion.

Axle bearing seat diameters should be concentric with the wheel seat diameters.

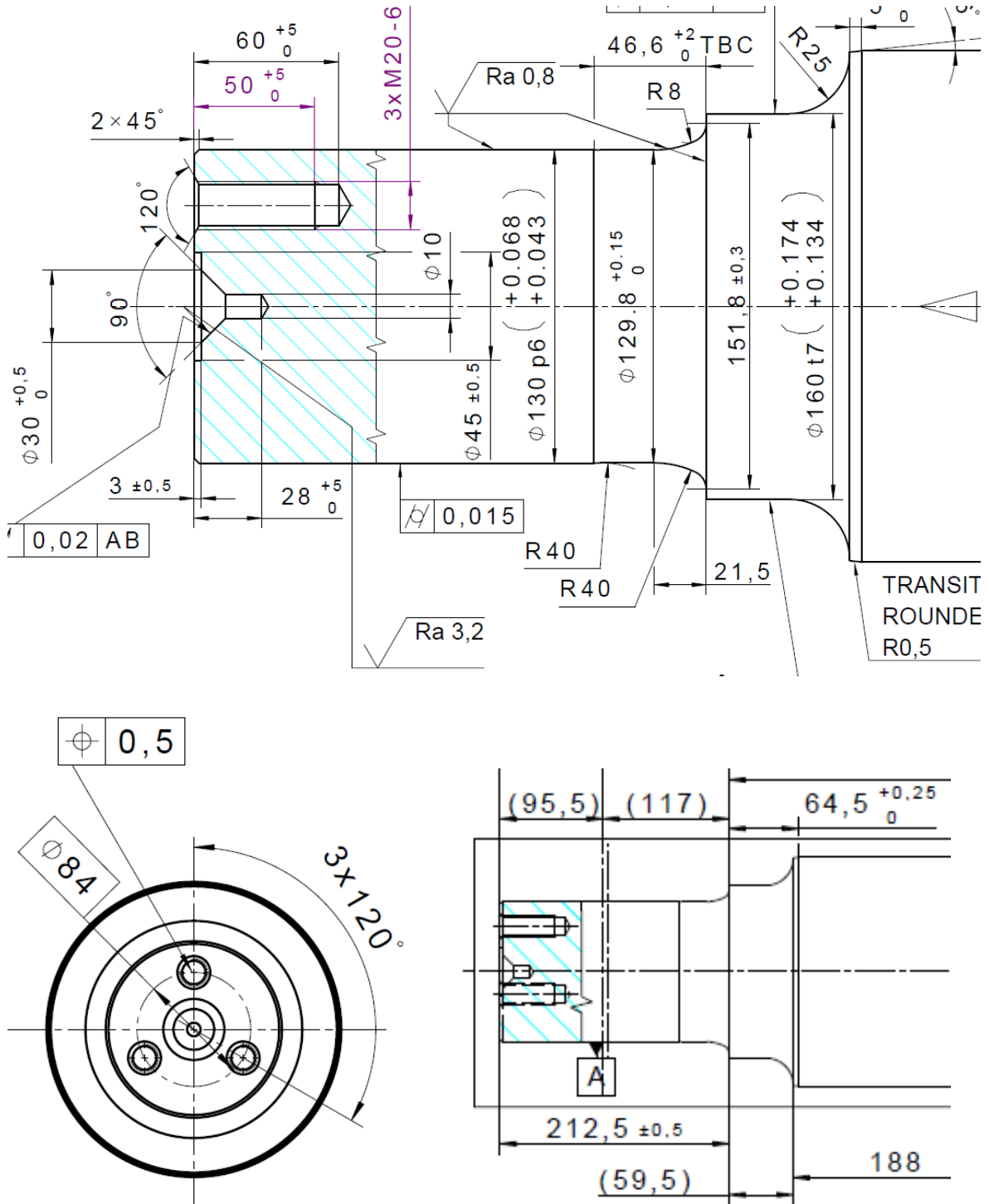
Axle journals should be protected if there is a possibility of damage or deformation resulting from mis-handling, or uneven pressures being applied to the axle ends.

CAUTION

Failure to follow these cautions may result in property damage.

Axle bearing seat diameters, shoulders, and radii should have a smooth machined and rolled or ground finish, and must be free from sharp corners, burrs, nicks, tool marks, scratches, or corrosion. Axle bearing seat diameters should be concentric with the wheel seat diameters. Axle journals should be protected from damage or deformation resulting from mishandling, in particular, damage to the axle ends. All steel chips, dirt, and grease must be cleaned out of the lathe centres and bolt holes in the ends of the axle before applying the bearings. Axles that have become magnetized must be demagnetised before bearings are applied.

AXLE DIMENSIONS - Figure BIR-3



APPLYING THE BEARING - a general description

Timken cartridge bearings must be pressed on the axle.

Note: To avoid damaging the grease, heat must not be applied to the bearing cone assemblies to facilitate installation.

Note: Rear cover should be assembled before installation of the bearing assembly.

Before installing the bearing assembly on to the axle, the hydraulic equipment should be checked to make sure that the ram travel is sufficient to seat the bearings on the axle.

The hydraulic system should be checked for leaks. The fluid reservoir should be full to ensure that the press rams will extend to their limit of travel.

Note: Coat the bearing seats of the axle with Molykote TP42 or equivalent. DO NOT USE WHITE LEAD. Lead compounds may be detrimental to lubricating greases by acting as an oxidation catalyst.

A thin coating of a quick-drying rust preventative must be applied to the “journal fillet” (the portion of the axle between the bearing seat and the axle shoulder) (Figure BIR-3). The rust preventative used must not contain lead or other compounds which may be detrimental to lubricating greases. Rust preventative must be used in accordance with the manufacturer’s instructions. The portion of the axle wheel hub and the backing ring seat is assumed to be painted.

PRESSING BEARING ASSEMBLIES ON AXLES

Place the wheel and axle assembly in a wheel press or bearing press, in position to press the bearing assembly on to the axle. Or support the axle in appropriate blocks to allow a portable press to be used.

Fit the pilot sleeve onto the end of the axle, using the screws to hold it in position. Slide the bearing assembly over the pilot as far as it will go and place the assembly sleeve behind the bearing assembly. (Figure BIR-1). Apply pressure to the end of the assembly sleeve until the bearing assembly is correctly seated.

To ensure that the bearing is firmly seated against the axle abutment, the pressure indicated on the gauge during pressing-on should be increased by 50%. This 50% increase should be applied after the surge of pressure indicates on the gauge that the bearing assembly has contacted the axle abutment. This seating load pressure should be within the limits shown in Table A.

Note: Caution should be used when applying the seating load, otherwise damage may be caused to the backing rings or sealing rings. On no account should the momentary seating load applied be any more than the maximum pressure specified in Table A.

PRESSING LOAD (tonnes)	SEATING LOAD (tonnes)
16 - 27	24 - 41

Table A. Pressure to be applied when installing bearings.

Rotate the bearing assembly to ensure that it will turn freely at initial application. New bearing assemblies are preadjusted at the factory. No adjustment is necessary at installation.

After the press rams have been retracted, roll the wheel and axle assembly out of the press. Remove the assembly sleeves and bearing pilot sleeves.

Fitting the bearings by means of portable jacks is carried out in accordance with the operating instructions of the equipment.

These jacks can be hand or electrically operated, pumps and jacks are available commercially to suit production requirements.

The hydraulic ram or jack used should have sufficient travel to install or remove the bearings in one operation without the use of intermediate blocking.

Note: After bearing installation, follow the guidelines specified by the OEM builder for fitment of the endcap and cap screws

To fit the second bearing to the opposite end of the wheelset, care must be taken to ensure that the first bearing fitted is not subjected to further transmitted pressure.

CHECKING BEARING MOUNTED END PLAY (BEARING ONLY)

Check the bearing mounted endplay with a dial indicator mounted on a magnetic base. Place the magnetic base on an appropriate part of the axle (for example the wheel if fitted) and position the indicator stem against the face of the cup, marking the position on the cup.

With the dial indicator in position, pull hard but steadily on the bearing cup and oscillate at the same time. Without releasing the pressure, steady the cup so that the indicator stem contacts the marked spot, and note the reading on the indicator dial.

Then push the bearing cup hard and oscillate as before, turn the cup until the stem of the indicator contacts the marked spot, and without releasing the pressure take a second reading. The difference between the two readings is the amount of mounted end play in the bearing.

Note: The reference load used for adjustment during bearing assembly at Timken is 150kg. Since it is difficult to apply an equivalent load during checking of the mounted end play slightly lower values may be measured.

If bearing end play as indicated by the dial indicator is less than Minimum "MEP at installation" or more than Maximum "MEP at installation", remove the bearing assembly from the axle and consult a Timken representative.

Minimum and Maximum end play values are shown in Table C.

Bench End Play (mm)	Mounted End Play (mm)
0.483 – 0.533	0.092 – 0.305

Table C. Bench End Play and Mounted End Play

INITIAL LUBRICATION

This Timken cartridge bearing is pre-lubricated at the factory. No additional lubricant is to be added after the bearing is applied to the axle.

BEARING REMOVAL - a general description

Note: Before disassembling the bearing, remove the front cover and the endcap assembly, loosen the screws of the rear cover and slide the bush out - follow the guidelines specified by the OEM builder.

Whenever bearing assemblies that have been in service are removed from the axles, the bearings should be disassembled, cleaned, inspected, and repaired by a competent bearing repair facility or sent to Timken for service before the equipment is returned to operation.

The bearing assemblies may be removed with a bearing press, wheel press, or with portable jacks. Thirty to forty tonnes pressure is sometimes required to break the bearing fit.

Pressure must only be applied to the backing ring to remove the bearing. If bearings are to be removed along with the wheels, a suitable shoe must be used to make contact between the wheel hub and backing ring withdrawal face.

When bearings are removed from the axle, a pilot sleeve should be fastened to the end of the axle or to the press ram to keep the bearing parts together and protect them from damage. Do not drop the bearing assembly when removing it from the pilot sleeve.

After the bearing assembly is removed from the axle, a cardboard insert or a similar device should be inserted in the bore of the bearing assembly to hold the internal bearing parts in place.

REMOVING THE BEARING

Special device drives should be removed prior to the removal of the wheel and axle assembly from the bogie frame.

Thoroughly clean the bores of the housings, remove all rust or corrosion and apply a heavy coating of grease to the bores.

Bend the tabs of the bolt locking plate away from the heads of the bolts. Remove the bolts, locking plate, and axle end cap. Fit the Pilot Sleeve to the axle end.

A withdrawal and pulling ring adapter, which fits behind the backing ring as shown in Figure BIR-2 is used to remove the bearings when it is desirable to remove the bearings without removing the wheels.

Ensure that the withdrawal plate and pulling shoe insert is of the correct size for the bearing to be removed. Proper contact with the backing ring and puller alignment is necessary for efficient bearing removal.

Position the withdrawal plate behind the rear face of the backing ring. To ensure maximum contact area it may be necessary to hold the plate down in position behind the backing ring until the initial pressure has been applied. Extend the ram to remove the bearing assembly from the axle.

**FRAME OR BOGIE
ASSEMBLY AND DISASSEMBLY**

GENERAL

Note: Care should be exercised in applying or removing vehicle frames to prevent damage to the bearings.

After the vehicle bogie frames are removed from the wheel and axle assemblies, the housings should be removed from the bearings for cleaning and inspection.

Vehicle frames, bolsters and other bogie parts should be inspected and repaired before the bogies are reassembled.

If required, match the side frames. Mismatched side frames are detrimental to roller bearing performance.

The housing bore and the outside surfaces of the bearing cup must be free from dirt and other foreign material that may prevent the housings from seating properly on the bearings.

Wheel and axle assemblies should only be installed in side frames of the proper size for which they were designed.

FRAME OR BOGIE ASSEMBLY

Bearing housing bores and the outside surfaces of bearing cups must be clean and free from dirt or corrosion.

Coat the ID of the housing with a thin coat of mounting paste as mentioned in the installation and removal section.

Ensure that the bearing housings are applied correctly and properly seated on the bearing assembly.

If the bearing assembly has had previous service, the original load zone may be recognised by the imprint of the housing contact on the bearing cup, or a new load zone location may have been indicated on the outside of the bearing cup by marking the cup when the bearing was disassembled and inspected. Position the housing on the bearing so that a new wear surface on the bearing cup will be in the load zone.

FRAME OR BOGIE DISASSEMBLY

Remove control devices from the axle lever assembly.

Note: Care should be exercised to prevent damage from striking the bearings with the bogie frames.

Whenever a frame is disassembled the bearings and associated parts should be inspected as outlined under Service Inspection and in accordance with Shop Practice disassembly instructions.

CAUTION

When handling axle assemblies with housings on the bearings, care should be exercised to prevent the housings from slipping off the bearings.

**Warning**

Failure to follow these warnings may result in property damage.

When handling axle assemblies with bearing housings on the bearings, care should be exercised to prevent the components from becoming dislodged.

SERVICE INSPECTION

GENERAL

Bearings and housings should be given a visual inspection at terminals, and when equipment is on repair track or in the shop for wheel turning or for other reasons. In case of any damage, the housings must be disassembled.

Inspect Bearings for:

1. Overheating and/or roughness when bearing is rotated.
2. Excessive lubricant leakage and broken, loose, or missing parts such as bolts, blocked drain holes, loose or defective seals, cracked or broken cups or housings.
3. Damage or distortion to the outside of the bearing.

If any wheel set has a loose or missing part such as bolts, seals or axle end caps, that wheel set has to be removed from service and follow procedure in accordance with instructions in Bearing Installation and Removal section.

Examine the outside of the bearing for damage or distortion.

When possible, re-check bearings mounted end play in accordance with instructions in the Bearing Installation section of this manual. If mounted end play is outside the limits specified it must be removed from service and repaired, replaced or sent to Timken for service before the equipment is returned to operation.

Defective parts must be repaired or replaced before the equipment is returned to service.

The required tools, facilities, and spare parts should be available at terminals for the inspection, lubrication and maintenance.

BEARING RUNNING TEMPERATURE

The running temperature of the bearing is checked by on board sensors. A set of temperature limits and a corresponding reaction plan shall be established and observed during operation. Any bearing exceeding the limits in the established plan shall be removed and repaired before the criteria should be removed from service and repaired, replaced or sent to Timken for service before the equipment is returned to operation.

LUBRICANT CONTAMINATION

Lubricant containing water is destructive to roller bearings, causing rapid wear. All possible precautions should be taken to prevent water from entering the bearing assembly.

If the equipment has been submerged or operated through water of such a depth that the water could have entered the bearings, the bearing assemblies must be removed from the axle, disassembled, cleaned, inspected, and replacements or repairs made as necessary.

Drain pipes or holes must be located so that drainage will not be directed at the bearing assemblies.

When cleaning the exterior of equipment, the stream of water should not be directed at the bearing seals.

When sandblast or shot blast cleaning of the vehicle, a shield should be provided to protect both the front and rear of the bearing assemblies from sand or shot.

Tunnel cleaning machines, high pressure sprays, sandblast or shot blast cleaning of roller bearing equipped axle assemblies is not recommended.

Grease for roller bearing lubrication must be kept covered and in the container in which it was shipped.

SUBSEQUENT LUBRICATION IN SERVICE

The bearing for this application is supplied pre-greased. **NO** additional lubrication is required to be added to the bearing assembly in service.

BEARING SERVICE INTERVAL

Information regarding service intervals as recommended by the Timken Company is located in the Bearing Disassembly section.

The recommended bearing overhaul interval for this bearing assembly is **1,200,000km** or **eight years** (whichever occurs sooner).

DISPLACED HOUSINGS

A housing out of position causes a load concentration on the bearing and if continued in service for any length of time may result in serious bearing damage.

ACCIDENTAL DAMAGE

Bearing assemblies under equipment involved in derailment or collision, or subject to damage by fire, floods, or other causes, must be removed from service for inspection and repaired, replaced or sent to Timken for service before the equipment is returned to operation

After the removal of the bearings, all axles must be checked that they are straight in an axle lathe or other suitable equipment. A bent axle will cause premature bearing damage due to the oscillating movement and uneven load distribution in the bearing.

Note: Bearing housings must be inspected for damage and distortion; all necessary rectification must be made before being returned to service. A damaged bearing housing/adaptor may cause damage to the bearing due to load concentration. A bogie that is damaged or distorted will impose undesirable loads on the bearings, which may cause premature bearing damage.

SHOP PRACTICE

SHOP PRACTICE

BEARING INSPECTION AT FRAME OR BOGIE DISASSEMBLY

Note: Frames must not be permitted to strike the roller bearings when removing the frames from wheel and axle assemblies.

Remove the housings and clean the outside surface of the bearings. Sandblast or shot blast cleaning of roller bearing equipped axle assemblies is not recommended without protecting the bearing assembly.

Housings should be cleaned and inspected for excessive wear. Housings worn to the extent that proper load distribution on the bearing is affected should be repaired or replaced.

Rotate the bearing assemblies to detect any abnormal condition and visually check the outside of the bearing assembly for broken, loose, or missing parts. See Service Inspection Instructions section for more details.

Check the bearing mounted endplay, refer to Bearing Installation and removal section for more details.

Whenever the bearing assemblies are removed from the axle, due to excessive endplay or roughness, the bearings should be disassembled, cleaned, inspected, and reassembled in accordance with instructions or sent to Timken for service.

CAUTION <i>Failure to follow these cautions may result in property damage.</i>
Use of improper bearing fits may cause damage to equipment. Do not use damaged bearings. The use of a damaged bearing can result in equipment damage.

WHEEL TURNING

Wheel turning lathes or wheel truing machines may be used for turning wheels.

It is not necessary to remove the bearing assembly during wheel turning, **but the bearing assembly must be suitably protected to prevent any steel chips from damaging or entering the bearing.**

Lathe centres are typically lubricated with heavy grease.

DO NOT USE WHITE LEAD.

When wheel and axle assemblies are removed from the bogie for wheel turning, the bearing assemblies should be inspected in accordance with the Frame disassembly instructions.

After the wheel turning operation has been completed, clean the end faces and centre holes and bolt holes of the axle.

WHEEL RENEWAL

When worn or defective wheels are to be removed from the wheel and axle assemblies, if the roller bearings are to be removed, they must be removed separately using portable fixtures, refer to Bearing Installation and Removal Section.

Any time a bearing is removed from the axle the bearing should be disassembled, cleaned, inspected, and reassembled in accordance with instructions or sent to Timken for service.

ELECTRIC WELDING

Whenever it is necessary to do any electric welding on cars, or wheel and axle assemblies equipped with Timken bearings, the ground cable must be clamped to or near the part being welded.

Note: Do not allow electric current to pass through the bearing as it can damage the bearing.

STORAGE AND SHIPMENT

STORAGE AND SHIPMENT

STORAGE

Equipment with bearings applied

Note: Failure to observe the following instructions could result in damage to the bearing.

- When vehicles with roller bearings applied are placed in storage the brakes should be set, or the wheels chocked to prevent the equipment from moving.
- When a vehicle is in storage for one year, the car should be moved at least one car length or the bearings should be rotated several revolutions to distribute the lubricant over the bearing surfaces.
- If the equipment has been submerged in flood water of such a depth that the water could have entered the bearing, the bearings should be removed from the axle, disassembled, cleaned, inspected, and reassembled in accordance with instructions or sent to Timken for service..

Wheel and axle assemblies with bearings applied

Wheel and axle assemblies with roller bearings applied must be handled with care. Damage may result if the bearings are permitted to strike other objects.

When wheel and axle assemblies with roller bearings applied are not stored on track, the wheels should be flange to flange and not overlapped.

When axle assemblies with roller bearings applied are in storage for one year, the bearings should be rotated several revolutions to distribute lubricant over the bearing surfaces.

Wheel and axle assemblies with bearings applied should be used in the order in which they were stored, oldest stock first.

Bearing assemblies and component parts

Unmounted roller bearings and component parts must be stored in an area that is clean and well protected from moisture, excess heat or direct sunlight (UV rays).

Roller bearing assemblies with grease and seals fitted should be used within two years of assembly. Bearing assemblies stored for longer than this shall be disassembled, cleaned, inspected, and reassembled in accordance with instructions or sent to Timken for service prior to being installed.

A periodic inspection of stored roller bearings should be made. Any undesired condition should be corrected immediately.

Stored roller bearing assemblies or component parts that have been subjected to moisture or show evidence of moisture entering the bearings must be disassembled, cleaned, inspected, and reassembled in accordance with instructions or sent to Timken for service.

Roller bearings, either new or used, that are placed in storage as individual parts or as bearing assemblies, should be used in the order in which they were stored, oldest stock first.

Note: New roller bearings and component parts should not be removed from the shipping package until they are to be installed onto an axle or assembled as a bearing assembly.

When new roller bearing parts are removed from storage it is not necessary to clean the protective coating from the parts that have been retained in their original packaging.

SHIPPING

Wheel and Axle Assemblies with Roller Bearings Applied

When wheel and axle assemblies with roller bearings applied are shipped by rail, the wheel car should be equipped with a wheel rack that prevents objects or other wheel axle assemblies from striking the bearings. Certain wheel racks for plain bearing axles cannot be used because the wheel flange of adjacent wheel and axle assemblies will contact and damage the roller bearing assembly.

When loading or unloading wheel and axle assemblies with roller bearings applied, wooden boards should be placed between the bearing cups and the wheel flanges of adjacent wheel and axle assemblies to protect the bearings from damage.

Bearing assemblies and component parts

When bearing assemblies and component parts are shipped they must be protected from damage, dirt, dust and moisture.

New bearing assemblies and component parts should be shipped in their original packaging.

Bearing assemblies and component parts that have had previous service should be wrapped in special purpose paper impregnated with an appropriate preservative or other suitable protective wrapping, and packed in sturdy cartons for shipment.

Overseas Shipping Instructions

Below-deck cargo

When Timken bearing-equipped locomotives or cars are shipped overseas, it is recommended that roller bearing-equipped bogies or axle assemblies are loaded separately below deck to help avoid exposure to adverse environmental conditions.

Bogies should be raised up onto suitable bogie frames to avoid transferring the weight of the axle onto the bearings during shipping.

Deck cargo

If transporting Timken bearing equipped cars or bogies above deck, great care must be taken to protect the equipment from exposure to salt water and other adverse environmental conditions.

Cars and locomotives with bogies applied must be blocked up under the bogie frames to remove the weight of the bogie, as well as the load on the centre plate, from the bearings. Bogies should be raised up onto suitable bogie frames to avoid transferring the weight of the axle onto the bearings during shipping.

General

After the equipment has been unloaded, each bearing assembly must be examined to make sure, that the housing is properly seated on the bearing cup before the equipment is placed in service. Bearing assemblies showing evidence of direct contact with seawater should be further examined by removing the axle end caps. If evidence of seawater contamination is found inside the axle end cap, or any other damage is observed, the bearing should not be placed in service.

TYPICAL MOBILE BEARING PRESS

TYPICAL BEARING INSTALLATION AND REMOVAL PRESS

Bearings may be installed or removed with a bearing press, wheel press, or with portable jacks, depending on requirements and availability of equipment. Mobile press equipment designed specifically for this purpose is available. The figure below shows a typical example of such equipment.



The press equipment selected should typically have the following features:

- Pulling capacity adjustable up to 100t max.
- Optimized controls to allow use by a single operator.
- Mounted on mobile trolley with built in lift for alignment with bearing centreline.
- Hydraulic pump with sufficient capacity and calibrated gauge to enable control.
- Interchangeable tools to adapt to the interfaces of the subject bearings including,
 - Pulling shoe insert
 - Guide tube & cap screw assembly
 - Installing tube adapter ring

For safe use of press equipment always follow the press manufacturer's instructions alongside the contents of this bearing installation manual..



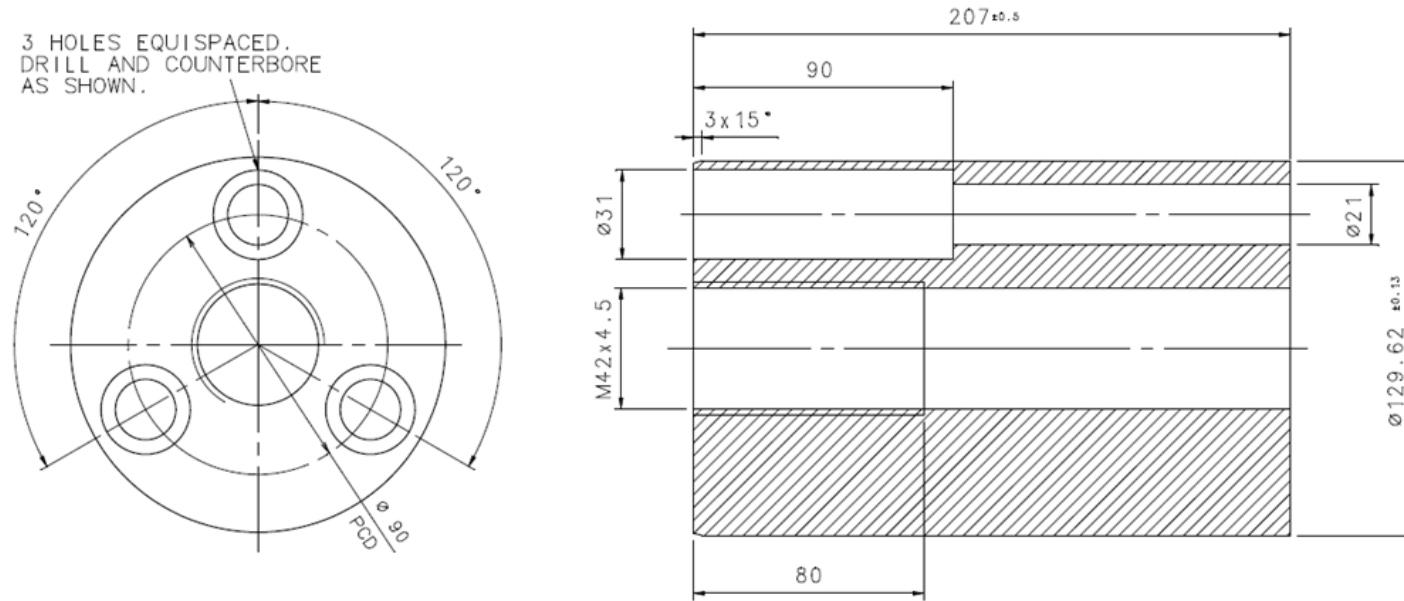
WARNING

Failure to follow these warnings may result in property damage.

Tensile stresses can be very high in tightly fitted bearing components. Attempting to remove such components by cutting the cone (inner race) may result in a sudden shattering of the component causing fragments of metal to be forcefully expelled. Always use properly guarded equipment to install bearings and always use suitable personal protective equipment, including safety glasses.

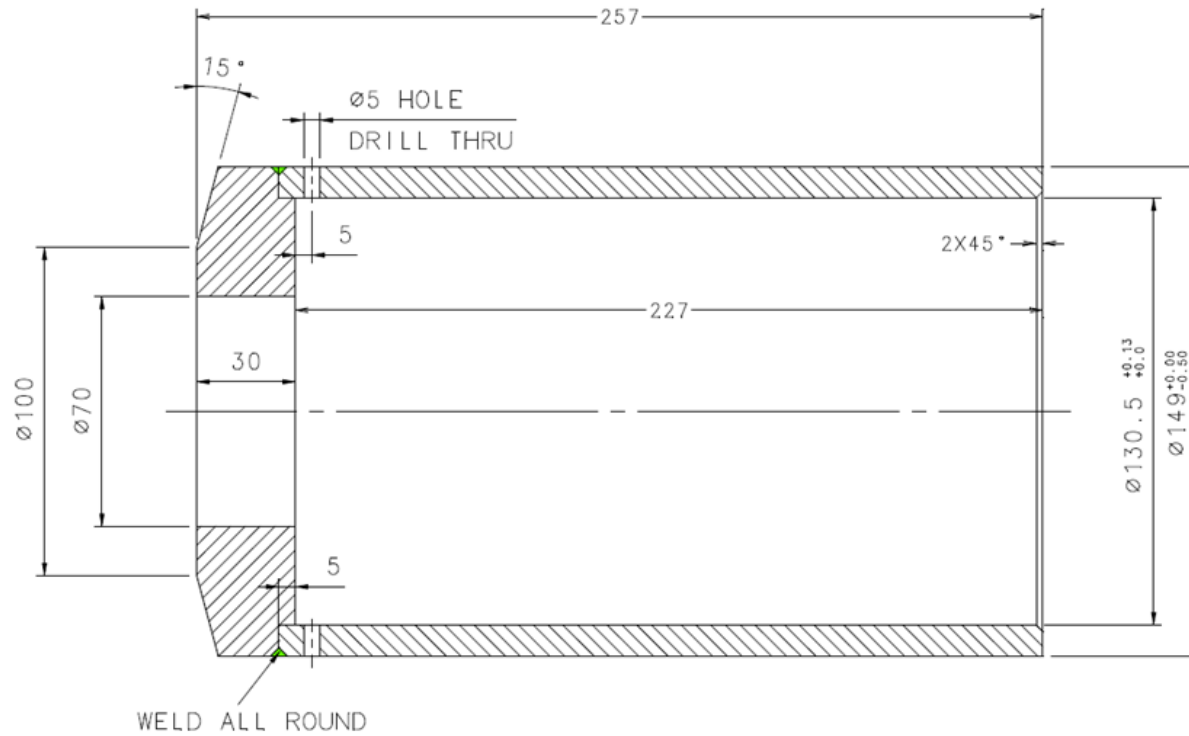
APPENDIX 2**BEARING INSTALLATION AND REMOVAL TOOLS
FOR TIMKEN 130mm AP2 CARTRIDGE TYPE BEARINGS****TOOL LIST:**

ITEM	NO. OFF
Guide tube	1
Assembly Sleeve	1
Pulling shoe adapter	1
Cap screw (Hexagon Socket head) M20x160L	3



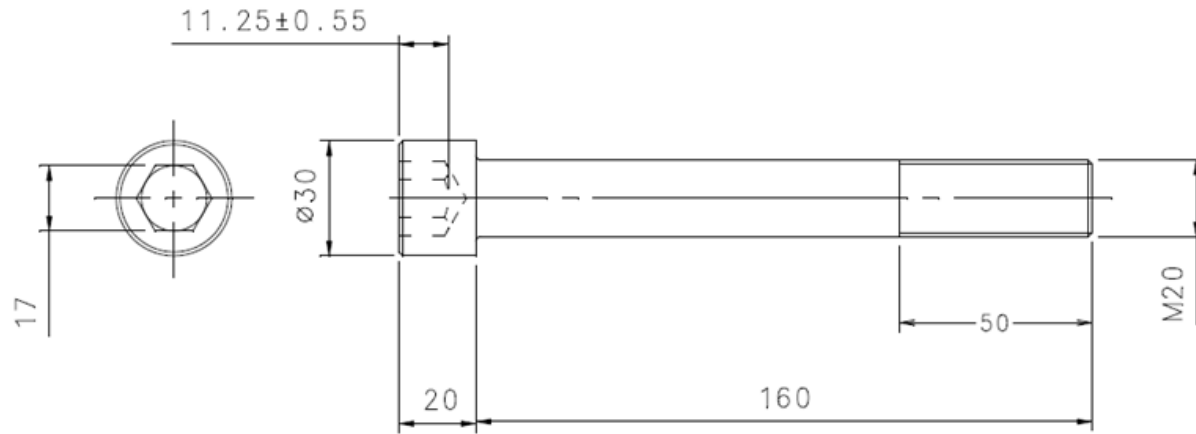
MATERIAL: STEEL BS 080M40 OR EQUIVALENT
 TREATMENT: ZINC PHOSPHATE TO BS3189 1991 (ISO 9717) Znph r7f min.
 DIMENSION ON DRAWING ARE FINISHED SIZES AFTER TREATMENT
 BREAK ALL SHARP CORNERS 1X45° MAX
 ALL UNTOLERANCED DIMENSIONS TO BE \pm 0.25
 $\sqrt{6.3}$ SURFACE FINISH UNLESS OTHERWISE STATED
 REFERENCED ON FIGURE BIR - 1.

GUIDE TUBE



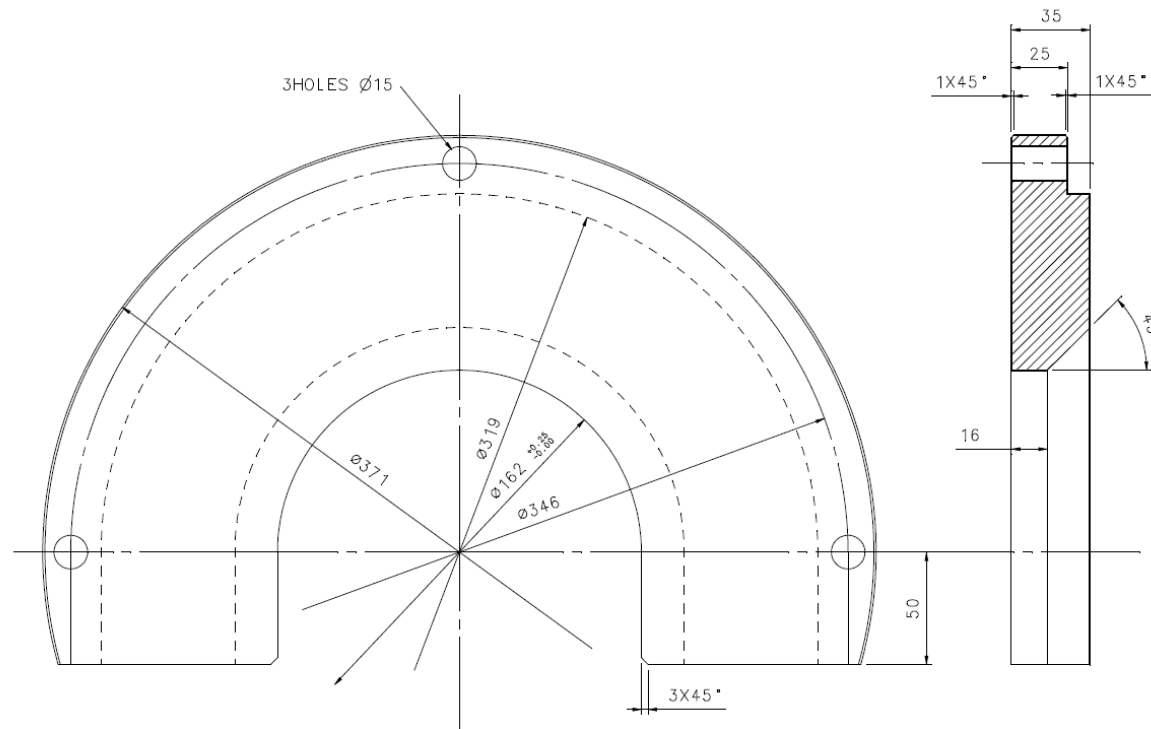
MATERIAL: STEEL BS 080M40 OR EQUIVALENT
 TREATMENT: ZINC PHOSPHATE TO BS3189 1991 (ISO 9717) Znph r7f min.
 DIMENSION ON DRAWING ARE FINISHED SIZES AFTER TREATMENT
 BREAK ALL SHARP CORNERS $1 \times 45^\circ$ MAX
 ALL UNTOLERANCED DIMENSIONS TO BE ± 0.25
 $\sqrt[6.3]{}$ SURFACE FINISH UNLESS OTHERWISE STATED
 REFERENCED ON FIGURE BIR - 1.

ASSEMBLY SLEEVE



SPECIFICATION: ISO GRADE 12.9 STEEL TO BS:4168

HEXAGON SOCKET HEAD CAP SCREW M20x160L



MATERIAL: STEEL BS 080M40 OR EQUIVALENT
 TREATMENT: ZINC PHOSPHATE TO BS3189 1991 (ISO 9717) Znph r7f min.
 DIMENSION ON DRAWING ARE FINISHED SIZES AFTER TREATMENT
 BREAK ALL SHARP CORNERS 1X45° MAX
 ALL UNTOLERANCED DIMENSIONS TO BE ±0.25
 √^{6.3} SURFACE FINISH UNLESS OTHERWISE STATED
 REFERENCED ON FIGURE BIR – 2.

PULLING SHOE ADAPTER

Maintenance manual

Air Spring System

GMT Part No. 17305201



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1 On this Manual

This maintenance manual describes the necessary maintenance operations incurring throughout the service life of the rubber metal parts and air spring systems.

Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

The maintenance intervals are based on the specification data and may be adapted according to the findings from the operation.

Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

1.1 Applicable Documents

- Drawing GMT Part No. 17305201
- Drawing GMT Part No. 17104501
- DIN 7716:1982-05: Rubber products; requirements for storage, cleaning and maintenance
- ISO 2230:2002-04: Rubber products - Guidelines for storage
- DIN 5514-2:1980-04: Materials for railway vehicles; elastomers, testing

1.2 Convention of Description

The following representations are used in these manual:

1.2.1 Notice and Information

NOTICE



- Indicates situations or maloperation that may lead to material damage.

INFORMATION

- Indicates important information or instructions.
- Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.

2 Safety

2.1 Warning and Safety Messages



This manual contains important warnings and safety instructions which must be observed by the user.

The product may only be used and operated by qualified personnel who are capable of complying with the necessary safety precautions for use and operation.

The repair of the product may only be carried out in the delivery unit or by the qualified personnel trained for this purpose.

Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

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2.2 Accident Prevention Regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated Warning and Safety Messages

The following icons and standard text formats are used in this manual:

2.3.1 Caution

CAUTION



- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Air Spring System GMT Part No. 17305201 is intended only for use in rail vehicles and shall be used only in the destined vehicle by the vehicle manufacturer / developer. The components shall be installed as specified and shall only be subjected to the specified operating conditions. Should individual parameters deviate or disturbances appear, GMT has to be contacted to avoid risks and damages. Intended use also includes compliance with the instructions in this maintenance manual, conducting tests and maintenance.

3 Product description

3.1 Designation of Delivery Item

Air Spring System GMT Part No. 17305201

3.2 Description of Delivery Item

The Air Spring System is assembled between car body and bogie frame and is used as isolation element and rotary element.

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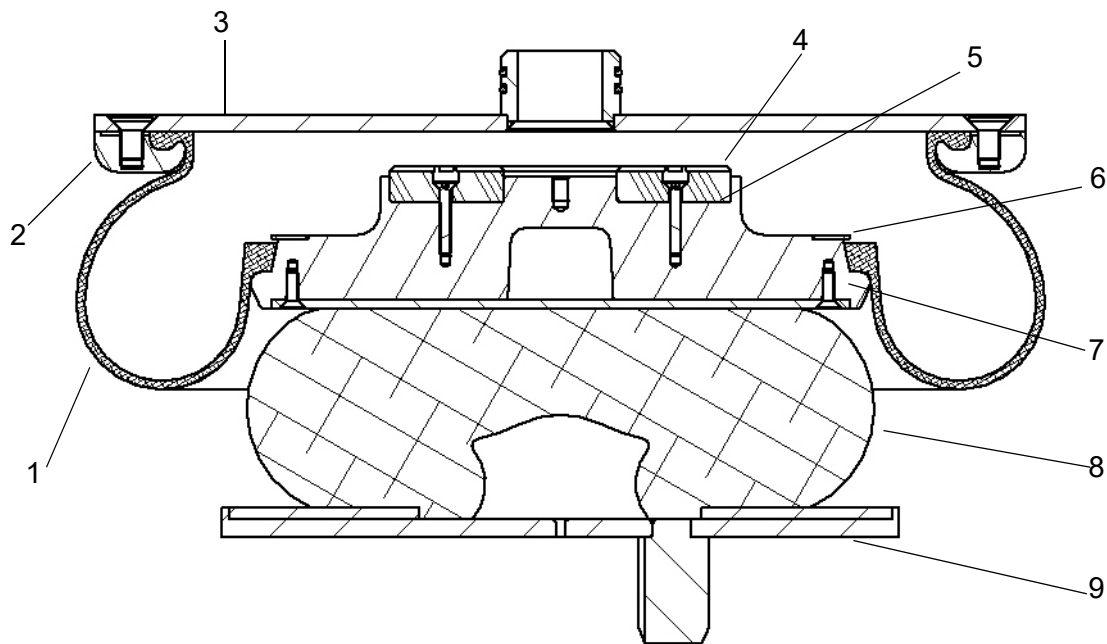


Figure 1: Air Spring System

The air spring system consists of an air bellows and an additional spring.

- 1 Air spring bellows 17014803
- 2 Mounting ring E860500
- 3 Top plate E860498

Additional Spring

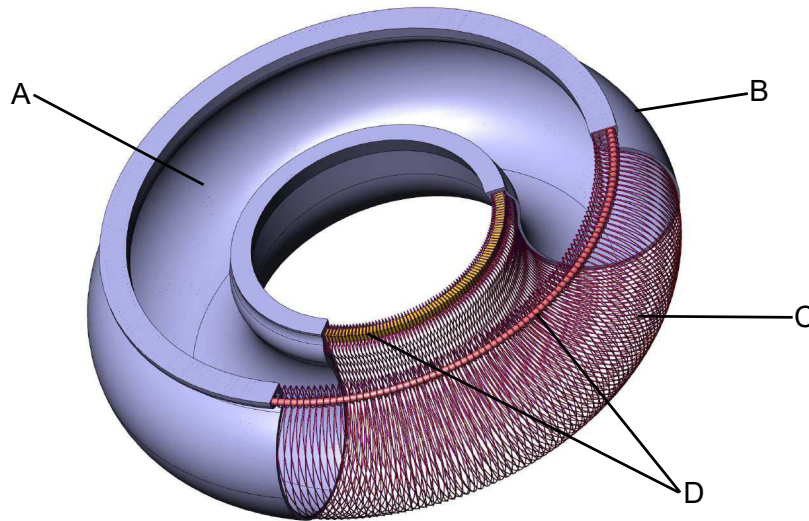
The additional spring consists of:

- 4 Sliding plate E860501
- 5 Washer E860514 / E860516 / E860517
- 6 Clamping plate E860400
- 7 Rim E860496
- 8 Half Hour Glass Spring 73900504
- 9 Ground plate E860499

3.3 Construction of the Air Spring Bellows

The air spring bellows consists of several layers of high-quality elastomers in which reinforcing material [C] is bedded. The inner layer [A] mainly has sealing function and the outer layer [B] is resistant against ozone and is weatherproof. Moreover the outer layer protects against mechanical damages. The steel core [D] in the top and lower bulge area serves for sealing between air spring and the respective holding fixtures.

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[A] Inner rubber layer
[B] Outer rubber layer

[C] Reinforcing material
[D] Steel core

Figure 2: Construction bellows

3.4 Technical Specification

Technical Specification	
Diameter	710 mm / max. 755 mm
Height (inflated, under load 70 kN)	300 mm
Weight	122,5 kg ± 5%

Table 1: Technical Specification

4 Transport and Storage

4.1 Transport

The air spring system is delivered completely assembled.

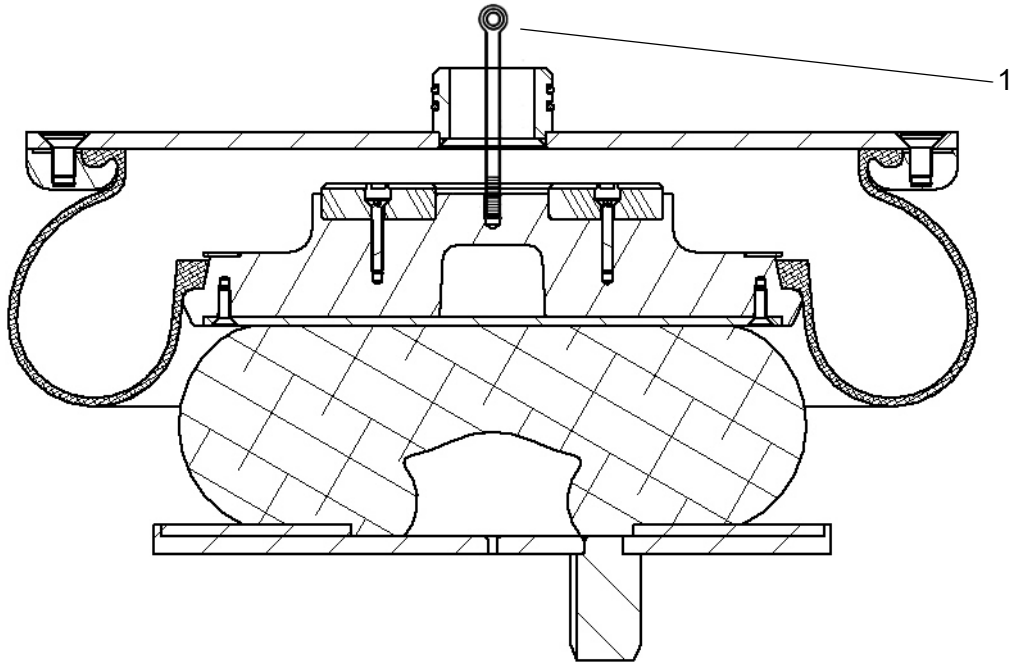
CAUTION



High weight of the air spring system

- The air spring system always carry a couple or with a lifting device.
- Lift the air spring system only by using an eye bolt
- Wear safety shoes!

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[1] Eye bolt DIN 444 A - M12x180

Figure 3: Lifting air spring system by an eye bolt

4.2 Storage

The storage of rubber parts is regulated in DIN7716:1982-05 and ISO 2230: 2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow. Storage and storage time recording of vulcanized rubber products are described in ISO 2230:2002-04. In this standard the elastomer products are divided into three groups with different storage times. These are shown in Table 2.

The elastomer of Air Spring System is part of group 1

Classification acc. to ISO 2230:2202-04	Designation	Storage time (in years)	Extension (in years)
Group 1	NR, AU, EU, SBR	5	2
Group 2	NBR, HNBR, ACM, AEM, XNBR, ECO, CR, IIR	7	3
Group 3	FKM, VMQ, EPDM, FVMQ, PVMQ, FFKM, CSM	10	5

Table 2: storage times of elastomers

The storage temperature shall be below 25 °C and products shall be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

If the storage temperature is below 15 °C, care should be exercised during the handling of stored products as they may have stiffened and become susceptible to distortion if not handled carefully.

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The temperature of products taken from such low-temperature storage should be raised to approximately 30 °C throughout their mass, before the products are put into service.

Rubber products made of certain chloroprene rubber types may not be stored at temperatures lower than + 12 °C.

Care must be taken to ensure that the components are protected from air supply, in particular to keep away the ozone which is detrimental to elastomers.

The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

NOTICE



- Solvents, fuels, lubricants, chemicals, acids, brines, disinfectants or else are not allowed in the storage room.
- Vapors of these substances can damage the rubber.

Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

NOTICE



- Particular metals, especially copper and manganese have a damaging effect on rubber products

Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

NOTICE



- Foils containing softeners are not allowed to be used as packaging material.

If rubber products have to be powdered, the powder should not contain any harmful ingredients for rubber-products. Appropriate materials for powdering purposes are French chalk, prepared chalk, fine-grained mica flour and rice starch.

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5 Assembly / Disassembly

INFORMATION

Incorrect mounting / dismounting

- Incorrect procedure leads to damages of the air spring bellows or the sealing areas of the top plate or rim.
- Perform the dismounting and mounting carefully by adequately trained and experienced staff.

5.1 Safety Messages

Note to Reader



Please read and observe the following safety instructions before and during assembly / disassembly or when using this air spring system. Maintenance and control work as well as the exchange of components must be carried out by suitably trained and knowledgeable personnel.

CAUTION



High weight of the additional spring system

- If the complete system is lifted, the additional spring may separate from the air spring bellows (see picture below).
- This leads to risks for injuries.
- Do not lift the complete system at the top plate for transportation, disassembly or similar.
- Wear safety shoes!

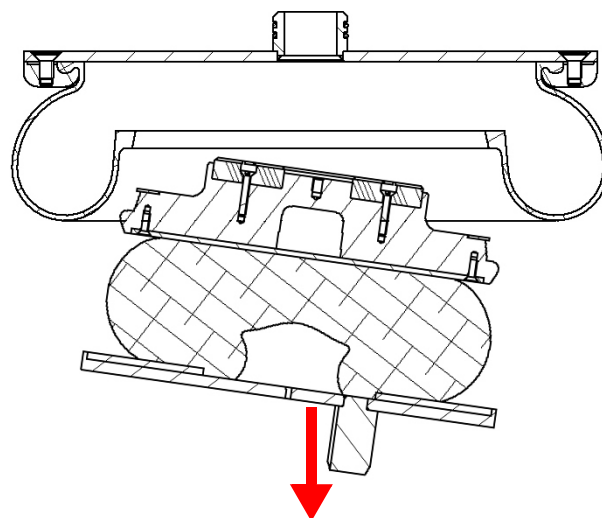


Figure 4: Loosen of the additional spring

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⚠ CAUTION



High Pressure in the air spring bellows

- If the system is not fixed, the air spring bellows can separate explosively from the additional spring.
- This leads to risks for injuries.
- Fix the system in a suitable mounting device or in the bogie and load the air spring system with the appropriate axial force, before applying pressure.

⚠ CAUTION



High Pressure in the air spring bellows

- When the air bellows will be set under pressure, it is possible that the bellows instantly become detached.
- This leads to risks of injury to people in the immediate vicinity (hearing damage).
- A hearing protection has to be worn all the time.

5.2 Required Tools

For the assembly and disassembly the following tools are required:

- Torque key (torque range 0 Nm up to 120 Nm)
- Hexagon socket screw key
- Hammer (1000 g)
- Assembling aid (hard wood)
- Cleaning wipes
- Grease
- Soap water
- Compressed air supply
- Press
- Mounting level

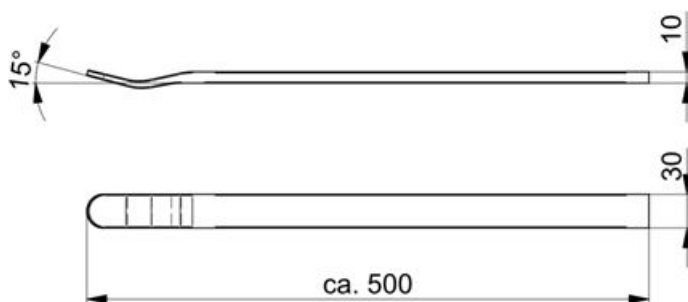


Figure 5: Mounting lever

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NOTICE



Sharp edges of the mounting levers

- Sharp edges can cause damages on the bellows.
- Make sure that the mounting levers have no sharp edges to avoid damages on the bellows.

5.3 Disassembly of Air Spring System

INFORMATION

Perform the disassembly only in a pressure-free state!

1. The additional spring should stand on to a solid support and not hang in the air.
2. Loosen the screws and remove the Top Plate.

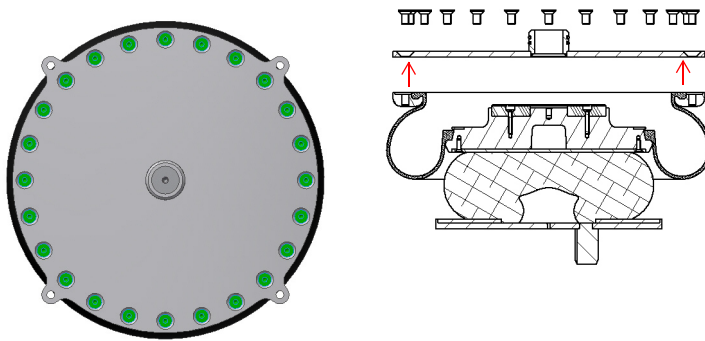


Figure 6: Disassemble the Top Plate

3. Loosen the screws and remove the Clamping Plate.

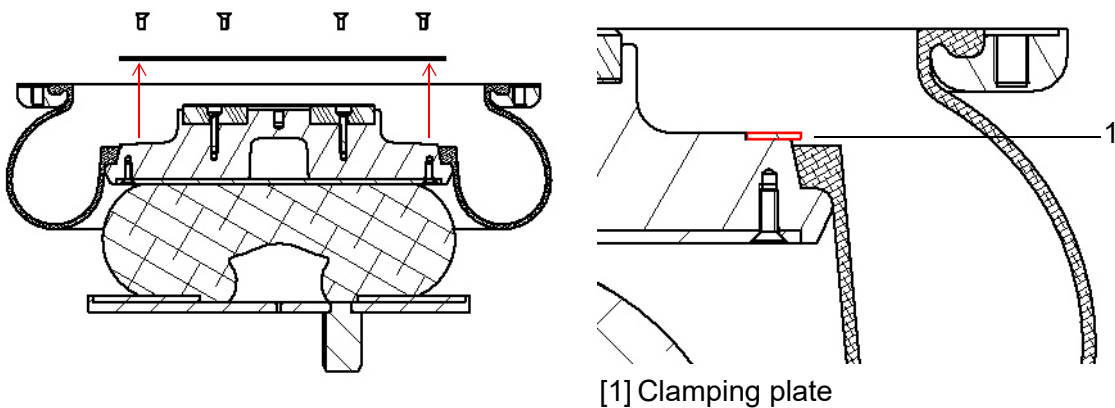


Figure 7: Disassemble the Clamping Plate

4. In the next step, the mounting lever is slowly inserted between the lower bulge of the air spring and the shoulder of the rim (see Picture below). The mounting lever is inserted until metal contact between the mounting lever and the conical receiving area takes place.

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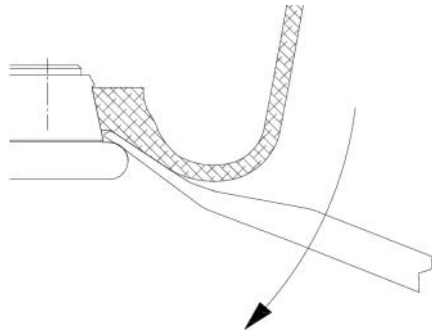


Figure 8: Disassembly additional spring (sample)

INFORMATION

- Push the mounting lever as far as possible. Otherwise damage may be caused to the air spring top plate and the bellows, or the bellows can not be disassembled.
- A second mounting lever in the near the first (approximately 10 cm) can be used for support.
- Damage to the corrosion protection that have arisen through the disassembly must be corrected.
- Sharp scratches can cause damage to the bellows.
- Remove sharp scratches on affected parts.

5.4 Assembly of the Bellows on Mounting Ring

1. Clean the air spring bellows with a cleaning cloth.
2. The mounting ring is clamped in a corresponding mounting device.

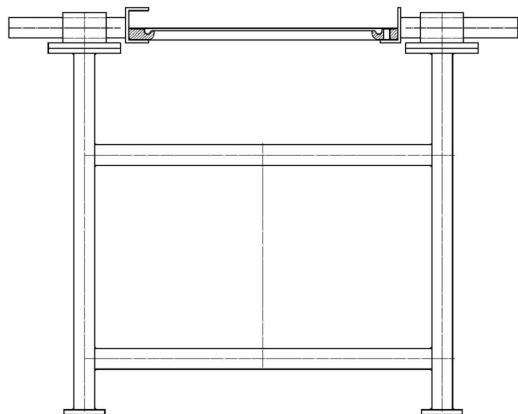


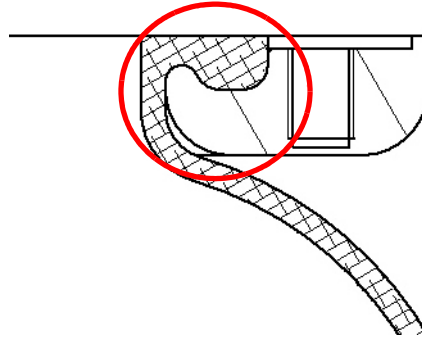
Figure 9: Mounting device

3. Moisten the outside of the bellows with soapy water so that the bellows can easily slide through the ring.
4. Set the bellows one-sided at the clamped mounting ring and press it step by step behind the clamp nose.

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Figure 10: fix bellows to mounting ring



5. The bellows must be located on each point on the circumference clean and completely behind the clamp nose.

5.5 Mounting the Sliding Plate

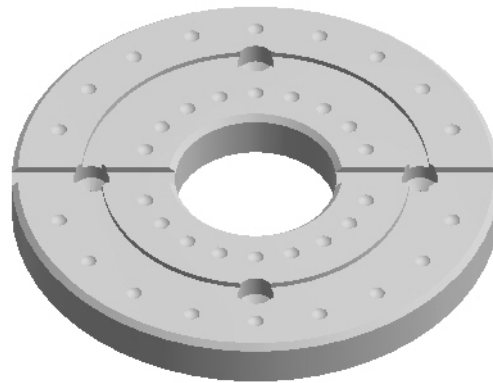
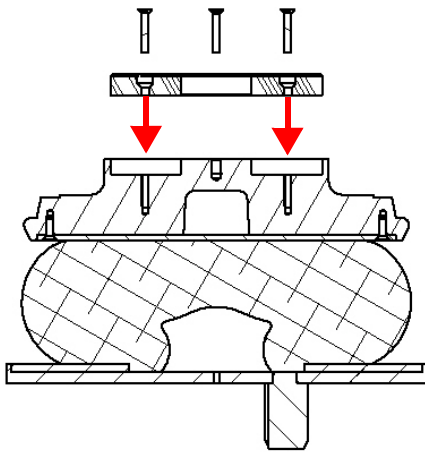


Figure 11: Mounting the Sliding Plate

1. Place the sliding plate with the appropriate washer on the rim.
2. Wet the 4 screws M8x50 - A2-70 DIN 25201-G2 with Loctite 243 and place them in the corresponding holes.
3. Tighten the screws with a torque of 3 Nm according to drawing GMT-No. 17104501.
4. After exchange the bellows or the additional spring fill the indentations with Berusil FO 22 to lubricate the sliding plate.

5.6 Assembly of the Bellows

1. Clean the air bellows with a cleaning cloth. The cleaned areas are then coated with clear or soapy water.
2. The bellows is initially manually placed on the rim by hand. Ensure that the air spring bellows is placed in a straight position in order to avoid tilting.

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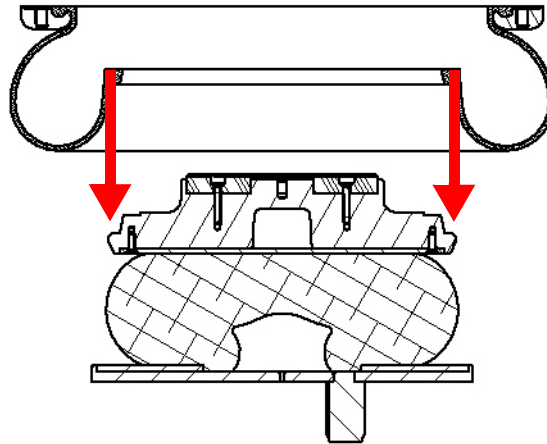


Figure 12: Place bellows on additional spring

3. After being fitted, the air spring bellows is pressed downwards along the circumference by hand to ensure a uniform fit. The assembly can be supported by means of a hammer (1000 g) and the assembly aid (hardwood).

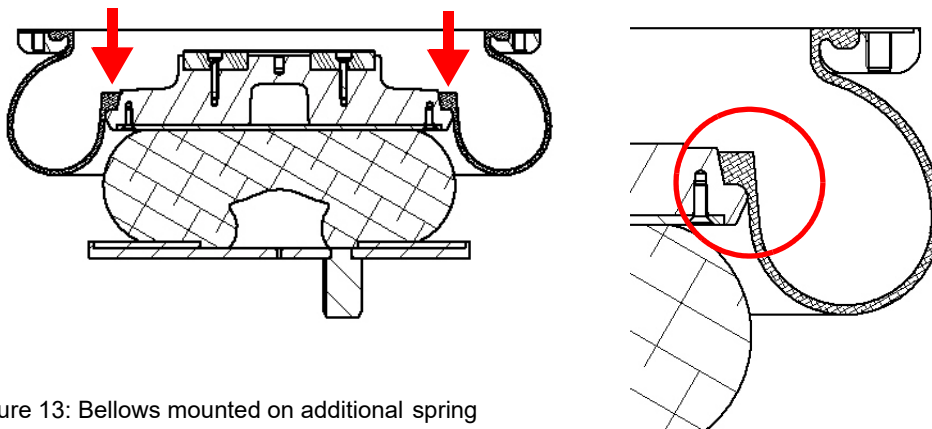


Figure 13: Bellows mounted on additional spring

4. Place the clamping plate on the inside of the rim.

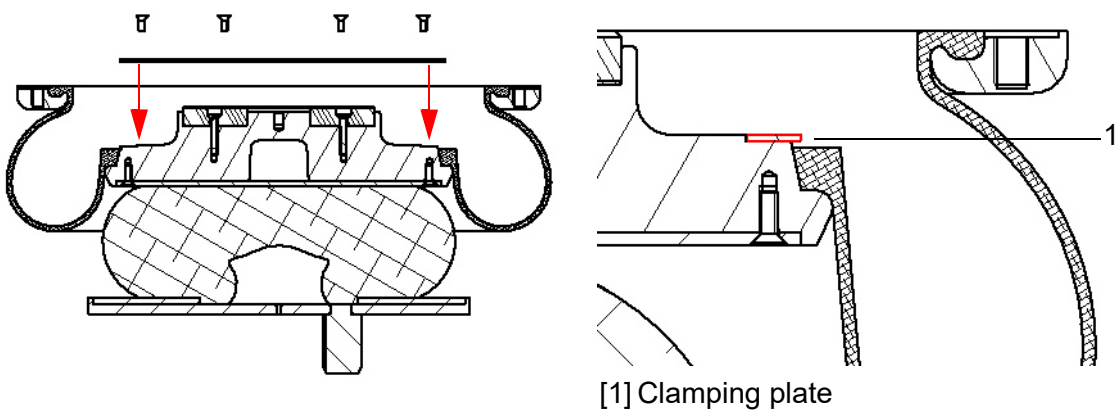


Figure 14: Mounting the clamping plate

5. Wet the screws with Loctite 243 and tighten them with a torque of 20 Nm.
6. Note the curing time of the adhesive manufacturer.

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5.7 Mounting the Top Plate

1. Place the top plate on the pre-assembled system.

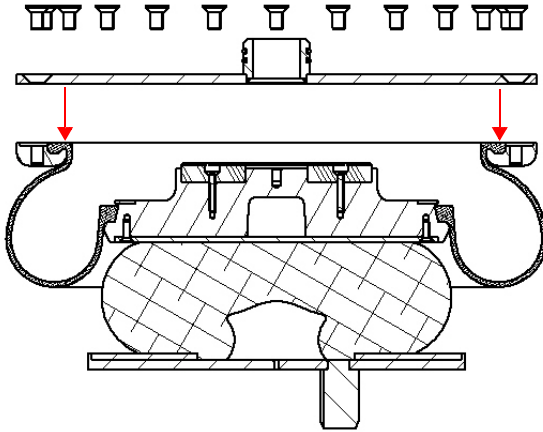


Figure 15: Mounting the top plate

2. Wet the screws ISO 10642 - M16x30 - A2-70 with Loctite 243 and place them in the holes.

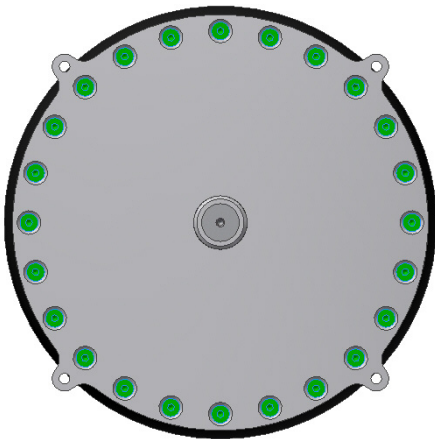


Figure 16: Screws on top plate

3. Tighten the screws step by step to the specified torque.
 - pre-assembly: 20 Nm clockwise
 - step 1: 90 Nm crosswise
 - step 2: 120 Nm clockwise
 - step 3: serial test
 - step 4: 120 Nm clockwise
4. Note the curing time of the adhesive manufacturer.

5.8 Leakage Test

The leakage test shall be performed after assembling completely the air spring system. During the test, appropriate safety precautions such as the wearing of safety gloves, safety goggles

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and hearing protection must be strictly observed. The leakage test can be performed at the completed bogie.

⚠ CAUTION



High pressure in the bellows

- If the installation height is not fixed, the bellows can explosively separate from the additional spring.
- This leads to risks of injury
- Fix the system in a suitable mounting device or in the bogie and load the air spring system with the appropriate axial force before applying pressure.

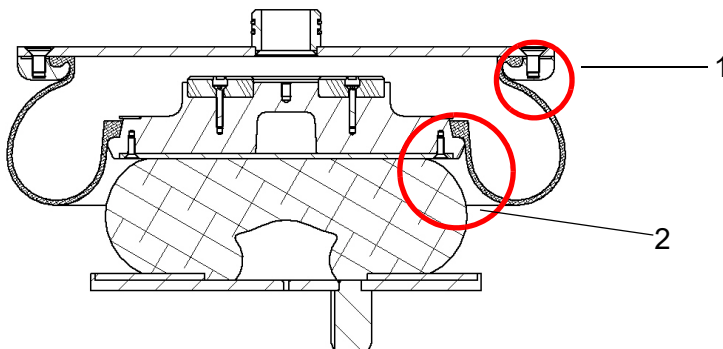
⚠ CAUTION



When air is supplied, the bellows fills suddenly with the operating pressure

Here is an acute danger that limbs (fingers, etc.) are clamped.

- Do not grab between the bellows and additional spring.
- Do not grab between the bellows and the upper plate.



[1] danger spot bellows - top plate

[2] danger spot bellows - additional spring

Figure 17: place of danger

We recommend following test procedure:

1. Connect a pressure measuring device to the pressure conduction between the stop valve and the air spring system
2. Fill up the air spring up to 1.3 times the maximal pressure P_M 6.5 bar at F_M 160 kN), that means 8.45 bar. Keep the compression constantly for 30 seconds.
3. Reduce the pressure to 0.9 times the nominal pressure, that means 5.85 bar. Close the air supply for at least 10 minutes.
4. Measure the decrease in pressure. This should not exceed 0.15 bar between 5 and 10 minutes.
5. In case of a major pressure loss, the leakage location must be localized with leakage detection spray or soapy water and sealed by appropriate measures.

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6 Initial Operation

- not applicable -

7 Operation

- not applicable -

8 Maintenance

8.1 General Instructions

Controlling, cleaning and maintaining rubber-metal parts and molded rubber parts

8.2 Range of Coverage

The following guidelines apply to elastomeric components and rubber-metal components, based on the use of caoutchouc and rubber in pure form. Alternatively to metallic materials partially plastics are used. These documentation were drawn up in line with DIN 7716:1985-05 and ISO 2230:2002-04 and are also valid for the use of synthetic rubber products regarding the general conditions.

8.3 General

Under unfavorable storage conditions or improper treatment most elastomer products change their physical properties. This can lead to a significant decrease in lifetime of elastomer products. For example from excessive hardening, softening, permanent deformation as well as from flaking, cracks or other surface damage they can become unusable. The changes can be caused by the influence of oxygen, ozone, heat, light, humidity, solvents or by storing under stress.

Properly stored and treated rubber products remain virtually unchanged in their characteristics for a long time (several years).

INFORMATION

- Rubber-to-metal-bonded parts are mainly suited for the usage in compression- and shear-loads, pulling-loads should be avoided.

8.4 Service Life and Control

The Air Spring System does not require any servicing.

8.5 Visual Check

8.5.1 Air Spring Bellows

Check the air spring bellows visually at least once a month.

NOTICE



In general: If first fabric layers visible, the air spring must be replaced preventively.

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INFORMATION

Deposits at the Bellows

- Remove deposits on the bellows or at contact points to other parts according to the specifications for cleaning in the next chapter. An operational risk is not necessarily given at this time.
- On locally damaged areas in the form of cracks, scuffs, rubber peeling or blistering should be checked immediately how far the damage has progressed.
- For this check, use only dull and edgeless tooling.

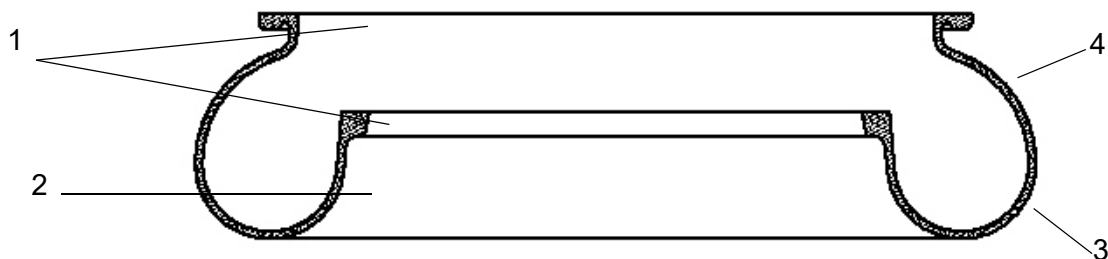


Figure 18: Air Spring Bellows

1. Top and lower sealing surface

These areas are extremely important for the functionality of the air spring bellows and is checked by performing a 100 % tightness check after production. Provided that the air spring bellows has been fitted properly, there is no way of hurting these areas. If any damages are detected there could be following reasons:

- Incorrect mounting
- Incorrect dismounting
- Incorrect storage before initial operation

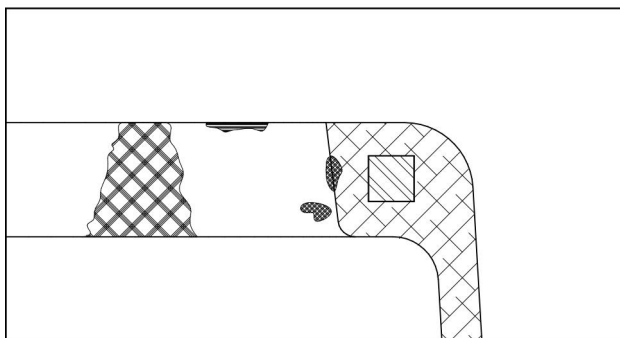


Figure 19: Delamination

NOTICE



- Delamination due to mechanical influences or foreign bodies could cause leaks.
- Do not use spring bellows with these defects again.
- Replace the bellows within the next 3 months!

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INFORMATION

- Irregular partial detachments can be caused by former dismounting of the bellows. Usually these defects can be tolerated.
2. Cuts in the lower area of the loop

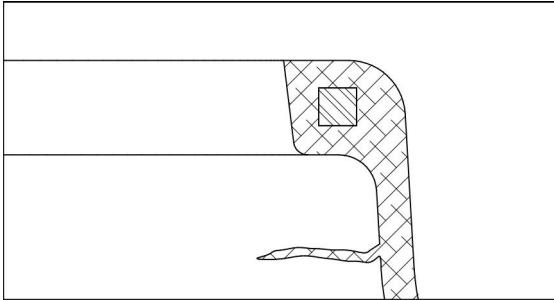


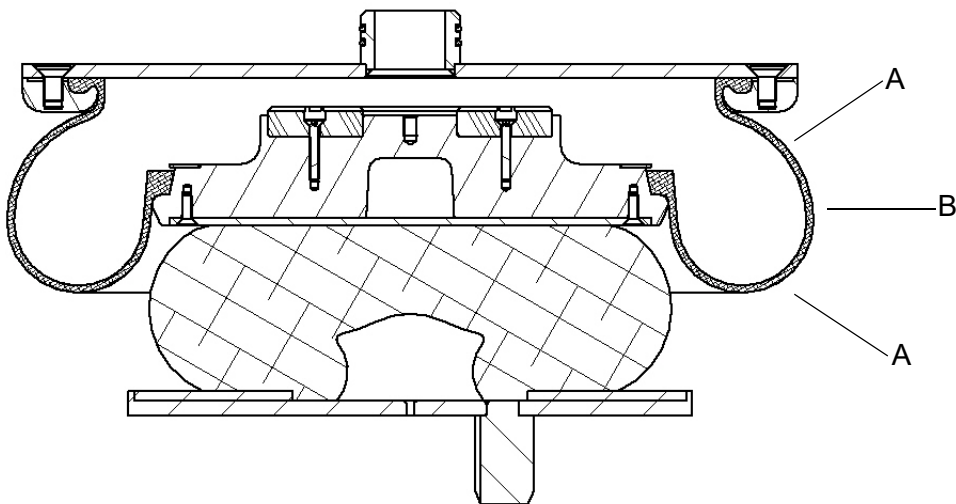
Figure 20: Cuts

NOTICE



- **Exchange the air spring bellows within the next 3 months if any cuts are detected in this area during inspection.**

3. Abrasive damages and cuts



A - Abrasive damages

B - Cuts

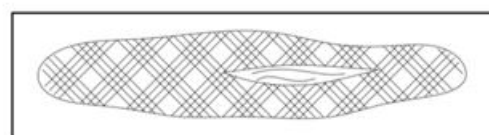
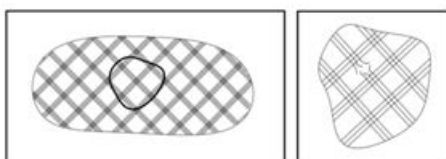


Figure 21: Abrasive damages and cuts

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NOTICE



- Abrasive damages or small cuts on the outer rubber layer of the bellows can be tolerated as long as the reinforcing material is not visible.
- **Exchange the air spring bellows within the next 3 months, if it is visible and frayed (A) or incised (B).**

4. Detachment of the outer layer of the rubber

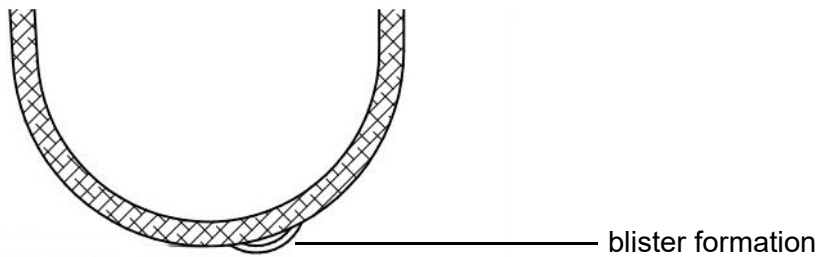


Figure 22: Blistering

When a bubble appears on the surface during operation, it is usually caused by incorrect storage and long-term oil contact.

Small bubbles:

Highlight the bubbles. Pierce the bubbles with the dimensions (diameter or length) <30 mm with a needle. The needle should penetrate into the bubble as far as possible parallel to the surface of the air spring bellows.

No additional checks are required, visual check of marked area at next regular visual inspection.

Medium bubbles:

Highlight the bubbles. Pierce the bubbles with dimensions between 30 and 50 mm. The bellows may stay in operation under normal service conditions.

Replace it preventively at next opportunity. No additional checks are required, visual check of marked area at next regular visual inspection.

Big bubbles:

Do not pierce the bubbles with dimensions > 50 mm!

Critical: Replace the bellow immediately.

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8.5.2 Additional Spring

INFORMATION

Perform a visual check before assembly and afterwards regularly between the general inspections.

The check of the bonding between rubber and metal can be supported by hand by a mechanical bonding test. The rubber may be pressed back with a blunt test iron (rounded corners > 1 mm).

NOTICE



Partial debonding of the edges of the bonding zone between the elastomer and the metal

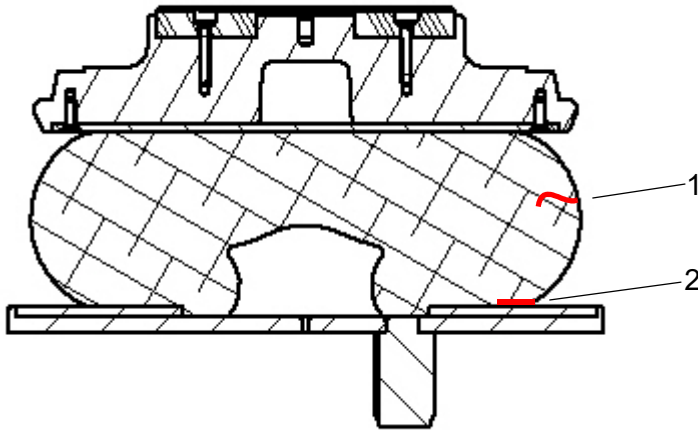
- Partial debonding of the edges of the bonding zone between the elastomer and the metal up to a depth of 8 mm is acceptable and do not affect the function and safety of the components.
- Exchange the part if the debonding is larger than 8 mm.

8.6 Replacement Criteria

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when:

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- crack depth < 10 mm is acceptable, no further actions are necessary
- crack depth > 10 mm to 20 mm is to be observed, documenting the crack growth
- crack depth > 20 mm: additional spring is to be exchanged at short notice

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[1] Replacement criterion: crack depth

[2] Replacement criterion: debonding $T > 8 \text{ mm}$

Figure 23: Replacement criterion

During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by compression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.



[1] Discoloration

Figure 24: Discoloration example

INFORMATION

- Slippery surfaces of PA or similar materials must be free from cracks and breakouts. A fixed connection to the other component is required.

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8.7 Maintenance Plan

MAINTENANCE									
Activity	Interval							Page	
	monthly	3 month	6 month	yearly	before assembly	between main inspection	after 8 years		after revision (after exchange bellows/additional spring)
Visual inspection bellows	X				X				18
Visual inspection additional spring		X			X	X			22
Leakage Test					X				16
Exchange bellows							X		12
Exchange additional spring							X		22
Lubricating Sliding Plate					X			X	14

Table 3: Maintenance Plan

8.8 Media Resistance

8.8.1 General Information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

8.8.2 Resistance against Environmental Impacts and Loads

The rubber compounds used in bogies are resistant to environmental influences under normal climatic conditions which mean temperatures between -30 °C and $+50\text{ °C}$. Resistance against climatic influence, especially against ozone, and higher temperatures, caused e.g. by the waste heat of motors, is improved by the proportioning of appropriate chemicals.

INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
- Elastomers made of natural rubber are not permanently resistant against mineral oils and fuels.

8.8.3 Resistance against Machine Cleaning

The elastomers used are resistant against phosphoric acids and hydrochloric acids as well as against alkaline cleaning agents used for cleaning of the exterior of vehicles.

The resistance has been proven at selective elastomers made of natural rubber in test fluids according to DIN 5514 part 2 table 3 representing other cleaning agents which are customary in trade.

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INFORMATION

Non pH neutral cleaning agents

- Non ph-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

8.9 Cleaning

The components can be cleaned using detergents mentioned in Table 4. The specified concentrations as well as the specifications of manufacturer shall be observed obligatorily. The residues of the detergents shall be rinsed with clear water. The cleaned Air Spring System has to be dried at room temperature.

NOTICE



Use of other differing cleaning agents

- The use of different detergents as mentioned in Table 4 can damage the rubber.
- Only use detergents mentioned in Table 4.

Detergent	Concentration
Alkaline detergent	
Oxalic detergent	
Rapidol A	10 %
Rapidol W	10 %
Rapidol 58	10 %
Rapox	5 %
Rapox OS	5 %

Table 4: Detergents

NOTICE



Cleaning with sharp objects

- Cleaning with sharp objects, e.g. wire brushes, emery paper etc. will cause damage on the air spring system.
- Do not use sharp objects for cleaning.

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Brief overview of resistance behavior of different elastomer compounds:

	GROUP 1			GROUP 2							GROUP 3					
	NR	AU / EU	SBR	NBR	HNBR	ACM	CR	IIR	AEM	CIIR	EPDM	FKM	FFKM	VMQ	FVMQ	CSM
acid resistance	B	U	B	B	B	B	A	A	U	B	A	A	A	B	B	A
alkali resistance	B	U	B	B	B	B	A	A	U	B	A	A	A	B	B	A
oil resistance	U	A	U	A	A	A	B	U	A	U	U	A	A	B	A	B
Resistance to fuel	U	A	U	B	B	A	U	U	A	U	U	A	A	U	A	U
Solvent resistance	U	B	U	B	B	B	B	B	B	B	B	B	A	B	B	B
ozone resistance	B	A	B	B	B	A	A	A	A	B	A	A	A	A	A	A
weatherability	B	A	A	A	B	A	A	A	A	B	A	A	A	A	A	A
A = very good, little or no attack																
B = satisfactory, moderate to severe attack.																
Please contact the manufacturer!																
U = unsuitable for the application																

Table 5: resistance behavior of elastomers

8.10 Fire Protection

The elastomers made of natural rubber used in bogie components do not contain flame retardants. The materials used were tested in accordance with EN45545-2 requirements set R9.

A classification is not possible.

9 Decommissioning

- not applicable -

10 Disassembly

- see chapter 5 Assembly -

11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
- After dismantling, metallic components can be disposed of in the metal scrap recycling.

12 Error Identification

- not applicable -

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13 Annex

13.1 Part numbers of items / components

Description	Quantity	GMT Part No.
Air Spring Bellows	1	17014803
Additional Spring	1	17104501
Top Plate	1	E860498
Mounting Ring	1	E860500
Clamping Plate	1	E860400
Countersunk Screw M8x20	8	E860096
Countersunk Screw M16x30	24	E860494
O-Ring	2	E860009
Sliding Plate	1	E860501
Half Hour Glass Spring	1	73900504
Rim	1	E860496
Ground Plate	1	E860499
Washer	0	E860394
Washer	0	E860395
Washer	0	E860396
Countersunk Screw M8x25	8	E860144
Countersunk Screw M8x20	8	E860109
Countersunk Screw M8x50	4	E860502

Table 6: Spare parts list

14 Subject Index

- not applicable -

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Document Created (Date)	Index	Document Created (Name)

State of Revision

Document Modification										
Mod.	Index (Record Modified Chapters Here)									
	01	02	03	04	05	06	07	08	09	10
1	8.6									
2										
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00	2018-01-18	First issue	C. Palm
01	2018-10-02	Modification chapter 8.6	C. Palm

Prepared	Date	2018-10-02	GMT Engineering	Christian Palm
Released	Date	2018-10-02	GMT Engineering	Philipp Noga

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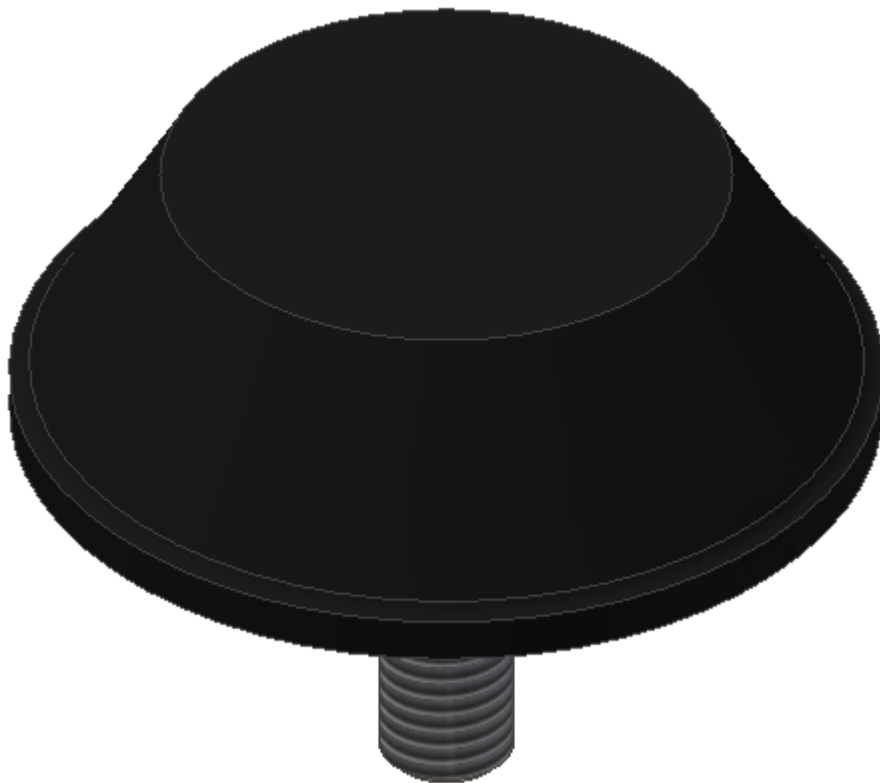
Gummi · Metall · Technik

Bump Stop Primary Suspension
GMT No. 62049602

Maintenance Manual

Bump Stop Primary Suspension

GMT No. 62049602



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Gummi · Metall · Technik

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1 On this manual

INFORMATION

These maintenance instructions for rubber-metal components refer exclusively to the visual inspection of the components when installed during operation in the vehicle depot.

The separate maintenance instructions of the vehicle manufacturer are authoritative for the inspection and main inspection of the bogies!

This maintenance manual describes the necessary maintenance operations incurring throughout the service life of the rubber metal parts.

Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

The maintenance intervals are based on the specification data and may be adapted according to the findings from the operation.

Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

1.1 Applicable Documents

- Drawing GMT No. 62049602
- DIN 7716:1982-05: Rubber products; requirements for storage, cleaning and maintenance
- ISO 2230:2002-04: Rubber products - Guidelines for storage
- DIN EN 13913:2003-08: Railway applications - Rubber suspension components - Elastomer-based mechanical parts
- DIN EN 45545-1:2013-08: Railway applications - Fire protection on railway vehicles

1.2 Presentation convention

The following representations are used in these manual:

NOTICE



- Indicates situations or maloperation that may lead to material damage.

INFORMATION

- Indicates important information or instructions.
- Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.

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2 Safety

2.1 Safety instructions



This manual contains important warnings and safety instructions which must be observed by the user.

The product may only be used and operated by qualified personnel who are capable of complying with the necessary safety precautions for use and operation.

The repair of the product may only be carried out by the supplier or by the qualified personnel trained for this purpose.

Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

2.2 Accident prevention regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated warning and safety messages

The following icons and standard text formats are used in this manual:

CAUTION



- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Bump Stop Primary Suspension is exclusively intended for installation in rail vehicles. The parts may only be used and installed under the intended operating conditions. Should individual parameters deviate, this must be agreed with GMT GmbH in order to exclude dangers and damage. The intended use also includes the observance of the instructions in this maintenance manual as well as the performance of tests and maintenance.

3 Product description

3.1 Designation of delivery item

Bump Stop Primary Suspension GMT No. 62049602

3.2 Description of delivery item

- not applicable -

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3.3 Technical specifications

Technical Specifications	
Diameter	77 mm
Height	62 mm
Weight	0.2 kg
Temperature range / operating conditions	-30 °C to +70 °C

Table 1: Technical specifications

3.4 Identification

Marking in rubber (raised)

GMT-Logo

Date of manufacture

62049602

4 Transport and Storage

4.1 Transport

- not applicable -

4.2 Storage

The storage of elastomer components is regulated in DIN 7716:1982-05 and ISO 2230:2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow.

Storage and storage time recording of elastomer components are described in ISO 2230:2002-04. In this standard the elastomer products are divided into three groups with different storage times. These are shown in table 2.

The elastomer of the Bump Stop Primary Suspension is part of group 1.

Classification acc. to ISO 2230:2002-04	Designation	Storage time (in years)	Extension of storage time (in years)*
Group 1	NR (Natural Rubber)	5	2
Group 2	NBR (Acrylic Nitrile Rubber), CR (Chloroprene Rubber)	7	3
Group 3	EPDM (Ethylene-propylene Rubber)	10	5

* same storage conditions as for the initial storage time

Table 2: storage times of elastomers

The storage temperature should be below +25 °C and products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

If the storage temperature is below +15 °C, handle the stored products carefully as they may have stiffened and become susceptible to distortion.

The temperature of products taken from such low-temperature storage should be raised to approximately +30 °C throughout their mass, before the products are put into service.

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Care must be taken to ensure that the components are protected from air supply, in particular to keep away the ozone which is detrimental to elastomers.

The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

NOTICE



- Solvents, fuels, lubricants, chemicals, acids, brines, disinfectants or suchlike are not allowed in the storage room.

Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

NOTICE



- Particular metals, especially copper and manganese have a damaging effect on rubber products

Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

NOTICE



- Foils containing softeners are not allowed to be used as packaging material.

If rubber products have to be powdered, the powder should not contain any harmful ingredients for rubber-products. Appropriate materials for powdering purposes are French chalk, prepared chalk, fine-grained mica flour and rice starch.

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5 Assembly

5.1 Mounting instructions

The assembly and disassembly is carried out according to the specifications of the rail vehicle manufacturer.

INFORMATION

- When mounting rubber-metal components, the forces and torques or paths and angles shown on the drawing GMT No. 62049602 (see Annex) are not to be exceeded by more than 20 %.
- If possible, do not introduce the assembly forces via the elastomer.
- Apart from static pre-loads, the components are virtually free of tension after installation.

NOTICE



- In particular it must be ensured that the exposed rubber surface is not damaged during installation.

6 Initial operation

- not applicable -

7 Operation

- not applicable -

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8 Maintenance

8.1 Maintenance intervals

Action	Mileage	Chapter
Visual check	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Bonding test	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Exchange of elastomer components		see chapter 8.6
Cleaning of elastomer products		see chapter 8.8

Table 3: Maintenance intervals

8.2 General instructions

Controlling, cleaning and maintaining rubber-metal parts and molded rubber parts

8.3 Range of coverage

The following guidelines apply to elastomeric components and rubber-metal components, based on the use of caoutchouc and rubber in pure form. Alternatively to metallic materials partially plastics are used. These documentation were drawn up in line with DIN 7716:1985-05 and ISO 2230:2002-04 and are also valid for the use of synthetic rubber products regarding the general conditions.

8.4 General

Under unfavorable storage conditions or improper treatment most elastomer products change their physical properties. This can lead to a significant decrease in lifetime of elastomer products. For example from excessive hardening, softening, permanent deformation as well as from flaking, cracks or other surface damage they can become unusable. The changes can be caused by the influence of oxygen, ozone, heat, light, humidity, solvents or by storing under stress.

Properly stored and treated rubber products remain virtually unchanged in their characteristics for a certain period of time.

INFORMATION

Rubber-to-metal-bonded parts are mainly suited for the usage in compression- and shear-loads. Pulling-loads should be avoided.

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8.5 Service life and Control

Elastomers are subject to a natural aging process and are not durable.

The service life of elastomer-components depends on the design and the strain of the component and conforms to the specific agreements of the order.

INFORMATION

- If elastomer components are only exposed to loads within the permissible range during the operating time, a maximum service life of 8 years can be assumed.
- During this operational period, elastomer components are maintenance-free. This does not exclude a visual inspection or control of the elastomer components.
- A visual inspection of the elastomer components must be carried out no later than 6 months after installation and then at least once a year.
- At the latest after reaching an operating time of 8 years, an examination and evaluation of a representative number of components must be carried out with the involvement of the manufacturer. If necessary, a residual life test should be carried out.

Regular visual inspections are essential for checking the condition of the elastomer components.

When visual inspection or inspection of an elastomer component, take care i.a. on:

- Fatigue cracks at the connecting ends of the elements
- discoloration
- volume changes
- Surface cracks in the body of the element

INFORMATION

- If you experience any damage or irregularities, report immediately.
- Document the observation according to the operational regulations.
- If necessary, replace the faulty element.

The bonding test between rubber and metal can be carried out by hand. The rubber can thereby be pressed back with a dull test-iron (edge with radius).

The use of sharp objects for inspection is not allowed!

NOTICE



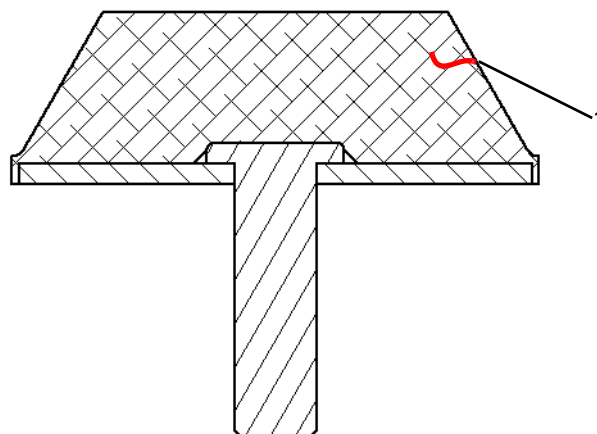
- Partial border delamination in the bonding zone between the elastomer and metal or surface cracks in the individual elastomer layers are to be reported immediately.
- These areas must be examined in regular intervals.
- If necessary, a performance and safety test of the components under participation of the manufacturer is to be initiated.

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8.6 Replacement

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- a crack depth >6 mm is reached (both in rubber itself as well as at the transitions to the metal)



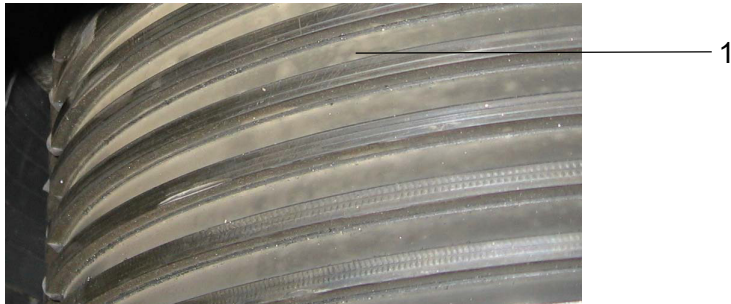
[1] Replacement criterion: crack depth > 6 mm

Figure 1: Crack depth

During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by compression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.

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[1] Discoloration

Figure 2: Discoloration example

8.7 Media resistance

8.7.1 General information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

8.7.2 Resistance against environmental impacts and loads

The rubber compounds used in bogies are resistant to environmental influences under normal climatic conditions which mean temperatures between -30 °C to +70 °C. Resistance against climatic influence, especially against ozone, and higher temperatures, caused e.g. by the waste heat of motors, is improved by the proportioning of appropriate chemicals.

INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
- Elastomers made of natural rubber are not permanently resistant against mineral oils and fuels.

8.7.3 Resistance against machine cleaning

The elastomers used are resistant against phosphoric acids and hydrochloric acids as well as against alkaline cleaning agents used for cleaning of the exterior of vehicles.

The resistance has been proven at selective elastomers made of natural rubber in test fluids according to DIN EN 13913:2003-08 representing other cleaning agents which are customary in trade.

INFORMATION

Non pH-neutral cleaning agents

- Non pH-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

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8.8 Cleaning

The components can be cleaned using detergents mentioned in table 4. The specified concentrations as well as the specifications of manufacturer shall be observed obligatorily. The residues of the detergents shall be rinsed with clear water. The cleaned component has to be dried at room temperature.

NOTICE



Use of other differing cleaning agents

- The use of different detergents can damage the rubber.
- Only use detergents mentioned in table 4.

Detergent	Concentration
Alkaline detergent	
Oxalic detergent	
Rapidol A	10 %
Rapidol W	10 %
Rapidol 58	10 %
Rapox	5 %
Rapox OS	5 %

Table 4: Detergents

NOTICE



Cleaning with sharp objects

- The use of sharp-edged objects (e.g. wire brushes, emery paper, etc.) is not permitted for cleaning elastomer products!

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Brief overview of resistance behavior or different elastomer compounds:														
	GROUP 1			GROUP 2						GROUP 3				
	NR			NBR	CR						EPDM			
acid resistance	B			B	A						A			
alkali resistance	B			B	A						A			
oil resistance	U			A	B						U			
Resistance to fuel	U			B	U						U			
Solvent resistance	U			B	B						B			
ozone resistance	B			B	A						A			
weatherability	B			A	A						A			
A = very good, little or no attack														
B = satisfactory, moderate to severe attack. Please contact the manufacturer!														
U = unsuitable for the application														

Table 5: resistance behavior of elastomers

8.9 Fire protection

Unless expressly required, elastomers made of natural rubber do not include any fire protection agents. The use of halogen-free fire protection agents causes a reduction in the mechanical properties; therefore, these protection agents are not used in components for dynamic load.

9 Decommissioning

- not applicable -

10 Disassembly

- not applicable -

11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
- After dismantling, metallic components can be disposed of in the metal scrap recycling.

Waste code according to the European Waste List (Waste Catalogue Ordinance):

The AVV waste code numbers are not product-related but are largely source-related. The manufacturer is therefore unable to specify the waste code for articles or products used in various sectors. Waste codes can be requested from the manufacturer.

12 Error identification

- not applicable -

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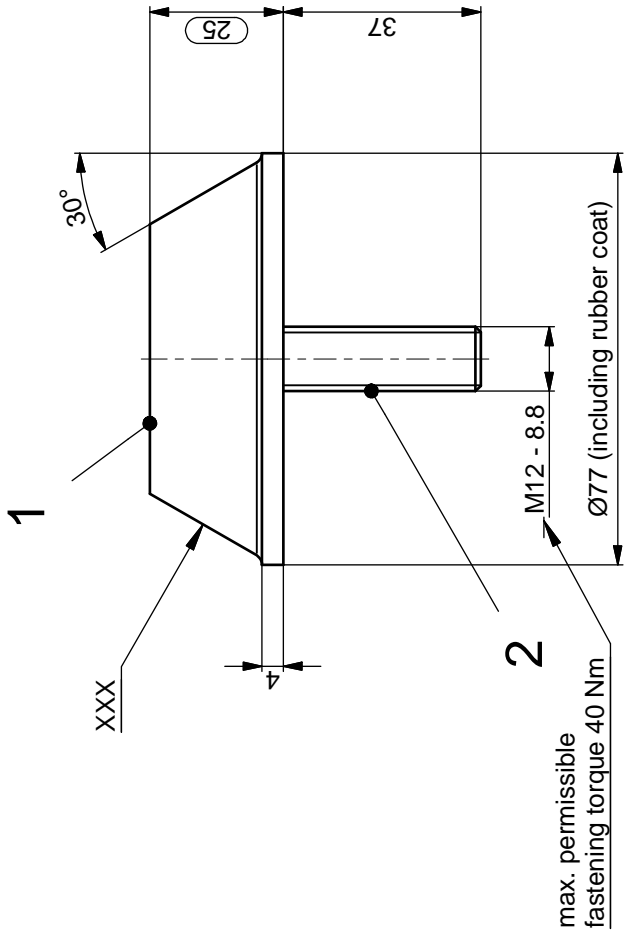
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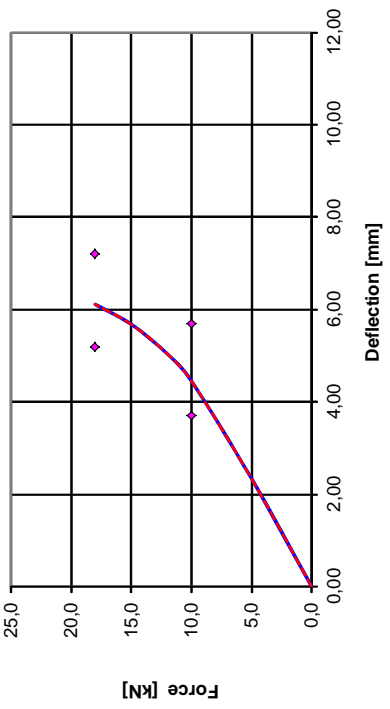


max. permissible fastening torque 40 Nm

XXX
 Markings in rubber (raised):
 GMT-Logo
 Date of manufacture (month and year)
 62049602 (changeable stamp)

Injection neop. rubber coat and parting line (dash allowable). Lacquer exhalation on rubber allowable!
 For components with surface coating the enlisted dimensions can be exceeded corresponding to the status before coating. Consequently tolerances can be exceeded correspondingly to the Layer thickness allowable.

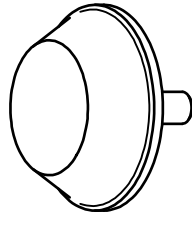
Measured axial characteristic



TEST SPECIFICATIONS FOR SPRING DEFECTION

- force direction: axial
- frequency of testing: first sample
- test control unit: ambient temperature
- testing temperature: 1 kN
- initial loading: 2
- number of settling cycles: 60 mm/min
- settling speed: 2x 18 kN
- settling load up to: 30 mm/min
- testing speed: 1. deflection measurement: S = 6,2 mm ±1 mm at F= 18 kN
- 1. deflection measurement: S = 4,7 mm ±1 mm at F= 10 kN
- 2. deflection measurement: 3. stiffness measurement:

(1:2)



QUM TS 005 - 107
 Galvanischer Überzug
 Electroplated coating

Rz 64
 -0,3

DIN EN ISO 4753 FL		Oberfläche, Form- / Lage toleranz Surface shape / position tolerance		Maßstab / Scale: 1: 1		Gewicht / Weight: 0,2 kg	
Maße ohne Toleranzangabe Dimension without tolerance indication		ISO 12715		Material: Elastomer: OP685		Material acc. to part list	
DIN ISO 2768 mK		DIN ISO 8015		Material acc. to part list			
DIN EN 10088		DIN ISO 1101					
		All dimensions in mm		Benennung / Description: Bump stop		Zeichnungsnr. / Drawing no.: 62049602	
		Date		Name		sheet 1 of 2 sh	
		Established		miano		Index: 003	
		Reviewed		dicomanow		1	
		Approved		jmarlin		A3	
		Date		Name		Model: 62049602	
		24.06.18		mmieland			
		12.07.18		mmieland			
		19.04.18		jvwopfel			
003 P.V. Kennlinie		Date		Name			
002 Elastomer, Kennzeichnung							
001 Kennz.							
Ident.		Modification					

CAD Zeichnung - Darf manuell nicht geändert werden!
 CAD drawing - Must not be changed manually!



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14 Subject Index

- not applicable -

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Document Created (Date)	Index	Document Created (Name)

State of Revision:

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Mod.	Index (Record Modified Chapters Here)									
	01	02	03	04	05	06	07	08	09	10
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Released	Date	2020-07-01	GMT Engineering	Stefan Schemel

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Maintenance instruction Bump Stop Primary Suspension GMT No. 62049602 Rev. 00

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Maintenance Manual

Center Pivot Bearing

GMT - No. 41057501



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1 On this manual

INFORMATION

These maintenance instructions for rubber-metal components refer exclusively to the visual inspection of the components when installed during operation in the vehicle depot.

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This maintenance manual describes the necessary maintenance operations incurring throughout the service life of the rubber metal parts.

Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

The maintenance intervals are based on the specification data and may be adapted according to the findings from the operation.

Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

1.1 Applicable Documents

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- DIN 7716:1982-05: Rubber products; requirements for storage, cleaning and maintenance
- ISO 2230:2002-04: Rubber products - Guidelines for storage
- DIN EN 13913:2003-08: Railway applications - Rubber suspension components - Elastomer-based mechanical parts
- DIN EN 45545-1:2013-08: Railway applications - Fire protection on railway vehicles

1.2 Presentation convention

The following representations are used in these manual:

NOTICE



- Indicates situations or maloperation that may lead to material damage.

INFORMATION

- Indicates important information or instructions.
- Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.

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2 Safety

2.1 Safety instructions



This manual contains important warnings and safety instructions which must be observed by the user.

The product may only be used and operated by qualified personnel who are capable of complying with the necessary safety precautions for use and operation.

The repair of the product may only be carried out by the supplier or by the qualified personnel trained for this purpose.

Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

2.2 Accident prevention regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated warning and safety messages

The following icons and standard text formats are used in this manual:

CAUTION



- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Center Pivot Bearing is exclusively intended for installation in rail vehicles. The parts may only be used and installed under the intended operating conditions. Should individual parameters deviate, this must be agreed with GMT GmbH in order to exclude dangers and damage. The intended use also includes the observance of the instructions in this maintenance manual as well as the performance of tests and maintenance.

3 Product description

3.1 Designation of delivery item

Center Pivot Bearing GMT - No. 41057501

3.2 Description of delivery item

- not applicable -

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3.3 Technical specifications

Technical Specifications	
Diameter	207 mm
Width	190 mm
Weight	20.3 kg
Temperature range / operating conditions	-30 °C to +50 °C

Table 1: Technical specifications

3.4 Identification

Marking in rubber (raised)

GMT-Logo

Date of manufacture

41057501

Cavity no.

4 Transport and Storage

4.1 Transport

- not applicable -

4.2 Storage

The storage of elastomer components is regulated in DIN 7716:1982-05 and ISO 2230:2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow.

Storage and storage time recording of elastomer components are described in ISO 2230:2002-04. In this standard the elastomer products are divided into three groups with different storage times. These are shown in Table 2.

The elastomer of the Center Pivot Bearing is part of group 1.

Classification acc. to ISO 2230:2002-04	Designation	Storage time (in years)	Extension of storage time (in years)*
Group 1	NR (Natural Rubber)	5	2
Group 2	NBR (Acrylic Nitrile Rubber), CR (Chloroprene Rubber)	7	3
Group 3	EPDM (Ethylene-propylene Rubber)	10	5

* same storage conditions as for the initial storage time

Table 2: storage times of elastomers

The storage temperature should be below +25 °C and products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

If the storage temperature is below +15 °C, handle the stored products carefully as they may have stiffened and become susceptible to distortion.

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The temperature of products taken from such low-temperature storage should be raised to approximately +30 °C throughout their mass, before the products are put into service.

Care must be taken to ensure that the components are protected from air supply, in particular to keep away the ozone which is detrimental to elastomers.

The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

NOTICE



- Solvents, fuels, lubricants, chemicals, acids, brines, disinfectants or suchlike are not allowed in the storage room.

Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

NOTICE



- Particular metals, especially copper and manganese have a damaging effect on rubber products

Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

NOTICE



- Foils containing softeners are not allowed to be used as packaging material.

If rubber products have to be powdered, the powder should not contain any harmful ingredients for rubber-products. Appropriate materials for powdering purposes are French chalk, prepared chalk, fine-grained mica flour and rice starch.

5 Assembly

5.1 Mounting instructions

The assembly and disassembly is carried out according to the specifications of the rail vehicle manufacturer.

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INFORMATION

- When mounting rubber-metal components, the forces and torques or paths and angles shown on the drawing GMT - No. 41057501 (see annex) are not to be exceeded by more than 20 %.
- If possible, do not introduce the assembly forces via the elastomer.
- Apart from static pre-loads, the components are virtually free of tension after installation.

NOTICE



- In particular it must be ensured that the exposed rubber surface is not damaged during installation.

5.2 Mounting the Center Pivot Bearing

The bushing may only be pressed into the housing via the outer pipe. In order to facilitate the press-fitting process, it is permissible to cool the bushing to -25 °C for 24 hours and then to add it to the housing unlubricated.

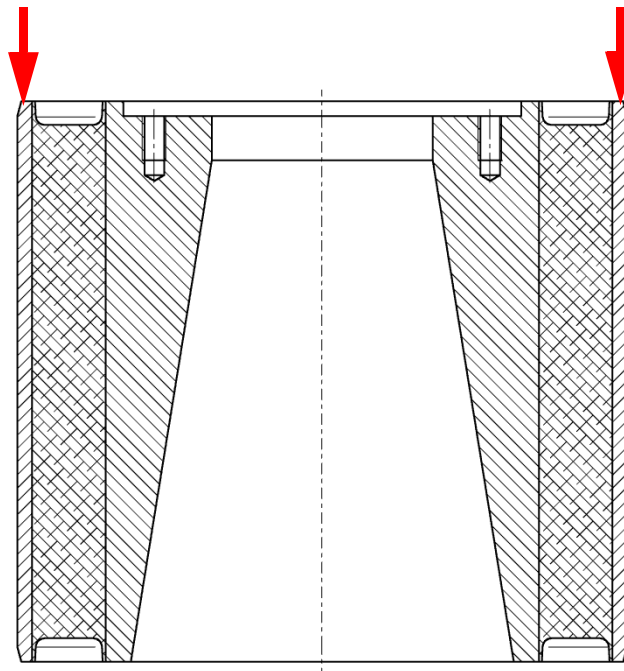


Figure 1: Mounting

6 Initial operation

- not applicable -

7 Operation

- not applicable -

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8 Maintenance

8.1 Maintenance intervals

Action	Mileage	Chapter
Visual check	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.4
Bonding test	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.4
Exchange of elastomer components		see chapter 8.5
Cleaning of elastomer components		see chapter 8.7

Table 3: Maintenance intervals

8.2 Range of coverage

The following guidelines for controlling, cleaning and maintaining apply to elastomeric components and rubber-metal components, based on the use of caoutchouc and rubber in pure form. Alternatively to metallic materials partially plastics are used. These documentation were drawn up in line with DIN 7716:1985-05 and ISO 2230:2002-04 and are also valid for the use of synthetic rubber products regarding the general conditions.

8.3 General

Under unfavorable storage conditions or improper treatment most elastomer products change their physical properties. This can lead to a significant decrease in lifetime of elastomer products. For example from excessive hardening, softening, permanent deformation as well as from flaking, cracks or other surface damage they can become unusable. The changes can be caused by the influence of oxygen, ozone, heat, light, humidity, solvents or by storing under stress.

Properly stored and treated rubber products remain virtually unchanged in their characteristics for a certain period of time.

INFORMATION

Rubber-to-metal-bonded parts are mainly suited for the usage in compression- and shear-loads. Pulling-loads should be avoided.

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8.4 Service life and Control

Elastomers are subject to a natural aging process and are not durable.

The service life of elastomer-components depends on the design and the strain of the component and conforms to the specific agreements of the order.

INFORMATION

- If elastomer components are only exposed to loads within the permissible range during the operating time, a maximum service life of 8 years can be assumed.
- During this operational period, elastomer components are maintenance-free. This does not exclude a visual inspection or control of the elastomer components.
- A visual inspection of the elastomer components must be carried out no later than 6 months after installation and then at least once a year.
- At the latest after reaching an operating time of 8 years, an examination and evaluation of a representative number of components must be carried out with the involvement of the manufacturer. If necessary, a residual life test should be carried out.

Regular visual inspections are essential for checking the condition of the elastomer components.

When visual inspection or inspection of an elastomer component, take care i.a. on:

- Fatigue cracks at the connecting ends of the elements
- discoloration
- volume changes
- Surface cracks in the body of the element

INFORMATION

- If you experience any damage or irregularities, report immediately.
- Document the observation according to the operational regulations.
- If necessary, replace the faulty element.

The bonding test between rubber and metal can be carried out by hand. The rubber can thereby be pressed back with a dull test-iron (edge with radius).

The use of sharp objects for inspection is not allowed!

NOTICE



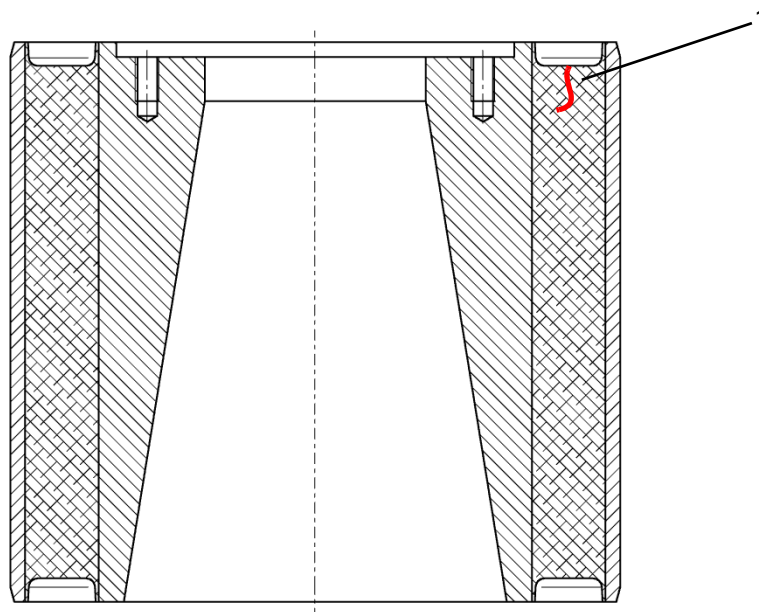
- Partial border delamination in the bonding zone between the elastomer and metal or surface cracks in the individual elastomer layers are to be reported immediately.
- These areas must be examined in regular intervals.
- If necessary, a performance and safety test of the components under participation of the manufacturer is to be initiated.

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8.5 Replacement

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- a crack depth >17 mm is reached (both in rubber itself as well as at the transitions to the metal)



[1] Replacement criterion: crack depth > 17 mm

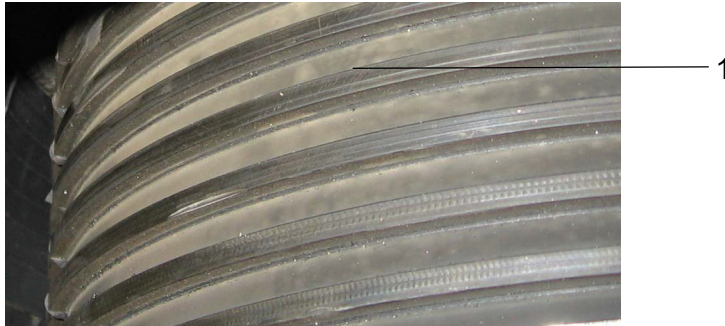
Figure 2: Crack depth

During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by com-

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pression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.



[1] Discoloration

Figure 3: Discoloration example

8.6 Media resistance

8.6.1 General information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

8.6.2 Environmental impacts and loads

The rubber compounds used in bogies are resistant to environmental influences under normal climatic conditions which mean temperatures between -30 °C to +50 °C. Resistance against climatic influence, especially against ozone, and higher temperatures, caused e.g. by the waste heat of motors, is improved by the proportioning of appropriate chemicals.

INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
- Elastomers made of natural rubber are not permanently resistant against mineral oils and fuels.

8.6.3 Resistance against machine cleaning

The elastomers used are resistant against phosphoric acids and hydrochloric acids as well as against alkaline cleaning agents used for cleaning of the exterior of vehicles.

The resistance has been proven at selective elastomers made of natural rubber in test fluids according to DIN EN 13913:2003-08 representing other cleaning agents which are customary in trade.

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INFORMATION

Non pH-neutral cleaning agents

- Non pH-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

8.7 Cleaning

The components can be cleaned using detergents mentioned in Table 4. The specified concentrations as well as the specifications of manufacturer shall be observed obligatorily. The residues of the detergents shall be rinsed with clear water. The cleaned component has to be dried at room temperature.

NOTICE



Use of other differing cleaning agents

- The use of different detergents can damage the rubber.
- Only use detergents mentioned in Table 4.

Detergent	Concentration
Alkaline detergent	
Oxalic detergent	
Rapidol A	10 %
Rapidol W	10 %
Rapidol 58	10 %
Rapox	5 %
Rapox OS	5 %

Table 4: Detergents

NOTICE



Cleaning with sharp objects

- The use of sharp-edged objects (e.g. wire brushes, emery paper, etc.) is not permitted for cleaning elastomer products!

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Brief overview of resistance behavior of different elastomer compounds:														
	GROUP 1			GROUP 2						GROUP 3				
	NR			NBR	CR						EPDM			
acid resistance	B			B	A						A			
alkali resistance	B			B	A						A			
oil resistance	U			A	B						U			
Resistance to fuel	U			B	U						U			
Solvent resistance	U			B	B						B			
ozone resistance	B			B	A						A			
weatherability	B			A	A						A			
A = very good, little or no attack														
B = satisfactory, moderate to severe attack. Please contact the manufacturer!														
U = unsuitable for the application														

Table 5: resistance behavior of elastomers

8.8 Fire protection

Unless expressly required, elastomers made of natural rubber do not include any fire protection agents. The use of halogen-free fire protection agents causes a reduction in the mechanical properties; therefore, these protection agents are not used in components for dynamic load.

9 Decommissioning

- not applicable -

10 Disassembly

- not applicable -

For disassembly, the Center Pivot Bearing are pressed in the axial direction. It should be ensured that the force is applied only in the outer, metallic segments of the Center Pivot Bearing.

11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
- After dismantling, metallic components can be disposed of in the metal scrap recycling.

Waste code according to the European Waste List (Waste Catalogue Ordinance):

The AVV waste code numbers are not product-related but are largely source-related. The manufacturer is therefore unable to specify the waste code for articles or products used in various sectors. Waste codes can be requested from the manufacturer.

12 Error identification

- not applicable -

13 Annex

- Drawing GMT - No. 41057501

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14 Subject Index

- not applicable -

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Document		
2021-11-17	00	C. Palm
Document Created (Date)	Index	Document Created (Name)

State of Revision

Document Modification										
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Released	Date	2021-11-18	GMT Engineering	Stefan Schemel

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Maintenance instruction Center Pivot Bearing GMT - No. 41057501 Rev. 00

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Maintenance Manual

Lateral Buffer

GMT - No. 62093601



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1 On this manual

INFORMATION

These maintenance instructions for rubber-metal components refer exclusively to the visual inspection of the components when installed during operation in the vehicle depot.

The separate maintenance instructions of the vehicle manufacturer are authoritative for the inspection and main inspection of the bogies!

This maintenance manual describes the necessary maintenance operations incurring throughout the service life of the rubber metal parts.

Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

The maintenance intervals are based on the specification data and may be adapted according to the findings from the operation.

Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

1.1 Applicable Documents

- Drawing GMT - No. 62093601
- DIN 7716:1982-05: Rubber products; requirements for storage, cleaning and maintenance
- ISO 2230:2002-04: Rubber products - Guidelines for storage
- DIN EN 13913:2003-08: Railway applications - Rubber suspension components - Elastomer-based mechanical parts
- DIN EN 45545-1:2013-08: Railway applications - Fire protection on railway vehicles

1.2 Presentation convention

The following representations are used in these manual:

NOTICE



- Indicates situations or maloperation that may lead to material damage.

INFORMATION

- Indicates important information or instructions.
- Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.

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2 Safety

2.1 Safety instructions



This manual contains important warnings and safety instructions which must be observed by the user.

The product may only be used and operated by qualified personnel who are capable of complying with the necessary safety precautions for use and operation.

The repair of the product may only be carried out by the supplier or by the qualified personnel trained for this purpose.

Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

2.2 Accident prevention regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated warning and safety messages

The following icons and standard text formats are used in this manual:

CAUTION



- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Lateral Buffer is exclusively intended for installation in rail vehicles. The parts may only be used and installed under the intended operating conditions. Should individual parameters deviate, this must be agreed with GMT GmbH in order to exclude dangers and damage. The intended use also includes the observance of the instructions in this maintenance manual as well as the performance of tests and maintenance.

3 Product description

3.1 Designation of delivery item

Lateral Buffer GMT - No. 62093601

3.2 Description of delivery item

- not applicable -

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3.3 Technical specifications

Technical Specifications	
Diameter	140 mm
Height	80 mm
Weight	3.4 kg
Temperature range / operating conditions	-40 °C to +70 °C

Table 1: Technical specifications

3.4 Identification

Marking in rubber (raised)

GMT-Logo

Date of manufacture

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4 Transport and Storage

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The storage of elastomer components is regulated in DIN 7716:1982-05 and ISO 2230:2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow.

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* same storage conditions as for the initial storage time

Table 2: storage times of elastomers

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The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

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Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

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Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

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5 Assembly

5.1 Mounting instructions

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INFORMATION

- When mounting rubber-metal components, the forces and torques or paths and angles shown on the drawing GMT - No. 62093601 (see annex) are not to be exceeded by more than 20 %.
- If possible, do not introduce the assembly forces via the elastomer.
- Apart from static pre-loads, the components are virtually free of tension after installation.

NOTICE



- In particular it must be ensured that the exposed rubber surface is not damaged during installation.

6 Initial operation

- not applicable -

7 Operation

- not applicable -

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8 Maintenance

8.1 Maintenance intervals

Action	Mileage	Chapter
Visual check	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.4
Bonding test	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.4
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8.4 Service life and Control

Elastomers are subject to a natural aging process and are not durable.

The service life of elastomer-components depends on the design and the strain of the component and conforms to the specific agreements of the order.

INFORMATION

- If elastomer components are only exposed to loads within the permissible range during the operating time, a maximum service life of 8 years can be assumed.
- During this operational period, elastomer components are maintenance-free. This does not exclude a visual inspection or control of the elastomer components.
- A visual inspection of the elastomer components must be carried out no later than 6 months after installation and then at least once a year.
- At the latest after reaching an operating time of 8 years, an examination and evaluation of a representative number of components must be carried out with the involvement of the manufacturer. If necessary, a residual life test should be carried out.

Regular visual inspections are essential for checking the condition of the elastomer components.

When visual inspection or inspection of an elastomer component, take care i.a. on:

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- discoloration
- volume changes
- Surface cracks in the body of the element

INFORMATION

- If you experience any damage or irregularities, report immediately.
- Document the observation according to the operational regulations.
- If necessary, replace the faulty element.

The bonding test between rubber and metal can be carried out by hand. The rubber can thereby be pressed back with a dull test-iron (edge with radius).

The use of sharp objects for inspection is not allowed!

NOTICE



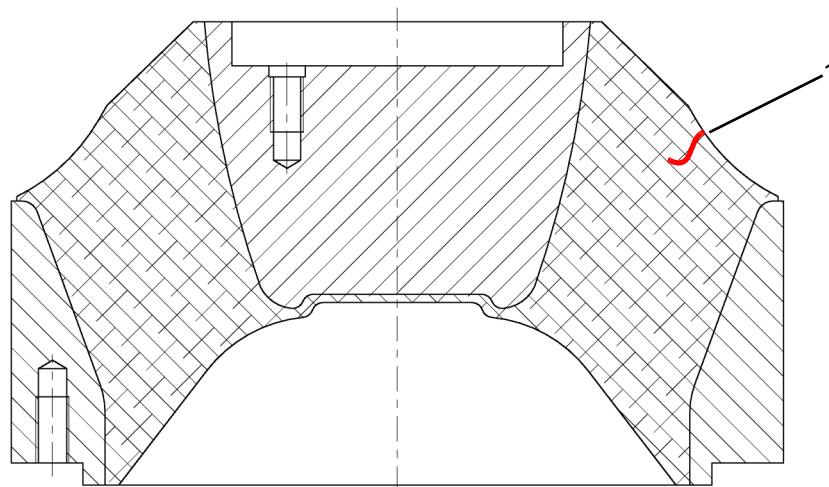
- Partial border delamination in the bonding zone between the elastomer and metal or surface cracks in the individual elastomer layers are to be reported immediately.
- These areas must be examined in regular intervals.
- If necessary, a performance and safety test of the components under participation of the manufacturer is to be initiated.

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8.5 Replacement

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- a crack depth >4 mm is reached (both in rubber itself as well as at the transitions to the metal)



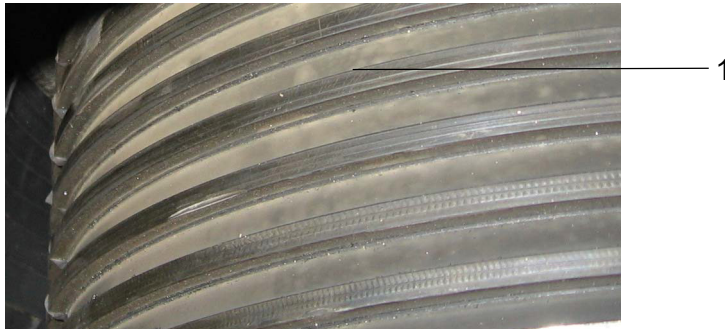
[1] Replacement criterion: crack depth > 4 mm

Figure 1: Crack depth

During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by compression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.

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[1] Discoloration

Figure 2: Discoloration example

8.6 Media resistance

8.6.1 General information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

8.6.2 Environmental impacts and loads

The rubber compounds used in bogies are resistant to environmental influences under normal climatic conditions which mean temperatures between -40 °C to +70 °C. Resistance against climatic influence, especially against ozone, and higher temperatures, caused e.g. by the waste heat of motors, is improved by the proportioning of appropriate chemicals.

INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
- Elastomers made of natural rubber are not permanently resistant against mineral oils and fuels.

8.6.3 Resistance against machine cleaning

The elastomers used are resistant against phosphoric acids and hydrochloric acids as well as against alkaline cleaning agents used for cleaning of the exterior of vehicles.

The resistance has been proven at selective elastomers made of natural rubber in test fluids according to DIN EN 13913:2003-08 representing other cleaning agents which are customary in trade.

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INFORMATION

Non pH-neutral cleaning agents

- Non pH-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

8.7 Cleaning

The components can be cleaned using detergents mentioned in Table 4. The specified concentrations as well as the specifications of manufacturer shall be observed obligatorily. The residues of the detergents shall be rinsed with clear water. The cleaned component has to be dried at room temperature.

NOTICE



Use of other differing cleaning agents

- The use of different detergents can damage the rubber.
- Only use detergents mentioned in Table 4.

Detergent	Concentration
Alkaline detergent	
Oxalic detergent	
Rapidol A	10 %
Rapidol W	10 %
Rapidol 58	10 %
Rapox	5 %
Rapox OS	5 %

Table 4: Detergents

NOTICE



Cleaning with sharp objects

- The use of sharp-edged objects (e.g. wire brushes, emery paper, etc.) is not permitted for cleaning elastomer products!

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Brief overview of resistance behavior or different elastomer compounds:														
	GROUP 1			GROUP 2						GROUP 3				
	NR			NBR	CR						EPDM			
acid resistance	B			B	A						A			
alkali resistance	B			B	A						A			
oil resistance	U			A	B						U			
Resistance to fuel	U			B	U						U			
Solvent resistance	U			B	B						B			
ozone resistance	B			B	A						A			
weatherability	B			A	A						A			
A = very good, little or no attack														
B = satisfactory, moderate to severe attack. Please contact the manufacturer!														
U = unsuitable for the application														

Table 5: resistance behavior of elastomers

8.8 Fire protection

Unless expressly required, elastomers made of natural rubber do not include any fire protection agents. The use of halogen-free fire protection agents causes a reduction in the mechanical properties; therefore, these protection agents are not used in components for dynamic load.

9 Decommissioning

- not applicable -

10 Disassembly

- not applicable -

11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
- After dismantling, metallic components can be disposed of in the metal scrap recycling.

Waste code according to the European Waste List (Waste Catalogue Ordinance):

The AVV waste code numbers are not product-related but are largely source-related. The manufacturer is therefore unable to specify the waste code for articles or products used in various sectors. Waste codes can be requested from the manufacturer.

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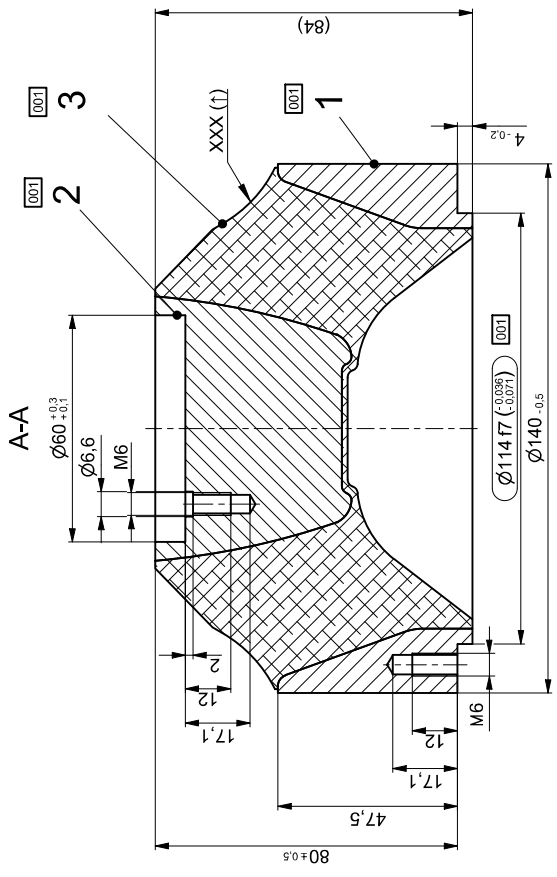
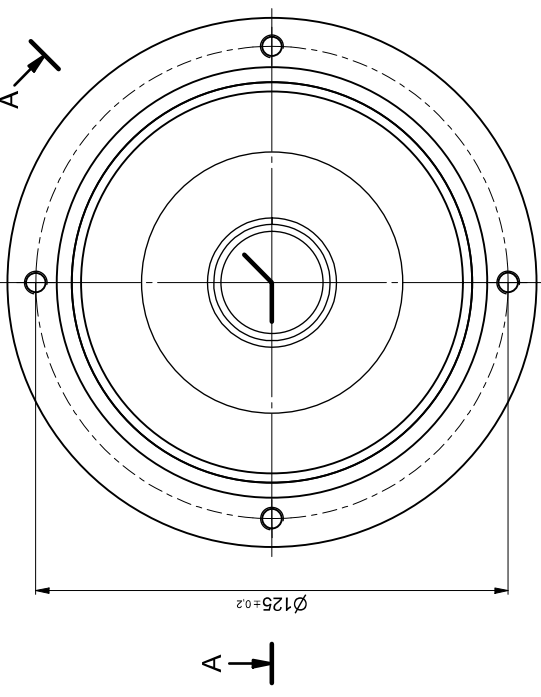
12 Error identification

- not applicable -

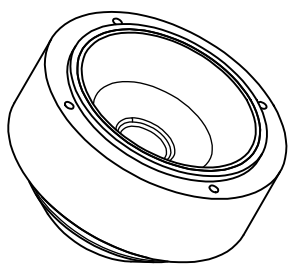
13 Annex

- Drawing GMT - No. 62093601

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- Quality requirements according to BN 918043¹⁾ for OP1540
- Temperature range from: -40°C to +70°C
- | | | |
|----------------------|-------|---------|
| Hardness: 60 SH A | Class | III / M |
| Abrasion: | Class | III |
| Elongation at break: | Class | III |
| Compression set: | Class | III |
- Impact resilience:
- | | | |
|-----------------------|-------|----|
| Impact | Class | NI |
| Tea-growin resistance | Class | NI |
| Tensile strength: | Class | NI |
- Resistance to:
- | | | |
|------------------|-------|----|
| Aging: (at 70°C) | Class | NI |
| Vapor test: | Class | - |
| Cold: | Class | G |
| Heat: | Class | N |
| Weather: | Class | N |
- Resistance against mineral and fuel oil following DIN EN 13913 7.2.5 is not permanent.
- Resistance against cleaning agents and feces following DIN EN 13913 7.2.6 is given.
- Resistance against cleaning agents: in the pH range of 7-12
Cleaner residues should be rinsed with clear water.



(1 : 2)

ACHTUNG ! / ATTENTION !
Passungen und Passmaße gelten erst nach der Oberflächenbeschichtung
Fits and fitting dimensions are only valid after surface coating

001

Federkennlinie wird am Muster gemessen und nachgetragen!
Spring Characteristic values are measured at sample and will be completed!

TEST SPECIFICATIONS FOR SPRING DEFLECTION

- axial
5% min. 3 parts per batch
PW...
ambient temperature
100N
2
90 mm/min
50,5 kN
90 mm/min
-
-
Ca = 0,7 kN/mm ± 15%
between 5 and 10 mm
- force direction:
frequency of testing:
test control unit:
testing temperature:
initial loading:
number of settling cycles:
settling speed:
settling load up to:
testing speed:
force measurement:
2. deflection measurement:
3. stiffness measurement:

XXX

Markings in rubber (raised):

GMT Logo

Date of Manufacture

62093501

Cavity number

Rz 25
QUM TS 005 - 107
Galvanischer Überzug
Electroplated coating

Materialeigenschaften Material Properties		All dimensions in mm	
Material	OP1540	Established	01.09.21
Material acc. to parts list		Reviewed	22.09.21
		Approved	27.09.21
Benennung / Description:		Querpuffer	
		Lateral buffer	
Zeichnungsnr. / Drawing no.:		62093601	
Index:		001	
Blatt / Sheet:		1	
Anzahl / Qty:		1	
Modell / Model:		62093601	

GAD Zeichnung - Darf manuell nicht geändert werden!
CAD drawing - Must not be changed manually!

Maßstab / Scale: 1 : 1
Gewicht / Weight: 3,4 kg

Material: Elastomer OP1540
Materials acc. to parts list

Benennung / Description:
Querpuffer
Lateral buffer

Zeichnungsnr. / Drawing no.: 62093601
Index: 001
Blatt / Sheet: 1
Anzahl / Qty: 1
Modell / Model: 62093601

Injection neps, rubber coating and parting line burr allowable! Paint spray allowable on rubber!
For components with surface coating the enlisted dimensions are valid for the status before coating. Consequently, tolerances may be exceeded by the allowable coat thickness.

Resistance against mineral and fuel oil following DIN EN 13913 7.2.5 is not permanent.
Resistance against cleaning agents and feces following DIN EN 13913 7.2.6 is given.
Resistance against cleaning agents: in the pH range of 7-12
Cleaner residues should be rinsed with clear water.

14 Subject Index

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Manufacturer	Article	Drawing Number
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Document		
2021-11-17	00	C. Palm
Document Created (Date)	Index	Document Created (Name)

State of Revision

Document Modification										
Mod.	Index (Record Modified Chapters Here)									
	01	02	03	04	05	06	07	08	09	10
1										
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Index	Date	Reason of Modification	Responsibility
00	2021-11-17	First Issue	C. Palm

Prepared	Date	2021-11-17	GMT Engineering	Christian Palm
Released	Date	2021-11-18	GMT Engineering	Stefan Schemel

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Maintenance instruction Lateral Buffer GMT - No. 62093601 Rev. 00

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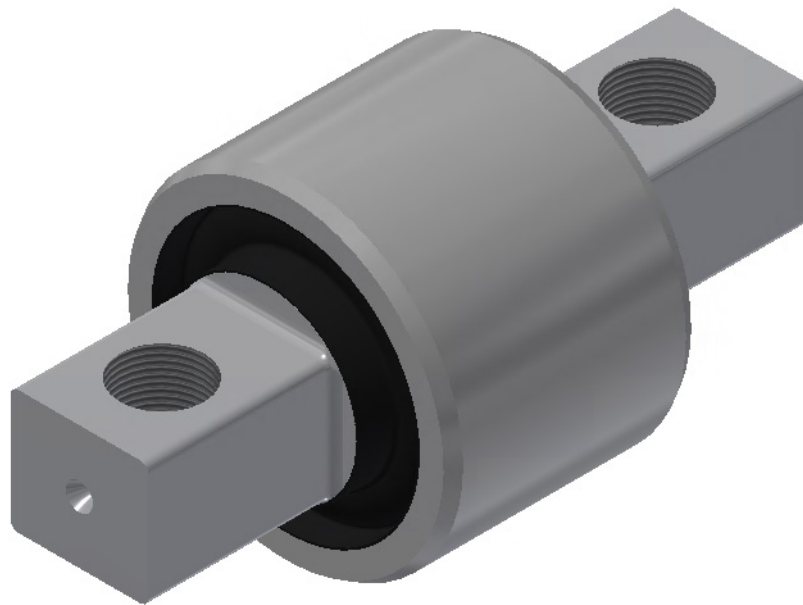
Gummi · Metall · Technik

Motor Suspension Bush
GMT No. 64064201

Maintenance Manual

Motor Suspension Bush

GMT No. 64064201



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Gummi · Metall · Technik

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1 On this manual

INFORMATION

These maintenance instructions for rubber-metal components refer exclusively to the visual inspection of the components when installed during operation in the vehicle depot.

The separate maintenance instructions of the vehicle manufacturer are authoritative for the inspection and main inspection of the bogies!

This maintenance manual describes the necessary maintenance operations incurring throughout the service life of the rubber metal parts.

Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

The maintenance intervals are based on the specification data and may be adapted according to the findings from the operation.

Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

1.1 Applicable Documents

- Drawing GMT No. 64064201
- DIN 7716:1982-05: Rubber products; requirements for storage, cleaning and maintenance
- ISO 2230:2002-04: Rubber products - Guidelines for storage
- DIN EN 13913:2003-08: Railway applications - Rubber suspension components - Elastomer-based mechanical parts
- DIN EN 45545-1:2013-08: Railway applications - Fire protection on railway vehicles

1.2 Presentation convention

The following representations are used in these manual:

NOTICE



- Indicates situations or maloperation that may lead to material damage.

INFORMATION

- Indicates important information or instructions.
- Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.

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2 Safety

2.1 Safety instructions



This manual contains important warnings and safety instructions which must be observed by the user.

The product may only be used and operated by qualified personnel who are capable of complying with the necessary safety precautions for use and operation.

The repair of the product may only be carried out by the supplier or by the qualified personnel trained for this purpose.


Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

2.2 Accident prevention regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated warning and safety messages

The following icons and standard text formats are used in this manual:

 **CAUTION**

- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Motor Suspension Bush is exclusively intended for installation in rail vehicles. The parts may only be used and installed under the intended operating conditions. Should individual parameters deviate, this must be agreed with GMT GmbH in order to exclude dangers and damage. The intended use also includes the observance of the instructions in this maintenance manual as well as the performance of tests and maintenance.

3 Product description

3.1 Designation of delivery item

Motor Suspension Bush GMT No. 64064201

3.2 Description of delivery item

- not applicable -

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3.3 Technical specifications

Technical Specifications	
Diameter	80 mm
Width	160 mm
Weight	2.4 kg
Temperature range / operating conditions	-40 °C to +90 °C

Table 1: Technical specifications

3.4 Identification

Marking in metal (stamped)

GMT-Logo

Date of manufacture

64064201

4 Transport and Storage

4.1 Transport

- not applicable -

4.2 Storage

The storage of elastomer components is regulated in DIN 7716:1982-05 and ISO 2230:2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow.

Storage and storage time recording of elastomer components are described in ISO 2230:2002-04. In this standard the elastomer products are divided into three groups with different storage times. These are shown in table 2.

The elastomer of the Motor Suspension Bush is part of group 1.

Classification acc. to ISO 2230:2002-04	Designation	Storage time (in years)	Extension of storage time (in years)*
Group 1	NR (Natural Rubber)	5	2
Group 2	NBR (Acrylic Nitrile Rubber), CR (Chloroprene Rubber)	7	3
Group 3	EPDM (Ethylene-propylene Rubber)	10	5

* same storage conditions as for the initial storage time

Table 2: storage times of elastomers

The storage temperature should be below +25 °C and products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

If the storage temperature is below +15 °C, handle the stored products carefully as they may have stiffened and become susceptible to distortion.

The temperature of products taken from such low-temperature storage should be raised to approximately +30 °C throughout their mass, before the products are put into service.

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Care must be taken to ensure that the components are protected from air supply, in particular to keep away the ozone which is detrimental to elastomers.

The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

NOTICE



- Solvents, fuels, lubricants, chemicals, acids, brines, disinfectants or suchlike are not allowed in the storage room.

Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

NOTICE



- Particular metals, especially copper and manganese have a damaging effect on rubber products

Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

NOTICE



- Foils containing softeners are not allowed to be used as packaging material.

If rubber products have to be powdered, the powder should not contain any harmful ingredients for rubber-products. Appropriate materials for powdering purposes are French chalk, prepared chalk, fine-grained mica flour and rice starch.

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5 Assembly

5.1 Mounting instructions

The assembly and disassembly is carried out according to the specifications of the rail vehicle manufacturer.

INFORMATION

- When mounting rubber-metal components, the forces and torques or paths and angles shown on the drawing GMT No. 64064201 (see Annex) are not to be exceeded by more than 20 %.
- If possible, do not introduce the assembly forces via the elastomer.
- Apart from static pre-loads, the components are virtually free of tension after installation.

NOTICE



- In particular it must be ensured that the exposed rubber surface is not damaged during installation.

5.2 Mounting the Motor Suspension Bush

The Motor Suspension Bush may only be pressed into the housing via the outer pipe. In order to facilitate the press-fitting process, it is permissible to cool the bushing to -25 °C for 24 hours and then to add it to the housing unlubricated.

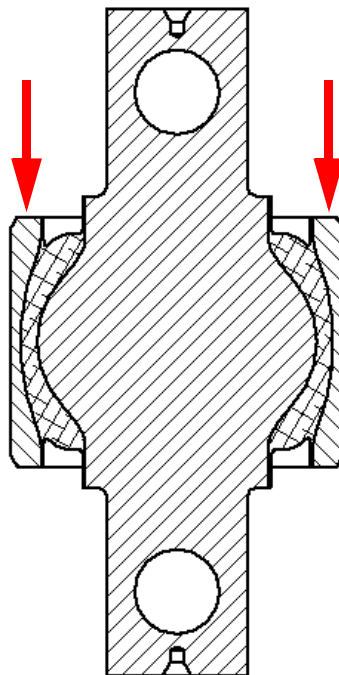


Figure 1: Mounting

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6 Initial operation

- not applicable -

7 Operation

- not applicable -

8 Maintenance

8.1 Maintenance intervals

Action	Mileage	Chapter
Visual check	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Bonding test	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Exchange of elastomer components		see chapter 8.6
Cleaning of elastomer products		see chapter 8.8

Table 3: Maintenance intervals

8.2 General instructions

Controlling, cleaning and maintaining rubber-metal parts and molded rubber parts

8.3 Range of coverage

The following guidelines apply to elastomeric components and rubber-metal components, based on the use of caoutchouc and rubber in pure form. Alternatively to metallic materials partially plastics are used. These documentation were drawn up in line with DIN 7716:1985-05 and ISO 2230:2002-04 and are also valid for the use of synthetic rubber products regarding the general conditions.

8.4 General

Under unfavorable storage conditions or improper treatment most elastomer products change their physical properties. This can lead to a significant decrease in lifetime of elastomer products. For example from excessive hardening, softening, permanent deformation as well as from flaking, cracks or other surface damage they can become unusable. The changes can be caused by the influence of oxygen, ozone, heat, light, humidity, solvents or by storing under stress.

Properly stored and treated rubber products remain virtually unchanged in their characteristics for a certain period of time.

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INFORMATION

Rubber-to-metal-bonded parts are mainly suited for the usage in compression- and shear-loads. Pulling-loads should be avoided.

8.5 Service life and Control

Elastomers are subject to a natural aging process and are not durable.

The service life of elastomer-components depends on the design and the strain of the component and conforms to the specific agreements of the order.

INFORMATION

- If elastomer components are only exposed to loads within the permissible range during the operating time, a maximum service life of 8 years can be assumed.
- During this operational period, elastomer components are maintenance-free. This does not exclude a visual inspection or control of the elastomer components.
- A visual inspection of the elastomer components must be carried out no later than 6 months after installation and then at least once a year.
- At the latest after reaching an operating time of 8 years, an examination and evaluation of a representative number of components must be carried out with the involvement of the manufacturer. If necessary, a residual life test should be carried out.

Regular visual inspections are essential for checking the condition of the elastomer components.

When visual inspection or inspection of an elastomer component, take care i.a. on:

- Fatigue cracks at the connecting ends of the elements
- discoloration
- volume changes
- Surface cracks in the body of the element

INFORMATION

- If you experience any damage or irregularities, report immediately.
- Document the observation according to the operational regulations.
- If necessary, replace the faulty element.

The bonding test between rubber and metal can be carried out by hand. The rubber can thereby be pressed back with a dull test-iron (edge with radius).

The use of sharp objects for inspection is not allowed!

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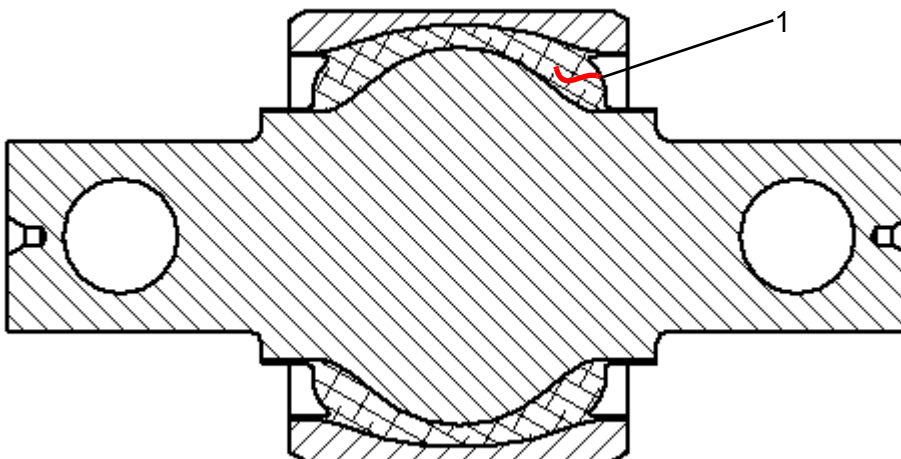


- Partial border delamination in the bonding zone between the elastomer and metal or surface cracks in the individual elastomer layers are to be reported immediately.
- These areas must be examined in regular intervals.
- If necessary, a performance and safety test of the components under participation of the manufacturer is to be initiated.

8.6 Replacement

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- a crack depth >5 mm is reached (both in rubber itself as well as at the transitions to the metal)



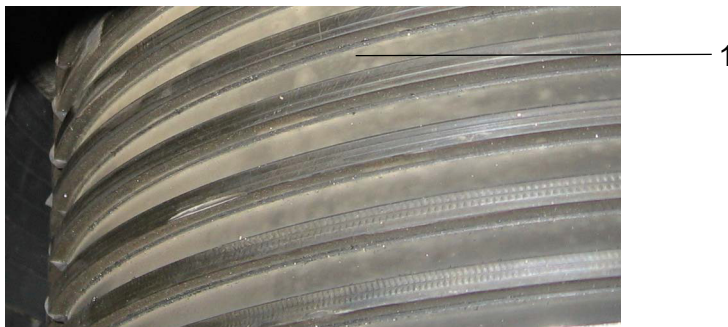
[1] Replacement criterion: crack depth > 5 mm

Figure 2: Crack depth

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During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by compression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.



[1] Discoloration

Figure 3: Discoloration example

8.7 Media resistance

8.7.1 General information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

8.7.2 Resistance against environmental impacts and loads

The rubber compounds used in bogies are resistant to environmental influences under normal climatic conditions which mean temperatures between -40 °C to +90 °C. Resistance against climatic influence, especially against ozone, and higher temperatures, caused e.g. by the waste heat of motors, is improved by the proportioning of appropriate chemicals.

INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
- Elastomers made of natural rubber are not permanently resistant against mineral oils and fuels.

8.7.3 Resistance against machine cleaning

The elastomers used are resistant against phosphoric acids and hydrochloric acids as well as against alkaline cleaning agents used for cleaning of the exterior of vehicles.

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The resistance has been proven at selective elastomers made of natural rubber in test fluids according to DIN EN 13913:2003-08 representing other cleaning agents which are customary in trade.

INFORMATION

Non pH-neutral cleaning agents

- Non pH-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

8.8 Cleaning

The components can be cleaned using detergents mentioned in table 4. The specified concentrations as well as the specifications of manufacturer shall be observed obligatorily. The residues of the detergents shall be rinsed with clear water. The cleaned component has to be dried at room temperature.

NOTICE



Use of other differing cleaning agents

- The use of different detergents can damage the rubber.
- Only use detergents mentioned in table 4.

Detergent	Concentration
Alkaline detergent	
Oxalic detergent	
Rapidol A	10 %
Rapidol W	10 %
Rapidol 58	10 %
Rapox	5 %
Rapox OS	5 %

Table 4: Detergents

NOTICE



Cleaning with sharp objects

- The use of sharp-edged objects (e.g. wire brushes, emery paper, etc.) is not permitted for cleaning elastomer products!

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Brief overview of resistance behavior or different elastomer compounds:														
	GROUP 1			GROUP 2						GROUP 3				
	NR			NBR	CR						EPDM			
acid resistance	B			B	A						A			
alkali resistance	B			B	A						A			
oil resistance	U			A	B						U			
Resistance to fuel	U			B	U						U			
Solvent resistance	U			B	B						B			
ozone resistance	B			B	A						A			
weatherability	B			A	A						A			
A = very good, little or no attack														
B = satisfactory, moderate to severe attack. Please contact the manufacturer!														
U = unsuitable for the application														

Table 5: resistance behavior of elastomers

8.9 Fire protection

Unless expressly required, elastomers made of natural rubber do not include any fire protection agents. The use of halogen-free fire protection agents causes a reduction in the mechanical properties; therefore, these protection agents are not used in components for dynamic load.

9 Decommissioning

- not applicable -

10 Disassembly

For disassembly, the Motor Suspension Bush are pressed in the axial direction. It should be ensured that the force is applied only in the outer, metallic segments of the Motor Suspension Bush.

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11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
- After dismantling, metallic components can be disposed of in the metal scrap recycling.

Waste code according to the European Waste List (Waste Catalogue Ordinance):

The AVV waste code numbers are not product-related but are largely source-related. The manufacturer is therefore unable to specify the waste code for articles or products used in various sectors. Waste codes can be requested from the manufacturer.

12 Error identification

- not applicable -

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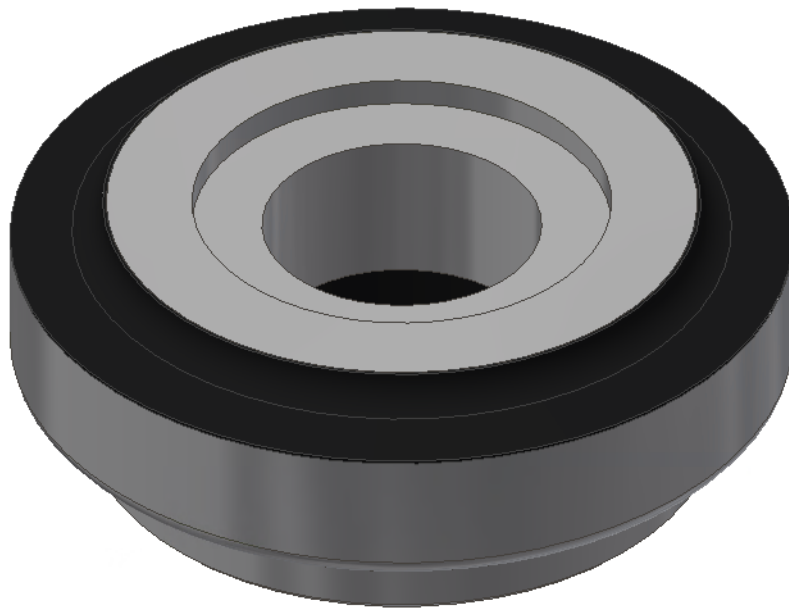
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Maintenance Manual

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1 On this manual

INFORMATION

These maintenance instructions for rubber-metal components refer exclusively to the visual inspection of the components when installed during operation in the vehicle depot.

The separate maintenance instructions of the vehicle manufacturer are authoritative for the inspection and main inspection of the bogies!

This maintenance manual describes the necessary maintenance operations incurring throughout the service life of the rubber metal parts.

Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

The maintenance intervals are based on the specification data and may be adapted according to the findings from the operation.

Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

1.1 Applicable Documents

- Drawing GMT No. 63052101
- DIN 7716:1982-05: Rubber products; requirements for storage, cleaning and maintenance
- ISO 2230:2002-04: Rubber products - Guidelines for storage
- DIN EN 13913:2003-08: Railway applications - Rubber suspension components - Elastomer-based mechanical parts
- DIN EN 45545-1:2013-08: Railway applications - Fire protection on railway vehicles

1.2 Presentation convention

The following representations are used in these manual:

NOTICE



- **Indicates situations or maloperation that may lead to material damage.**

INFORMATION

- **Indicates important information or instructions.**
- **Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.**

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2 Safety

2.1 Safety instructions



This manual contains important warnings and safety instructions which must be observed by the user.

The product may only be used and operated by qualified personnel who are capable of complying with the necessary safety precautions for use and operation.

The repair of the product may only be carried out by the supplier or by the qualified personnel trained for this purpose.

Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

2.2 Accident prevention regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated warning and safety messages

The following icons and standard text formats are used in this manual:

CAUTION



- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Motor Suspension Pad is exclusively intended for installation in rail vehicles. The parts may only be used and installed under the intended operating conditions. Should individual parameters deviate, this must be agreed with GMT GmbH in order to exclude dangers and damage. The intended use also includes the observance of the instructions in this maintenance manual as well as the performance of tests and maintenance.

3 Product description

3.1 Designation of delivery item

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3.2 Description of delivery item

- not applicable -

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3.3 Technical specifications

Technical Specifications	
Diameter	112 mm
Height unloaded	39.7 mm
Weight	1.8 kg
Temperature range / operating conditions	-40 °C to +70 °C

Table 1: Technical specifications

3.4 Identification

Marking in rubber (raised)

GMT-Logo

Date of manufacture

63052101

4 Transport and Storage

4.1 Transport

- not applicable -

4.2 Storage

The storage of elastomer components is regulated in DIN 7716:1982-05 and ISO 2230:2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow.

Storage and storage time recording of elastomer components are described in ISO 2230:2002-04. In this standard the elastomer products are divided into three groups with different storage times. These are shown in table 2.

The elastomer of the Motor Suspension Pad is part of group 1.

Classification acc. to ISO 2230:2002-04	Designation	Storage time (in years)	Extension of storage time (in years)*
Group 1	NR (Natural Rubber)	5	2
Group 2	NBR (Acrylic Nitrile Rubber), CR (Chloroprene Rubber)	7	3
Group 3	EPDM (Ethylene-propylene Rubber)	10	5

* same storage conditions as for the initial storage time

Table 2: storage times of elastomers

The storage temperature should be below +25 °C and products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

If the storage temperature is below +15 °C, handle the stored products carefully as they may have stiffened and become susceptible to distortion.

The temperature of products taken from such low-temperature storage should be raised to approximately +30 °C throughout their mass, before the products are put into service.

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Care must be taken to ensure that the components are protected from air supply, in particular to keep away the ozone which is detrimental to elastomers.

The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

NOTICE



- Solvents, fuels, lubricants, chemicals, acids, brines, disinfectants or suchlike are not allowed in the storage room.

Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

NOTICE



- Particular metals, especially copper and manganese have a damaging effect on rubber products

Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

NOTICE



- Foils containing softeners are not allowed to be used as packaging material.

If rubber products have to be powdered, the powder should not contain any harmful ingredients for rubber-products. Appropriate materials for powdering purposes are French chalk, prepared chalk, fine-grained mica flour and rice starch.

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5 Assembly

5.1 Mounting instructions

The assembly and disassembly is carried out according to the specifications of the rail vehicle manufacturer.

INFORMATION

- When mounting rubber-metal components, the forces and torques or paths and angles shown on the drawing GMT No. 63052101 (see Annex) are not to be exceeded by more than 20 %.
- If possible, do not introduce the assembly forces via the elastomer.
- Apart from static pre-loads, the components are virtually free of tension after installation.

NOTICE



- In particular it must be ensured that the exposed rubber surface is not damaged during installation.

6 Initial operation

- not applicable -

7 Operation

- not applicable -

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8 Maintenance

8.1 Maintenance intervals

Action	Mileage	Chapter
Visual check	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Bonding test	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Exchange of elastomer components		see chapter 8.6
Cleaning of elastomer products		see chapter 8.8

Table 3: Maintenance intervals

8.2 General instructions

Controlling, cleaning and maintaining rubber-metal parts and molded rubber parts

8.3 Range of coverage

The following guidelines apply to elastomeric components and rubber-metal components, based on the use of caoutchouc and rubber in pure form. Alternatively to metallic materials partially plastics are used. These documentation were drawn up in line with DIN 7716:1985-05 and ISO 2230:2002-04 and are also valid for the use of synthetic rubber products regarding the general conditions.

8.4 General

Under unfavorable storage conditions or improper treatment most elastomer products change their physical properties. This can lead to a significant decrease in lifetime of elastomer products. For example from excessive hardening, softening, permanent deformation as well as from flaking, cracks or other surface damage they can become unusable. The changes can be caused by the influence of oxygen, ozone, heat, light, humidity, solvents or by storing under stress.

Properly stored and treated rubber products remain virtually unchanged in their characteristics for a certain period of time.

INFORMATION

Rubber-to-metal-bonded parts are mainly suited for the usage in compression- and shear-loads. Pulling-loads should be avoided.

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8.5 Service life and Control

Elastomers are subject to a natural aging process and are not durable.

The service life of elastomer-components depends on the design and the strain of the component and conforms to the specific agreements of the order.

INFORMATION

- If elastomer components are only exposed to loads within the permissible range during the operating time, a maximum service life of 8 years can be assumed.
- During this operational period, elastomer components are maintenance-free. This does not exclude a visual inspection or control of the elastomer components.
- A visual inspection of the elastomer components must be carried out no later than 6 months after installation and then at least once a year.
- At the latest after reaching an operating time of 8 years, an examination and evaluation of a representative number of components must be carried out with the involvement of the manufacturer. If necessary, a residual life test should be carried out.

Regular visual inspections are essential for checking the condition of the elastomer components.

When visual inspection or inspection of an elastomer component, take care i.a. on:

- Fatigue cracks at the connecting ends of the elements
- discoloration
- volume changes
- Surface cracks in the body of the element

INFORMATION

- If you experience any damage or irregularities, report immediately.
- Document the observation according to the operational regulations.
- If necessary, replace the faulty element.

The bonding test between rubber and metal can be carried out by hand. The rubber can thereby be pressed back with a dull test-iron (edge with radius).

The use of sharp objects for inspection is not allowed!

NOTICE



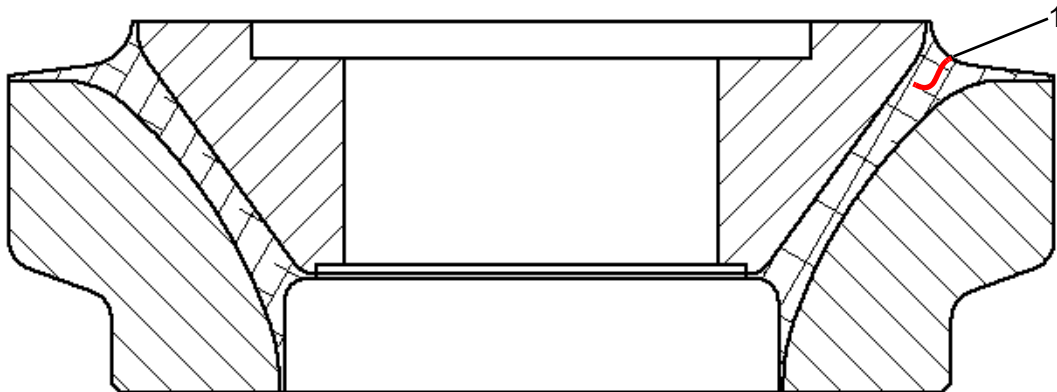
- Partial border delamination in the bonding zone between the elastomer and metal or surface cracks in the individual elastomer layers are to be reported immediately.
- These areas must be examined in regular intervals.
- If necessary, a performance and safety test of the components under participation of the manufacturer is to be initiated.

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8.6 Replacement

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- a crack depth >3 mm is reached (both in rubber itself as well as at the transitions to the metal)



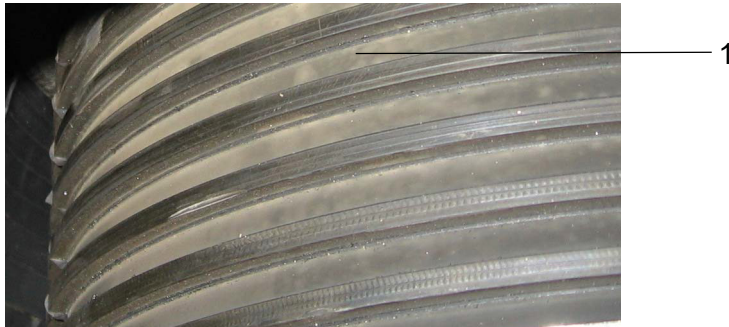
[1] Replacement criterion: crack depth > 3 mm

Figure 1: Crack depth

During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by compression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.

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[1] Discoloration

Figure 2: Discoloration example

8.7 Media resistance

8.7.1 General information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

8.7.2 Resistance against environmental impacts and loads

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INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
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INFORMATION

Non pH-neutral cleaning agents

- Non pH-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

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alkali resistance	B			B	A						A			
oil resistance	U			A	B						U			
Resistance to fuel	U			B	U						U			
Solvent resistance	U			B	B						B			
ozone resistance	B			B	A						A			
weatherability	B			A	A						A			
A = very good, little or no attack														
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8.9 Fire protection

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9 Decommissioning

- not applicable -

10 Disassembly

- not applicable -

11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
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12 Error identification

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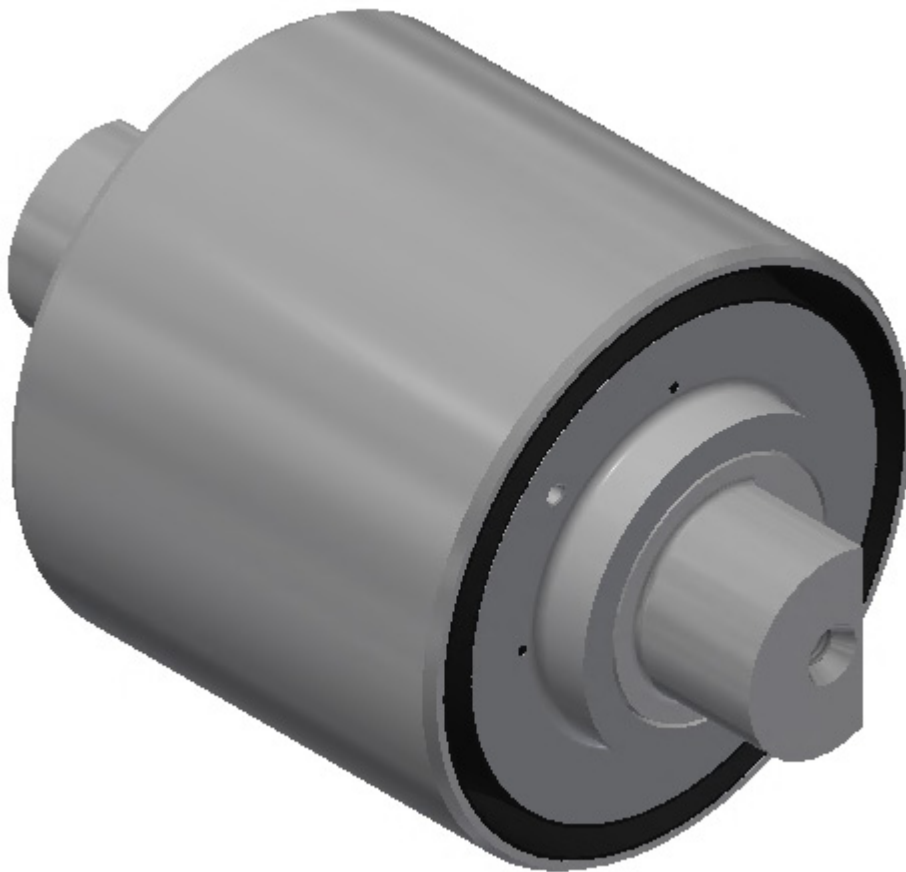
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1 On this manual

INFORMATION

These maintenance instructions for rubber-metal components refer exclusively to the visual inspection of the components when installed during operation in the vehicle depot.

The separate maintenance instructions of the vehicle manufacturer are authoritative for the inspection and main inspection of the bogies!

This maintenance manual describes the necessary maintenance operations incurring throughout the service life of the rubber metal parts.

Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

The maintenance intervals are based on the specification data and may be adapted according to the findings from the operation.

Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

1.1 Applicable Documents

- Drawing GMT No. 64064102
- DIN 7716:1982-05: Rubber products; requirements for storage, cleaning and maintenance
- ISO 2230:2002-04: Rubber products - Guidelines for storage
- DIN EN 13913:2003-08: Railway applications - Rubber suspension components - Elastomer-based mechanical parts
- DIN EN 45545-1:2013-08: Railway applications - Fire protection on railway vehicles

1.2 Presentation convention

The following representations are used in these manual:

NOTICE



- **Indicates situations or maloperation that may lead to material damage.**

INFORMATION

- **Indicates important information or instructions.**
- **Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.**

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2 Safety

2.1 Safety instructions



This manual contains important warnings and safety instructions which must be observed by the user.

The product may only be used and operated by qualified personnel who are capable of complying with the necessary safety precautions for use and operation.

The repair of the product may only be carried out by the supplier or by the qualified personnel trained for this purpose.

Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

2.2 Accident prevention regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated warning and safety messages

The following icons and standard text formats are used in this manual:

CAUTION



- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Primary Suspension Bush is exclusively intended for installation in rail vehicles. The parts may only be used and installed under the intended operating conditions. Should individual parameters deviate, this must be agreed with GMT GmbH in order to exclude dangers and damage. The intended use also includes the observance of the instructions in this maintenance manual as well as the performance of tests and maintenance.

3 Product description

3.1 Designation of delivery item

Primary Suspension Bush GMT No. 64064102

3.2 Description of delivery item

- not applicable -

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3.3 Technical specifications

Technical Specifications	
Diameter	160 mm
Width	244 mm
Weight	17.0 kg
Temperature range / operating conditions	-30 °C to +50 °C

Table 1: Technical specifications

3.4 Identification

XXX Marking in metal

GMT Logo

Date of manufacture

64064102

YYY Marking in metal

GMT Logo

Date of manufacture

64064302

4 Transport and Storage

4.1 Transport

- not applicable -

4.2 Storage

The storage of elastomer components is regulated in DIN 7716:1982-05 and ISO 2230:2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow.

Storage and storage time recording of elastomer components are described in ISO 2230:2002-04. In this standard the elastomer products are divided into three groups with different storage times. These are shown in table 2.

The elastomer of the Primary Suspension Bush is part of group 1.

Classification acc. to ISO 2230:2002-04	Designation	Storage time (in years)	Extension of storage time (in years)*
Group 1	NR (Natural Rubber)	5	2
Group 2	NBR (Acrylic Nitrile Rubber), CR (Chloroprene Rubber)	7	3
Group 3	EPDM (Ethylene-propylene Rubber)	10	5

* same storage conditions as for the initial storage time

Table 2: storage times of elastomers

The storage temperature should be below +25 °C and products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

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If the storage temperature is below +15 °C, handle the stored products carefully as they may have stiffened and become susceptible to distortion.

The temperature of products taken from such low-temperature storage should be raised to approximately +30 °C throughout their mass, before the products are put into service.

Care must be taken to ensure that the components are protected from air supply, in particular to keep away the ozone which is detrimental to elastomers.

The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

NOTICE



- Solvents, fuels, lubricants, chemicals, acids, brines, disinfectants or suchlike are not allowed in the storage room.

Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

NOTICE



- Particular metals, especially copper and manganese have a damaging effect on rubber products

Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

NOTICE



- Foils containing softeners are not allowed to be used as packaging material.

If rubber products have to be powdered, the powder should not contain any harmful ingredients for rubber-products. Appropriate materials for powdering purposes are French chalk, prepared chalk, fine-grained mica flour and rice starch.

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5 Assembly

5.1 Mounting instructions

The assembly and disassembly is carried out according to the specifications of the rail vehicle manufacturer.

INFORMATION

- When mounting rubber-metal components, the forces and torques or paths and angles shown on the drawing GMT No. 64064102 (see Annex) are not to be exceeded by more than 20 %.
- If possible, do not introduce the assembly forces via the elastomer.
- Apart from static pre-loads, the components are virtually free of tension after installation.

NOTICE



- In particular it must be ensured that the exposed rubber surface is not damaged during installation.

5.2 Mounting the Primary Suspension Bush

The Primary Suspension Bush may only be pressed into the housing via the outer pipe. In order to facilitate the press-fitting process, it is permissible to cool the bushing to -25 °C for 24 hours and then to add it to the housing unlubricated.

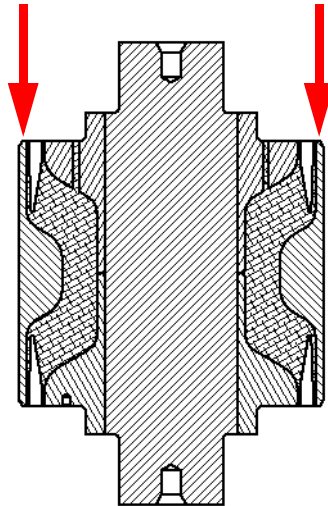


Figure 1: Mounting

6 Initial operation

- not applicable -

7 Operation

- not applicable -

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8 Maintenance

8.1 Maintenance intervals

Action	Mileage	Chapter
Visual check	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Bonding test	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Exchange of elastomer components		see chapter 8.6
Cleaning of elastomer products		see chapter 8.8

Table 3: Maintenance intervals

8.2 General instructions

Controlling, cleaning and maintaining rubber-metal parts and molded rubber parts

8.3 Range of coverage

The following guidelines apply to elastomeric components and rubber-metal components, based on the use of caoutchouc and rubber in pure form. Alternatively to metallic materials partially plastics are used. These documentation were drawn up in line with DIN 7716:1985-05 and ISO 2230:2002-04 and are also valid for the use of synthetic rubber products regarding the general conditions.

8.4 General

Under unfavorable storage conditions or improper treatment most elastomer products change their physical properties. This can lead to a significant decrease in lifetime of elastomer products. For example from excessive hardening, softening, permanent deformation as well as from flaking, cracks or other surface damage they can become unusable. The changes can be caused by the influence of oxygen, ozone, heat, light, humidity, solvents or by storing under stress.

Properly stored and treated rubber products remain virtually unchanged in their characteristics for a certain period of time.

INFORMATION

Rubber-to-metal-bonded parts are mainly suited for the usage in compression- and shear-loads. Pulling-loads should be avoided.

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8.5 Service life and Control

Elastomers are subject to a natural aging process and are not durable.

The service life of elastomer-components depends on the design and the strain of the component and conforms to the specific agreements of the order.

INFORMATION

- If elastomer components are only exposed to loads within the permissible range during the operating time, a maximum service life of 8 years can be assumed.
- During this operational period, elastomer components are maintenance-free. This does not exclude a visual inspection or control of the elastomer components.
- A visual inspection of the elastomer components must be carried out no later than 6 months after installation and then at least once a year.
- At the latest after reaching an operating time of 8 years, an examination and evaluation of a representative number of components must be carried out with the involvement of the manufacturer. If necessary, a residual life test should be carried out.

Regular visual inspections are essential for checking the condition of the elastomer components.

When visual inspection or inspection of an elastomer component, take care i.a. on:

- Fatigue cracks at the connecting ends of the elements
- discoloration
- volume changes
- Surface cracks in the body of the element

INFORMATION

- If you experience any damage or irregularities, report immediately.
- Document the observation according to the operational regulations.
- If necessary, replace the faulty element.

The bonding test between rubber and metal can be carried out by hand. The rubber can thereby be pressed back with a dull test-iron (edge with radius).

The use of sharp objects for inspection is not allowed!

NOTICE



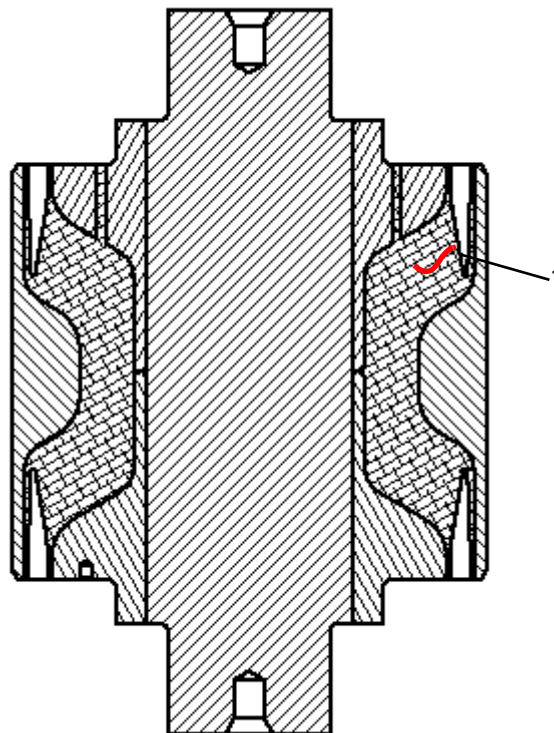
- Partial border delamination in the bonding zone between the elastomer and metal or surface cracks in the individual elastomer layers are to be reported immediately.
- These areas must be examined in regular intervals.
- If necessary, a performance and safety test of the components under participation of the manufacturer is to be initiated.

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8.6 Replacement

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- a crack depth >9 mm is reached (both in rubber itself as well as at the transitions to the metal)



[1] Replacement criterion: crack depth > 9 mm

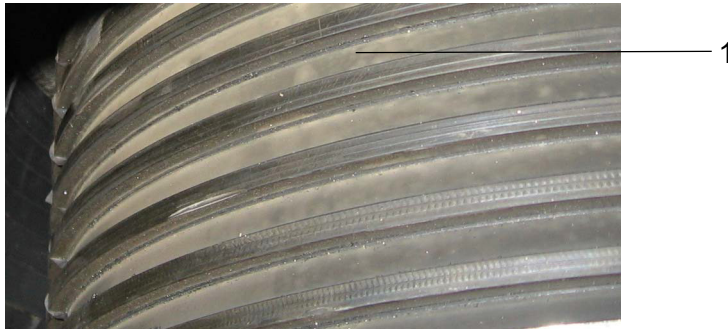
Figure 2: Crack depth

During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations

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these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by compression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.



[1] Discoloration

Figure 3: Discoloration example

8.7 Media resistance

8.7.1 General information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

8.7.2 Resistance against environmental impacts and loads

The rubber compounds used in bogies are resistant to environmental influences under normal climatic conditions which mean temperatures between -30 °C to +50 °C. Resistance against climatic influence, especially against ozone, and higher temperatures, caused e.g. by the waste heat of motors, is improved by the proportioning of appropriate chemicals.

INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
- Elastomers made of natural rubber are not permanently resistant against mineral oils and fuels.

8.7.3 Resistance against machine cleaning

The elastomers used are resistant against phosphoric acids and hydrochloric acids as well as against alkaline cleaning agents used for cleaning of the exterior of vehicles.

The resistance has been proven at selective elastomers made of natural rubber in test fluids according to DIN EN 13913:2003-08 representing other cleaning agents which are customary in trade.

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INFORMATION

Non pH-neutral cleaning agents

- Non pH-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

8.8 Cleaning

The components can be cleaned using detergents mentioned in table 4. The specified concentrations as well as the specifications of manufacturer shall be observed obligatorily. The residues of the detergents shall be rinsed with clear water. The cleaned component has to be dried at room temperature.

NOTICE



Use of other differing cleaning agents

- The use of different detergents can damage the rubber.
- Only use detergents mentioned in table 4.

Detergent	Concentration
Alkaline detergent	
Oxalic detergent	
Rapidol A	10 %
Rapidol W	10 %
Rapidol 58	10 %
Rapox	5 %
Rapox OS	5 %

Table 4: Detergents

NOTICE



Cleaning with sharp objects

- The use of sharp-edged objects (e.g. wire brushes, emery paper, etc.) is not permitted for cleaning elastomer products!

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Brief overview of resistance behavior or different elastomer compounds:														
	GROUP 1			GROUP 2						GROUP 3				
	NR			NBR	CR		CR				EPDM			
acid resistance	B			B	A		A				A			
alkali resistance	B			B	A		A				A			
oil resistance	U			A	B		B				U			
Resistance to fuel	U			B	U		U				U			
Solvent resistance	U			B	B		B				B			
ozone resistance	B			B	A		A				A			
weatherability	B			A	A		A				A			
A = very good, little or no attack														
B = satisfactory, moderate to severe attack. Please contact the manufacturer!														
U = unsuitable for the application														

Table 5: resistance behavior of elastomers

8.9 Fire protection

Unless expressly required, elastomers made of natural rubber do not include any fire protection agents. The use of halogen-free fire protection agents causes a reduction in the mechanical properties; therefore, these protection agents are not used in components for dynamic load.

9 Decommissioning

- not applicable -

10 Disassembly

For disassembly, the Primary Suspension Bush are pressed in the axial direction. It should be ensured that the force is applied only in the outer, metallic segments of the Primary Suspension Bush.

11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
- After dismantling, metallic components can be disposed of in the metal scrap recycling.

Waste code according to the European Waste List (Waste Catalogue Ordinance):

The AVV waste code numbers are not product-related but are largely source-related. The manufacturer is therefore unable to specify the waste code for articles or products used in various sectors. Waste codes can be requested from the manufacturer.

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GMT No. 64064102

12 Error identification

- not applicable -

13 Annex

- Drawing GMT No. 64064102

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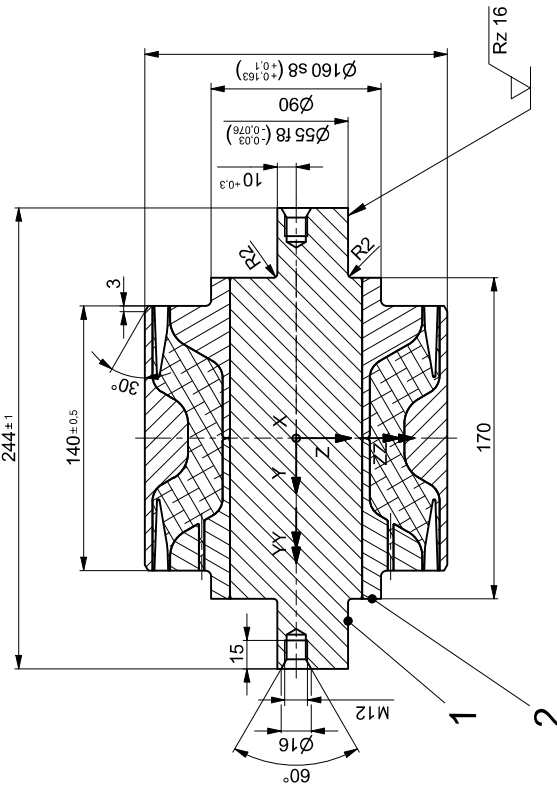
Federkennlinie wird am Muster gemessen und nachgetragen!
 Spring Characteristic values are measured at sample and will be completed!

TEST SPECIFICATIONS FOR SPRING DEFLECTION

- force direction: radial
- frequency of testing: 5%, min. 3 parts per batch
- test control unit: ambient temperature
- testing temperature: 200 N
- initial loading: 2
- number of settling cycles: 40 mm/min
- settling speed: 60 kN
- settling load up to: 20 mm/min
- testing speed: -
- 1. force measurement: Cx= 12 kN/mm ± 15%
- 2. deflection measurement: between 15 - 30 kN
- 3. stiffness measurement: -

calculated stiffness:
 Cx = 12 kN/mm ±15%
 Cy = 7.2 kN/mm ±15%
 Cyy = 72 Nm/° ±30%

max. allowable loads:
 Fx = ±60 kN
 Fy = ±40 kN
 Wyy = ±6°
 WZZ = ±2°



XXX
 Markings in metal (engraved):
 GMT logo
 Date of manufacture
 64064102

YYY
 Markings in metal (engraved):
 GMT logo
 Date of manufacture
 64064302

(1:5)



- Basic requirements under clauses 1-6 in appendix to BN 918043 apply in all cases.
- It is essential to indicate temperature range of application when outside room temperature.
- Indicate here resistance to: e.g. accumulator acid and alkali, anti-freeze, propane, urine, feces, other alkalis, corrosive action on other materials.
- Contact with mineral based oil and grease must be avoided, short-time wetting during the assembly is permissible.

Quality requirements according to BN 918043¹⁾ for OP1352

Temperature range from: -30°C to +50°C	Class N I
Impact resilience:	Class N III
Hardness:	Class N I
Abrasion:	Class N I
Elongation at break:	Class N I
Compression set:	Class N I
Resistance to:	Class G
Aging: (at 70°C)	Class -
Vapor heat:	Class G
Cold:	Class G
Heat:	Class N
Weather:	Class G

Resistance against mineral and fuel oil following DIN EN 13913 7.2.5 is not permanent.
 Resistance against cleaning agents and feces following DIN EN 13913 7.2.6 is given.
 Resistance against cleaning agents: in the pH range of 7±2
 Cleaner residues should be rinsed with clear water.

Injection nepe, rubber coating and parting line burr allowable! Paint spray allowable on rubber!
 For components with surface coating the enlisted dimensions are valid for the status before coating. Consequently, tolerances may be exceeded by the allowable coat thickness.

Metals slightly oiled

CAD Zeichnung - darf manuell nicht geändert werden! CAD drawing - Must not be changed manually!	
Maßstab / Scale: 1 : 2 Material: Elastomer: OP1352 Materials acc. to parts list	Gewicht / Weight: 17.0 kg
Benennung / Description: Achslenkerlager Axle guide bearing	
Zeichnungsnr. / Drawing no.: 64064102	
Blatt / Sheet: 1	
Index: 000	
Model: 64064102	



Make also the following inspection without further notice: 1) Visual inspection 2) Dimensional inspection 3) Material inspection 4) Surface inspection 5) Mechanical inspection	
All dimensions in mm	Name: _____ Date: _____ Status: _____ Checked: _____ Approved: _____
GfM GfM GmbH GfM-Str. 1 42699 Solingen	
Position: _____ Modification: _____ Date: _____	Sheet: 1 of 1



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14 Subject Index

- not applicable -

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Document		
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Document Created (Date)	Index	Document Created (Name)

State of Revision:

Document Modification										
Mod.	Index (Record Modified Chapters Here)									
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Released	Date	2021-11-17	GMT Engineering	Stefan Schemel

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Maintenance instruction Primary Suspension Bush GMT No. 64064102 Rev. 00

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Maintenance Manual

Spring Pad

GMT - No. 62093401



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1 On this manual

INFORMATION

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Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

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Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

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- DIN EN 45545-1:2013-08: Railway applications - Fire protection on railway vehicles

1.2 Presentation convention

The following representations are used in these manual:

NOTICE



- Indicates situations or maloperation that may lead to material damage.

INFORMATION

- Indicates important information or instructions.
- Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.

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2 Safety

2.1 Safety instructions



This manual contains important warnings and safety instructions which must be observed by the user.

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The repair of the product may only be carried out by the supplier or by the qualified personnel trained for this purpose.

Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

2.2 Accident prevention regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated warning and safety messages

The following icons and standard text formats are used in this manual:

CAUTION



- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Spring Pad is exclusively intended for installation in rail vehicles. The parts may only be used and installed under the intended operating conditions. Should individual parameters deviate, this must be agreed with GMT GmbH in order to exclude dangers and damage. The intended use also includes the observance of the instructions in this maintenance manual as well as the performance of tests and maintenance.

3 Product description

3.1 Designation of delivery item

Spring Pad GMT - No. 62093401

3.2 Description of delivery item

- not applicable -

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3.3 Technical specifications

Technical Specifications	
Diameter	285 mm
Height	31.5 mm unloaded
Weight	6.8 kg
Temperature range / operating conditions	-35 °C to +50 °C

Table 1: Technical specifications

3.4 Identification

Marking in rubber (raised)

GMT-Logo

Date of manufacture

62093401

Cavity no.

4 Transport and Storage

4.1 Transport

- not applicable -

4.2 Storage

The storage of elastomer components is regulated in DIN 7716:1982-05 and ISO 2230:2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow.

Storage and storage time recording of elastomer components are described in ISO 2230:2002-04. In this standard the elastomer products are divided into three groups with different storage times. These are shown in Table 2.

The elastomer of the Spring Pad is part of group 1.

Classification acc. to ISO 2230:2002-04	Designation	Storage time (in years)	Extension of storage time (in years)*
Group 1	NR (Natural Rubber)	5	2
Group 2	NBR (Acrylic Nitrile Rubber), CR (Chloroprene Rubber)	7	3
Group 3	EPDM (Ethylene-propylene Rubber)	10	5

* same storage conditions as for the initial storage time

Table 2: storage times of elastomers

The storage temperature should be below +25 °C and products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

If the storage temperature is below +15 °C, handle the stored products carefully as they may have stiffened and become susceptible to distortion.

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The temperature of products taken from such low-temperature storage should be raised to approximately +30 °C throughout their mass, before the products are put into service.

Care must be taken to ensure that the components are protected from air supply, in particular to keep away the ozone which is detrimental to elastomers.

The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

NOTICE



- Solvents, fuels, lubricants, chemicals, acids, brines, disinfectants or suchlike are not allowed in the storage room.

Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

NOTICE



- Particular metals, especially copper and manganese have a damaging effect on rubber products

Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

NOTICE



- Foils containing softeners are not allowed to be used as packaging material.

If rubber products have to be powdered, the powder should not contain any harmful ingredients for rubber-products. Appropriate materials for powdering purposes are French chalk, prepared chalk, fine-grained mica flour and rice starch.

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5 Assembly

5.1 Mounting instructions

The assembly and disassembly is carried out according to the specifications of the rail vehicle manufacturer.

INFORMATION

- When mounting rubber-metal components, the forces and torques or paths and angles shown on the drawing GMT - No. 62093401 (see annex) are not to be exceeded by more than 20 %.
- If possible, do not introduce the assembly forces via the elastomer.
- Apart from static pre-loads, the components are virtually free of tension after installation.

NOTICE



- In particular it must be ensured that the exposed rubber surface is not damaged during installation.

6 Initial operation

- not applicable -

7 Operation

- not applicable -

8 Maintenance

8.1 Maintenance intervals

Action	Mileage	Chapter
Visual check	- within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer	see chapter 8.4
Bonding test	- within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer	see chapter 8.4
Exchange of elastomer components		see chapter 8.5
Cleaning of elastomer components		see chapter 8.7

Table 3: Maintenance intervals

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8.2 Range of coverage

The following guidelines for controlling, cleaning and maintaining apply to elastomeric components and rubber-metal components, based on the use of caoutchouc and rubber in pure form. Alternatively to metallic materials partially plastics are used. These documentation were drawn up in line with DIN 7716:1985-05 and ISO 2230:2002-04 and are also valid for the use of synthetic rubber products regarding the general conditions.

8.3 General

Under unfavorable storage conditions or improper treatment most elastomer products change their physical properties. This can lead to a significant decrease in lifetime of elastomer products. For example from excessive hardening, softening, permanent deformation as well as from flaking, cracks or other surface damage they can become unusable. The changes can be caused by the influence of oxygen, ozone, heat, light, humidity, solvents or by storing under stress.

Properly stored and treated rubber products remain virtually unchanged in their characteristics for a certain period of time.

INFORMATION

Rubber-to-metal-bonded parts are mainly suited for the usage in compression- and shear-loads. Pulling-loads should be avoided.

8.4 Service life and Control

Elastomers are subject to a natural aging process and are not durable.

The service life of elastomer-components depends on the design and the strain of the component and conforms to the specific agreements of the order.

INFORMATION

- If elastomer components are only exposed to loads within the permissible range during the operating time, a maximum service life of 8 years can be assumed.
- During this operational period, elastomer components are maintenance-free. This does not exclude a visual inspection or control of the elastomer components.
- A visual inspection of the elastomer components must be carried out no later than 6 months after installation and then at least once a year.
- At the latest after reaching an operating time of 8 years, an examination and evaluation of a representative number of components must be carried out with the involvement of the manufacturer. If necessary, a residual life test should be carried out.

Regular visual inspections are essential for checking the condition of the elastomer components.

When visual inspection or inspection of an elastomer component, take care i.a. on:

- Fatigue cracks at the connecting ends of the elements
- discoloration
- volume changes
- Surface cracks in the body of the element

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INFORMATION

- If you experience any damage or irregularities, report immediately.
- Document the observation according to the operational regulations.
- If necessary, replace the faulty element.

The bonding test between rubber and metal can be carried out by hand. The rubber can thereby be pressed back with a dull test-iron (edge with radius).

The use of sharp objects for inspection is not allowed!

NOTICE



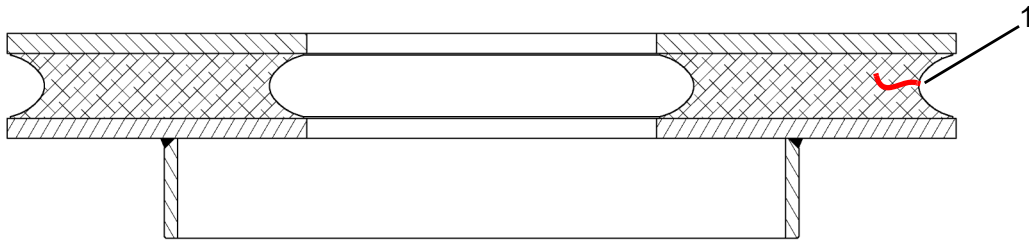
- Partial border delamination in the bonding zone between the elastomer and metal or surface cracks in the individual elastomer layers are to be reported immediately.
- These areas must be examined in regular intervals.
- If necessary, a performance and safety test of the components under participation of the manufacturer is to be initiated.

8.5 Replacement

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- a crack depth >6 mm is reached (both in rubber itself as well as at the transitions to the metal)

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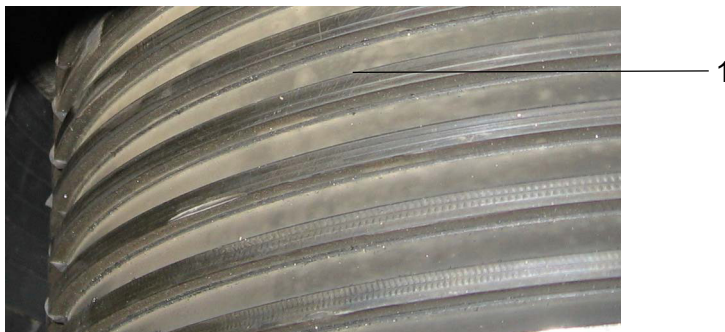


[1] Replacement criterion: crack depth > 6 mm

Figure 1: Crack depth

During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by compression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.



[1] Discoloration

Figure 2: Discoloration example

8.6 Media resistance

8.6.1 General information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

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8.6.2 Environmental impacts and loads

The rubber compounds used in bogies are resistant to environmental influences under normal climatic conditions which mean temperatures between -35 °C to +50 °C. Resistance against climatic influence, especially against ozone, and higher temperatures, caused e.g. by the waste heat of motors, is improved by the proportioning of appropriate chemicals.

INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
- Elastomers made of natural rubber are not permanently resistant against mineral oils and fuels.

8.6.3 Resistance against machine cleaning

The elastomers used are resistant against phosphoric acids and hydrochloric acids as well as against alkaline cleaning agents used for cleaning of the exterior of vehicles.

The resistance has been proven at selective elastomers made of natural rubber in test fluids according to DIN EN 13913:2003-08 representing other cleaning agents which are customary in trade.

INFORMATION

Non pH-neutral cleaning agents

- Non pH-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

8.7 Cleaning

The components can be cleaned using detergents mentioned in Table 4. The specified concentrations as well as the specifications of manufacturer shall be observed obligatorily. The residues of the detergents shall be rinsed with clear water. The cleaned component has to be dried at room temperature.

NOTICE



Use of other differing cleaning agents

- The use of different detergents can damage the rubber.
- Only use detergents mentioned in Table 4.

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Detergent	Concentration
Alkaline detergent	
Oxalic detergent	
Rapidol A	10 %
Rapidol W	10 %
Rapidol 58	10 %
Rapox	5 %
Rapox OS	5 %

Table 4: Detergents

NOTICE



Cleaning with sharp objects

- The use of sharp-edged objects (e.g. wire brushes, emery paper, etc.) is not permitted for cleaning elastomer products!

Brief overview of resistance behavior of different elastomer compounds:

	GROUP 1			GROUP 2					GROUP 3					
	NR			NBR	CR						EPDM			
acid resistance	B			B	A						A			
alkali resistance	B			B	A						A			
oil resistance	U			A	B						U			
Resistance to fuel	U			B	U						U			
Solvent resistance	U			B	B						B			
ozone resistance	B			B	A						A			
weatherability	B			A	A						A			
A = very good, little or no attack														
B = satisfactory, moderate to severe attack. Please contact the manufacturer!														
U = unsuitable for the application														

Table 5: resistance behavior of elastomers

8.8 Fire protection

Unless expressly required, elastomers made of natural rubber do not include any fire protection agents. The use of halogen-free fire protection agents causes a reduction in the mechanical properties; therefore, these protection agents are not used in components for dynamic load.

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9 Decommissioning

- not applicable -

10 Disassembly

- not applicable -

11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
- After dismantling, metallic components can be disposed of in the metal scrap recycling.

Waste code according to the European Waste List (Waste Catalogue Ordinance):

The AVV waste code numbers are not product-related but are largely source-related. The manufacturer is therefore unable to specify the waste code for articles or products used in various sectors. Waste codes can be requested from the manufacturer.

12 Error identification

- not applicable -

13 Annex

- Drawing GMT - No. 62093401

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Federkennlinie wird am Muster gemessen und nachgetragen!
 Spring Characteristic values are measured at sample and will be completed!

TEST SPECIFICATIONS FOR SPRING DEFLECTION

- force direction: Axial
 frequency of testing: 5% / min 3 parts per batch
 test control unit: ambient temperature
 testing temperature: 500 N
 initial loading: 2
 number of settling cycles: 10 mm/min
 settling speed: 75 kN
 testing load up to: 10 mm/min
 testing speed: 10 mm/min
 1. deflection measurement: H = (30 - 1) mm at F = 60,2 kN
 2. deflection measurement:
 3. stiffness measurement: Ca = 38,9 kN/mm ± 15%

calculated stiffness:

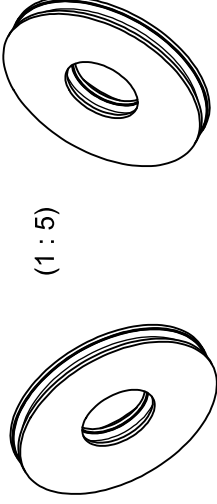
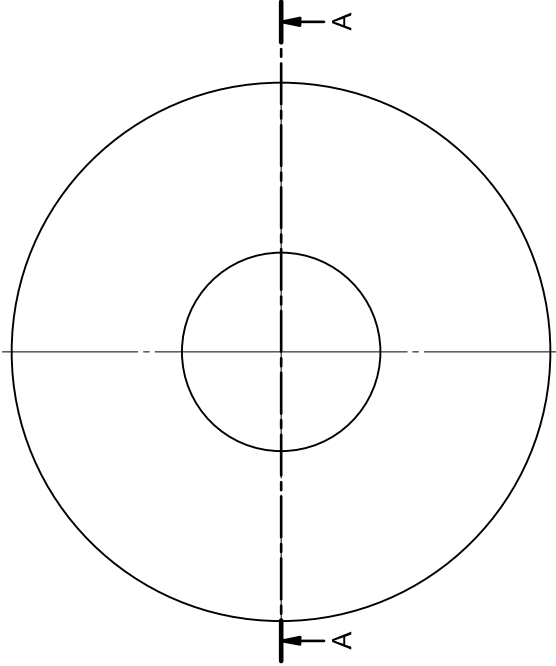
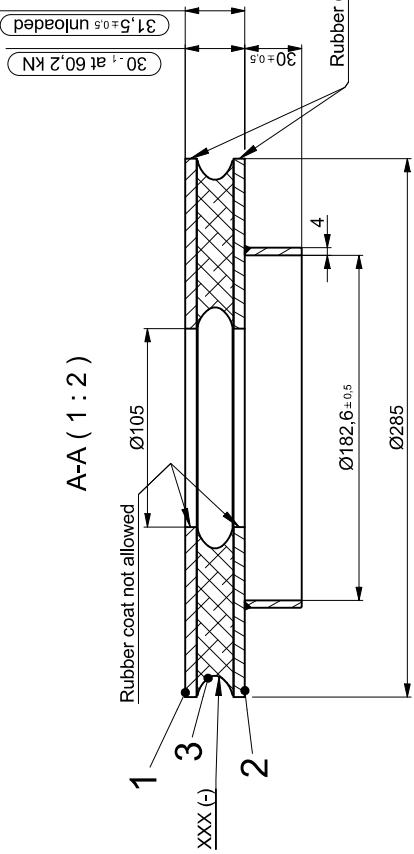
radial Cr = 1,5 kN/mm
 axial Ca = 38,9 kN/mm

Allowable axial loads:

Service: F_{a,ser} = 70,4 kN
 Exceptional: F_{a,exc} = 91,5 kN

XXX

Markings in rubber (raised):
 GMT logo
 Date of manufacture
 62093401
 Cavity no.



Quality requirements according to BN 918043 for: OP1515

Hardness:	Class S II
Adhesion:	Class N I
Ultimate elongation:	Class N I
Deformation, set:	Class N I
Resistance to:	Class G
Aging (at 70°C):	Class N III
Veget. heat:	Class N III
Cold:	Class N
Heat:	Class N
Weather:	Class N
Impact elasticity:	Class S II
Crack propagation:	Class N I
Tensile strength:	Class N I
Fuel:	Class -
Oil:	Class -
Organic:	Class -
Misc.:	Class -

The resistance against mineral and fuel oil following DIN EN 13913 7.2.5 do not mean a warranty of lifetime.
 The rubber compounds used resist to cleaning agent and faeces following DIN EN 13913 7.2.6

Resistance against cleaning agents: in pH range 7+2.
 Cleaner residues should be rinsed with clean water.

Rz 40
 Galvanischer Überzug
 Electroplated coating

QUM TS 005 - 107
 Galvanischer Überzug
 Electroplated coating

Material: Elastomer OP1515 Materials acc. to parts list	
Benennung / Description: Federunterlage Spring pad	
Zeichnungsnr. / Drawing no.: 62093401	
Index: 000	
Blatt / Sheet: 1	
Stück / Part: 1	
Modell / Model: 62093401	

Injection neeps, rubber coating and parting line burr allowable! Paint spray allowable on rubber!
 For components with surface coating the enlisted dimensions are valid for the status before coating. Consequently, tolerances may be exceeded by the allowable coat thickness.

14 Subject Index

- not applicable -

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Manufacturer	Article	Drawing Number
WH_62093401_Spring Pad_en		
Document		
2021-11-18	00	C. Palm
Document Created (Date)	Index	Document Created (Name)

State of Revision

Document Modification										
Mod.	Index (Record Modified Chapters Here)									
	01	02	03	04	05	06	07	08	09	10
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00	2021-11-18	First Issue	C. Palm

Prepared	Date	2021-11-18	GMT Engineering	Christian Palm
Released	Date	2021-11-18	GMT Engineering	Stefan Schemel

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Maintenance instruction Spring Pad GMT - No. 62093401 Rev. 00

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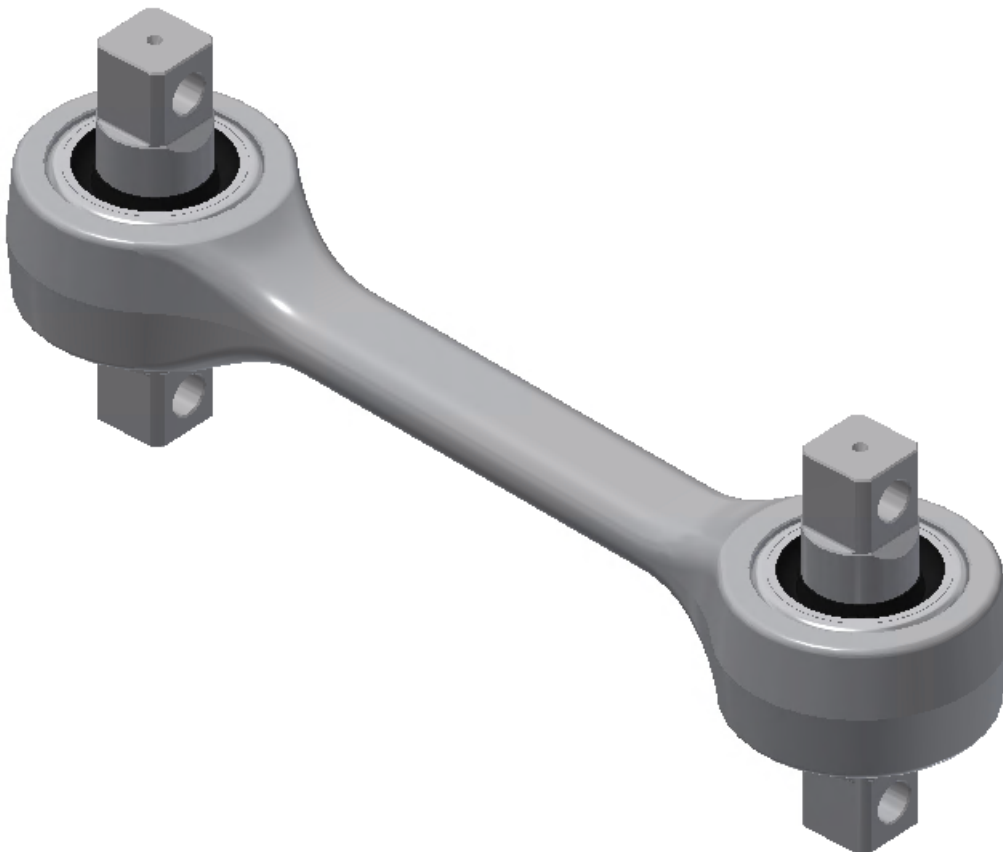
<http://www.gmt-gmbh.de>

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Maintenance Manual

Stabilizer Link

GMT No. 65087601



Freigabe

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Gummi · Metall · Technik

Stabilizer Link
GMT No. 65087601

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1 On this manual

INFORMATION

These maintenance instructions for rubber-metal components refer exclusively to the visual inspection of the components when installed during operation in the vehicle depot.

The separate maintenance instructions of the vehicle manufacturer are authoritative for the inspection and main inspection of the bogies!

This maintenance manual describes the necessary maintenance operations incurring throughout the service life of the rubber metal parts.

Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

The maintenance intervals are based on the specification data and may be adapted according to the findings from the operation.

Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

1.1 Applicable Documents

- Drawing GMT No. 65087601
- DIN 7716:1982-05: Rubber products; requirements for storage, cleaning and maintenance
- ISO 2230:2002-04: Rubber products - Guidelines for storage
- DIN EN 13913:2003-08: Railway applications - Rubber suspension components - Elastomer-based mechanical parts
- DIN EN 45545-1:2013-08: Railway applications - Fire protection on railway vehicles

1.2 Presentation convention

The following representations are used in these manual:

NOTICE



- Indicates situations or maloperation that may lead to material damage.

INFORMATION

- Indicates important information or instructions.
- Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.

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2 Safety

2.1 Safety instructions



This manual contains important warnings and safety instructions which must be observed by the user.

The product may only be used and operated by qualified personnel who are capable of complying with the necessary safety precautions for use and operation.

The repair of the product may only be carried out by the supplier or by the qualified personnel trained for this purpose.


Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

2.2 Accident prevention regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated warning and safety messages

The following icons and standard text formats are used in this manual:

 **CAUTION**

- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Stabilizer Link is exclusively intended for installation in rail vehicles. The parts may only be used and installed under the intended operating conditions. Should individual parameters deviate, this must be agreed with GMT GmbH in order to exclude dangers and damage. The intended use also includes the observance of the instructions in this maintenance manual as well as the performance of tests and maintenance.

3 Product description

3.1 Designation of delivery item

Stabilizer Link GMT No. 65087601

3.2 Description of delivery item

- not applicable -

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3.3 Technical specifications

Technical Specifications	
Outer Diameter Rod Eye	86 mm
Length Rod	686 mm
Diameter Ball Joint	67 mm
Width Ball Joint	125 mm
Weight complete	12.9 kg
Temperature range / operating conditions	-30 °C to +60 °C

Table 1: Technical specifications

3.4 Identification

Ball Joint GMT No. 64403503

Marking in rubber (raised)

GMT-Logo

Marking in metal (stamped)

Date of manufacture

64403503

4 Transport and Storage

4.1 Transport

- not applicable -

4.2 Storage

The storage of elastomer components is regulated in DIN 7716:1982-05 and ISO 2230:2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow.

Storage and storage time recording of elastomer components are described in ISO 2230:2002-04. In this standard the elastomer products are divided into three groups with different storage times. These are shown in table 2.

The elastomer of the Stabilizer Link is part of group 1.

Classification acc. to ISO 2230:2002-04	Designation	Storage time (in years)	Extension of storage time (in years)*
Group 1	NR (Natural Rubber)	5	2
Group 2	NBR (Acrylic Nitrile Rubber), CR (Chloroprene Rubber)	7	3
Group 3	EPDM (Ethylene-propylene Rubber)	10	5

* same storage conditions as for the initial storage time

Table 2: storage times of elastomers

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The storage temperature should be below +25 °C and products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

If the storage temperature is below +15 °C, handle the stored products carefully as they may have stiffened and become susceptible to distortion.

The temperature of products taken from such low-temperature storage should be raised to approximately +30 °C throughout their mass, before the products are put into service.

Care must be taken to ensure that the components are protected from air supply, in particular to keep away the ozone which is detrimental to elastomers.

The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

NOTICE



- Solvents, fuels, lubricants, chemicals, acids, brines, disinfectants or suchlike are not allowed in the storage room.

Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

NOTICE



- Particular metals, especially copper and manganese have a damaging effect on rubber products

Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

NOTICE



- Foils containing softeners are not allowed to be used as packaging material.

If rubber products have to be powdered, the powder should not contain any harmful ingredients for rubber-products. Appropriate materials for powdering purposes are French chalk, prepared chalk, fine-grained mica flour and rice starch.

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5 Assembly

5.1 Mounting instructions

The assembly and disassembly is carried out according to the specifications of the rail vehicle manufacturer.

INFORMATION

- When mounting rubber-metal components, the forces and torques or paths and angles shown on the drawing GMT No. 65087601 (see Annex) are not to be exceeded by more than 20 %.
- If possible, do not introduce the assembly forces via the elastomer.
- Apart from static pre-loads, the components are virtually free of tension after installation.

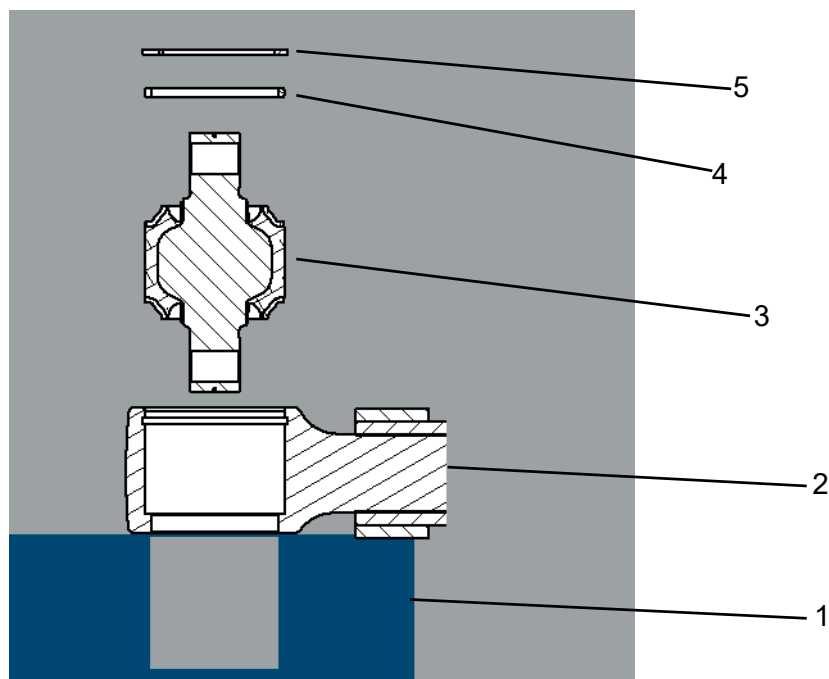
NOTICE



- In particular it must be ensured that the exposed rubber surface is not damaged during installation.

5.2 Mounting

1. Place the rod eye on a socket.



- [1] Retaining ring E200449
[2] Spacer ring E200446
[3] Ball Joint 64403503

- [4] Rod 99228001
[5] Socket

Figure 1: Mounting 1

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2. Place the Ball Joint, the spacer ring and the retaining ring on the rod eye.



Figure 2: Mounting 2

3. Press in the Ball Joint until the retaining ring springs into the groove.

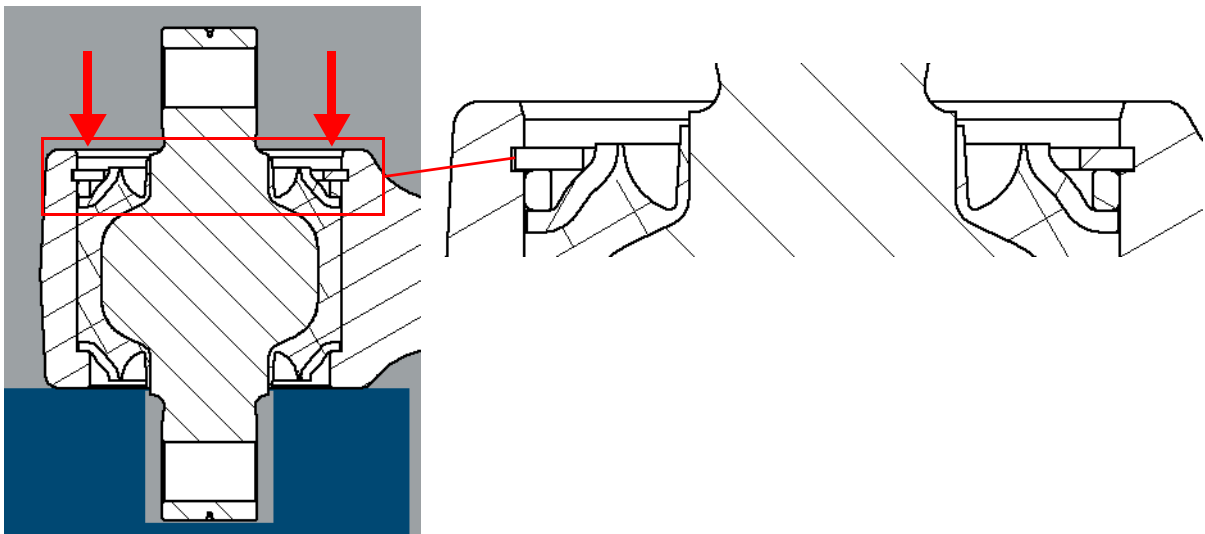


Figure 3: Mounting 3

6 Initial operation

- not applicable -

7 Operation

- not applicable -

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8 Maintenance

8.1 Maintenance intervals

Action	Mileage	Chapter
Visual check	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Bonding test	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Exchange of elastomer components		see chapter 8.6
Cleaning of elastomer products		see chapter 8.8

Table 3: Maintenance intervals

8.2 General instructions

Controlling, cleaning and maintaining rubber-metal parts and molded rubber parts

8.3 Range of coverage

The following guidelines apply to elastomeric components and rubber-metal components, based on the use of caoutchouc and rubber in pure form. Alternatively to metallic materials partially plastics are used. These documentation were drawn up in line with DIN 7716:1985-05 and ISO 2230:2002-04 and are also valid for the use of synthetic rubber products regarding the general conditions.

8.4 General

Under unfavorable storage conditions or improper treatment most elastomer products change their physical properties. This can lead to a significant decrease in lifetime of elastomer products. For example from excessive hardening, softening, permanent deformation as well as from flaking, cracks or other surface damage they can become unusable. The changes can be caused by the influence of oxygen, ozone, heat, light, humidity, solvents or by storing under stress.

Properly stored and treated rubber products remain virtually unchanged in their characteristics for a certain period of time.

INFORMATION

Rubber-to-metal-bonded parts are mainly suited for the usage in compression- and shear-loads. Pulling-loads should be avoided.

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8.5 Service life and Control

Elastomers are subject to a natural aging process and are not durable.

The service life of elastomer-components depends on the design and the strain of the component and conforms to the specific agreements of the order.

INFORMATION

- If elastomer components are only exposed to loads within the permissible range during the operating time, a maximum service life of 8 years can be assumed.
- During this operational period, elastomer components are maintenance-free. This does not exclude a visual inspection or control of the elastomer components.
- A visual inspection of the elastomer components must be carried out no later than 6 months after installation and then at least once a year.
- At the latest after reaching an operating time of 8 years, an examination and evaluation of a representative number of components must be carried out with the involvement of the manufacturer. If necessary, a residual life test should be carried out.

Regular visual inspections are essential for checking the condition of the elastomer components.

When visual inspection or inspection of an elastomer component, take care i.a. on:

- Fatigue cracks at the connecting ends of the elements
- discoloration
- volume changes
- Surface cracks in the body of the element

INFORMATION

- If you experience any damage or irregularities, report immediately.
- Document the observation according to the operational regulations.
- If necessary, replace the faulty element.

The bonding test between rubber and metal can be carried out by hand. The rubber can thereby be pressed back with a dull test-iron (edge with radius).

The use of sharp objects for inspection is not allowed!

NOTICE



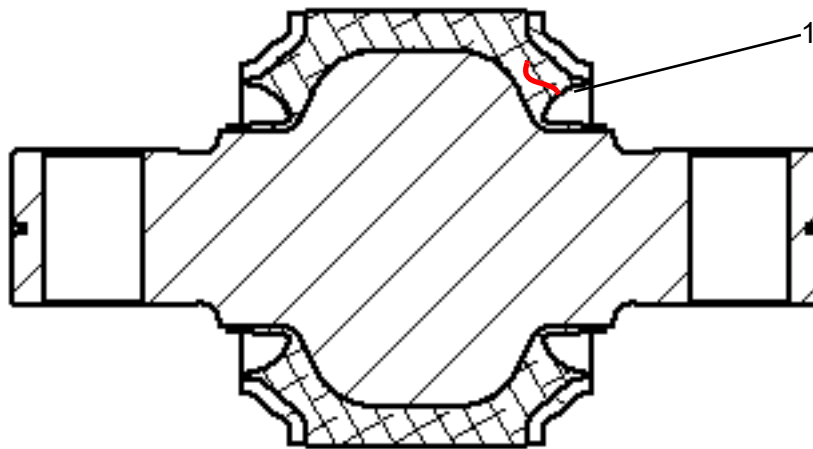
- Partial border delamination in the bonding zone between the elastomer and metal or surface cracks in the individual elastomer layers are to be reported immediately.
- These areas must be examined in regular intervals.
- If necessary, a performance and safety test of the components under participation of the manufacturer is to be initiated.

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8.6 Replacement

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- a crack depth >2 mm is reached (both in rubber itself as well as at the transitions to the metal)



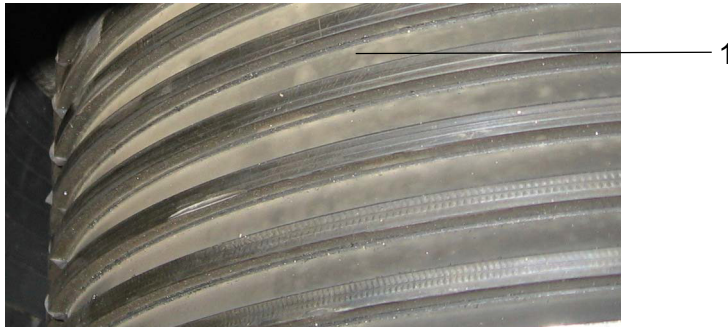
[1] Replacement criterion: crack depth > 2 mm

Figure 4: Crack depth

During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by compression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.

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[1] Discoloration

Figure 5: Discoloration example

8.7 Media resistance

8.7.1 General information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

8.7.2 Resistance against environmental impacts and loads

The rubber compounds used in bogies are resistant to environmental influences under normal climatic conditions which mean temperatures between -30 °C to +60 °C. Resistance against climatic influence, especially against ozone, and higher temperatures, caused e.g. by the waste heat of motors, is improved by the proportioning of appropriate chemicals.

INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
- Elastomers made of natural rubber are not permanently resistant against mineral oils and fuels.

8.7.3 Resistance against machine cleaning

The elastomers used are resistant against phosphoric acids and hydrochloric acids as well as against alkaline cleaning agents used for cleaning of the exterior of vehicles.

The resistance has been proven at selective elastomers made of natural rubber in test fluids according to DIN EN 13913:2003-08 representing other cleaning agents which are customary in trade.

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INFORMATION

Non pH-neutral cleaning agents

- Non pH-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

8.8 Cleaning

The components can be cleaned using detergents mentioned in table 4. The specified concentrations as well as the specifications of manufacturer shall be observed obligatorily. The residues of the detergents shall be rinsed with clear water. The cleaned component has to be dried at room temperature.

NOTICE



Use of other differing cleaning agents

- The use of different detergents can damage the rubber.
- Only use detergents mentioned in table 4.

Detergent	Concentration
Alkaline detergent	
Oxalic detergent	
Rapidol A	10 %
Rapidol W	10 %
Rapidol 58	10 %
Rapox	5 %
Rapox OS	5 %

Table 4: Detergents

NOTICE



Cleaning with sharp objects

- The use of sharp-edged objects (e.g. wire brushes, emery paper, etc.) is not permitted for cleaning elastomer products!

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Brief overview of resistance behavior or different elastomer compounds:														
	GROUP 1			GROUP 2						GROUP 3				
	NR			NBR	CR						EPDM			
acid resistance	B			B	A						A			
alkali resistance	B			B	A						A			
oil resistance	U			A	B						U			
Resistance to fuel	U			B	U						U			
Solvent resistance	U			B	B						B			
ozone resistance	B			B	A						A			
weatherability	B			A	A						A			
A = very good, little or no attack														
B = satisfactory, moderate to severe attack. Please contact the manufacturer!														
U = unsuitable for the application														

Table 5: resistance behavior of elastomers

8.9 Fire protection

Unless expressly required, elastomers made of natural rubber do not include any fire protection agents. The use of halogen-free fire protection agents causes a reduction in the mechanical properties; therefore, these protection agents are not used in components for dynamic load.

9 Decommissioning

- not applicable -

10 Disassembly

For disassembly, the Ball Joint are pressed in the axial direction. It should be ensured that the force is applied only in the outer, metallic segments of the Ball Joint.

11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
- After dismantling, metallic components can be disposed of in the metal scrap recycling.

Waste code according to the European Waste List (Waste Catalogue Ordinance):

The AVV waste code numbers are not product-related but are largely source-related. The manufacturer is therefore unable to specify the waste code for articles or products used in various sectors. Waste codes can be requested from the manufacturer.

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12 Error identification

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13 Annex

- Drawing GMT No. 65087601

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To be degreased by using e.g. MEK. Please take into consideration that the used solvent does not corrode rubber and/or adhesive medium.

- Covering of all fitting surfaces free of paint
- Covering of outside threads and inside threads
- Covering of all contact surfaces excluding areas marked with "XX"

Surfaces dry, rust-free, dust-free as well as free of grease. Pre-treatment by sand-streaming, brushing or grinding acc. to DIN 12944 T4 Sa 2.5 approx. Rz20µm excluding thread, fitting and contact surfaces.

g

1. Primer only for not sand-streamed fitting and bush surfaces (Merkmal)
EP-metal priming beige red RAL 3012
DB-mat.-no. 598.03.33
layer thickness: 20-50µm

G

1. Primer for metal surfaces sand-blasted by sand-streaming and/or brushing etc.
EP-metal primer beige red RAL 3012
DB-mat.-no. 588.03.33
layer thickness: 60-100µm

D

2. Coats of paint (top coat) elastified 2K-epoxy-thick-film lacquer
Dry layer thickness reference 140-200 µm
RAL9005

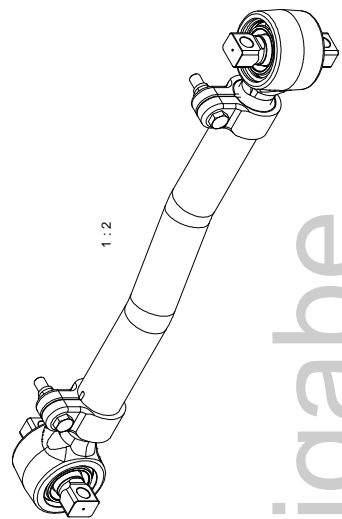
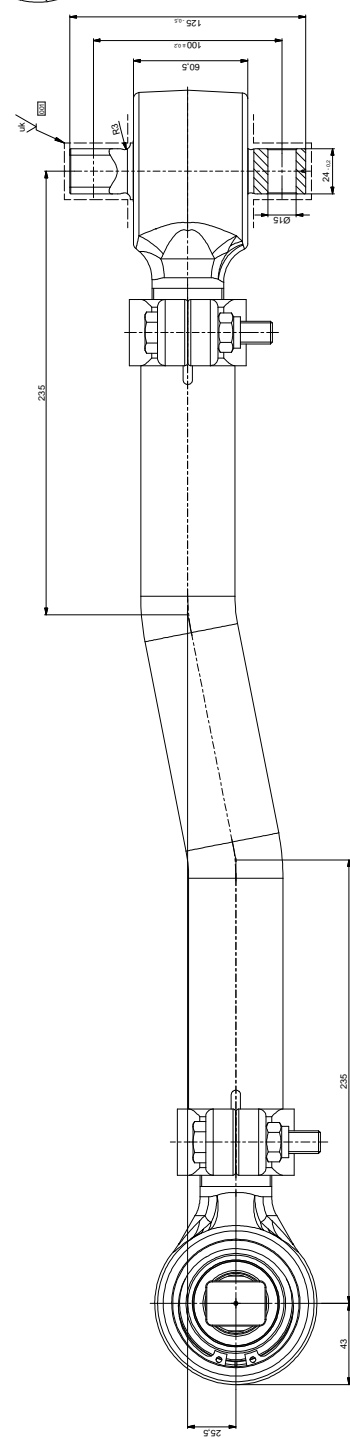
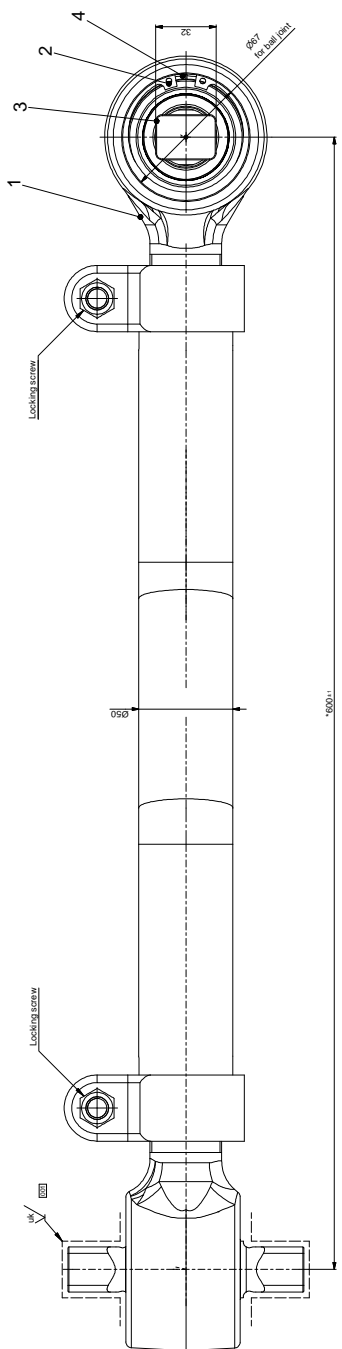
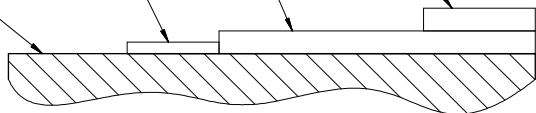
uk

= not primed, treated with anticorrosive:

HÖLTEROL MF1424 GOLD. Alternatively:
TECTYL 506, TECTYL 846

qualified paint acc. BN 918 300:
Water dilutable coatings:

Marking
in the area designated "M"
-version number
-serial number for part
-month / year of production



stiffness of ball joint:

radial $C_r = 50 \text{ kN/mm}$
axial $C_a = 10.5 \text{ kN/mm}$
cardanic $C_k = 42 \text{ Nm/}^\circ$
torsional $C_t = 46 \text{ Nm/}^\circ$

***length adjustment:**

min. length: 590 ±2 mm
max. length: 640 ±2 mm

max. allowable Loads:

working condition:
-normal forces $F_{-z} = 30 \text{ kN}$
-exceptional forces (accidentally) $F_{-z} = 50 \text{ kN}$

cardanic angle (for each bush):
-normal work = 5°
-exceptional = 8,5°

torsional angle (for each bush):
-normal work = 12°
-exceptional (eg. in depot) = 21°

GUMTS 005-107
Electroplated coating
Bush

Part No.	65097601
Material	Stainless steel
Material No.	1.4571
Material Name	AISI 316L
Material No. 2	65097602
Material Name 2	Substrate Ink
Material No. 3	65097603
Material Name 3	Substrate Ink
Material No. 4	65097604
Material Name 4	Substrate Ink
Material No. 5	65097605
Material Name 5	Substrate Ink
Material No. 6	65097606
Material Name 6	Substrate Ink
Material No. 7	65097607
Material Name 7	Substrate Ink
Material No. 8	65097608
Material Name 8	Substrate Ink
Material No. 9	65097609
Material Name 9	Substrate Ink
Material No. 10	65097610
Material Name 10	Substrate Ink
Material No. 11	65097611
Material Name 11	Substrate Ink
Material No. 12	65097612
Material Name 12	Substrate Ink
Material No. 13	65097613
Material Name 13	Substrate Ink
Material No. 14	65097614
Material Name 14	Substrate Ink
Material No. 15	65097615
Material Name 15	Substrate Ink
Material No. 16	65097616
Material Name 16	Substrate Ink
Material No. 17	65097617
Material Name 17	Substrate Ink
Material No. 18	65097618
Material Name 18	Substrate Ink
Material No. 19	65097619
Material Name 19	Substrate Ink
Material No. 20	65097620
Material Name 20	Substrate Ink

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Based on AZ009568



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14 Subject Index

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Document Created (Date)	Index	Document Created (Name)

State of Revision:

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Mod.	Index (Record Modified Chapters Here)									
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Released	Date	2020-07-01	GMT Engineering	Stefan Schemel

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Maintenance instruction Stabilizer Link GMT No. 65087601 Rev. 00

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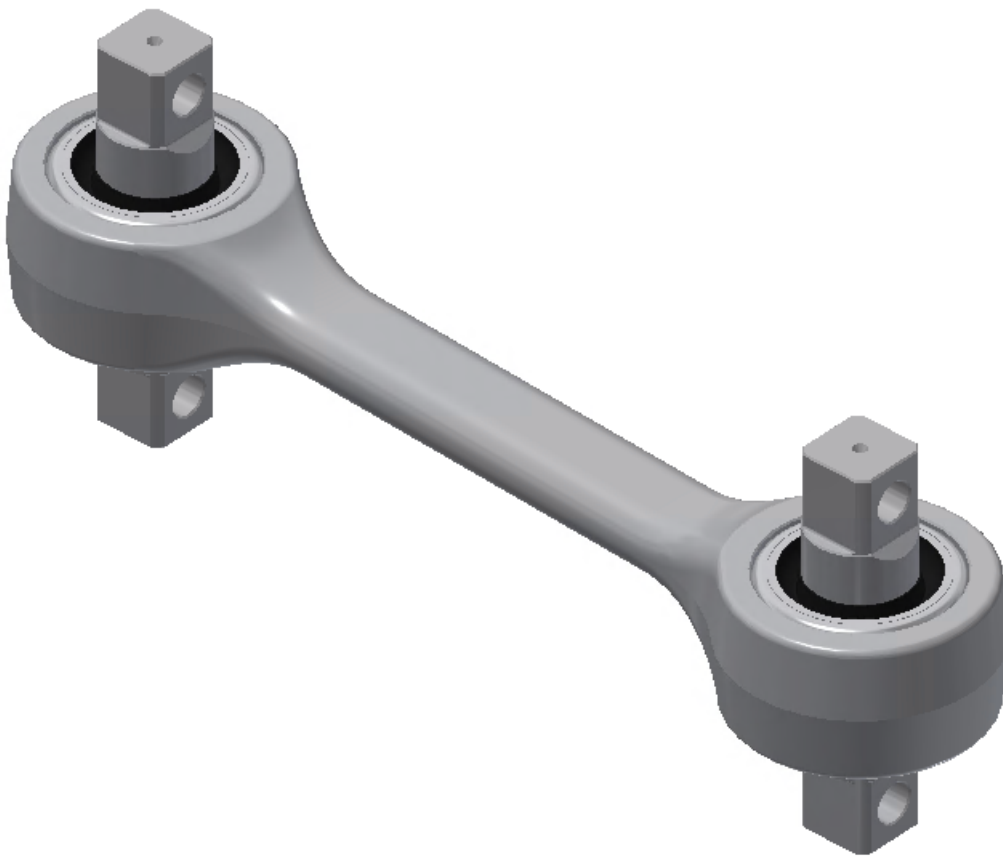
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Maintenance Manual

Traction Rod

GMT No. 65081502



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Traction Rod
GMT No. 65081502

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1 On this manual

INFORMATION

These maintenance instructions for rubber-metal components refer exclusively to the visual inspection of the components when installed during operation in the vehicle depot.

The separate maintenance instructions of the vehicle manufacturer are authoritative for the inspection and main inspection of the bogies!

This maintenance manual describes the necessary maintenance operations incurring throughout the service life of the rubber metal parts.

Proposals are made for the necessary tools and auxiliary devices and the necessary dimensions are named.

The maintenance intervals are based on the specification data and may be adapted according to the findings from the operation.

Criteria are described in which the parts are to be replaced or respectively forwarded to the supplier for an assessment of the further applicability.

1.1 Applicable Documents

- Drawing GMT No. 65081502
- DIN 7716:1982-05: Rubber products; requirements for storage, cleaning and maintenance
- ISO 2230:2002-04: Rubber products - Guidelines for storage
- DIN EN 13913:2003-08: Railway applications - Rubber suspension components - Elastomer-based mechanical parts
- DIN EN 45545-1:2013-08: Railway applications - Fire protection on railway vehicles

1.2 Presentation convention

The following representations are used in these manual:

NOTICE



- Indicates situations or maloperation that may lead to material damage.

INFORMATION

- Indicates important information or instructions.
- Failure to comply with these instructions will prevent or substantially hinder the successful completion of the actions described in this documentation.

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2 Safety

2.1 Safety instructions



This manual contains important warnings and safety instructions which must be observed by the user.

The product may only be used and operated by qualified personnel who are capable of complying with the necessary safety precautions for use and operation.

The repair of the product may only be carried out by the supplier or by the qualified personnel trained for this purpose.


Any damage resulting from non-compliance with the safety regulations and operating instructions described in this manual are excluded from the warranty and liability claims against the manufacturer!

2.2 Accident prevention regulations

Besides the instructions in this manual, the personnel must be familiar with all applicable local accident prevention regulations and the national safety regulations and must always comply with them.

2.3 Graduated warning and safety messages

The following icons and standard text formats are used in this manual:

 **CAUTION**

- Indicates a hazard that may result in minor or moderate injuries.
- This is the general warning sign. It is used to alert the product user to potential hazards. All safety statements that follow this symbol must be followed in order to prevent possible damage.

2.4 Intended Use

The Traction Rod is exclusively intended for installation in rail vehicles. The parts may only be used and installed under the intended operating conditions. Should individual parameters deviate, this must be agreed with GMT GmbH in order to exclude dangers and damage. The intended use also includes the observance of the instructions in this maintenance manual as well as the performance of tests and maintenance.

3 Product description

3.1 Designation of delivery item

Traction Rod GMT No. 65081502

3.2 Description of delivery item

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3.3 Technical specifications

Technical Specifications	
Outer Diameter Rod Eye	150 mm
Length Rod	650 mm
Diameter Ball Joint	110 mm
Width Ball Joint	230 mm
Weight complete	28.8 kg
Temperature range / operating conditions	-30 °C to +70 °C

Table 1: Technical specifications

3.4 Identification

XXX Marking in metal (engraved)

GMT-Logo

Date of manufacture

64064601

YYY Marking in metal (graved)

Date of manufacture (month and year)

Charge-no. from raw material

Serial number

4 Transport and Storage

4.1 Transport

CAUTION



High weight

- Always carry the component in pairs or with a lifting device.
- Wear safety shoes!

4.2 Storage

The storage of elastomer components is regulated in DIN 7716:1982-05 and ISO 2230:2002-04 and mainly covers long-term storage (longer than 6 months). However, it can also be used for short-term storage (less than 6 months), e.g. production or delivery storage with continuous material flow.

Storage and storage time recording of elastomer components are described in ISO 2230:2002-04. In this standard the elastomer products are divided into three groups with different storage times. These are shown in table 2.

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The elastomer of the Ball Joint is part of group 1.

Classification acc. to ISO 2230:2002-04	Designation	Storage time (in years)	Extension of storage time (in years)*
Group 1	NR (Natural Rubber)	5	2
Group 2	NBR (Acrylic Nitrile Rubber), CR (Chloroprene Rubber)	7	3
Group 3	EPDM (Ethylene-propylene Rubber)	10	5

* same storage conditions as for the initial storage time

Table 2: storage times of elastomers

The storage temperature should be below +25 °C and products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight.

If the storage temperature is below +15 °C, handle the stored products carefully as they may have stiffened and become susceptible to distortion.

The temperature of products taken from such low-temperature storage should be raised to approximately +30 °C throughout their mass, before the products are put into service.

Care must be taken to ensure that the components are protected from air supply, in particular to keep away the ozone which is detrimental to elastomers.

The storage of elastomeric products in humid storage areas is to be avoided. Condensation should not occur. A relative humidity of 65 % in the storage room is most favorable.

NOTICE



- Solvents, fuels, lubricants, chemicals, acids, brines, disinfectants or suchlike are not allowed in the storage room.

Elastomer products are to be stored stress-free which means without tension, compression or any other deformation since stress promotes a lasting deformation as well as the development of cracks, unless this is provided for constructively.

NOTICE



- Particular metals, especially copper and manganese have a damaging effect on rubber products

Due to this, rubber products should not be stored in contact with these metals but have to be protected by packaging them or by covering them with a layer of a suitable material, e.g. paper or polyethylene.

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The material of the containers and the material for packaging- and covering should not contain any damaging ingredients for the rubber products, e.g. copper or copper-containing alloys, petrol, oil or suchlike.

NOTICE



- Foils containing softeners are not allowed to be used as packaging material.

If rubber products have to be powdered, the powder should not contain any harmful ingredients for rubber-products. Appropriate materials for powdering purposes are French chalk, prepared chalk, fine-grained mica flour and rice starch.

5 Assembly

5.1 Mounting instructions

The assembly and disassembly is carried out according to the specifications of the rail vehicle manufacturer.

INFORMATION

- When mounting rubber-metal components, the forces and torques or paths and angles shown on the drawing GMT No. 65081502 (see Annex) are not to be exceeded by more than 20 %.
- If possible, do not introduce the assembly forces via the elastomer.
- Apart from static pre-loads, the components are virtually free of tension after installation.

NOTICE



- In particular it must be ensured that the exposed rubber surface is not damaged during installation.

5.2 Mounting the Traction Rod

The Ball Joint may only be pressed into the housing via the outer pipe. In order to facilitate the press-fitting process, it is permissible to cool the Ball Joint to -25 °C for 24 hours and then to add it to the housing unlubricated.

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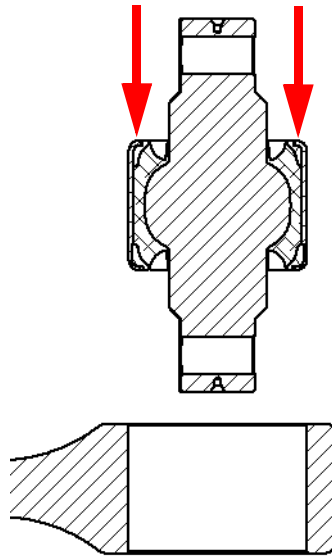


Figure 1: Mounting

6 Initial operation

- not applicable -

7 Operation

- not applicable -

8 Maintenance

8.1 Maintenance intervals

Action	Mileage	Chapter
Visual check	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Bonding test	<ul style="list-style-type: none"> - within 6 months after installation - thereafter all least once per year - after an operating period of 8 years testing and evaluation with the involvement of the manufacturer 	see chapter 8.5
Exchange of elastomer components		see chapter 8.6
Cleaning of elastomer products		see chapter 8.8

Table 3: Maintenance intervals

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8.2 General instructions

Controlling, cleaning and maintaining rubber-metal parts and molded rubber parts

8.3 Range of coverage

The following guidelines apply to elastomeric components and rubber-metal components, based on the use of caoutchouc and rubber in pure form. Alternatively to metallic materials partially plastics are used. These documentation were drawn up in line with DIN 7716:1985-05 and ISO 2230:2002-04 and are also valid for the use of synthetic rubber products regarding the general conditions.

8.4 General

Under unfavorable storage conditions or improper treatment most elastomer products change their physical properties. This can lead to a significant decrease in lifetime of elastomer products. For example from excessive hardening, softening, permanent deformation as well as from flaking, cracks or other surface damage they can become unusable. The changes can be caused by the influence of oxygen, ozone, heat, light, humidity, solvents or by storing under stress.

Properly stored and treated rubber products remain virtually unchanged in their characteristics for a certain period of time.

INFORMATION

Rubber-to-metal-bonded parts are mainly suited for the usage in compression- and shear-loads. Pulling-loads should be avoided.

8.5 Service life and Control

Elastomers are subject to a natural aging process and are not durable.

The service life of elastomer-components depends on the design and the strain of the component and conforms to the specific agreements of the order.

INFORMATION

- If elastomer components are only exposed to loads within the permissible range during the operating time, a maximum service life of 8 years can be assumed.
- During this operational period, elastomer components are maintenance-free. This does not exclude a visual inspection or control of the elastomer components.
- A visual inspection of the elastomer components must be carried out no later than 6 months after installation and then at least once a year.
- At the latest after reaching an operating time of 8 years, an examination and evaluation of a representative number of components must be carried out with the involvement of the manufacturer. If necessary, a residual life test should be carried out.

Regular visual inspections are essential for checking the condition of the elastomer components.

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When visual inspection or inspection of an elastomer component, take care i.a. on:

- Fatigue cracks at the connecting ends of the elements
- discoloration
- volume changes
- Surface cracks in the body of the element

INFORMATION

- If you experience any damage or irregularities, report immediately.
- Document the observation according to the operational regulations.
- If necessary, replace the faulty element.

The bonding test between rubber and metal can be carried out by hand. The rubber can thereby be pressed back with a dull test-iron (edge with radius).

The use of sharp objects for inspection is not allowed!

NOTICE



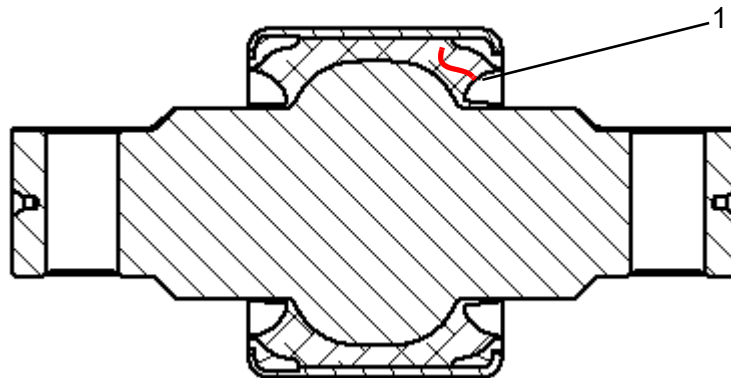
- Partial border delamination in the bonding zone between the elastomer and metal or surface cracks in the individual elastomer layers are to be reported immediately.
- These areas must be examined in regular intervals.
- If necessary, a performance and safety test of the components under participation of the manufacturer is to be initiated.

8.6 Replacement

A replacement of elastomer components or elastomer-metal components is required e.g. in the following cases when

- more than 10 clearly visible cracks per cm² have appeared on the rubber surface as a result of atmospheric exposure
- the parts have swollen strongly, due to inadmissible oil-moistening.
- a loss in the rubber-metal bonding (possibly due to rust creep or corrosion of the metal parts) has occurred
- there is mechanical damage which could lead to a further destruction of the product due to sensitivity for notches of natural rubber
- local bulges are visible that do cover the entire side and with a depth of a multiple of the layer thickness
- Frayed bulges occur parallel to metal parts
- an above-average deformation occurs on metal parts of an elastomer-metal component as a result of deflection
- a crack depth >6 mm is reached (both in rubber itself as well as at the transitions to the metal)

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[1] Replacement criterion: crack depth > 6 mm

Figure 2: Crack depth

During operation a white-grayish film might show on the rubber surface. This film is aging protecting wax or compounding ingredients that are blended with the elastomer compound to protect against ozone and other environmental influences. Due to component deformations these ingredients migrate to the surface of an elastomeric component. In the area of wrinkles the film might be levigated.

At first sight, such an area can be diagnosed incorrectly as cracks in the elastomer or sulfur rash. This folding is typical for the structure of the elastomeric surface and is caused by compression of the component and the incompressibility of the elastomer. Should uncertainty persist, report to the supervisor.



[1] Discoloration

Figure 3: Discoloration example

8.7 Media resistance

8.7.1 General information

The bogie components include rubber compounds out of natural rubber with different shore hardness and related synthetic rubber composites. The chemical resistance of these rubber compounds is chosen according to the mechanical requirements and therefore is comparable among each other.

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8.7.2 Resistance against environmental impacts and loads

The rubber compounds used in bogies are resistant to environmental influences under normal climatic conditions which mean temperatures between -30 °C to $+70\text{ °C}$. Resistance against climatic influence, especially against ozone, and higher temperatures, caused e.g. by the waste heat of motors, is improved by the proportioning of appropriate chemicals.

INFORMATION

- The elastomers used are resistant against loads which are usual in railway application.
- Pollutions caused by oil and lubricants as well as feces have to be removed regularly by using cleaning agents commonly used for bogies.
- Elastomers made of natural rubber are not permanently resistant against mineral oils and fuels.

8.7.3 Resistance against machine cleaning

The elastomers used are resistant against phosphoric acids and hydrochloric acids as well as against alkaline cleaning agents used for cleaning of the exterior of vehicles.

The resistance has been proven at selective elastomers made of natural rubber in test fluids according to DIN EN 13913:2003-08 representing other cleaning agents which are customary in trade.

INFORMATION

Non pH-neutral cleaning agents

- Non pH-neutral cleaning agents damage the rubber.
- Use cleaning agents with a neutral pH-value. Do not use cleaning agents containing non-polar solvents (e.g. petrol). The components of the bogie have to be rinsed with water after the cleaning process otherwise the rubber-metal-bonding has to be protected against cleaning agents by constructive measures.

8.8 Cleaning

The components can be cleaned using detergents mentioned in table 4. The specified concentrations as well as the specifications of manufacturer shall be observed obligatorily. The residues of the detergents shall be rinsed with clear water. The cleaned component has to be dried at room temperature.

NOTICE



Use of other differing cleaning agents

- The use of different detergents can damage the rubber.
- Only use detergents mentioned in table 4.

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Detergent	Concentration
Alkaline detergent	
Oxalic detergent	
Rapidol A	10 %
Rapidol W	10 %
Rapidol 58	10 %
Rapox	5 %
Rapox OS	5 %

Table 4: Detergents

NOTICE



Cleaning with sharp objects

- The use of sharp-edged objects (e.g. wire brushes, emery paper, etc.) is not permitted for cleaning elastomer products!

Brief overview of resistance behavior of different elastomer compounds:

	GROUP 1			GROUP 2					GROUP 3					
	NR			NBR	CR						EPDM			
acid resistance	B			B	A						A			
alkali resistance	B			B	A						A			
oil resistance	U			A	B						U			
Resistance to fuel	U			B	U						U			
Solvent resistance	U			B	B						B			
ozone resistance	B			B	A						A			
weatherability	B			A	A						A			

A = very good, little or no attack
 B = satisfactory, moderate to severe attack.
 Please contact the manufacturer!
 U = unsuitable for the application

Table 5: resistance behavior of elastomers

8.9 Fire protection

Unless expressly required, elastomers made of natural rubber do not include any fire protection agents. The use of halogen-free fire protection agents causes a reduction in the mechanical properties; therefore, these protection agents are not used in components for dynamic load.

9 Decommissioning

- not applicable -

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10 Disassembly

For disassembly, the Ball Joint are pressed in the axial direction. It should be ensured that the force is applied only in the outer, metallic segments of the Ball Joint.

11 Disposal

Disposal / Product:

- Rubber-metal bonded materials with high rubber content may be disposed of in compliance with the local regulations of combustion (e.g. thermal recycling).
- Smaller quantities can be disposed of in compliance with the local regulations in the domestic waste dump.
- After dismantling, metallic components can be disposed of in the metal scrap recycling.

Waste code according to the European Waste List (Waste Catalogue Ordinance):

The AVV waste code numbers are not product-related but are largely source-related. The manufacturer is therefore unable to specify the waste code for articles or products used in various sectors. Waste codes can be requested from the manufacturer.

12 Error identification

- not applicable -

13 Annex

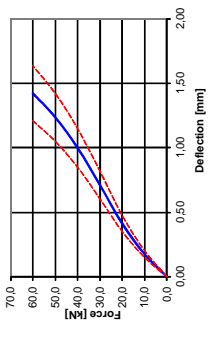
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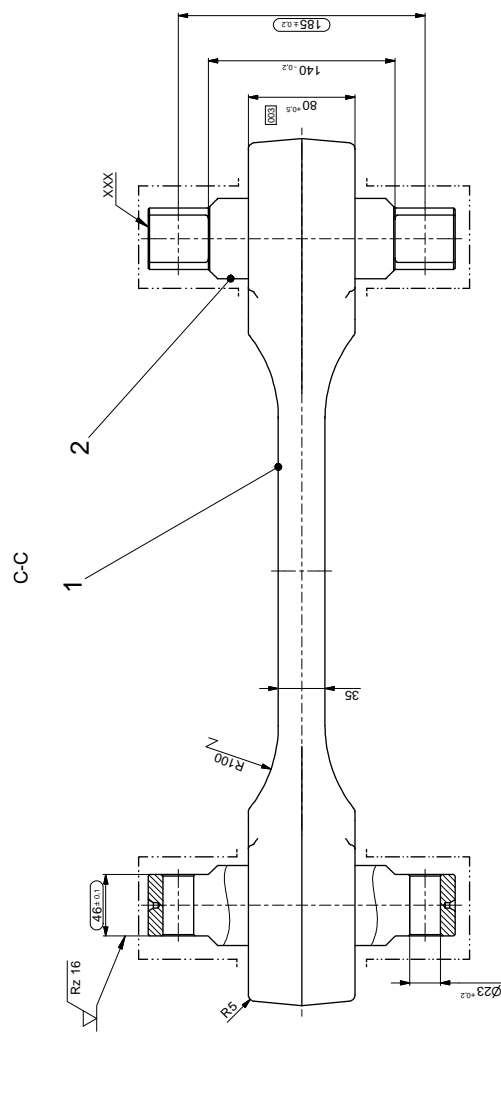
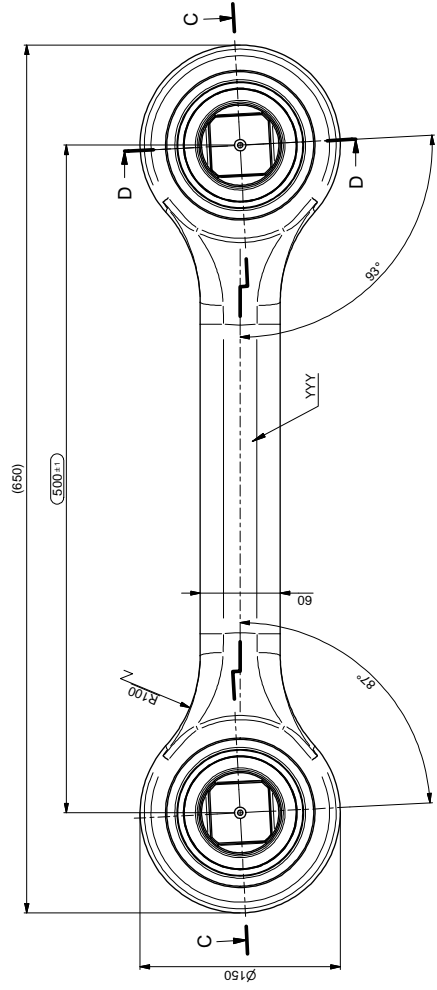
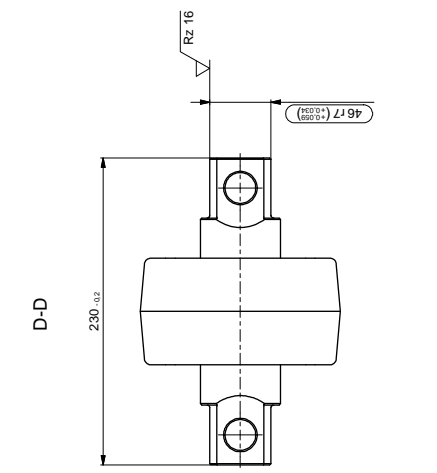
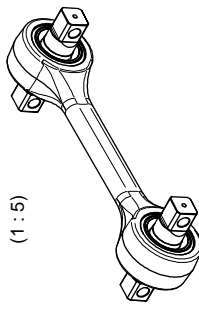
Injection neeps, rubber coating and painting the burr allowable! Paint spray allowable on rubber! Injection neeps, rubber coating and painting the burr allowable! Paint spray allowable on rubber! Consequently, tolerances may be exceeded by the allowable coat thickness.



calculated stiffness:
radial: $C_r = 34 \text{ kN/mm}$
axial: $C_a = 8 \text{ kN/mm}$

allowable loads:
radial $F_r = 60 \text{ kN}$
 $F_r \text{ max.} = 150 \text{ kN}$
 $F_r \text{ crash} = 210 \text{ kN}$
torsion: $\alpha = \pm 7.5^\circ$
 $\alpha \text{ max.} = \pm 11^\circ$
cardanic: $\beta = \pm 5.5^\circ$
 $\beta \text{ max.} = \pm 9^\circ$

Surface protection (red):
primer:
2K EP primer RAL 7032
layer thickness: 60-100 μm .
top coat:
2K EP top coat - RAL7021
layer thickness: 80-150 μm
- - - - - : free of paint



XXX
Markings in metal engraving:
GMT-Logo
Date of manufacture (month and year)
64064601

YYY
Markings in metal (graved) font size (10mm).
Date of manufacture (month and year)
Charge-no. from raw material
Serial number

Quality requirements according to BN 918043¹⁾ for OP22663

Temperature range from: -30°C bis +70°C

Impact elasticity:	Class S III
Crack propagation:	Class N I
Tensile strength:	Class N I
Resistance to:	Class G
- fuel:	Class N
- oil:	Class N
- ozone:	Class N
- vapor heat:	Class N
- heat:	Class N
- weather:	Class N

The resistance against mineral and fuel oil following DIN 5514 Part 2 No. 1-3 do not mean a warranty of lifetime.
The rubber compounds used meet to cleaning agent and solvents following DIN 5514 Part 2 No. 4-7.
Stability against cleaning agents: in the pH value range of 7-2

✓ Rz 40
QUM TS 005 - 107
Galvanischer Überzug
Electroplated coating
Bolt + support ring

Name: QUM TS 005 - 107		Material: Elektrometall OP2263	
Menge / Stück: 1,2		Gewicht / Weight: 28,8 kg	
Materialien nach: to parts list			
Benennung / Description:			
Lenker komplett			
Traktion bar / metal-rubber bush			
Zustellung / Drawing no.: 65081502			
Menge / Stück: 2			
Menge / Stück: 003			
Menge / Stück: 1			
Menge / Stück: 1			

Freigabe



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- not applicable -

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Prepared	Date	2020-07-01	GMT Engineering	Christian Palm
Released	Date	2020-07-01	GMT Engineering	Stefan Schemel

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Maintenance instruction Traction Rod GMT No. 65081502 Rev. 00

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INSTRUCTION MANUAL

Performance Line type 97

Installation and Operation

Document Number: 0100 78 00 92, rev **B**

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1 Safety precautions

1.1 General

KONI's hydraulic railway dampers are designed, developed and manufactured with state-of-the-art technologies in modern facilities. Our dampers are produced with great care and commitment to continuous quality control, utilising sophisticated quality techniques.

These instructions are intended to facilitate familiarization with the product and its use. Operating the product in compliance with these instructions is important to help ensure reliability in service and avoid risks. The instructions may not take into account local regulations; ensure such regulations are observed by all, including those installing the product. Always follow your company's safety requirements and applicable safety and health laws/regulations.



These instructions must be read prior to installing, operating and maintaining the dampers in any region worldwide. The dampers must not be put into service until all the conditions relating to safety, noted in the instructions, have been met.

Failure to follow and apply the relevant user instructions is considered to be misuse. Personal injury, product damage, delay or failures caused by misuse are not covered by the KONI warranty.

1.2 Copyright

All rights reserved. No part of these instructions may be reproduced, stored in a retrieval system or transmitted in any form or by any means without prior written permission of KONI.

1.3 Safety

1.3.1 Marking

These user instructions contain a specific safety marking where non-observance of an instruction may cause danger. The specific safety marking is:



This symbol indicates safety instructions where non-compliance will involve risk to safe operation and personal safety and could damage the damper or train.

1.3.2 Personnel qualification and training

All personnel involved in the installation, inspection and maintenance of the damper must be qualified to carry out the work involved. If the personnel in question do not already possess the necessary knowledge and skills, appropriate training and instructions must be provided. If required the customer may commission KONI to provide applicable training.

1.3.3 Safety action

This is a summary of conditions and actions to prevent injury to personnel and damage to the environment and to equipment.

Although the damper has a strong construction, it must be treated with care. The damper must never be dropped. When working with the dampers proper protective clothing must be worn, such as steel-capped shoes, working gloves and safety glasses. During cleaning, degreasing and blow-cleaning the damper or components, the inhalation of dust or degreasing fumes must be prevented.

The dampers contain oil. Please use caution and do not spill oil on the workshop floor as this may lead to dangerous situations. During the maintenance work you should always comply with your local health, safety and environmental regulations.

2 Storage Instruction

2.1 General

When the dampers are received, they should be inspected for damage or other signs of rough handling. Any damage found should be reported to the carrier immediately.

Any shortage and / or damage must be reported immediately to KONI.

Each damper has a unique serial number which can be found on the type plate. Check that this number corresponds with the sticker on the packing.

Do not drop dampers or damage dampers during handling.

2.2 Storage Conditions

Dampers should be stored in a horizontal position under normal industrial conditions. This means a dry (maximum humidity of 60%) and ventilated room with an ambient temperature between 0 °C ~ 40°C.

Furthermore the room should be ozone-free and protected from direct sunlight.

The shelf life of hydraulic dampers is 5 years.

If the shelf life is exceeded the dampers should be functionally checked at a KONI recognised service centre before use.

2.3 Recycling and end of product life

At the end of the service life of the damper, the relevant materials and parts should be recycled or disposed of by using an environmentally acceptable method and in accordance with local regulations.

KONI dampers contain components made of various types of steel, copper, rubber, plastic and contain a certain volume of mineral oil. The paint used on the dampers is generally water based without solvents, unless otherwise specified by the customer. The damper does not contain any dangerous substances.

Damper disposal can be realised through any of the following methods:

- Sending the dampers back to KONI
- Sending the dampers to a recognised and accredited disposal company
- Disassembling the damper at your own premises and sending parts to an accredited recycling or disposal company.

2.3.1 Sending the dampers back to KONI

The KONI address and the addresses of KONI recognised service centres can be found at the KONI website www.koni.com

2.3.2 Sending the dampers to a recognized disposal company

Disposal companies often are registered at the national government.

For local company names and addresses, please refer to the associated websites.

2.3.3 Disassembling the damper at your own premises

After disassembling, the parts and the oil must be disposed of according to the local regulations which comply with the separation and recycling processes available.

3 Damper Description

3.1 General description on Application

3.1.1 Primary vertical (axle box) dampers

These dampers control the vertical movements between axle box and bogie frame, in particular the motion of bogie bouncing on the axle boxes and more important, pitching of the bogie frame in relation to the axles. The latter is induced by irregularities in the track, rail joints and crossing. This causes the one end of the bogie frame to move down while the other moves upwards. Unless this motion is controlled, it can result in a serious wheel unloading with danger of derailment.

The primary vertical damper can be provided with a mechanical lift stop which provides the possibility to lift the bogie by means of the damper. The mechanical lift stop consists of a metal ring, mounted on the piston rod above the piston in order to safeguard the piston function. The maximum allowable static load is mentioned on the outline drawing and on the nameplate of the damper.

3.1.2 Secondary Vertical Dampers

The secondary vertical dampers control the vertical movements between car body and bogie frame, such as pitching. Correct damping is essential in relation to body mass and spring stiffness. Secondary vertical dampers, if widely spaced, will assist secondary springs to control rolling oscillations of the car body.

3.1.3 Lateral Dampers

The lateral dampers are used to control lateral movements of the car body (both ends of the body moving in the same direction relative to the bogie) as well as body nosing oscillations (one end of the body moving opposite to the other). It is essential to ensure correct lateral damping as both an under and over damped secondary lateral suspension can induce excessive sway to the car body.

It is very important to carefully select the lateral damper rates in relation to the vertical and lateral suspension stiffness.

3.2 General working principles

The KONI railway damper is a hydraulic system: the resistance of the liquid flowing through valves and restrictions generates the damping force. The damper has a two-way function: damping force is generated through both inward and outward movement. In nearly all cases, the bump and rebound forces are basically equal; in other words, its characteristic is symmetrical.

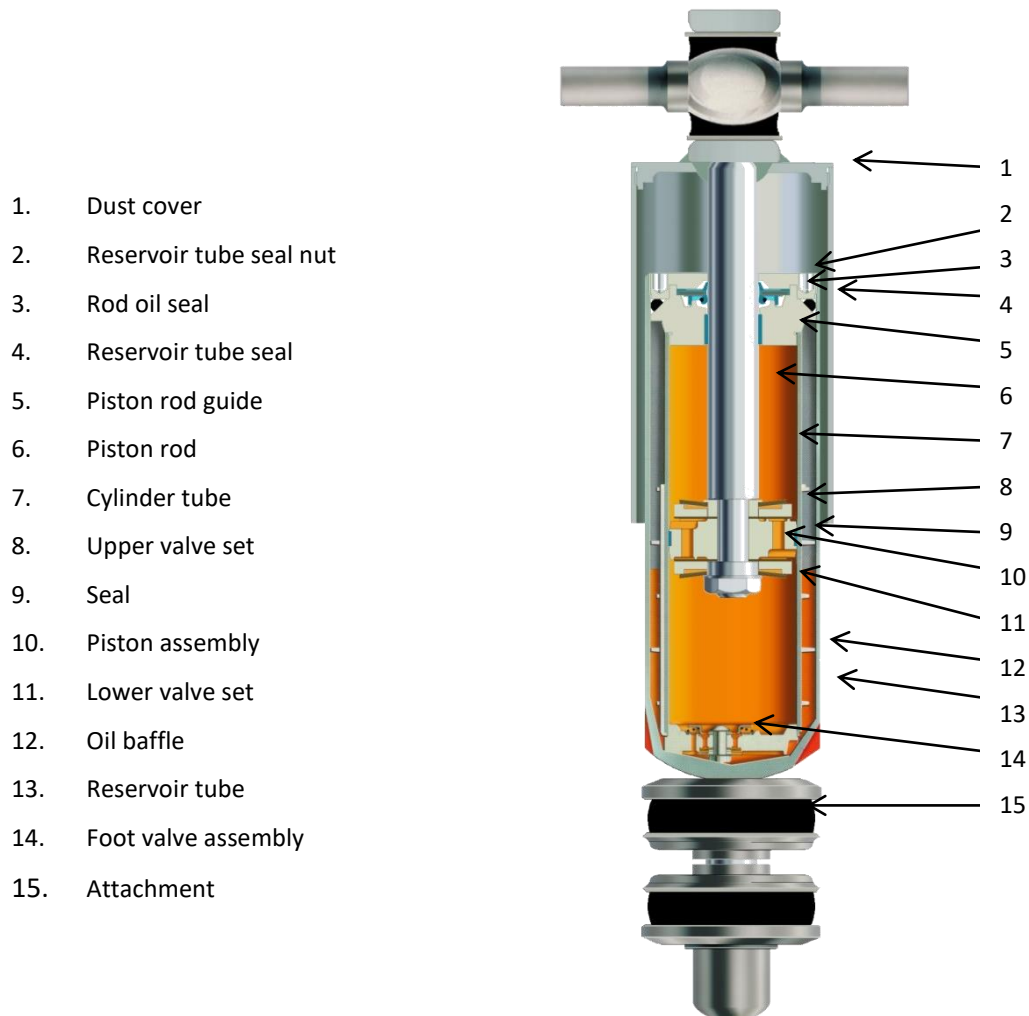
3.2.1 Performance Line type 97 dampers

3.2.1.1 General technical data

Maximum damping force	15,000 N
Nominal velocity	0.1 m/s
Maximum velocity	1.5 m/s
Maximum damping rate	100 kNs/m
Maximum allowable ambient temperature in service	-40° +80°C (-50°C with special Arctic Pack)
Reservoir diameter	70 mm
Dust cover diameter	80 mm
Piston rod diameter	20 mm
Piston diameter	50 mm

3.2.1.2 Construction

The damper is constructed from a number of main components. Please refer to the general cross sectional drawing in Figure 3-1.



1. Dust cover
2. Reservoir tube seal nut
3. Rod oil seal
4. Reservoir tube seal
5. Piston rod guide
6. Piston rod
7. Cylinder tube
8. Upper valve set
9. Seal
10. Piston assembly
11. Lower valve set
12. Oil baffle
13. Reservoir tube
14. Foot valve assembly
15. Attachment

Figure 3-1 Cross sectional drawing

Not shown in the picture is the option to equip the damper with the so-called “Arctic Pack” or “Desert-Pack”, whereby a special rubber bellow fitted around the dust cover, protecting the damper against ingress of snow/ice/sand. This can be removed easily by loosening the hose clamp.

3.2.1.3 Principle of damping

There is a two-direction oil flow through the piston. The foot valve supplies the relatively small volume difference due to the piston rod volume. The construction of the damper is such that the damping force during the extension and compression stroke is symmetrical.

During the extension stroke the damping is performed by a package of valves below the piston, while during the compression stroke the package of valves on top of the piston, in cooperation with the foot valve, create the desired damping forces.

The assembly of the piston components is shown in Figure 3-2:

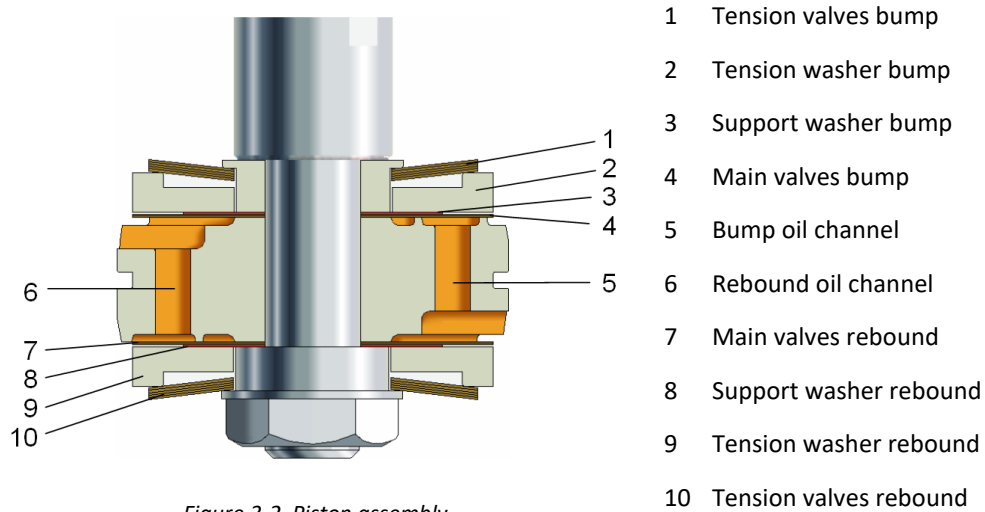


Figure 3-2 Piston assembly

By variation of the components used, a damper characteristic can be created to suit the customer requirements. This characteristic can be defined both in the linear normal operation area, as well as in the blow-off area at high damper speeds.

In the following figures, the various operating modes of the piston moving in rebound direction are shown. The operation in bump is similar and is therefore not further described.

Depending on the imposed damping speeds, the valve system of the piston operates as follows:

Low damper speeds

At low piston speeds, the damper force is created by the oil flow through an orifice between the main valve and the piston.

Please refer to Figure 3-3.

Medium damping speeds (normal damping area)

At medium piston speeds, the main valves bend around the support washer. The created damping force has a linear characteristic.

Please refer to Figure 3-4.

High damping speeds

At high piston speeds, the tension washer is pushed down against the pretension of the tension springs. This enables the main valves to open completely and by this providing for the blow-off function of the damper.

Please refer to Figure 3-5.

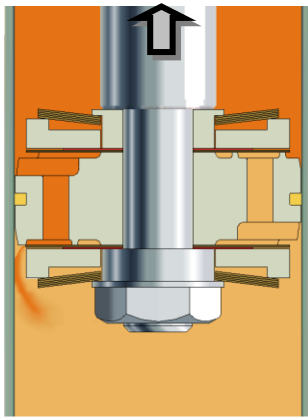


Figure 3-3 Low damping speeds

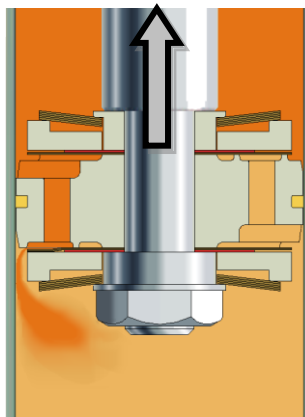


Figure 3-4 Medium damping speeds

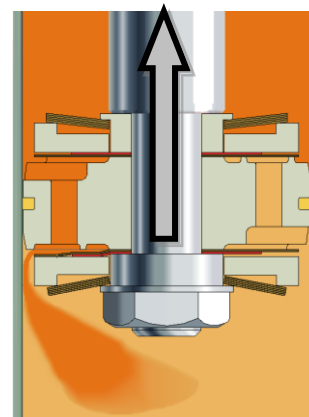


Figure 3-5 High damping speeds

3.3 Nameplate information

Every damper has a nameplate that provides information about the damper. The nameplate is located on the dust cover. In addition, the damper type number and serial number are also rolled in the reservoir tube.

When ordering spare parts, please always communicate the following damper information:

- Damper type
- Serial number
- Item numbers of the required parts

See Parts List for item numbers.

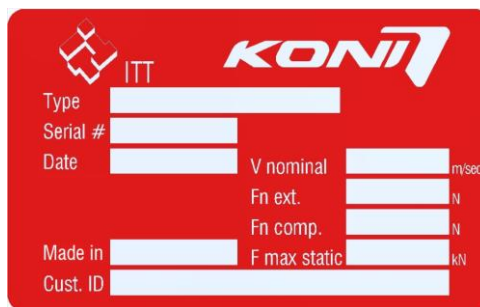


Figure 3-6 Damper nameplate

Table 3-1 Explanation of the nameplate

Nameplate field	Explanation
<i>Type</i>	Damper type
<i>Serial #</i>	Serial number of the damper
<i>Date</i>	Production date
<i>V nominal</i>	Nominal test speed
<i>Fn ext</i>	Nominal damping force in rebound at V nominal
<i>Fn comp</i>	Nominal damping force in compression at V nominal
<i>F max static</i>	Maximum static extension load (Lift Stop)
<i>Made in</i>	Indicates production location: NL – OB: Netherlands – Oud-Beijerland CZ – OS: Czech Republic – Ostrava CN – WX: China – Wuxi Or blank, with “Assembled in USA” above it for Hebron
<i>Cust. ID</i>	Customer damper identification

4 Installation

4.1 Mounting and priming Instruction

Before mounting a damper or a damper batch, take a sample and verify that the shelf life is not exceeded and the damper is in good visual condition.

Visual check points:

- Check the rubber of the attachments for cracks
- Check the damper for oil leakage and dents or other damages
- Check if the piston rod can rotate freely

Although the damper is self-priming in service; we advise to prime the dampers before mounting. Priming can be done by hand or by using a damper testing machine.

Priming instruction (using machine):

1. Mount the damper in vertical position, with the dust cover on top, at the testing machine
2. Press the piston rod to the minimum length
3. Pull the piston rod to the maximum length.
4. Repeat step 2 + 3 for 4 times.
5. Press the piston rod to the mounting length.

The procedure can also be done in horizontal position for lateral dampers. It is most effective however when done in vertical position.

Depending on the setting of the damper (force levels), it may be possible to prime by hand.

Priming instruction (by hand):

1. Position the damper in vertical position with the dust cover side up.
2. Hold damper by placing two feet over the silentbloc end and pull with two hands on upper silentbloc until damper reaches maximum length.
3. Compress damper by pushing by hand to minimum length.
4. Repeat this action 2 + 3 another 4 times.
5. Press the piston rod to the mounting length.

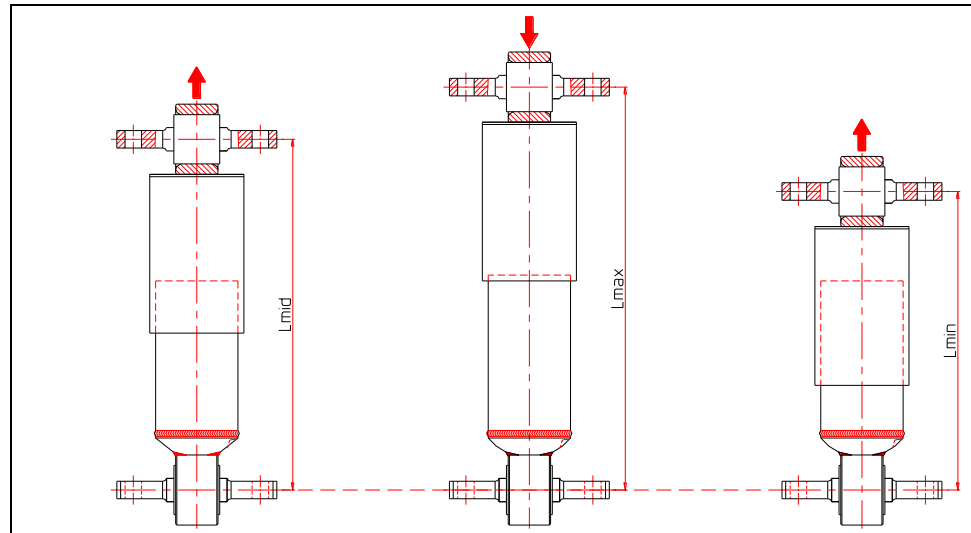


Figure 4-1 Priming positions

After these priming actions keep the dampers in vertical position until they are mounted on the bogie.

4.1.1 Primary Vertical

For the primary vertical dampers no special priming actions are required.

Mounting

The damper has to be mounted in a vertical position. The attachments must be bolted to the bracket and tightened to the right mounting torque.

Make sure that the attachments are mounted without an angular pre-stress as this could have a negative influence on the service life of these rubbers.

4.1.2 Secondary Horizontal (Lateral)

Before mounting the lateral type 97-dampers, we advise to prime the damper. After these priming actions keep the dampers in vertical position until they are mounted on the bogie.

Mounting

The damper has to be placed in a horizontal position under a positive angle. The attachments must be bolted to the bracket and tightened to the right mounting torque.

Make sure the attachments are mounted without an angular pre-stress as this could have a negative influence on the service life of these silentbloks.

The top of the damper is marked with a single deep groove, as shown in Figure 4-2, while an indication decal identifies the bottom of the damper, see Figure 4-3.

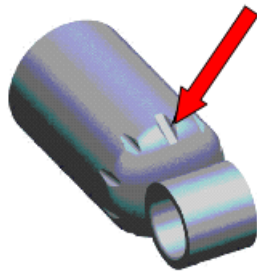


Figure 4-2: Typical top marking

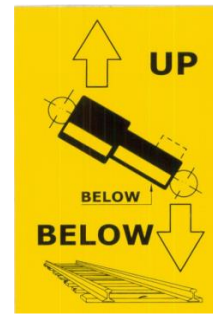


Figure 4-3: Below decal

5 Operation

5.1 Planned inspection and replacement schedule

We advise the periodical inspection and replacement of the dampers in accordance with Figure 5-1. These values are however indications and can vary by application and contractual agreement.

Frequency	Maintenance action	Chapter
Monthly	Visual inspection of the dampers	5.2
1.200.000 km Or 6 years in service	Replacement of the dampers	4

Figure 5-1; Maintenance schedule

5.2 Visual inspection

5.2.1 General

The dampers are exposed to dirt and oil from outside sources due to the operating environment. Road dirt accumulation covering the entire outer surface of the damper is normal and will have no adverse effects on the damper's performance.

5.2.2 Inspection for oil leakage

Inspection on new dampers

Sometimes new KONI railway dampers can appear to show a little oil loss during the first service period and as a result are suspected of leakage. In almost all cases this is assembly lubricant which has nothing to do with oil leakage.

Assembly lubricants (greases) are yellow, black or white in colour, and can easily be distinguished from the red hydraulic damping fluid. When the damper is new, the assembly lubricant may cause a slightly moist piston rod or damper body. If this occurs, simply wipe off the excess oil and return the damper to service. If a new damper has red oil droplets, the damper should not be installed but returned under warranty.

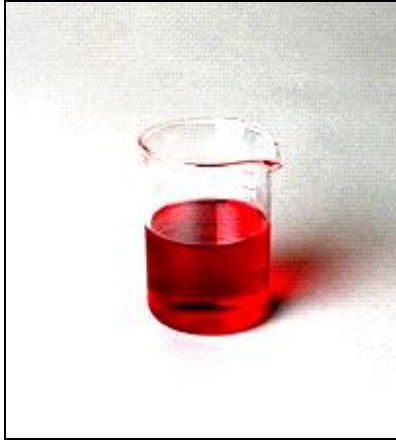


Figure 5-2; KONI damper oil Fluid-A

For a long service life, it is necessary for the rod oil seal to remain lubricated. The continuous inward and outward movement of the piston rod may cause oil “sweat” from the rod oil seal. This loss of oil can be recognized by the outside of the damper being slightly moist and dirty. However, there should not be any droplets of oil clinging to the damper. A slight oil sweating will not affect the damping force and such a damper may remain in service.

Even in the case of a real leakage, the damping forces will not be reduced abruptly, but very slowly, pending on the amount of oil that is left in the damper. However, when red droplets of oil are clearly formed on the damper body, it is advised to remove the damper from the train and replace it.

5.2.3 Roadmap for oil leakage


The following steps can be helpful to identify a real leakage problem of a suspicious damper.


- 1 Exclude an external source of oil (or another fluid)
The external source could be wheel lubrication systems, gear boxes, hydraulic brakes during servicing or when being maintained, detergents, etc.
 - a) *Check the upper damper tube (also "dust cover")*
If the upper part of the damper (with larger diameter) is polluted on its outside with fluid, it could not come from the damper itself.
 - b) *Compare with corresponding dampers of other bogies / wheelsets*
It is also an indication for external sources, when there are significant differences between comparable dampers of bogies or wheelsets (e.g. no wheel lubrication at the second axle).


When no external source can be seen, please follow the next steps.

- 2 *Clean the damper housing*
The surface of the damper has to be freed completely from all dirt/moisture. For this action the damper should be dismantled from the bogie, pulled to its max. length and then cleaned. After cleaning, the damper should be mounted to the bogie again. As an alternative action the oiled area can be marked at its lower edge on the lower damper tube, for instance with a felt pen. When the damper is then installed again and inspected after a certain period, it will be possible to see if the oiled area has been extended.
- 3 *Operate the train with cleaned damper*
- 4 *Check the cleaned damper*
Please check the damper after a period, which can last from a week up to the next maintenance period in the workshop. If the surface of the lower damper tube is now oiled and really wet over a wide range, or when even oil drops are visible (or the marked area is considerably extended) it is an indication of a leakage problem of the damper and the damper should be returned.

In addition to the above, the following criteria can also be used during the visual inspection of the dampers:

Visual appearance	Action	Picture
<p><u>Dirt</u></p> <p>Normal contamination caused by the operating environment of the dampers is harmless.</p> <p>If a damper has a damp film over the whole body (including the dust cover), it is very probable that this is the result of an outside source of oil or dirt.</p> <p>In this case the damper can remain in service.</p>	<p>None</p>	 <p><i>Figure 5-3; Dirt</i></p>

Visual appearance	Action	Picture
<p><u>Sweating</u></p> <p>For a long service life, it is necessary for the rod oil seal to remain lubricated. The continuous inward and outward movement of the piston rod may cause oil “sweat” from the rod oil seal.</p> <p>This loss of oil can be recognized by the outside of the damper being slightly moist and dirty. However, there should not be any droplets of oil clinging to the damper.</p> <p>A slight oil sweating will not affect the damping force and this damper may remain in service.</p>	<p>None</p>	 <p><i>Figure 5-4; Sweating</i></p>

Visual appearance	Action	Picture
<p><u>Oil drops</u></p> <p>A true oil leakage becomes apparent by a damp surface, which usually covers a large part of the reservoir tube.</p> <p>Isolated oil drop formation is possible.</p> <p>When wiping the damper with a paper cloth, clear oil stains are visible.</p>	<p>Replacement / Overhaul</p>	 <p><i>Figure 5-5; Leakage</i></p>

5.2.4 Attachments

It is important to visually check the condition of all rubber attachments. Worn or deteriorated rubber parts may adversely affect the damper's performance and cause internal damage to the damper.

While inspecting the bushings, it is advised to examine the welds between the eye and the damper body. The welds should show no evidence of cracking or deterioration.

5.2.4.1 Pin attachments

The pin attachments do not have to be removed in the following cases

Small damages to the surface of the rubber are not affecting the service life.

The pin attachment should be removed in the following cases

Pin rubbers should be replaced when the rubber develops a cut or a split. Furthermore the centring seats should be free of any damage.

5.2.4.2 Rubber bushings

The rubber bushings do not have to be removed in the following cases

Small damages to the surface of the rubber are not affecting the service life.

The rubber bushing should be removed in the following cases

Rubber bushings should be replaced when the rubber develops a cut or a split. Special attention should be paid to the position of the bushings. They should never be further from the centre of the eye than a maximum of 5 mm (Figure 5-6).

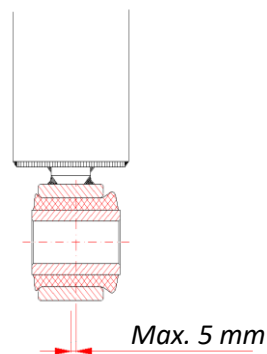


Figure 5-6; Bushing position

5.2.4.3 Silent blocks

The silentbloc do not have to be removed in the following cases

During service of the damper the rubber attachments are subject to wear. The wear is normal and if the rubber part has only developed small cracks on the surface, no action is required. The function of the silentbloc is secured mainly by the internal bonding of the rubber to the metal part. Small damages to the surface of the rubber are not affecting the service life. Please refer to below pictures.

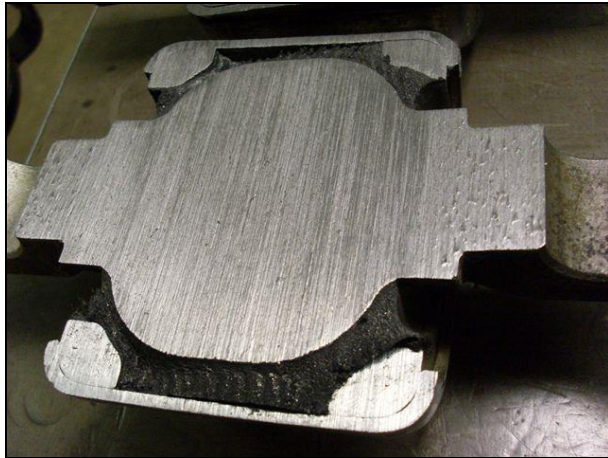


Figure 5-7; Bonding of the internal rubber



Figure 5-8; Acceptable surface cracks

The silentbloc should be removed in the following cases

Silentblocs should be replaced when the rubber develops a cut or a split. If the silent bloc has only developed small cracks on the surface of the rubber, no action is necessary.

If the rubber is deteriorated or the pin is loose in the rubber, the damper must be removed and the silentbloc replaced.



Figure 5-9; Examples of worn bushings

Guideline for replacement of silentblocs

Phenomenon	Criteria		Action
Cracks in rubber	Depth of crack	Max. 8mm	Replace attachment
	Surface cracks	Only a visual issue	No action required
De-bonding of metal and rubber	De-bonding	Max 10% of the total rubber	Replace attachment
Rubber deterioration	Pulverized rubber	Max. 10% of the total rubber	Replace attachment
Creeping of rubber	Bulging outwards	Max 12 mm from origin	Replace attachment
	Loose collar	Only a cosmetic issue	No action required

5.3 Replacement of attachments

5.3.1 Pin attachment

In case of pin attachments the rubbers or centring seats can simply be replaced without the requirement of special tools, see Figure 5-10.

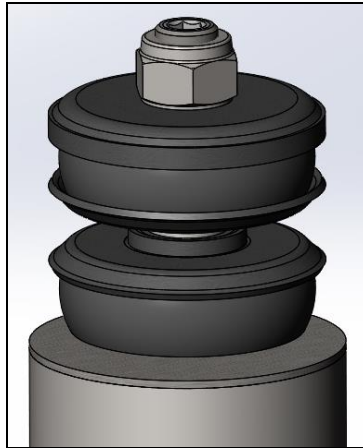


Figure 5-10; Pin attachment

5.3.2 Rubber bushing

5.3.2.1 Rubber block with a separate bush or trunnion

1. Remove the old rubber with bush or trunnion and clean the eye.
2. Immerse the new rubber in hot soapy water of about 60°C.
3. Place the eye on a suitable tool (Figure 5-11/1).
4. Place the rubber over the eye and press it in. If necessary, a plastic or wooden hammer can be used. The rubber must be pressed in so far that the collar of the rubber projects above the bottom side of the eye (Figure 5-11/2).
5. Rotate the damper 180° around the longitudinal axis and place the eye back on the tool (Figure 5-11/3).
6. Heat the assembly cone and the bush or trunnion to be mounted to about 60°C. Place the assembly cone in the rubber and the bush on the cone (Figure 5-11/4) or place the trunnion in the rubber and the assembly cone on the trunnion (Figure 5-11/5).
7. Press the bush or trunnion into the rubber as quickly as possible.
8. When the rubber has been pressed through the eye too far, the damper must be rotated to press it back in the centre.

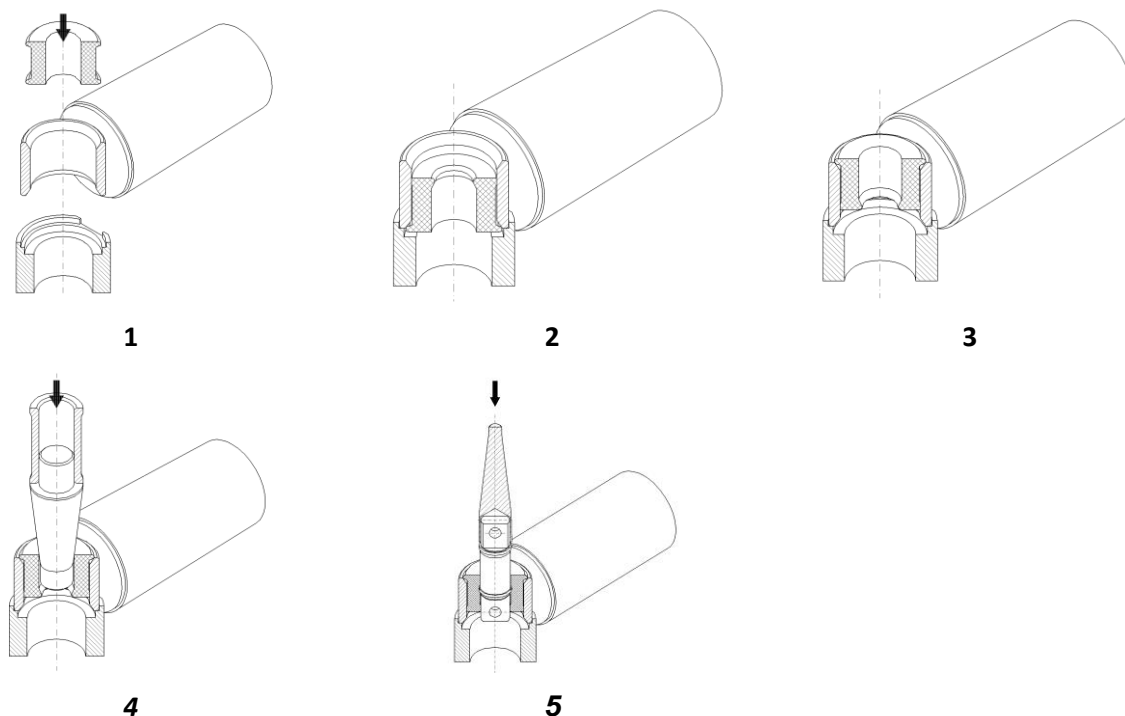


Figure 5-11 Replacement of rubber blocks

5.3.2.2 Rubber bloc with a vulcanized bush or trunnion

1. Remove the old rubber bloc and clean and degrease the eye and the rubber bloc.
2. Place the damper eye on a suitable tool (Figure 5-12/1).
3. Apply locking agent Loctite 601 to the inside of the eye and the outside of the rubber bloc.
4. Place the guiding tool on the eye (Figure 5-12/1)
5. Place the rubber bloc into the guiding tool (Figure 5-12/2)
6. Press the rubber bloc into the eye and press it in about 5 mm too far.
7. Rotate the damper 180° around its longitudinal axis and press the rubber bloc back into the middle.



Make sure you always press on the metal part of the bush.

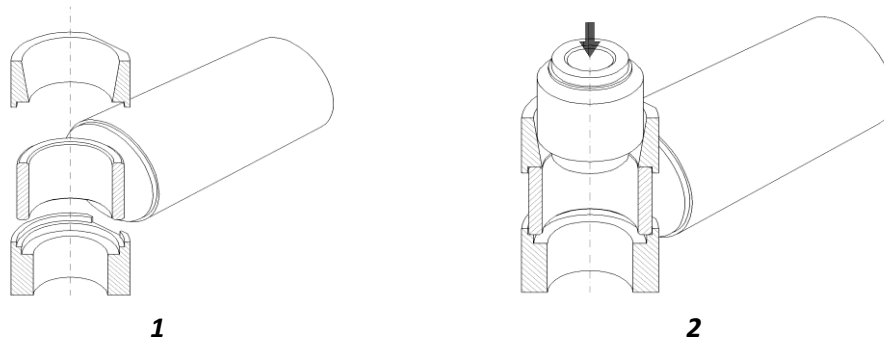


Figure 5-12 Replacement of vulcanized rubber blocks

5.3.3 Silentblocs

In case of a worn silentbloc, the complete part has to be removed from the damper eye. Since these attachments are locked in the eye by means of a press fitting and/or Loctite, they can only be removed or assembled by means of a tool set and a press (Figure 5-13, Figure 5-14).



Figure 5-13; Pressing adapter set

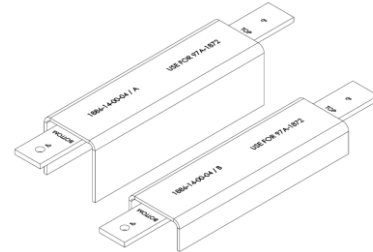


Figure 5-14; Auxiliary tooling set

Silentbloc removal

1. Place the eye of the damper on the big support tool.
2. Now place the smaller tool with the smaller diameter down, on the metal part of the silentbloc, and apply pressure.(Figure 5-15/1)

Be careful only to apply pressure on the metal part of the silentbloc, and not on the eye of the damper.

3. The block will now be pressed out of the eye.

Silentbloc assembly

1. Place the eye of the damper on the big support tool.
2. Apply Loctite 601 to the attachment and the eye.

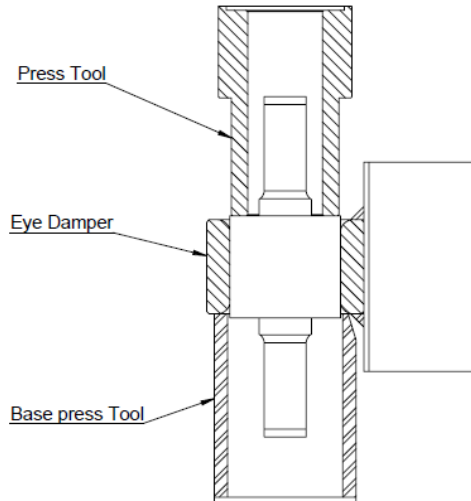
Place the silentbloc onto the eye, and use the high version of the auxiliary tooling to verify the orientation of the silentbloc, according to the damper (Figure 5-16)

3. Now place the smaller tool with the bigger diameter down, on the metal part of the silentbloc, and apply pressure. (Figure 5-15/2)

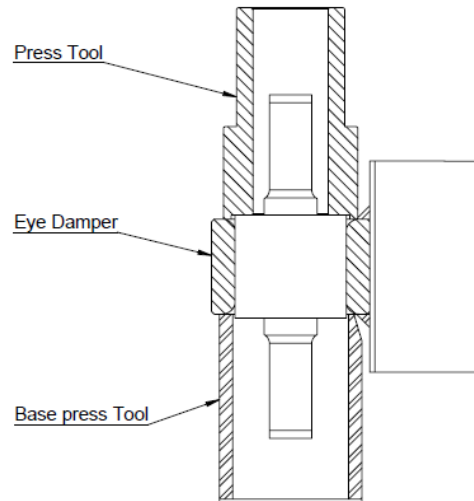
Be careful only to put pressure on the metal part of the silentbloc.

4. The silentbloc will now be pressed into the eye.

Use the low auxiliary tool to check the angle after pressing it in. (Figure 5-17)



1 - Pressing out silentbloc



2 - Pressing in the silentbloc

Figure 5-15; Replacement of silentblocs

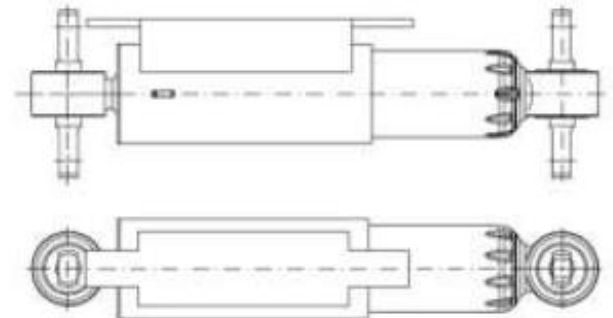
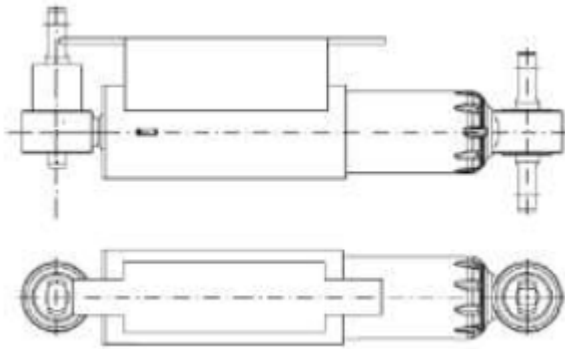


Figure 5-16: Auxiliary tool "High"

Figure 5-17: Auxiliary tool "Low"



INSTRUCTION MANUAL

Endurance Line type 02

Installation, Operation and Maintenance

Document Number: 0100 78 00 94, rev -

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1 Safety precautions

1.1 General

KONI's hydraulic railway dampers are designed, developed and manufactured with state-of-the-art technologies in modern facilities. Our dampers are produced with great care and commitment to continuous quality control, utilising sophisticated quality techniques.

These instructions are intended to facilitate familiarization with the product and its use. Operating the product in compliance with these instructions is important to help ensure reliability in service and avoid risks. The instructions may not take into account local regulations; ensure such regulations are observed by all, including those installing the product. Always follow your company's safety requirements and applicable safety and health laws/regulations.



These instructions must be read prior to installing, operating and maintaining the dampers in any region worldwide. The dampers must not be put into service until all the conditions relating to safety, noted in the instructions, have been met.

Failure to follow and apply the relevant user instructions is considered to be misuse.

Personal injury, product damage, delay or failures caused by misuse are not covered by the KONI warranty.

1.2 Copyright

All rights reserved. No part of these instructions may be reproduced, stored in a retrieval system or transmitted in any form or by any means without prior written permission of KONI.

1.3 Safety

1.3.1 Marking

These user instructions contain a specific safety marking where non-observance of an instruction may cause danger. The specific safety marking is:



This symbol indicates safety instructions where non-compliance will involve risk to safe operation and personal safety and could damage the damper or train.

1.3.2 Personnel qualification and training

All personnel involved in the installation, inspection and maintenance of the damper must be qualified to carry out the work involved. If the personnel in question do not already possess the necessary knowledge and skills, appropriate training and instructions must be provided. If required the customer may commission KONI to provide applicable training.

1.3.3 Safety action

This is a summary of conditions and actions to prevent injury to personnel and damage to the environment and to equipment.

Although the damper has a strong construction, it must be treated with care. The damper must never be dropped. When working with the dampers proper protective clothing must be worn, such as steel-capped shoes, working gloves and safety glasses. During cleaning, degreasing and blow-cleaning the damper or components, the inhalation of dust or degreasing fumes must be prevented.

The dampers contain oil. Please use caution and do not spill oil on the workshop floor as this may lead to dangerous situations. During the maintenance work you should always comply with your local health, safety and environmental regulations.

1.4 Workshop

The major issue affecting damper performance and longevity is dirt inside the damper. It is therefore very important to prevent dirt entering the damper during re-assembly of the damper. For this reason it is advised that the workshop consists of two separate sections:

- A section where the damper is disassembled and its components are cleaned
- A clean section where only the assembly takes place

2 Storage Instruction

2.1 General

When the dampers are received, they should be inspected for damage or other signs of rough handling. Any damage found should be reported to the carrier immediately.

Any shortage and / or damage must be reported immediately to KONI.

Each damper has a unique serial number which can be found on the type plate. Check that this number corresponds with the sticker on the packing.

Do not drop dampers or damage dampers during handling.

2.2 Storage Conditions

Dampers should be stored in a horizontal position under normal industrial conditions. This means a dry (maximum humidity of 60%) and ventilated room with an ambient temperature between 0 °C ~ 40°C.

Furthermore the room should be ozone-free and protected from direct sunlight.

The shelf life of hydraulic dampers is 5 years.

If the shelf life is exceeded the dampers should be functionally checked at a KONI recognised service centre before use.

2.3 Recycling and end of product life

At the end of the service life of the damper, the relevant materials and parts should be recycled or disposed of by using an environmentally acceptable method and in accordance with local regulations.

KONI dampers contain components made of various types of steel, copper, rubber, plastic and contain a certain volume of mineral oil. The paint used on the dampers is generally water based without solvents, unless otherwise specified by the customer. The damper does not contain any dangerous substances.

Damper disposal can be realised as follows:

- Sending the dampers back to KONI
- Sending the dampers to a recognised and accredited disposal company
- Disassembling the damper at your own premises and sending parts to an accredited recycling or disposal company

2.3.1 Sending the dampers back to KONI

The KONI address and the addresses of KONI recognised service centres can be found at the KONI website www.KONI.com

2.3.2 Sending the dampers to a recognized disposal company

Disposal companies often are registered at the national government.

For local company names and addresses, please refer to the associated websites.

2.3.3 Disassembling the damper at your own premises

After disassembling, the parts and the oil must be disposed of according to the local regulations which comply with the separation and recycling processes available.

3 Damper description

3.1 General description on application

3.1.1 Primary vertical (axle box) dampers

These dampers control the vertical movements between axle box and bogie frame, in particular the motion of bogie bouncing on the axle boxes and more important, pitching of the bogie frame in relation to the axles. The latter is induced by irregularities in the track, rail joints and crossing. This causes the one end of the bogie frame to move down while the other moves upwards. Unless this motion is controlled, it can result in a serious wheel unloading with danger of derailment.

The primary vertical damper can be provided with a mechanical lift stop which provides the possibility to lift the bogie by means of the damper. The mechanical lift stop consists of a metal ring, mounted on the piston rod above the piston in order to safeguard the piston function. The maximum allowable static load is mentioned on the outline drawing and on the nameplate of the damper.

3.1.2 Secondary vertical dampers

The secondary vertical dampers control the vertical movements between car body and bogie frame, such as pitching. Correct damping is essential in relation to body mass and spring stiffness. Secondary vertical dampers, if widely spaced, will assist secondary springs to control rolling oscillations of the car body.

3.1.3 Secondary horizontal (lateral) dampers

The lateral dampers are used to control lateral movements of the car body (both ends of the body moving in the same direction relative to the bogie) as well as body nosing oscillations (one end of the body moving opposite to the other). It is essential to ensure correct lateral damping as both an under and over damped secondary lateral suspension can induce excessive sway to the car body.

It is very important to carefully select the lateral damper rates in relation to the vertical and lateral suspension stiffness.

3.1.4 Yaw dampers

Yaw dampers are special dampers designed to control small amplitude sinusoidal rotation movements. Without this damping the rotation of the bogie around the centre pivot of the bogie may become excessive. These hunting movements result in discomfort for the passengers and in case of high-speed trains in risk of derailment.

Yaw dampers are usually positioned longitudinally to control rotation of the bogie without influencing lateral damping. The damping rate must be carefully chosen. Excessive damping would result in too much resistance to bogie rotation with consequential risk of derailment, excessive wheel wear and noise.

3.2 General working principles

The KONI railway damper is a hydraulic system: the resistance of the liquid flowing through valves and restrictions generates the damping force. The damper has a two-way function: damping force is generated through both inward and outward movement. In nearly all cases, the compression and extension forces are basically equal; in other words, its characteristic is symmetrical.

3.2.1 Endurance Line type 02 dampers

3.2.1.1 General Technical Data

Maximum damping force	15,000 N
Nominal velocity	0.1 m/s
Maximum velocity	1.0 m/s
Maximum damping rate	170 kNs/m
Maximum allowable ambient temperature in service	-40°...+80°C (-50°C with special Arctic Pack)
Reservoir diameter	89 mm
Dust cover diameter	102 mm
Piston rod diameter	35 mm
Piston diameter	50 mm

3.2.1.2 Construction

The damper is constructed from a number of main components. Please refer to the general cross sectional drawing in Figure 3-1.

1. Dust cover; Protects the piston rod and bellow against flying particles from outside.
2. Dust bellow; Gives extra protection to the piston rod and the rod seals from penetrating dirt.
3. Wiper ring; Removes dirt film from the rod surface during the piston rod movements.
4. Piston rod oil seal; long-life piston rod oil seal, providing excellent fluid sealing while reducing the friction on the piston rod, even after long use.
5. Piston rod guide; Made from special perlitic cast-iron for minimal wear. The precision-ground working surfaces ensure maximum life. The oil pressure relief ports in the guide to the reservoir ensure that the rod oil seals are never overloaded by pressure.
6. Adjustable damping valve; By turning the adjusting screw the compression and extension forces can be altered. The pressure on the spring-loaded valve is changed to offer a higher or lower resistance to the oil as it flows out of the cylinder, through the damping valves, into the reservoir.
7. Synthetic (non-metallic) ring in the guide; With this synthetic bearing ring there is no metal-to-metal contact between piston rod and guide, thus further reducing wear.
8. Cylinder; Made from precision steel. Special attention is paid to the roundness and the superfinish of the bore.
9. Piston; Made from special perlitic cast-iron. Around the piston a synthetic (non-metallic) ring is fitted, ensuring there is no metal-to-metal contact between piston rod and cylinder, thus further reducing wear.
10. Non-return valve; Special flat valves are used in both bottom valve and piston, ensuring a perfect seal.
11. Oil Reservoir; Ample capacity for adequate oil reserve, ensuring the proper functioning of the damper and lubrication of the oil seals.

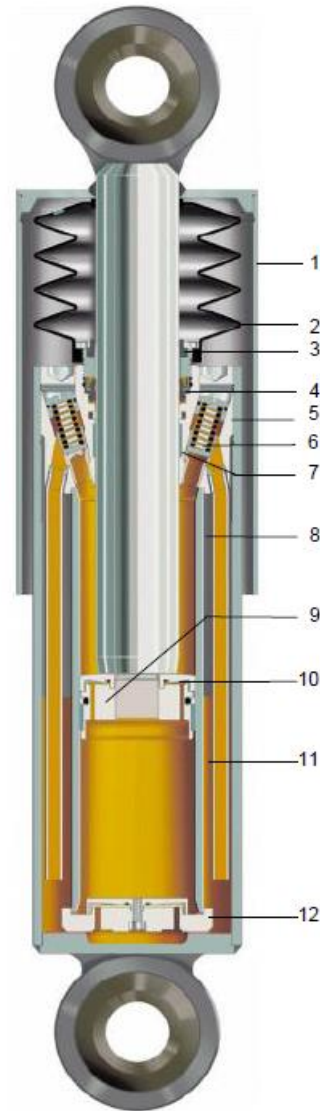


Figure 3-1 Cross sectional drawing

12. Bottom valve assembly; Machined from solid steel, the body is provided with large oil-flow ports, to ensure efficient damper functioning at the high damping velocities required in today's railroad environment.

Not shown in the picture; when the damper is equipped with the so-called "Arctic Pack" or "Desert-Pack", whereby a special rubber bellow is fitted around the dust cover, protecting the damper against ingress of snow/ice/sand. This can be removed easily by loosening the hose clamp.

3.2.1.3 Principle of damping

This damper type has a circulating oil principle (Figure 3-2). On the extension stroke the non-return valve in the piston is closed and the oil above the piston is forced through the damping valves into the reservoir. At the same time, because of the increased volume below the piston, oil is forced through the non-return bottom valve.

During the compression stroke the non-return bottom valve is closed and because the piston is forced down in the cylinder, oil flows through the now open non-return valve in the piston. The oil displaced by the piston rod is forced through the damping valves. Therefore during the compression stroke the oil pressures above and below the piston are equal.

It is noteworthy that the oil flows, during both strokes, constantly in one direction. Any air bubbles in the cylinder, formed during transport, are therefore dispersed in a very short time.

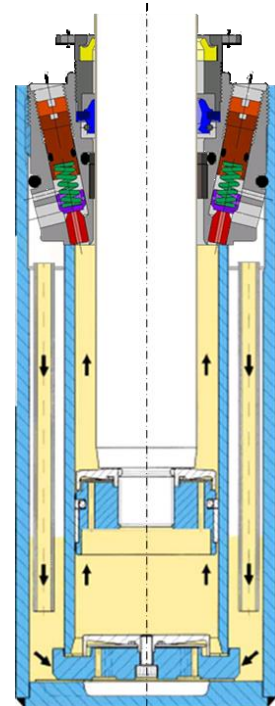


Figure 3-2 Circulating oil principle

3.2.1.4 Cooling

The circulating oil principle of the KONI dampers provides an excellent heat transfer between damper and the surrounding air, allowing a high maximum environmental temperature. This unique construction makes the KONI dampers especially suitable for warm climates (Figure 3-3).

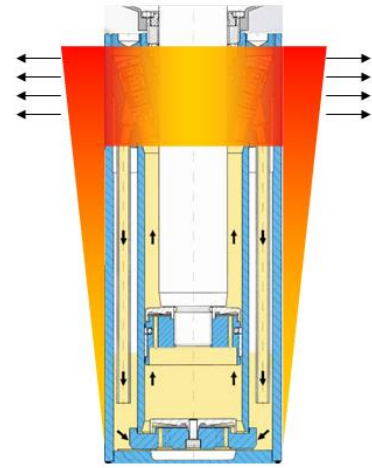


Figure 3-3; Heat transfer

3.3 Nameplate information

Every damper has a nameplate that provides information about the damper. The nameplate is located on the dust cover. In addition, the damper type number and serial number are also rolled in the reservoir tube.

When ordering spare parts, please always communicate the following damper information:

- Damper type
- Serial number
- Item numbers of the required parts

See Parts List for item numbers.

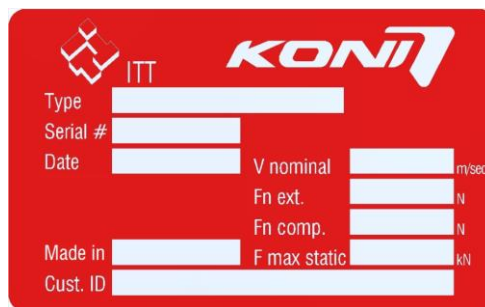


Figure 3-4; Nameplate

Table 3-1; Explanation of the nameplate

Nameplate field	Explanation	Example
Type	Damper type	02R 1201
Serial #	Serial number of the damper	70025
Date	Production date	2016 - 07
V nominal	Nominal test speed	0.1
Fn ext	Nominal damping force in extension at V nominal	7550
Fn comp	Nominal damping force in compression at V nominal	7550
F max static	Maximum static extension load (Lift Stop)	15
Made in	Indicates production location:	NL – OB: Netherlands – Oud-Beijerland CZ – OS: Czech Republic – Ostrava CN – WX: China – Wuxi Or blank, with “Assembled in USA” above it for Hebron
Cust. ID	Customer damper identification	12552

4 Installation

4.1 Mounting and priming instruction

Before mounting a damper or a damper batch, take a sample and verify that the shelf-life is not exceeded and the damper is in good visual condition.

Visual check points:

- Check the rubber of the attachments for cracks
- Check the damper for oil leakage and dents or other damages
- Check if the piston rod can rotate freely

Although the damper is self-priming in service; KONI advises to prime the dampers before mounting, this is especially advised for lateral dampers. Priming can be done by hand (when the damper has a “light” setting), or by using a damper test machine.

Priming instruction (using machine):

1. In vertical position, press the piston rod to the minimum length
2. For horizontal dampers: In horizontal position, pull the piston rod to the maximum length
3. For vertical dampers: In vertical position, pull the piston rod to the maximum length
4. Press the piston rod to the mounting length

Depending on the setting of the damper (force levels), it may be possible to prime by hand.

Priming instruction (by hand):

1. Position the damper in vertical position with the dust cover side up
2. Hold damper by placing two feet over the silentbloc end and pull with two hands on upper silentbloc until damper reaches maximum length
3. Compress damper by pushing by hand to minimum length
4. Repeat this action another 4 times
5. Press the piston rod to the mounting length

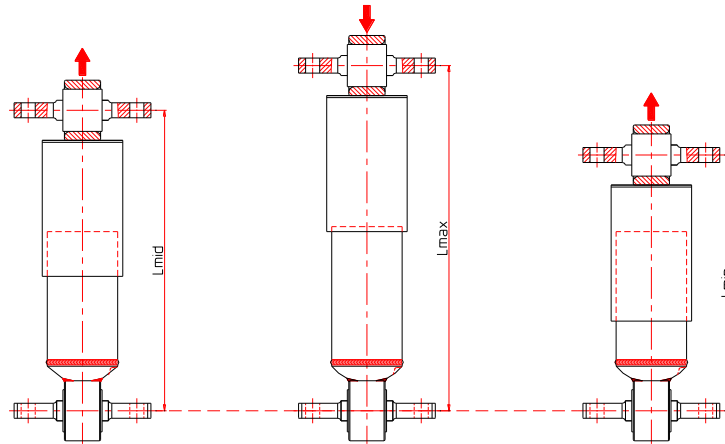


Figure 4-1 Priming positions

After these priming actions keep the dampers in vertical position until they are mounted on the bogie.

4.1.1 Primary vertical

For the primary vertical dampers no special priming actions are required.

Mounting

The primary vertical dampers are mounted vertically between the mounting brackets with the dust cover facing up.

The maximum allowable angle from the vertical is 45°.

Pin Attachment

The pin attachment must be tightened to the right mounting torque. The correct mounting torque is specified on the damper drawing (OFF drawing).

Silentbloc

The silentblocs must be bolted to the bracket and tightened at the right mounting torque. They must be mounted without any angular pre-tension as this could have a negative influence on the service life of these blocks.

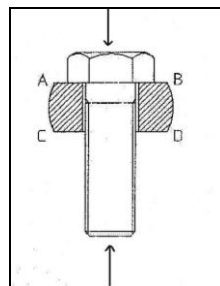


Figure 4-2; Mounting Advice

In order to avoid shearing forces in the mounting bolt, KONI advises to mount the bolt in longitudinal direction of the damper forces (Figure 4-2).

4.1.2 Secondary horizontal (lateral) and yaw dampers

The lateral and yaw dampers are mounted horizontally between the mounting brackets.

The dampers have a provision which prevents air from entering the cylinder. For this reason it is imperative that the dampers are mounted in the right position. The dampers are marked in the underside of the reservoir with the text “BELOW”, and clearly marked with a decal. In addition, the dampers also have a hard marking pressed into the reservoir. The location and shape can differ between individual damper types (see Figure 4-3), so always refer to the applicable damper drawing to see the details of the marking.

In some cases an extra air chamber (dome) is built on top of the damper. In this case the damper must be mounted with the dome facing up (Figure 4-4).

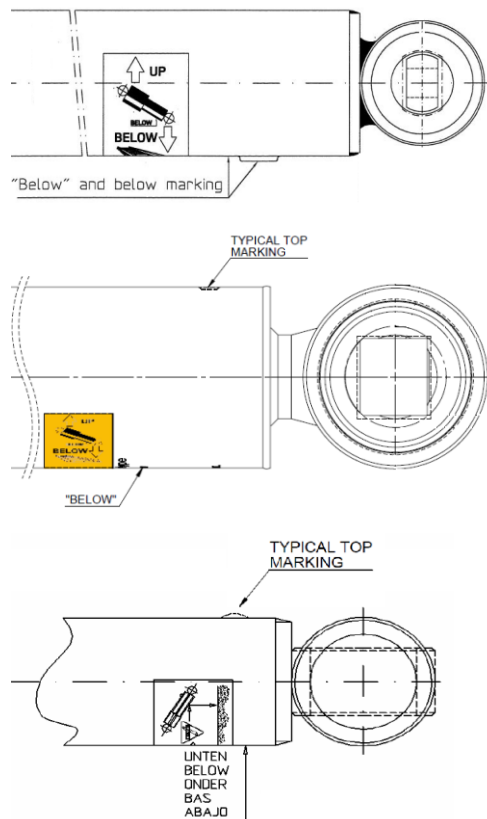


Figure 4-3; Different orientation markings

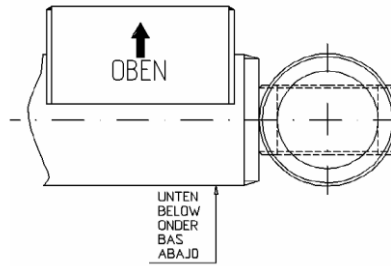


Figure 4-4; With dome

Furthermore the dampers must be mounted under a positive angle of 1° with the dust cover at the highest position (Figure 4-5).

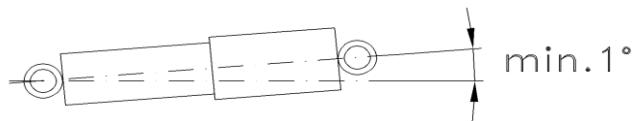


Figure 4-5; Mounting position

Pin Attachment

The pin attachment must be tightened to the right mounting torque. The correct mounting torque is specified on the damper drawing (OFF drawing).

Lateral dampers with a pin attachment are quite often provided with extra pins on the centring seat (chassis) to prevent the possibility of rotating of the damper

Silentbloc

The silentblocs must be bolted to the bracket and tightened with the right mounting torque. They must be mounted without any angular pre-tension as this could have a negative influence on the service life of these blocks.

In order to avoid shearing forces in the mounting bolt, KONI advises to mount the bolt in longitudinal direction of the damper forces (Figure 4-6).

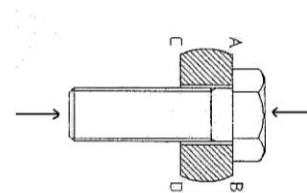


Figure 4-6; Mounting Advice

5 Operation

5.1 Planned inspection and overhaul/replacement schedule

KONI advises the periodical inspection and replacement of the dampers in accordance with Figure 5-1. These values are however indications and can vary by application and contractual agreement.

Frequency	Maintenance action	Chapter
Monthly	Visual inspection of the dampers	5.2
1.200.000 km Or 6 years in service	Overhaul or replacement of the dampers	6

Figure 5-1; Maintenance schedule

5.2 Visual inspection

5.2.1 General

The dampers are exposed to dirt and oil from outside sources due to the operating environment. Road dirt accumulation covering the entire outer surface of the damper is normal and will have no adverse effects on the damper's performance.

5.2.2 Inspection for oil leakage

Inspection on new dampers

Sometimes new KONI railway dampers can appear to show a little oil loss during the first service period and as a result are suspected of leakage. In almost all cases this is assembly lube which has nothing to do with oil leakage.

Assembly lubricants (greases) are yellow or black in colour, and can easily be distinguished from the red hydraulic damping fluid. When the damper is new, the assembly lube may cause a slightly moist piston rod or damper body. If this occurs, simply wipe off the excess oil and return the damper to service. If a new damper has red oil droplets, the damper should not be installed but returned under warranty.

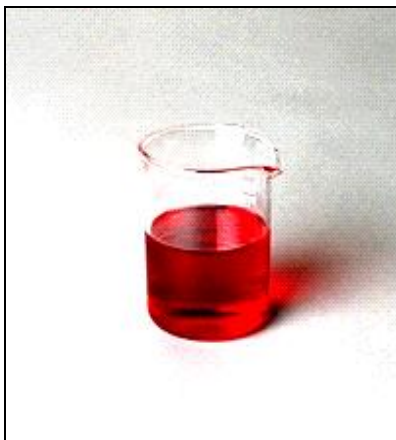


Figure 5-2; KONI damper oil Fluid-A

For a long service life, it is necessary for the rod oil seal to remain lubricated. The continuous inward and outward movement of the piston rod may cause oil “sweat” from the rod oil seal. This loss of oil can be recognized by the outside of the damper being slightly moist and dirty. However, there should not be any droplets of oil clinging to the damper. A slight oil sweating will not affect the damping force and such a damper may remain in service.

Even in the case of a real leakage, the damping forces will not be reduced abruptly, but very slowly, pending on the amount of oil that is left in the damper. However, when red droplets of oil are clearly formed on the damper body, it is advised to remove the damper from the train and replace it.

5.2.3 Roadmap for oil leakage

The following steps can be helpful to identify a real leakage problem of a suspicious damper.

1 *Exclude an external source of oil (or another fluid)*

The external source could be wheel lubrication systems, gear boxes, hydraulic brakes during servicing or when being maintained, detergents, etc.

a) *Check the upper damper tube (also "dust cover")*

If the upper part of the damper (with larger diameter) is polluted on its outside with fluid, it could not come from the damper itself.

b) *Compare with corresponding dampers of other bogies / wheelsets*

It is also an indication for external sources, when there are significant differences between comparable dampers of bogies or wheelsets (e.g. no wheel lubrication at the second axle).

When no external source can be seen, please follow the next steps.

2 *Clean the damper housing*

The surface of the damper has to be freed completely from all dirt/moisture. For this action the damper should be dismantled from the bogie, pulled to its max. length and then cleaned. After cleaning, the damper should be mounted to the bogie again.


As an alternative action the oiled area can be marked at its lower edge on the lower damper tube, for instance with a felt pen. When the damper is then installed again and inspected after a certain period, it will be possible to see if the oiled area has been extended.


3 *Operate the train with cleaned damper*


4 *Check the cleaned damper*

Please check the damper after a period, which can last from a week up to the next maintenance period in the workshop. If the surface of the lower damper tube is now oiled and really wet over a wide range, or when even oil drops are visible (or the marked area is considerably extended) it is an indication for a leakage problem of the damper and the damper should be returned.

In addition to the above, the following criteria can also be used during the visual inspection of the dampers:

Visual appearance	Action	Picture
<p><u>Dirt</u></p> <p>Normal contamination caused by the operating environment of the dampers is harmless.</p> <p>If a damper has a damp film over the whole body (including the dust cover), it is very probable that this is the result of an outside source of oil or dirt. In this case the damper can remain in service.</p>	<p>None</p>	 <p><i>Figure 5-3; Dirt</i></p>

Visual appearance	Action	Picture
<p><u>Sweating</u></p> <p>For a long service life, it is necessary for the rod oil seal to remain lubricated. The continuous inward and outward movement of the piston rod may cause oil “sweat” from the rod oil seal.</p> <p>This loss of oil can be recognized by the outside of the damper being slightly moist and dirty. However, there should not be any droplets of oil clinging to the damper.</p> <p>A slight oil sweating will not affect the damping force and this damper may remain in service.</p>	<p>None</p>	 <p><i>Figure 5-4; Sweating</i></p>

Visual appearance	Action	Picture
<p><u>Oil drops</u></p> <p>An oil leakage becomes apparent by a damp surface, which usually covers a large part of the reservoir tube.</p> <p>Isolated oil drop formation is possible.</p> <p>When wiping the damper with a paper cloth, clear oil stains are visible.</p>	<p>Replacement / Overhaul</p>	 <p><i>Figure 5-5; Leakage</i></p>

5.2.4 Attachments

It is important to visually check the condition of all rubber attachments. Worn or deteriorated rubber parts may adversely affect the damper's performance and cause internal damage to the damper.

While inspecting the bushings, it is advised to examine the welds between the eye and the damper body. The welds should show no evidence of cracking or deterioration.

5.2.4.1 Pin attachments

The pin attachments do not have to be removed in the following cases

Small damages to the surface of the rubber are not affecting the service life.

The pin attachment should be removed in the following cases

Pin rubbers should be replaced when the rubber develops a cut or a split. Furthermore the centring seats should be free of any damage.

5.2.4.2 Rubber bushings

The rubber bushings do not have to be removed in the following cases

Small damages to the surface of the rubber are not affecting the service life.

The rubber bushing should be removed in the following cases

Rubber bushings should be replaced when the rubber develops a cut or a split. Special attention should be paid to the position of the bushings. They should never be further from the centre of the eye than a maximum of 5 mm (Figure 5-1).

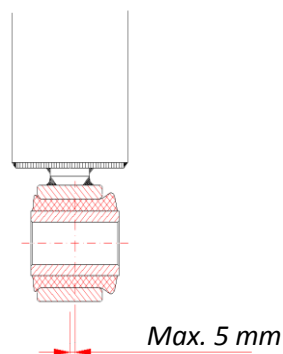


Figure 5-1; Bushing position

5.2.4.3 Silentblocs

The silentblocs do not have to be removed in the following cases

During service of the damper the rubber attachments are subject to wear. The wear is normal and if the rubber part has only developed small cracks on the surface, no action is required. The function of the silentbloc is secured mainly by the internal bonding of the rubber to the metal part. Small damages to the surface of the rubber are not affecting the service life. Please refer to below pictures.

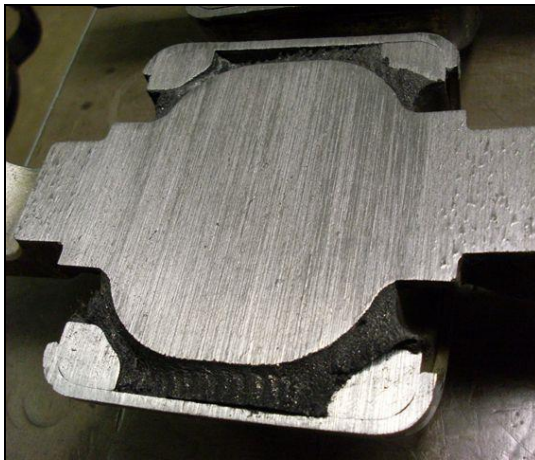


Figure 5-2; Bonding of the internal rubber



Figure 5-3; Acceptable surface cracks

The silentbloc should be removed in the following cases

Silentblocs should be replaced when the rubber develops a cut or a split. If the silent bloc has only developed small cracks on the surface of the rubber, no action is necessary.

If the rubber is deteriorated or the pin is loose in the rubber, the damper must be removed and the silentbloc replaced.

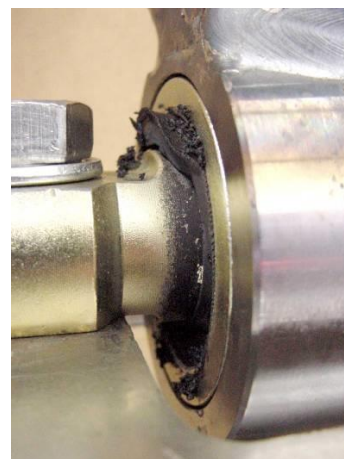


Figure 5-4; Examples of worn bushings

Guideline for replacement of silentblocs

Phenomenon	Criteria		Action
Cracks in rubber	Depth of crack	Max. 8mm	Replace attachment
	Surface cracks	Only a visual issue	No action required
De-bonding of metal and rubber	De-bonding	Max 10% of the total rubber	Replace attachment
Rubber deterioration	Pulverized rubber	Max. 10% of the total rubber	Replace attachment
Creeping of rubber	Loose collar	Only a cosmetic issue	No action required

5.3 Replacement of attachments

5.3.1 Pin attachment

In case of pin attachments the rubbers or centring seats can simply be replaced without the requirement of special tools, see Figure 5-5.

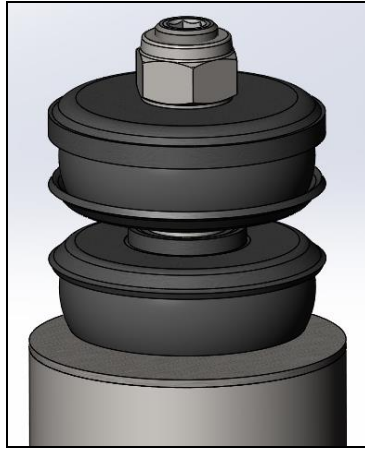


Figure 5-5; Pin attachment

5.3.2 Rubber bushing

5.3.2.1 Rubber block with a separate bush or trunnion

1. Remove the old rubber with bush or trunnion and clean the eye.
2. Immerse the new rubber in hot soapy water of about 60°C.
3. Place the eye on a suitable tool (Figure 5-6/1).
4. Place the rubber over the eye and press it in. If necessary, a plastic or wooden hammer can be used. The rubber must be pressed in so far that the collar of the rubber projects above the bottom side of the eye (Figure 5-6/2).
5. Rotate the damper 180° around the longitudinal axis and place the eye back on the tool (Figure 5-6/3).
6. Heat the assembly cone and the bush or trunnion to be mounted to about 60°C. Place the assembly cone in the rubber and the bush on the cone (Figure 5-6/4) or place the trunnion in the rubber and the assembly cone on the trunnion (Figure 5-6/5).
7. Press the bush or trunnion into the rubber as quickly as possible.
8. When the rubber has been pressed through the eye too far, the damper must be rotated to press it back in the centre.

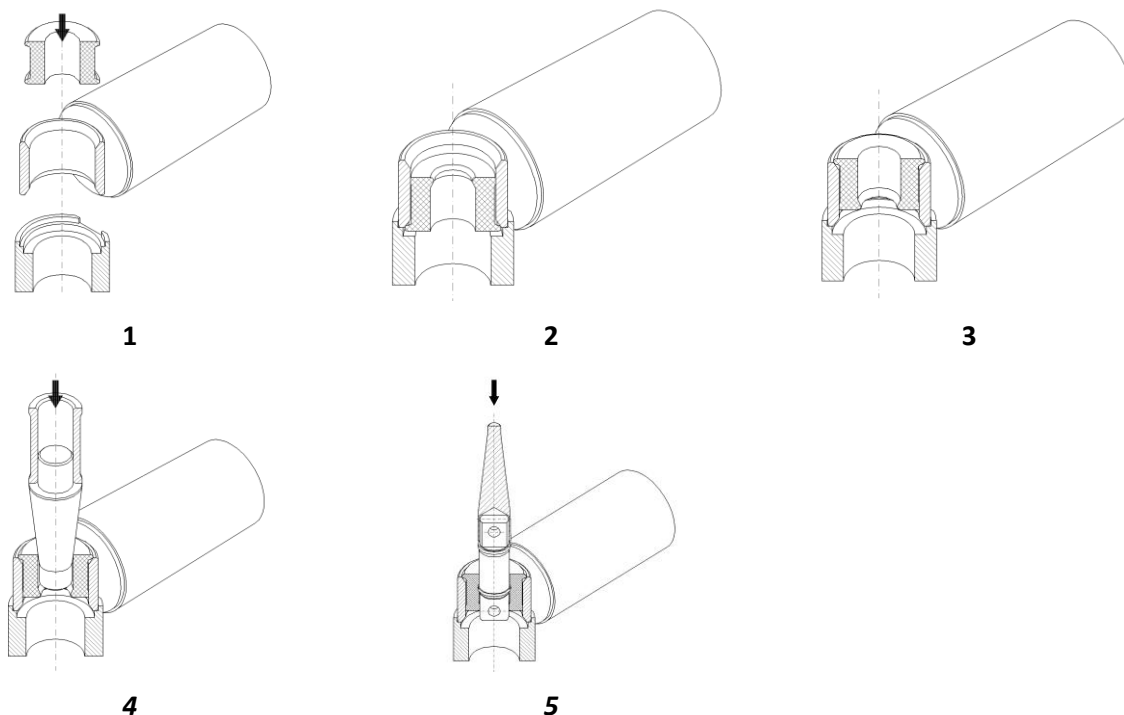


Figure 5-6 Replacement of rubber blocks

5.3.2.2 Rubber bloc with a vulcanized bush or trunnion

1. Remove the old rubber bloc and clean and degrease the eye and the rubber bloc.
2. Place the damper eye on a suitable tool (Figure 5-7/1).
3. Apply locking agent Loctite 601 to the inside of the eye and the outside of the rubber bloc.
4. Place the guiding tool on the eye (Figure 5-7/1)
5. Place the rubber bloc into the guiding tool (Figure 5-7/2)
6. Press the rubber bloc into the eye and press it in about 5 mm too far.
7. Rotate the damper 180° around its longitudinal axis and press the rubber bloc back into the middle.



Make sure you always press on the metal part of the bush.

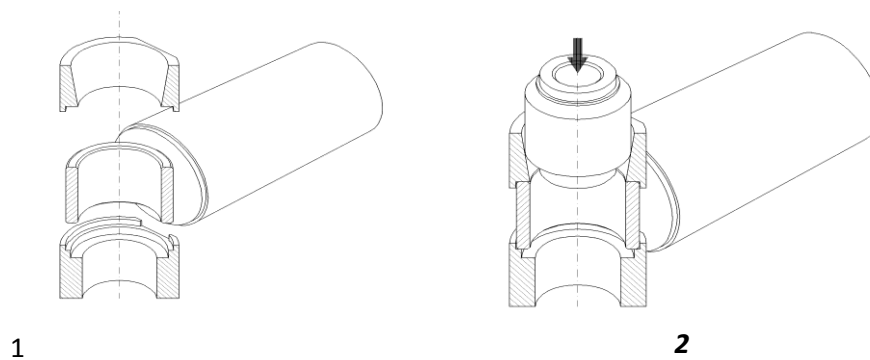


Figure 5-7 Replacement of vulcanized rubber blocks

5.3.3 Silentbloccs

In case of a worn silentbloc, the complete part has to be removed from the damper eye. Since these attachments are locked in the eye by means of a press fitting and/or Loctite, they can only be removed or assembled by means of a tool set and a press (Figure 5-8, Figure 5-9).



Figure 5-8; Pressing adapter set

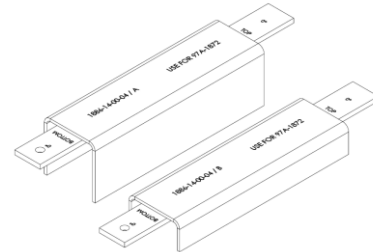


Figure 5-9; Auxiliary tooling set

Silentbloc removal

1. Place the eye of the damper on the big support tool.
2. Now place the smaller tool with the smaller diameter down, on the metal part of the silentbloc, and apply pressure. (Figure 5-10/1)

Be careful only to apply pressure on the metal part of the silentbloc, and not on the eye of the damper.

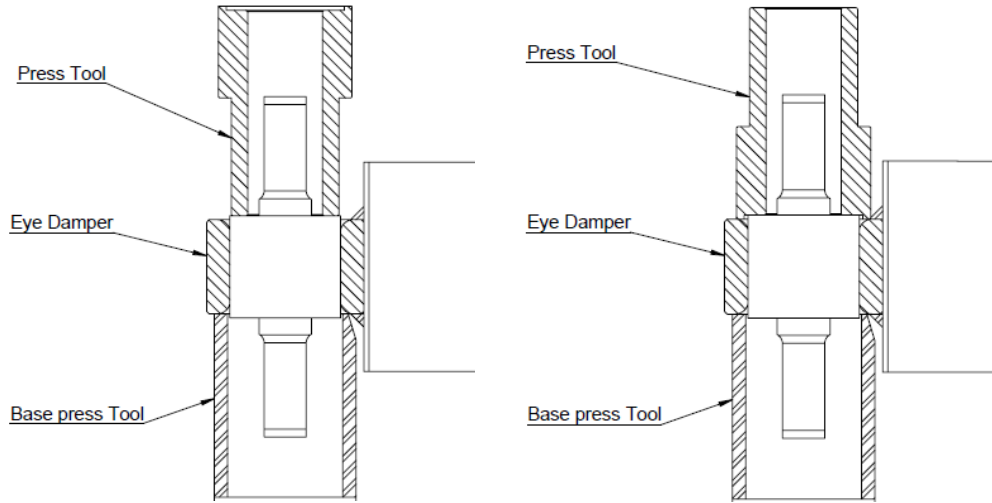
3. The block will now be pressed out of the eye.

Silentbloc assembly

1. Place the eye of the damper on the big support tool.
2. Apply Loctite 601 to the attachment and the eye.
3. Place the silentbloc onto the eye, and use the high version of the auxiliary tooling to verify the orientation of the silentbloc, according to the damper drawing. (Figure 5-11)
4. Now place the smaller tool with the bigger diameter down, on the metal part of the silentbloc, and apply pressure. (Figure 5-10/2)

Be careful only to put pressure on the metal part of the silentbloc.

5. The silentbloc will now be pressed into the eye.
6. Use the low auxiliary tool to check the angle after pressing it in. (Figure 5-12)



1 - Pressing out silentbloc

2 - Pressing in the silentbloc

Figure 5-10; Replacement of silentblocs

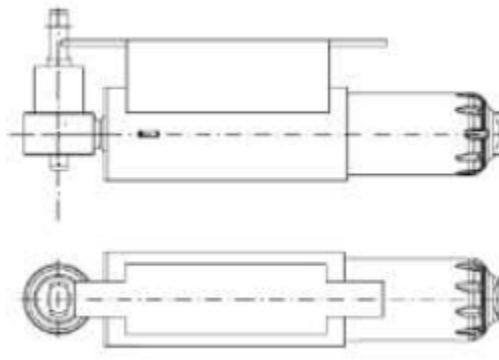


Figure 5-11: Auxiliary tool "High"

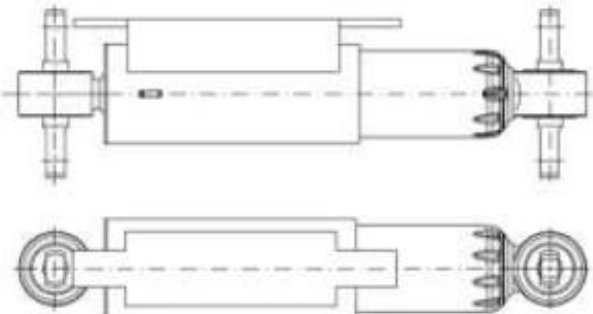


Figure 5-12: Auxiliary tool "Low"

6 Overhaul and Repair

6.1 Repair and service instructions

Please check the applicable spare parts list and cross sectional drawing for details. KONI advises to test the damper prior to overhaul, as this will give an indication of its condition.

6.2 Cleaning of components

- The cleaning of the components must be carried out very thoroughly by means of rinsing. Never clean components with cloth as this will always leave fibres on the surface. The tanks used for the rinsing must be big enough for the entire tubes to be submerged.
- Take extra care with the cleaning of the guide and piston assembly. Do not mix the valves and washers.
- All components with internal angles and orifices must be blow-cleaned with compressed air.
- Cleaned, grease-free components are susceptible to corrosion. For this reason all components that are not immediately mounted in a damper must be protected against corrosion with (preservative) oil, after which the components must be stored well away from dust and dirt.
- Check if the components are magnetic. If so, they must be de-magnetised.
- Before stored components can be used, they must first be rinsed clean again to remove the protective layer of oil and the dust contained in that layer.

6.3 Disassembly of the damper

6.3.1 General



This is a general description; please refer to the damper specific spare parts list including the cross-sectional drawing for the exact damper configuration.

For further inspection of the damper the dust cover (19) must be removed first.

6.3.2 Slide-on dust cover

Dampers with a pin attachment often have a slide-on dust cover. Firstly loosen the nut with a wrench. Then remove the attachment rubbers and the centring bush. Now the dust cover can be taken off the piston (*Figure 6-1*).

6.3.3 Screw-on dust cover

The dust cover has been screwed onto a cover welded onto the piston rod (*Figure 6-2*). Before disassembly break the locking agent by tapping the circumference of the dust cover at the thread. Then unscrew the dust cover with the help of a strap wrench.

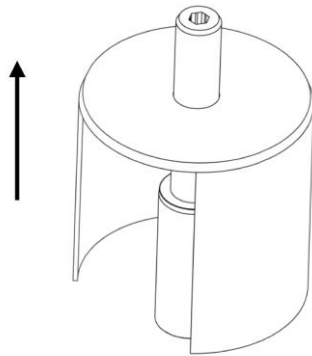


Figure 6-1; Slide-on dust cover

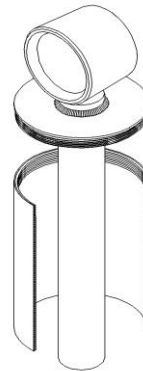


Figure 6-2; Screw-on dust cover

6.3.4 Bolted dust cover

The dust cover has been bolted to the cover using four small bolts (*Figure 6-3*). The cover is fitted with four threaded holes. The bolts and the spring washers must be removed.

Sometimes the dust cover can be pushed over the attachment (if necessary, turn the dust cover 90°). In most cases however, the attachment must be pressed out of the eye, prior to removal of the dust cover.

6.3.5 Flanged dust cover

The dust cover is fitted with a flange on the outside: this flange is attached to the cover by means of four small bolts and nuts (*Figure 6-4*). This version is used for dampers with large fixing eyes where the dust cover cannot be moved over the fixing eye. In this case the dust cover must, after removal of the bolts, be pushed over the reservoir tube as far as possible.

The dust cover may have a cut-out at the bottom. If so, special attention must be paid to the position of the dust cover during assembly. The cut-out must be positioned on the side of the dome on the reservoir.

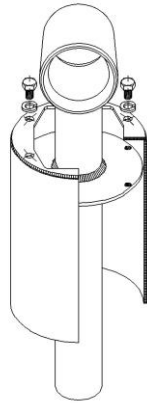


Figure 6-3; Bolted Dust Cover

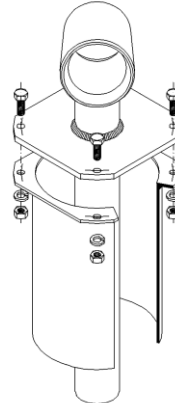


Figure 6-4; Flanged Dust Cover

6.3.6 Inspection of the bellows

The bellow (74) protects the piston rod against dirt. If the bellow is torn, the piston rod will wear sooner resulting in oil leakage and loss of damping forces. All damaged bellows must be replaced.

In case of a pin damper with slide-on dust cover the bellow can easily be pushed off the rod; in all cases where the cover has been welded onto the piston rod, the damper must be disassembled for bellow removal.

6.3.7 Disassembly of the complete guide section



If the damper is suspected of leakage, KONI advises to check if the rod oil seal nut (27) is tight. A loose rod oil seal nut can be a cause of oil leakage.

To remove the guide (122) KONI advises to loosen the rod oil seal nut (27) by half a turn. Then extent the damper to its maximum length. If this is very difficult, one of the valves in the guide can be loosened a few turns.

Both the rod oil seal nut and the guide must be loosened with either a special wrench (available from KONI), or dedicated machine. *Please refer to section 6.8.*

Important

The loosening of the guide requires a big torque. For this reason the damper must be properly clamped in a vice. In order to make the loosening easier the used wrench may be equipped with an extension pipe.

The damper can be clamped at the eye (bottom side), at the dome (if available) or with the help of special tools which fit around the reservoir tube (Figure 6-5).

The reservoir tube must not be clamped without proper support as otherwise the reservoir tube might be deformed.

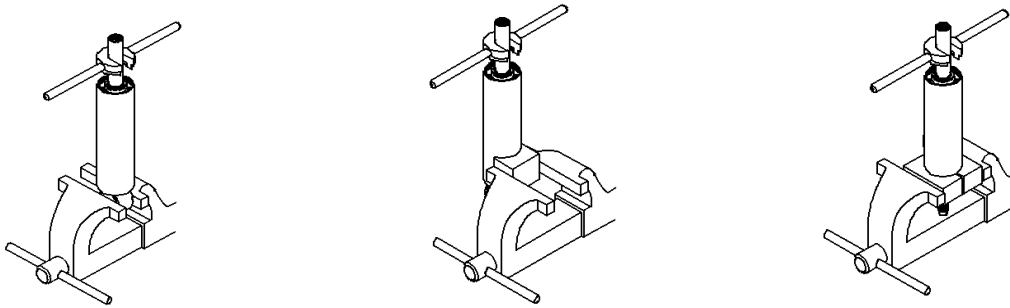


Figure 6-5; Various ways to clamp the damper

Once the guide has been loosened, it can be pulled out of the damper together with the piston rod and the piston (**Error! Reference source not found.**).

Usually the cylinder tube stays behind in the damper. When the cylinder tube is pulled out as well, take care that it does not fall back into the damper: that may damage the sealing rim of the tube.

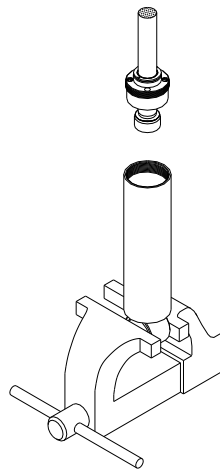


Figure 6-6; Removal of the guide

6.3.8 Disassembly of the other components

Pour the oil out of the damper (Figure 6-7), retaining the cylinder tube and any other components with one hand.

The colour and fragrance of the oil, as well as the state of the oil (including possible deposits inside the oil) are clear indications of the state of the damper.

Depending on the application and execution of the damper the following components should be retained.

- Cylinder tube
- Oil return assembly (Oil chamber, overflow receptacle, suction tube)
- Bottom valve assembly
- Washers

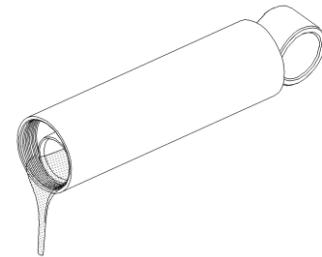
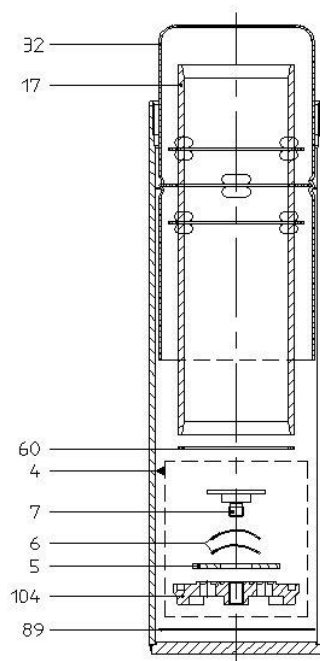


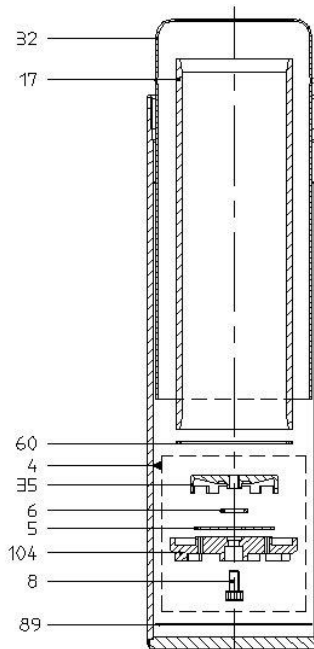
Figure 6-7; Oil removal



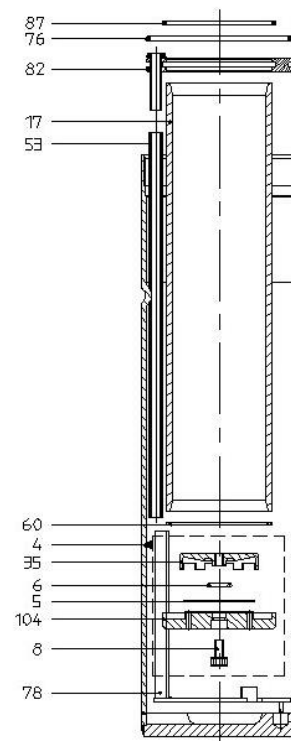
For the exact configuration and parts please refer to the damper specific parts list



Primary damper



Vertical damper



Lateral/Yaw damper

Figure 6-8; Various damper configurations

6.3.9 Disassembly of the copper gasket ring

The bottom valve assembly (4) is provided with a copper gasket ring (60). The disassembly of the copper gasket ring can be carried out with help of a sharp knife. The knife should be brought under the ring whereupon the ring can be cut through.

The cutting action should be carried out with great care without damaging the bottom valve housing.

Please use hand gloves to protect your hands during these operations.



The copper gasket ring should always be replaced by a new one after opening the damper.

6.3.10 Bottom and reservoir tube

The reservoir tube (2) of the damper consists of a welded assembly of reservoir tube, bottom and fixing eye.

After disassembly of the damper, the reservoir must be carefully cleaned on the inside. The thread must be checked for damages.

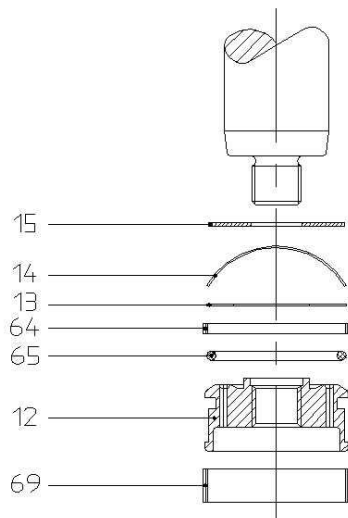
6.4 Disassembly and Inspection and of the internal damper parts

Carefully inspect all internal damper parts, such as:

- Piston
- Guide
- Piston rod
- Bottom valve assembly
- Cylinder tube

6.4.1 Piston section

Every piston section (Figure 6-9) consists of a piston screwed onto the piston rod, with a non-return valve and a spring. The non-return valve can allow the oil to flow with little resistance from the space below the piston to the space above the piston. During the outward movement of the piston rod the non-return valve is closed.



Parts List

- 12 Piston
- 13 Non return valve piston
- 14 Non return spring
- 15 Piston washer
- 64 Plastic ring for piston
- 65 O-ring piston
- 69 Plastic slide ring for piston

Figure 6-9; Piston Section

6.4.1.1 Inspection of the piston

The working surface and the closing function of the non-return valve must be checked. Wear of the working surface or a faulty non-return valve can be concluded from the test diagram. In that case the damper will generate less force outward than inward.

If the working surface shows clear evidence of wear, the piston must be replaced.

The closing function of the non-return valve can be checked by pouring a thin liquid into the orifices of the piston, holding the piston upside down. The liquid should not leak out.

6.4.1.2 Disassembly of the piston

All pistons have been screwed onto the piston rod and locked with Loctite. Disassembly can be carried out after heating the piston to about 150°C. This will largely neutralise the working of the locking agent.

Disassembly in case of piston replacement

In this case the piston rod can be clamped in a vice between soft clamping plates (over the longest possible length).

When the damper has two flat sides or a welded eye it is better to clamp the rod there.

Now the piston can be loosened with a pipe wrench (Figure 6-10).

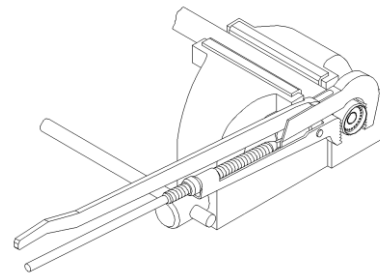


Figure 6-10; Disassembly

Disassembly in case of re-use of the piston

When the piston is re-used, the disassembly must always be carried out carefully.

Always use a properly fitting piston clamp

Please refer to section 6.8.

The torque required for loosening is high: you will need proper clamping force. For this reason place the piston clamp on the piston correctly, and apply sufficient clamping force (Figure 6-11). By doing this properly, the piston is prevented from 'slipping' in the clamp. Place the piston clamp in the vice. The piston can now be loosened with a bar or wrench.

If there is no eye welded onto the rod and if the rod has no flat sides, the rod itself can be clamped between soft clamping plates (over the longest possible length). In this case the piston clamp is clamped with a pipe wrench or with a bolt (depending on the version of the clamp), as indicated in Figure 6-10.

There will still be some Loctite clinging to the thread of the piston and/or piston rod. This must be removed, e.g. with a steel brush and compressed air. When this does not work you can use a thread cutting tool to remove the Loctite.

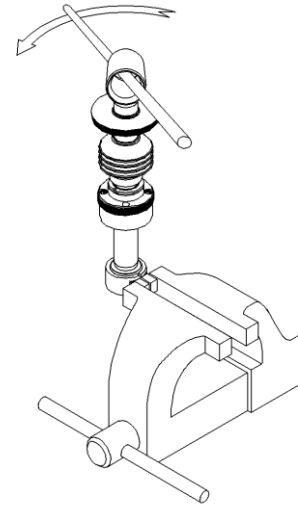


Figure 6-11; Clamping the piston

6.4.2 Non Return valves

The top of the piston is fitted with two ridges supporting the valve. In between these ridges there are orifices drilled in the piston (12). The valve (13) and the spring (14) centre on the piston (12).

If the non-return valve does not seal properly during the leakage test, this may point to dirt between valve and piston, a deformed non-return valve or a damaged ridge of the piston. Dirt must be removed carefully. A deformed or heavily indented non-return valve must be replaced.

The spring shall be checked on the lower side. When the contact faces are sharp the spring must be replaced.

When the ridge of the piston is slightly damaged, it can be repaired with help of a grinding/lapping compound (see 6.10.3), by lapping it on a flat surface. With larger damages, the piston has to be replaced. After lapping, test with the leakage test if the valve closes completely. When this is not the case, replace the piston.

After completion of work, the components must be carefully cleaned.

6.4.2.1 Low Noise version

In case of a low-noise version (Figure 6-12), the piston is fitted with a deviating non-return valve construction. In this case the non-return valve (13) also functions as spring.

The valve is pressed by a rubber O-ring (65) and is surrounded by a specially shaped cap (95). In this case the piston only is fitted with one (very low) ridge.

The causes of a leaking valve are the same as those described for the standard version. A damaged ridge must only be honed lightly with a grinding compound on a flat plate. The minimum height of the ridge is 0.05 mm. If the non-return valve continues to leak, the piston with the valve must be replaced.

Always replace the O-rings.

Parts List

- 12 Piston
- 13 Non return valve piston
- 64 Plastic ring for piston
- 65 O-ring piston
- 69 Plastic slide ring for piston
- 95 Piston cap

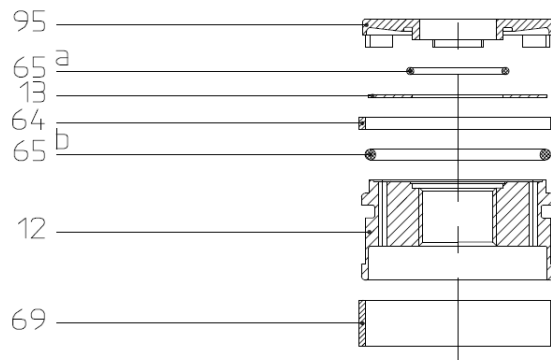


Figure 6-12; Low Noise piston

6.4.2.2 Air escape plate

For critical applications pistons may be fitted with an air escape plate (Figure 6-13). The purpose of this plate is to carry any air bubbles in the cylinder (between the piston and the bottom valve) to the space above the piston as quickly as possible.

The piston rod is fitted with a hole with internal thread. The air escape plate (159) is attached to the piston with a socket head screw (20).

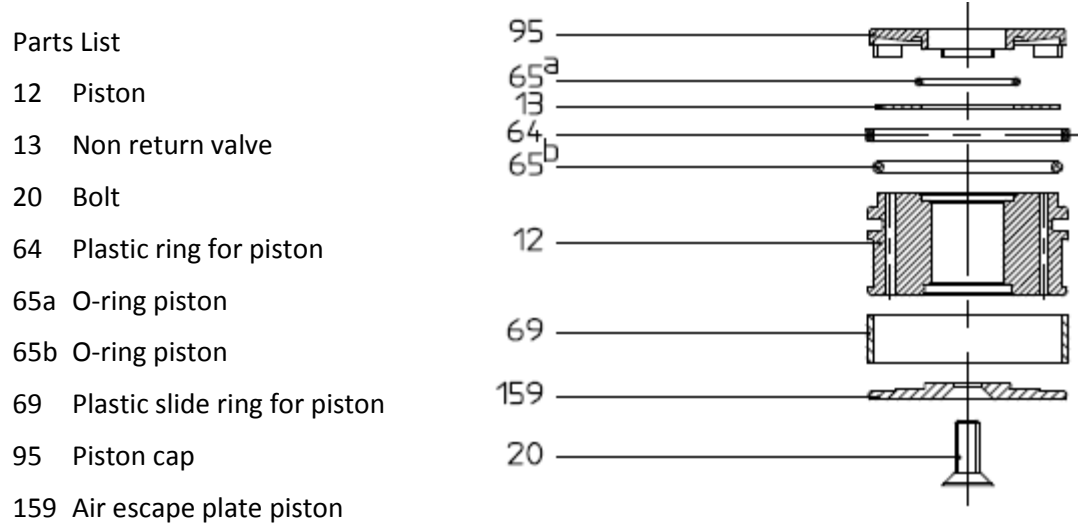


Figure 6-13; Piston with air escape plate

6.4.2.3 Working surfaces

As indicated above the piston is fitted with a plastic sealing ring (64) that is pre-tensioned by an O-ring (65) and a groove housing which holds a plastic slide ring (69).



When the damper is overhauled the plastic rings and O-ring must be replaced.

Disassembly

The rings can be removed by picking them out of the groove with a knife or a similar tool. During cutting please take care not to damage the piston and KONI advises to use hand gloves to protect your hands.

6.4.3 Guide section

The guide combines several functions; the guiding and sealing of the piston rod and the regulation of the damping force. The guide section also functions as the seal of the reservoir tube.

Please note that your actual guide can be slightly deviating from (Figure 6-14).

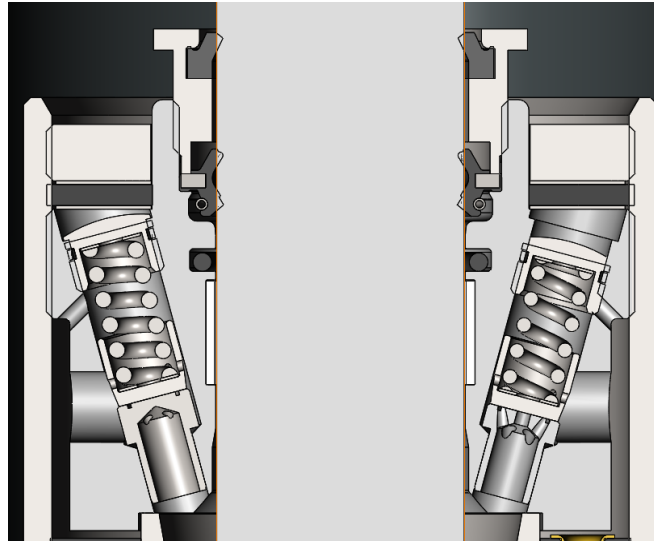


Figure 6-14; Cross-sectional of Guide

Parts List

- 27 Rod oil seal nut
- 31 Wiper ring
- 61 Plastic ring for guide
- 62 O-ring
- 63 Plastic slight ring for guide
- 122 Guide housing
- 126 Rod oil seal

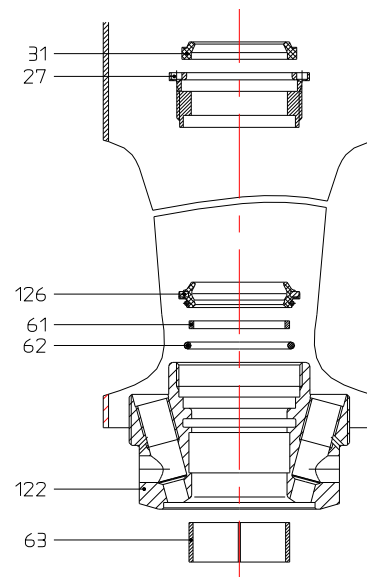


Figure 6-15; Guide Section Parts List

6.4.3.1 Disassembly of the guide section

In case of a pin attachment with a slide-on dust cover, the guide can be simply pushed off the piston rod. In all other cases the piston must be removed first. The removal of the guide must be carried out carefully to prevent damage to the running surface.



When the damper is overhauled all plastic rings, O-rings, seals and the wiper ring must be replaced.

6.4.3.2 Loosening the rod oil seal nut

Loosen the rod oil seal nut (27) and remove from the guide (122). The nut must be loosened with a special tool (available from KONI). *Please refer to section 6.8.*

6.4.3.3 Working surface

The working/running surface of the guide serves as the guide of the piston rod and for absorbing the lateral forces. The quality of the working surface largely determines the service life of the damper.

For this reason the guide is fitted with a plastic running surface in the form of a plastic slide ring (63). This plastic slide ring prevents a metal to metal contact between the guide and the piston rod.

6.4.3.4 High pressure rod seal

The high-pressure seal (pressure within cylinder relative to pressure within reservoir tube) is located in the guide, just above the guide ring. This seal consists of a closed plastic ring (61), which contacts the piston rod under pre-tension: the pre-tension is provided by an O-ring (62) behind the seal.

Disassembly

The rings can be removed by picking them out of the groove with a knife or a similar tool. The knife should be brought under the ring whereupon the ring can be cut through. During cutting please take attention not to damage the guide and KONI advises to use hand gloves to protect your hands.

6.4.3.5 Low-pressure rod oil seal

The low-pressure seal (126) serves as a seal between the reservoir tube pressure and the outside air. This seal consists of a steel support with two plastic lips. The lower lip (A) is fitted with a steel spring washer (B) providing a static pre-tension on the seal. The upper lip (C) has a wiper function: dirt on the piston surface is wiped off the piston rod during the inward movement.

(Figure 6-16)

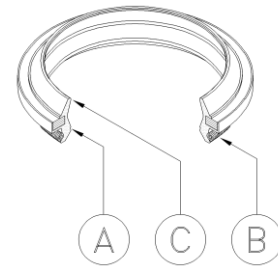


Figure 6-16; Lip seal

6.4.3.6 Wiper ring

The damper is fitted with a separate wiper ring (31) which wipes the dirt off the piston rod during the inward movement so that penetration of dirt into the guide and damage to the rod seal is prevented. The wiper ring is mounted in the rod oil seal nut (27). When the damper is overhauled, the wiper ring must be replaced. The wiper ring must be greased before mounting.

6.4.3.7 Damping valves

The guide contains a number of damping valves (Figure 6-17). These valves determine the characteristic of the damper. The components of the valves must be treated carefully during storage and assembly. The valve seat and the valve are manufactured and dimensioned with a high degree of precision. Scratches, dirt and corrosion must absolutely be avoided: they can affect the proper working of the damper to an important degree.

The valves are numbered with an engraved number or number/letter combination on the guide. Each valve consists of a valve seat (38), valve (39), spring coil (40) and an adjusting screw (41). Furthermore a distance washer (45) is fitted on both sides of the spring.

When the valves are disassembled, do not exchange the components; the valve seats, valves and springs are mounted in a great number of versions and combinations.

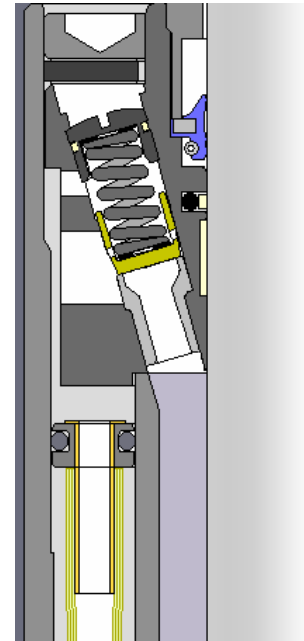


Figure 6-17; Damping Valves

Valve seats

The valve seats pressed into the guide have a very long service life. Yet, if a valve seat is dented, loose or otherwise damaged, it must be replaced.

The replacement of valve seats is a very critical operation. The position, press-in depth and locking of the valve seat must be exactly right. Any deviations may affect the working of the damper. KONI can carry out this work for you.

Valves and springs

The valves and springs are delivered in a great number of varieties. When disassembling the guide, the components must be kept together to avoid exchange. The valves or springs must be replaced if scratches or other signs of damage appear on the sealing surface.

6.4.3.8 Gasket reservoir tube seal

The reservoir tube of the damper is sealed off from the outside air by the guide. The oil tightness is provided by a rubber gasket reservoir tube seal (24).

6.4.4 Piston rod

6.4.4.1 Visual inspection

The working surface of the piston rod is hardened, chrome-plated and ground. Check the surface carefully for scratches and wear patterns. Damage may cause leakage and damper malfunction so a piston rod should be replaced if damaged.

6.4.4.2 Wear

The measured wear should be evaluated in combination with the number of running kilometres and the next maintenance period.

Perform the following actions in the described sequence to measure the wear.

1. For a proper function of the damper, the wear must not exceed a determined value.

Measure the diameter in two places (S1 and S2) **around the circumference (!)**, as indicated in (Figure 6-18) with help of a suitable micrometre gauge. For the first point (S1), measure the working surface of the guide. Calculate the difference (D1-D2) of the diameters. The difference may not be higher than indicated in Table 6-1.

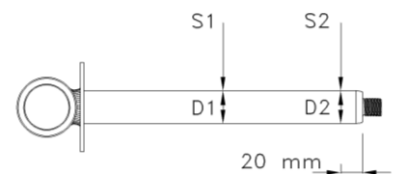


Figure 6-18; Wear measurement

Table 6-1

Type	Measured wear on rod diameter
Guide with plastic slide ring	When $D1-D2 > 0,04$ mm ; replace piston rod

2. The image of wear often shows that it has performed only at one side of the piston rod (Figure 6-19)

Measure the thickness of the chromium layer at position S1 and S2 around the circumference. The chromium layer at position S2 has the original layer thickness and should be used as reference. Determine the layer thickness, which has worn off during the last operating interval.

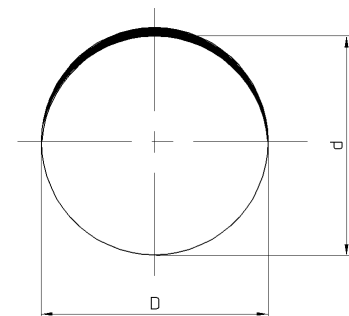


Figure 6-19; Typical wear pattern

The residual layer thickness at point S1 may not be less than the worn off chromium layer thickness (requested for the next maintenance interval.) With help of this measurement, experience over the maintenance interval can be gained.

The device, needed to measure the chromium layer thickness can be ordered through KONI.

3. The surface roughness may not exceed the value Ra = 0,1 micron. Areas with higher roughness values must be adequately repaired.

6.4.4.3 Deformation

Check the straightness of the piston rod (Figure 6-20). Place the piston rod on two V-blocks, the distance between the blocks shall be 200 mm. Place a dial gauge in the middle between the V-blocks. Ensure sufficient stability. The maximum gauge deflection may not be higher than indicated in Table 6-2.

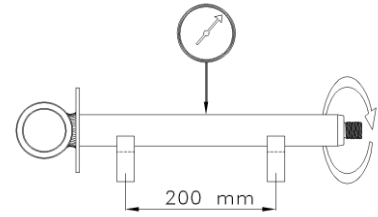


Figure 6-20 Straightness check

Table 6-2

Type	Maximum gauge deflection
Aluminum guide with Glacier bush	0,1 mm

6.4.5

6.4.6 Oil return

Special provisions have been made to guide the oil that flows from the valves to the reservoir tube.

6.4.6.1 Oil chamber

The 'oil chamber' (32) consists of a steel sleeve centered around the cylinder tube and clamped between the guide and the cylinder tube. A slot is formed between the oil chamber and the inside of the reservoir tube, through which the oil flows down in a controlled way.

Axle dampers are provided with an oil chamber which has small partitions to reduce the sloshing of the oil (Figure 6-21).

The oil chamber cannot be disassembled and needs no servicing. However, do check if the partitions are in place. Rattling partitions may cause noise and extra dirt.

Vertical dampers are provided with an oil chamber without these partitions

Older versions are provided with return tubes. In this case each outlet of the guide is fitted with a plastic return tube (53). These tubes have been screwed into the guide by means of a nipple (81) (Figure 6-22).

The tubes must be replaced if damaged or hardened.

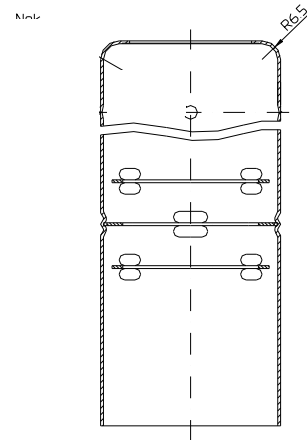


Figure 6-21; Oil chamber

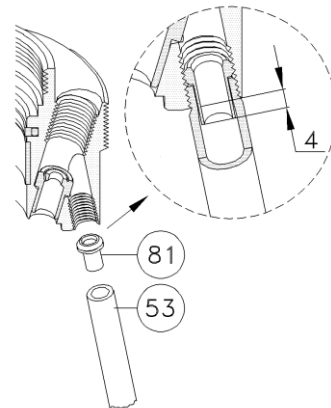


Figure 6-22; Fitting plastic return tubes (old type)

6.4.6.2 Overflow receptacle

The overflow receptacle (82) is applied in horizontal dampers. It is a device that collects the oil from the various valves and leads it to a particular outlet into the reservoir tube. The overflow receptacle consists of a steel ring as partition between the cylinder and reservoir tube below the guide. This ring is sealed against the wall of the cylinder and the wall of the reservoir tube with O-rings or a flat rubber plate. Nipples have been attached to the steel ring on which the nylon tubes have been mounted. When the damper is overhauled, it is recommended to replace the rubber components and nylon tubes.

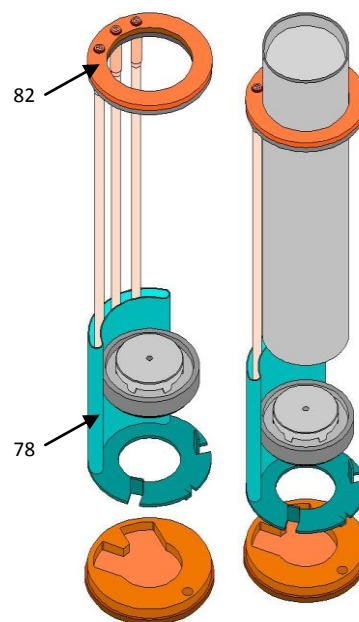


Figure 6-23; Overflow receptacle-suction tube assembly

6.4.6.3 Suction tube

The suction tube (78) collects the oil from the overflow receptacle and leads it to the bottom valve. In this way air is prevented from being drawn in.

It consists of a steel plate with a specially profiled tube mounted on it. The steel plate is clamped between the bottom valve and the bottom. The position of the plate relative to the bottom is fixed by means of a cam on the plate and a blind recess in the bottom: in this way the suction orifice is always on the bottom side. The suction tube cannot be disassembled and needs no servicing.

6.4.6.4 Air escape plates

The damper may be fitted with an air escape plate (158) between the guide and the cylinder tube. If there is an air bubble in the cylinder, this must be removed from the cylinder as quickly as possible. The air escape plate guides the oil along the inner diameter of the cylinder towards the valves. As the air collects at the top of the inner diameter, the flowing oil carries the air with it towards the reservoir tube.

A similar air escape plate can be applied on the piston, too. It is screwed against the bottom of the piston and works in a similar way.



If the damper is fitted with these air escape plates (please check parts list), it must not be fully extended or compressed to minimum length with force more than 500N! This would cause damage to the plates.

6.4.7 Bottom valve

The bottom valve closes the cylinder at the bottom. In the bottom valve the non-return valve is situated which allows the oil to flow from the reservoir to the cylinder during the outward movement.

A copper ring (60) has been mounted between the bottom valve and the cylinder tube, providing the seal between cylinder and bottom valve. This ring must always be replaced when the damper is assembled.

6.4.7.1 Disassembly of the bottom valve

When the damper is overhauled, it must be checked whether the non-return valve closes properly. This is done by placing the bottom valve upside down and pouring a thin liquid into the orifices. The liquid should not leak away. When the non-return valve does not close properly, the bottom valve must be disassembled.

6.4.7.2 Standard non return valve

The standard non-return valve is being used in axle dampers. This construction consists of a bottom valve housing with three ridges. Between these ridges there are orifices that connect the reservoir tube and the cylinder. The non-return valve (5) rests on the ridges and is pre-tensioned by 2 springs (6) and a valve stop (7) screwed into the bottom valve housing.

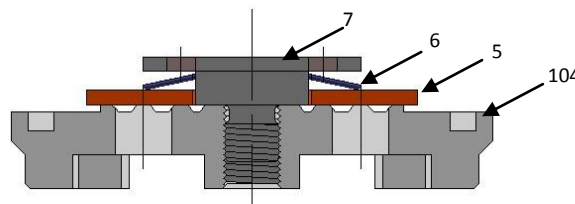


Figure 6-24; Cross-sectional bottom valve assembly for axle damper

Parts List

- 5 Non-return valve
- 6 Spring
- 7 Valve stop
- 104 Bottom valve housing

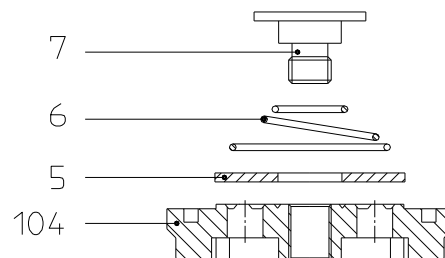


Figure 6-25; Bottom valve assembly Parts List

When the non-return valve does not close properly during the leak test, this may indicate dirt between the valve and bottom valve housing, a deformed non-return valve or a damaged ridge. Dirt must be removed carefully. A deformed or seriously indented non-return valve must be replaced.

If a ridge of the bottom valve housing is slightly damaged, the valve may be ground down on the ridges with grinding compound. In case of more serious damage the ridges can be turned

down on a lathe: however, the height of the ridges must be 0.5 mm at least. Test the closing function of the valve. If it is faulty, grind down the valve on the ridges.

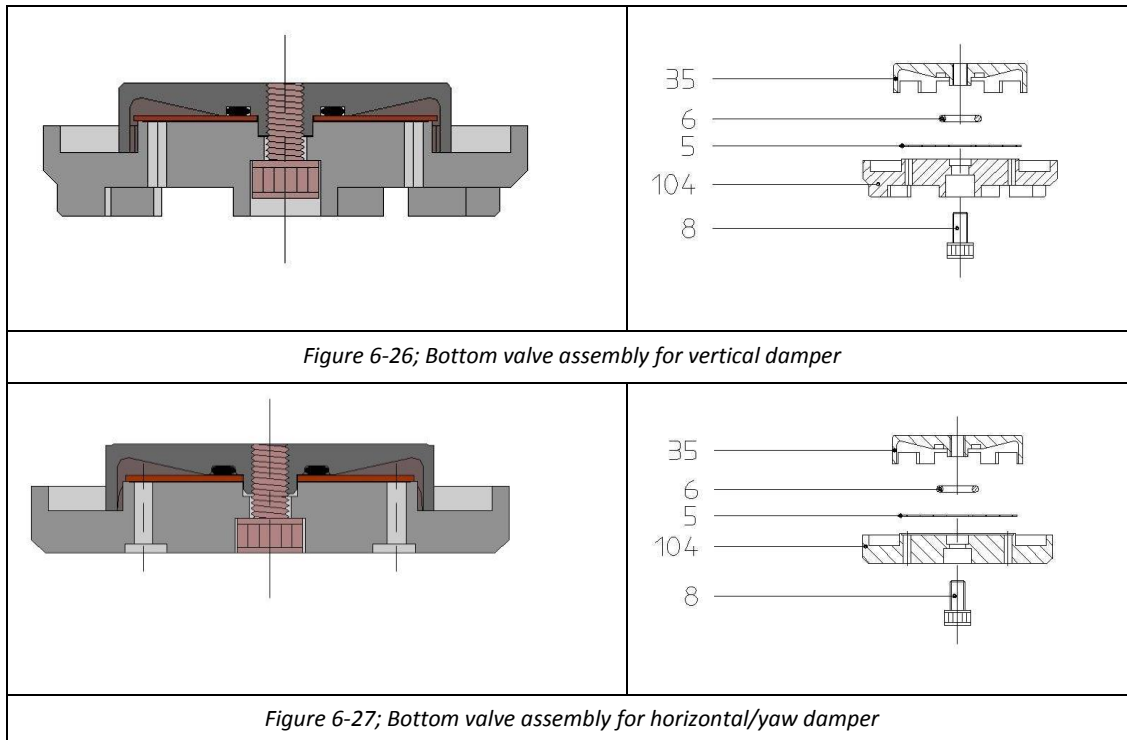
After completion of the work, all components must be carefully cleaned.

6.4.7.3 Low-noise non-return valve

A low-noise bottom valve is being used in a vertical and horizontal damper.

In case of vertical dampers the bottom valve is fitted with suction grooves in the bottom valve itself. In case of horizontal dampers the bottom valve is flat and the suction groove is situated in the bottom of the damper.

The non-return valve (5) also functions as non-return spring. The valve is pressed in by a rubber O-ring (6) and surrounded by a specially shaped cover (35). The bottom valve housing is fitted with only one (very low) ridge in this case. The components are fitted with a socket bolt (8).



Parts List

- 5 Non-return valve
- 6 O-ring
- 7 Valve stop
- 8 Set screw
- 35 Bottom valve cap
- 104 Bottom valve housing

Causes of a leaky valve are the same as described for the standard version.

A damaged ridge must only be ground lightly with grinding compound on a flat plate. The minimum height of the ridge is 0.05 mm. If the non-return valve continues to leak, the bottom valve housing with the valve must be replaced. Always replace the O-ring.

6.4.8 Bottom and reservoir tube

The reservoir of the damper consists of a welded assembly of reservoir tube, bottom and fixing eye. After disassembly of the damper the reservoir must be cleaned carefully on the inside. The thread must be checked for damage.

6.4.9 Cylinder tube

The cylinder should be clear from scratches and shall not show any damage on the end flats, as this will affect the sealing function.

6.5 Re-assembly of the damper



After disassembly all O-rings, seals, plastic bands, the wiper ring and the copper gasket ring must be replaced. In addition it is advised to replace all parts with signs of excessive wear.

Apply grease to all O-rings and other rubber seals before mounting.

Only original KONI spare parts shall be used during the overhaul.

During assembly various components must be greased or locked with prescribed torques or Loctite; *Please consult section 6.9 and 6.10.*

6.5.1 Assembly of the guide section

Before the guide is assembled, all components must be carefully cleaned. Pay special attention to the valves.

6.5.1.1 Damping valves

Reinstall the correct combinations of the valve seats (38), valves (39), spring coils (40), distance washers (45) and set screws (100) in the various damping valves (Figure 6-28).

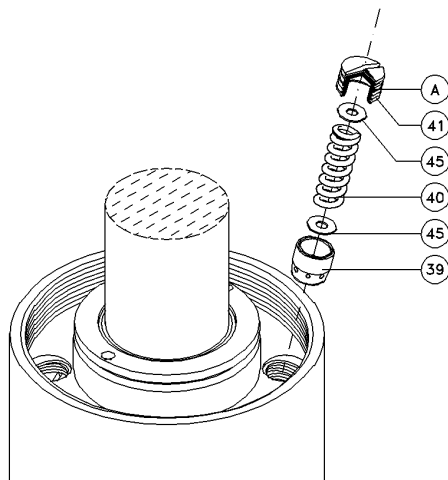


Figure 6-28; Damping valves

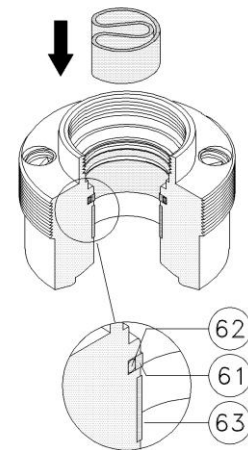


Figure 6-29; Mounting of plastic slide ring

6.5.1.2 High-pressure tube seal

First mount the O-ring (62) in the groove and assemble the sealing ring (61).

Repeat the above for the plastic slide ring (69).

Mounting of the slide rings is possible by first pressing them in as indicated in (Figure 6-29)

6.5.1.3 Low-pressure rod seal (rod oil seal)

Before mounting, grease must be applied to the rod oil seal (126). Then the rod oil seal (the spring washer at the bottom) is placed in the guide and tightened with the rod oil seal nut (27). In older types a separate distance washer (125) is being used. Nowadays the distance washer has been integrated in the rod oil seal nut (27) (Figure 6-30).

6.5.1.4 Wiper ring

The wiper ring is mounted in the rod oil seal nut (27). When the damper is overhauled, the wiper ring (31) must be replaced. The wiper ring must be greased before mounting. Always use a new wiper ring.

6.5.1.5 Rod oil seal nut

Tighten rod oil seal nut (27) at the prescribed torque with a special wrench. *Please consult section 6.9 and 6.10.*

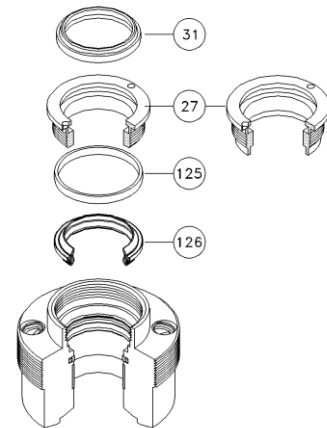


Figure 6-30; Mounting rod oil seal

6.5.1.6 Mounting the guide section on the piston rod

Before the piston rod section is mounted the guide section must be assembled first.

Carefully clean all components before mounting: they must be free of dirt, grease and remaining locking agent.

Clamp the piston rod vertically in a vice with the piston end facing up.

- Push the bellow (74) onto the piston rod
- Slide on Reservoir tube seal nut (25)
- Slide on Reservoir tube washer (86)
- Slide on Gasket reservoir tube seal (24)
- Slide on Reservoir tube washer (86)
- Now place the mounting sleeve (A) on the piston rod. *Please consult section 6.8 for the mounting sleeve*
- Apply grease to the inside of the piston rod seal
- Carefully push the guide section onto the rod and then remove the mounting sleeve (Figure 6-31).

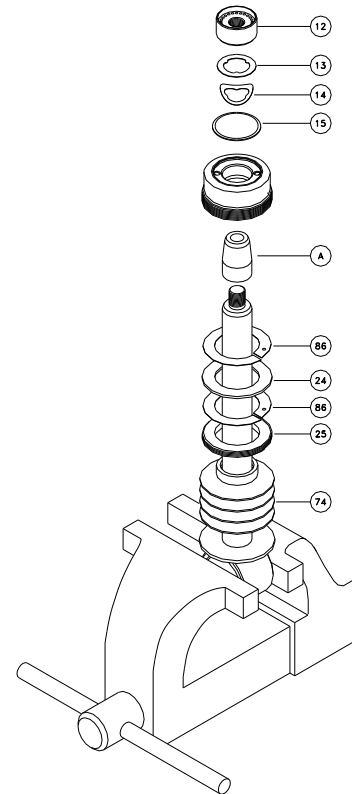


Figure 6-31; Mounting of the guide section

6.5.2 Assembly and mounting the piston section

Carefully clean all components before mounting: they must be free of dirt, grease and remaining locking agent.

Before assembly:

- Firstly place the piston washer (15), non-return spring (14) and the non-return valve on the piston.
- Apply some locking agent to the internal thread of the piston.
- Mount the piston on the piston rod. Ensure the non-return valve and non-return spring are not jammed between the piston and the piston rod.
- In case of a low-noise version, the O-ring must be carefully placed in the groove of the piston cover.
- Tighten the piston with a properly fitting piston clamp at the right tightening torque. Provide sufficient clamping force on the clamp so that the piston does not slip (refer to paragraph 6.8).
- In case of an air escape plate the piston rod is fitted with a hole with internal thread. The air escape plate (159) is attached to the piston with a socket head screw (20).

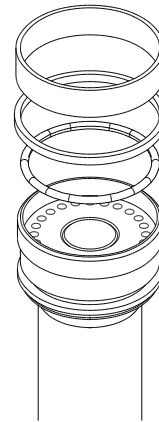


Figure 6-32; Assembly piston section

Check-up after mounting:

The non-return valve must be able to move freely. This can be checked by sticking a pen in one of the orifices of the piston and pressing the valve up (Figure 6-33). Never stick a screwdriver or a similar tool between the valve and the piston: this might damage the ridges.

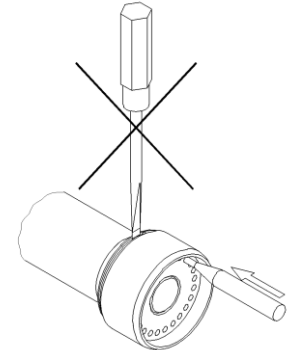


Figure 6-33; Check of the non-return valve

6.5.2.1 Working surface

For the assembly of the rings you require some special tools (Figure 6-34).

Please consult section 6.8.

- The mounting procedure is as follows:
- Mount the O-ring (65) in the groove.
- Place the assembly cone (A) on the piston.
- Place the sealing ring (64) on the cone.
- Push the sealing ring over the piston into the groove with the mounting tool (B).
- Remove the assembly cone and the mounting tool.
- Push the calibration tool (C) over the piston: the sealing ring is now sized correctly.
- Repeat the above for the plastic slide ring (69)

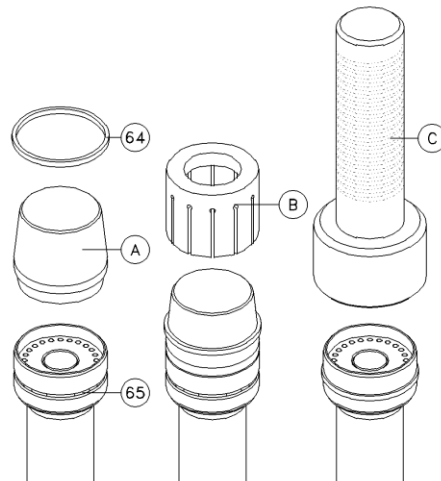


Figure 6-34; Mounting tools

6.5.3 Assembly of the bottom valve

Carefully clean all components before mounting: they must be free of dirt, grease and remaining locking agent.

- Mount the non-return valve (5) and the springs (6) and screw the valve stop (7) into the housing. In case of assembly always use a new valve and springs (Figure 6-35).
- In case of a low noise version the O-ring (6) must be mounted carefully in the groove of the bottom valve cap (35). In case of assembly always use a new valve and O-ring (Figure 6-36).
- Figure 6-36).
- See to it that the non-return valve and non-return springs are not jammed between the stop and the housing
- The valve stop (7) or the setscrew (8) must be locked with Loctite and tightened at the prescribed torque. *Please consult section 6.9 and 6.10.*
- Place a new copper ring (60) on the bottom valve

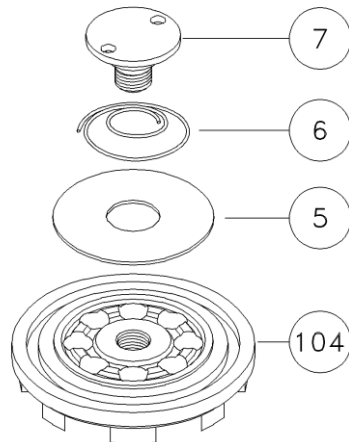


Figure 6-35; Standard bottom valve

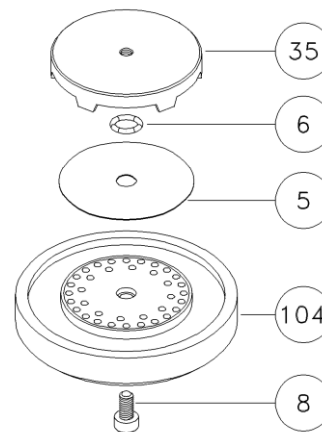


Figure 6-36; Low noise bottom valve

6.6 Final assembly of the damper



Before assembling the damper, all components must be carefully cleaned and blow-dried. This is a pre-condition to a properly working damper! Only use the specified KONI hydraulic oil.

6.6.1 General

The final assembly of the damper can only be carried out once all components and subassemblies are ready. In the previous section the assembly was described of the guide section, the piston section, the bottom valve and the complete piston rod section.

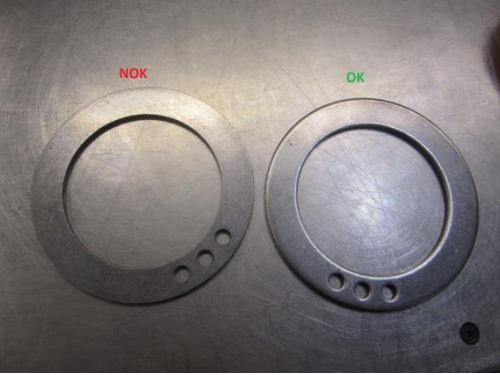



Before mounting apply grease to all O-rings and other rubber seals.

The assembly procedure is as follows.

6.6.2 Assembly of return tubes

This paragraph is only applicable to horizontally mounted dampers.

1	Fit the three sleeves into the plastic ring	
2	Assemble the metal ring on the plastic ring. Attention!!! Note correct orientation; (Radius side to the rubber gasket)	

		 
3	Preheat the tubes in hot water by using the warming cup on an electrical heater	
4	Fix the return tube assembly tool in a vice	

<p>5</p>	<p>Put overflow assembly on the return tube assembly tool</p>	
<p>6</p>	<p>Hold the tube into the pliers jaw</p>	
<p>7</p>	<p>Fit a tube on the pin of the return tube tooling and use the hammer and pliers to lower the tube on the overflow assembly. Repeat this for all return tubes (3x)</p>	

		
		
		
8	Finished assembly	

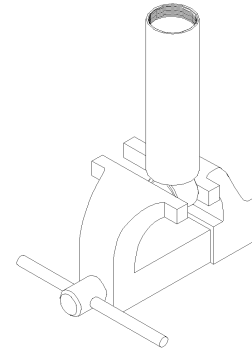
6.6.3 Final assembly

Place the reservoir tube vertically in a vice in such a way that the tube is not deformed (Figure 6-37).

For Primary/Secondary Vertical dampers

Place distance washer (89) first.

Then the bottom valve-assembly (4) must be inserted by hand. It is not allowed to mount the bottom valve with the aid of a magnet, because then the bottom valve will be magnetised and will attract dirt particles. Check that the copper ring (60) is still in the correct position.



Place the cylinder tube (17) on the bottom valve assembly. Check that the cylinder is centred to the reservoir tube and the bottom valve.

Figure 6-37; Proper clamping of damper in vice

Fill a clean graduated beaker with the required amount of oil, as specified in the damper specific parts list. Only use the KONI oil as prescribed in the parts list. Prevent the oil from getting mixed with air when filling the beaker: do not 'splash' the oil in.

Pour the oil gently in the cylinder tube, completely filling the cylinder. The remaining oil will flow into the reservoir. Be careful not to 'splash' the oil. Pour the last bit of oil along the inner thread of the reservoir tube; this will make it easier to screw in the guide later.

Place the oil chamber (32) over the cylinder tube.

For Horizontal/Yaw Dampers

In case of a horizontal damper firstly mount the suction tube (78). Ensure the suction tube is positioned correctly. The suction orifice must be situated on the bottom side. For this reason the bottom plate of the suction tube is fitted with a bent lip. This should engage in a blind recess drilled in the bottom (Figure 6-38).

Then the bottom valve-assembly (4) must be inserted by hand. It is not allowed to mount the bottom valve with the aid of a magnet, because then the bottom valve will be magnetised and will attract dirt particles. Check that the copper ring (60) is still in the correct position.

Place the cylinder tube (17) on the bottom valve assembly. Check that the cylinder is centred to the reservoir tube and the bottom valve.

Place the overflow receptacle (82) (assembled in paragraph 6.6.2) in the damper.

Ensure that the tubes of the overflow receptacle reach into the suction tube (Figure 6-39). If necessary, stick steel pins into the tubes to make the positioning easier. Press the overflow receptacle against the stop in the reservoir tube.

Always use new rubber components (O-rings) and nylon tubes when installing the overflow receptacle.

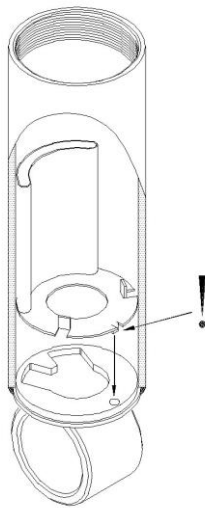


Figure 6-38; Placing the suction tube

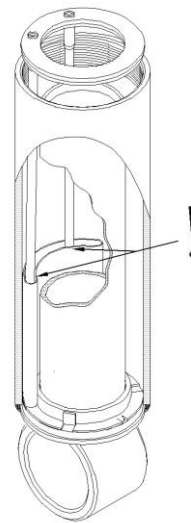


Figure 6-39; Placing the overflow receptacle

Fill a clean graduated beaker with the required amount of oil, as specified in the damper specific parts list. Only use the KONI oil as prescribed in the parts list. Prevent the oil from getting mixed with air when filling the beaker: do not 'splash' the oil in.

Pour the oil gently in the cylinder tube, completely filling the cylinder. The remaining oil will flow into the reservoir. Be careful not to 'splash' the oil. Pour the last bit of oil along the inner thread of the reservoir tube; this will make it easier to screw in the guide later.

For all damper applications

Push the guide over the piston rod against the piston section.

Carefully push the entire assembly into the reservoir tube, keeping the piston pressed against the guide. Lower the piston into the cylinder tube until the thread of the guide rests against the reservoir tube (Figure 6-40). Doing so, the guide must not be lifted because this also means lifting the cylinder tube: this might result in an incorrect position of the cylinder tube on the bottom valve. To avoid this, tighten the guide so the cylinder tube is secured, but do not torque at this stage.

Fully compress the piston rod once and then extend it completely (if necessary, slacken one of the valves), to align piston rod and cylinder.

Tighten the guide at the prescribed torque with a special wrench *Please refer to section 6.8 and 6.9.*

Important

The tightening of the guide requires a big torque. For this reason the damper must be properly fastened in a vice. In order to make the tightening easier the used wrench may be equipped with an extension pipe.

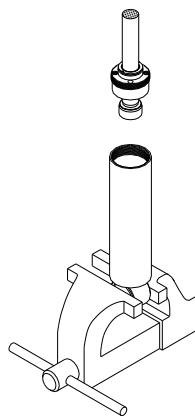


Figure 6-40; Mounting of the guide

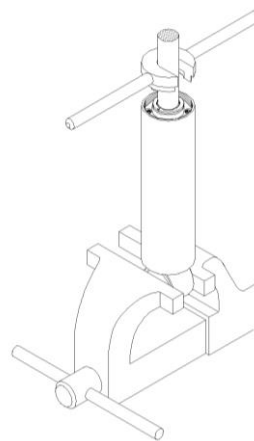


Figure 6-41; Tightening of the guide

During the tightening the piston must be checked regularly for the possibility of binding: do this by turning the piston rod. As soon as binding is detected loosen the guide and repeat the previous procedure.



If the damper cannot be assembled without binding, the components must be checked. A binding damper must never be used: this will result in accelerated wear.

Once the guide has been tightened, the copper ring (60) must be replaced when the damper is reopened again.

Now adjust the damper to the right forces according to the correct adjusting procedure.
Please refer to section 6.7.

After adjustment the washer (86) must be mounted between the gasket reservoir tube seal (24) and the reservoir tube seal nut (25). At assembly special attention must be paid to the position of the washer. The cut part of the washer must not be placed above one of the holes for the valves (Figure 6-43).

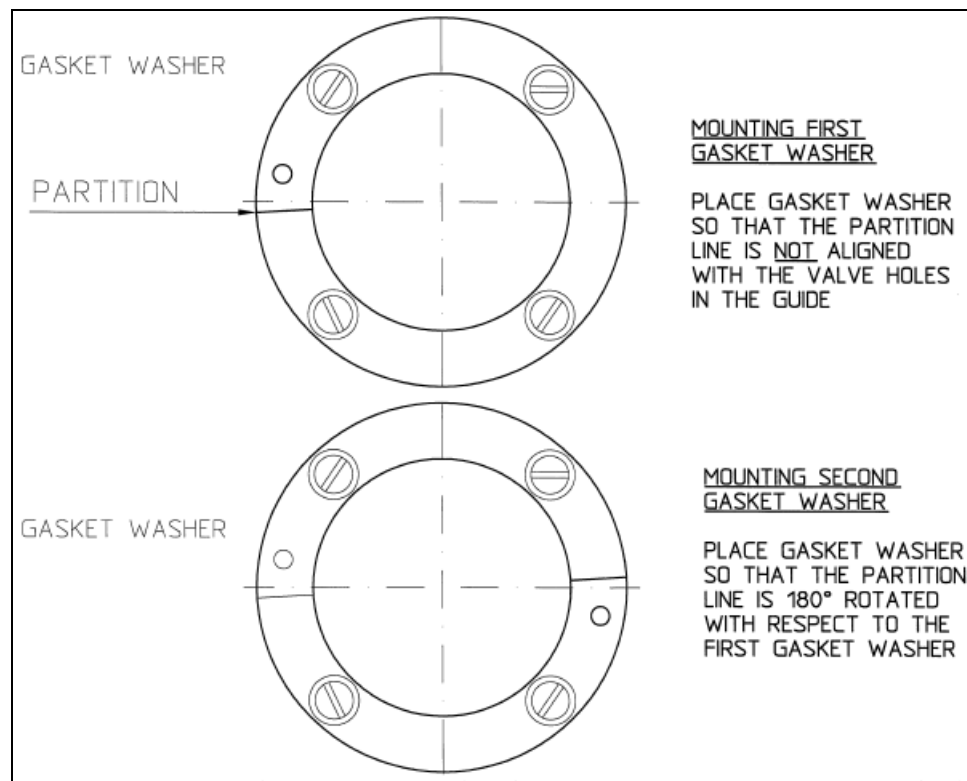


Figure 6-42; Installation of gasket washers

The easiest way to mount the gasket reservoir tube seal is to first place the outer edge in the tube (1). Then press in the inner edge (2) (Figure 6-44).

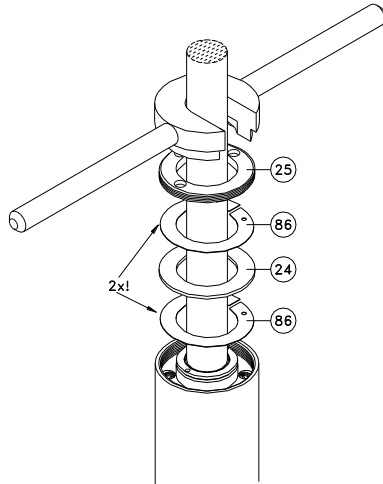


Figure 6-43; Mounting of the reservoir sealing

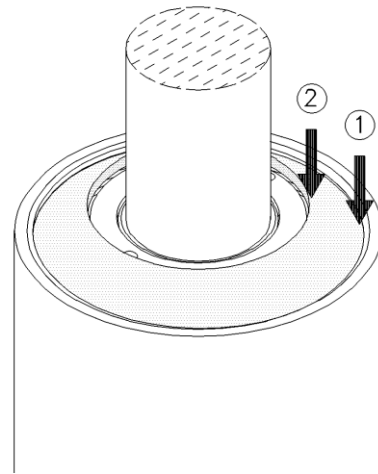


Figure 6-44; Mounting of the gasket

If a gasket reservoir tube seal must be replaced without dismantling the complete damper, a new seal can be cut through at an angle of 45°. When mounting the tube seal first press the gapped side into the tube (Figure 6-45).

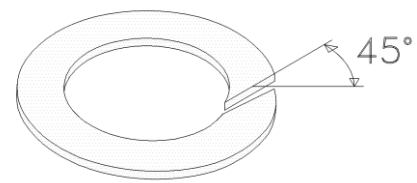


Figure 6-45; Tube seal

Now the reservoir tube seal nut (25) can be mounted at the right tightening torque.

Mount the dust bellow (74) over the rod oil seal nut (27).

Before mounting of the dust cover (19) first apply Loctite on the thread. The dust cover must then be tightened to the correct torque. A special tool (available through KONI) can be used to mount the dust cover at the correct torque. *Please refer to section 6.8 and 6.9.*

A loose dust cover with the centring bush can be mounted without any special tooling.

A new name plate and the attachments (*please refer to section 5*) can now be installed.

6.7 Re-adjustment of the shock damper

A proper adjustment is only possible if a calibrated test machine is used. This machine must be equipped with the proper auxiliary tools to mount the damper without clearance and without lateral load.



It is very important that the adjustment procedure is followed to the letter. Improper adjustment may damage both damper and test machine.

Before the damper is adjusted you must be certain it has been properly primed. This is already described in the previous sections.

6.7.1 Valve adjustment

The damping forces are regulated by the valves in the guide (Figure 6-46).

The adjustment of the valves must be carried out in the right order to achieve the required characteristic.

The damping force is determined by the pre-tension of valve (39) on the valve seat (pressed into the guide). The pre-tension is generated by coil spring (40) and adjusted by means of adjusting screw (41).

All adjusting screws are fitted with right-hand threading. Thus, for every valve a heavier setting is achieved by turning the adjusting screw clockwise.

The adjusting screw must be locked after adjustment. Therefore the adjusting screw is fitted with a plastic lock washer (A), which is self-locking.

Check the adjusting screws after adjustment: they must not extend above the surface of the guide! If they do; check that the right components have been mounted and if all valves have been adjusted correctly.

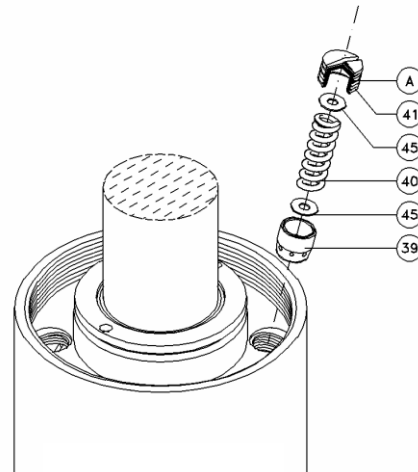


Figure 6-46; Damping valves

6.7.2 Adjusting procedure

Please refer to the damper specific adjustment Instruction for the correct instructions.

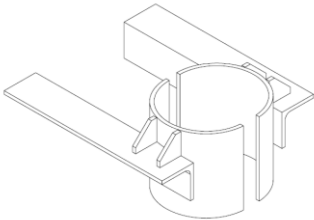
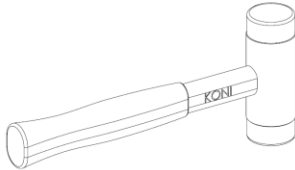
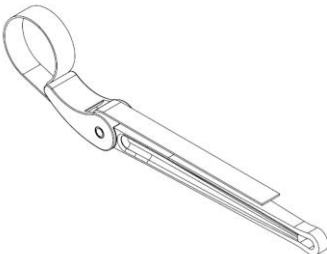
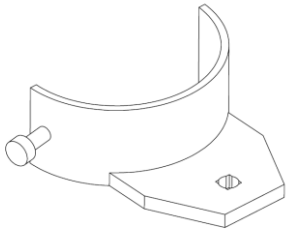
1. Partially open the valve that is to be adjusted first
2. Close all other valves
3. Start the test machine, with stroke and rpm as required for the adjustment of the first valve
4. Turn the adjusting screw of the valve to be adjusted first until the prescribed force is reached
5. Repeat 3 and 4 for the other valves

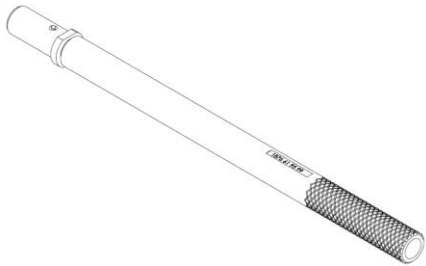
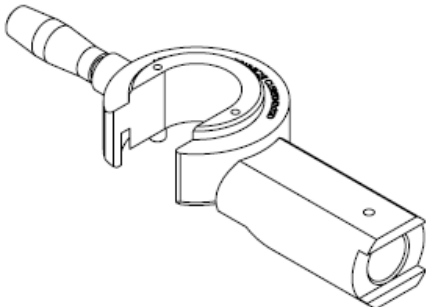
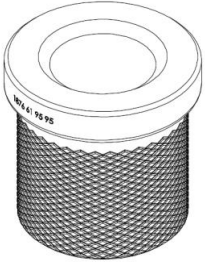
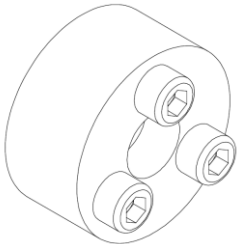
6.7.3 Tolerances on forces

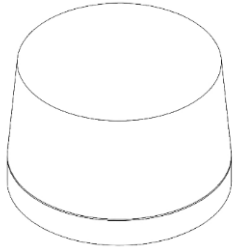
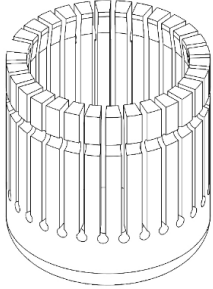
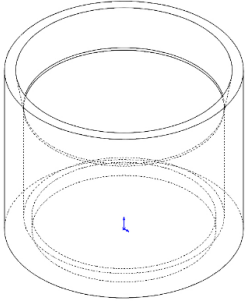
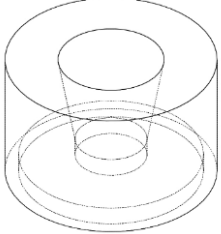
The tolerances on the adjustment- and check-forces are reported on the “Instruction for adjustment” for the referenced damper.

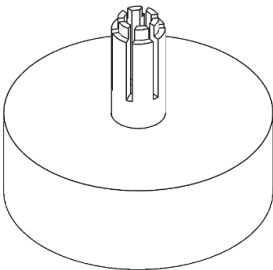
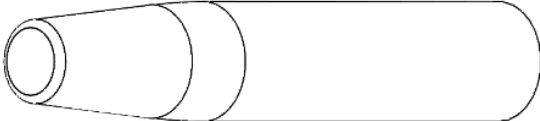
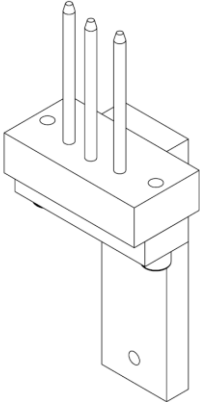
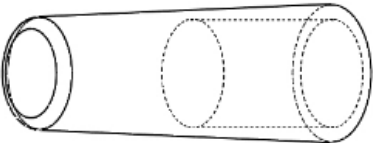
6.8 Special Tools

In order to efficiently overhaul the dampers the following special tools are recommended. In addition to the special tools, normal workshop tools as well as a damper test machine are required.

Item	Description	Tool number
1	Clamping tool for in vice 	1876 02 48 89
2	Plastic hammer 	1958 01 00 02
3	Strap wrench 	1959 20 00 02
4	Adapter for torque wrench 	1877 01 13 12

5	<p>Lever</p> 	1876 61 95 99
6	<p>Adapter for Gland nut installation/removal</p> 	1876 61 95 78
7	<p>Auxiliary tool (to loosen guide from cylinder)</p> 	1876 61 95 97
8	<p>Adapter (for torque wrench)</p> 	13 09 003 0

9	<p>Mounting cone for piston seal</p> 	12 09 025 0
10	<p>Mounting Sleeve for piston seal</p> 	12 09 024 0
11	<p>Calibration mandrel for piston seal</p> 	12 09 021 0
12	<p>Reduction Cone for piston bolt seal</p> 	13 09 001 0

13	<p>Assembly tool for piston bolt seal</p> 	13 09 002 0
14	<p>Calibration cone</p> 	13 09 004 0
15	<p>Return tubes assembly tool</p> 	16 09 003 0
16	<p>Protection cone</p> 	12 09 022 0

6.9 Tightening torques and locking

The tightening torques for all threaded fastenings in the damper are specified below. When thread locking is required, this is indicated as well. The thread locking must be carried out with due care in order to achieve the required strength:

- Remove all loose dirt
- Clean and degrease all components.
- White spirit can be used for degreasing (boiling point range 140°C - 190°C)
- When using solvents, the local regulations must be complied with.
- Apply the locking agent: In case of the piston/ piston rod fastening it must be applied to the inside thread. For all other fastenings it must be applied on the outside thread.
- Apply Loctite as short as possible (Max. 10 min.) before assembly.
- After assembly the locking agent must cure for 2 hours at a temperature of minimum 20°C: do not put any load on the fastening during this period.

Tightening torque's and locking type 02				
	Version	Torque (Nm)	Tolerance (Nm)	Locking (Loctite no.)
Piston	¾" UNF	150	±15	270 Steel-cast iron 648 steel-steel
	Air escape plate ¾"	60	±15	270 Steel-cast iron 648 steel-steel
Guide		550	±150	N.A.
Reservoir tube seal nut		350	±25	N.A.
Rod oil seal nut	Lip seal	40	±4	N.A.
Screwed dust cover	Primer Black	150	±30	2701
	Primer Brown / Yellow	150	±30	221
Valve stop (bottom valve)		18	±3	270
Screw (low noise bottom valve)		4	0 / +5	270
Bolts of dust cover	Hexagon-head bolt	8	1/-0	N.A.
	Hollow-head bolt	10	±1	N.A.
Valve seats		N.A.	N.A.	601

6.10 Oils, lubricants and grinding compound

6.10.1 Oil Type



Depending on the specific damper requirements, e.g. climatic requirements, different types of hydraulic oil can be used. It is imperative to use the correct KONI hydraulic damper oil. The characteristics and proper function of the damper are determined in combination with this specific oil. Please refer to the damper specific parts list for the correct damper oil.

6.10.2 Lubricants

Several lubricants are used for the assembly of the damper:

Polylub-GLY 801 Part number: 1006-02-00-42

Lip seal (rod oil seal) and wiper ring:

After the guide assembly, lubricate the work surface of the seal and the wiper ring.

Gasket reservoir tube seal:

The gasket reservoir tube seal of the damper is lubricated before assembly with the oil used in the damper.

O-rings:

Unless otherwise specified all O-rings must be lubricated before assembly.

6.10.3 Grinding compound

For grinding purposes use grinding compound:

Durolin fine + gross Part number: 1971-22-01-02

7 Testing and Troubleshooting

7.1 General

It is recommended to conduct all tests on a (KONI) test machine in order to verify correct damping forces. With the help of this machine the complete performance of the damper can be investigated.

Wear or incorrect assembly of the silentblocs in the eyes of the damper may result in incorrect performance graphs. If wear is found, the silentblocs should be disposed of and new ones should be used to fix the shock damper to the machine.

Before the dampers can be tested properly, ensure that there is no air left in the cylinder. It is therefore advised to prime the damper.

Priming instruction:

1. In vertical position, press the piston rod to the minimum length
2. For horizontal dampers: In horizontal position, pull the piston rod to the maximum length.
3. For vertical dampers: In vertical position, pull the piston rod to the maximum length.
4. Press the piston rod to the mounting length.

The vertical dampers have to be tested in a vertical position and the horizontal dampers have to be tested horizontally.

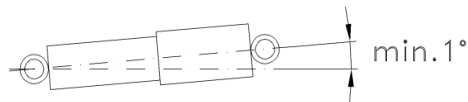


Figure 7-1: Mounting position lateral dampers

When testing horizontally, please note that the dampers are positioned in the right position (please note the “BELOW” mark on the damper) and under a positive angle of at least 1°.

When mounting the damper on the test machine, check if the full test stroke can be made. Furthermore the damper must be mounted in such a way that the test is conducted around the mid position of the damper.

7.2 Test data

The KONI Railway dampers have symmetrical forces, which mean that the forces during the extension and compression stroke are equal. The damper tests must be conducted at an ambient temperature of $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

For more test details please refer to the applicable *Test instructions* of each damper type.

NOTE

Because of some wear of the inner parts during service, the forces can drop with a maximum of 30%.

7.3 Test machine

In general dampers can be tested on any machine that allows the two fixing points of the dampers to move relative to each other. The forces generated by the damper can be measured mechanically, electronically or hydraulically. A force stroke diagram can be produced by recording the force and the displacement simultaneously. Be very careful when adjusting the machine to the movement of the damper in order to prevent serious damage to machine or damper.

The performance graph should be made on the test machine after the damper performed 5 test strokes in order to prevent interference of adhesion of seals.

7.4 Diagram analysis

The KONI test machine produces a force-stroke diagram (clockwise) (Figure 7-2). The displacement is written on the horizontal axis of the diagram, while at the same time the damping force is registered along the vertical axis. The outward damping forces can be found above the zero level, the inward damping forces below. Point A in the diagram is the starting point of the outward movement. At point B the piston has reached its maximum speed: here the outward damping force must be measured. Then the outward speed decreases again to zero at point C. Here the inward movement starts so that at point D the maximum inward speed is reached.

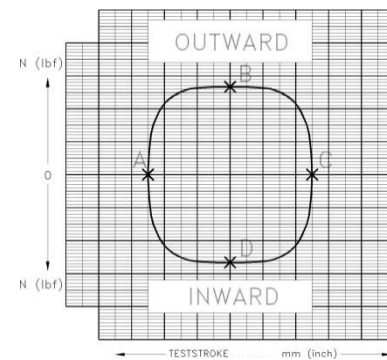


Figure 7-2 Typical Force-Stroke diagram

7.5 Deviating test diagrams

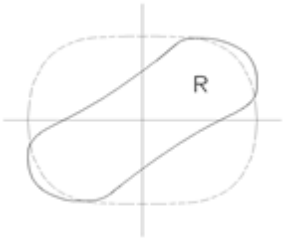
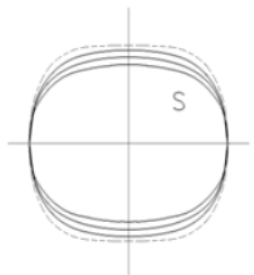
The following guidelines may be useful in case of malfunctions.

<p><u>Malfunction during both inward and outward movement.</u></p> <p>This may be caused by:</p> <ul style="list-style-type: none"> • Oil deficiency. • Malfunction in lock nut section (e.g. damping valve or rod guide). • Faulty seal between guide and cylinder. • A combination of the malfunctions below. 		
<p><u>Malfunction during inward movement.</u></p> <p>This may be caused by:</p> <ul style="list-style-type: none"> • A malfunction in the bottom valve section. • A faulty seal between bottom valve and cylinder. 		
<p><u>Malfunction during outward movement.</u></p> <p>This may be caused by:</p> <ul style="list-style-type: none"> • A malfunction in the piston section. 		
<p>With the help of the diagrams below it is possible to determine the possible causes of deviating forces or deviating diagram shapes. For the component numbers mentioned: see Appendix A for the parts list of the damper.</p>		
A	<p>Both the inward and outward damping force of the damper have lowered somewhat:</p> <ul style="list-style-type: none"> • Re-adjustment may restore the original damping forces. • Too much wear of the piston rod guide. 	
B	<p>No or hardly any damping forces during both inward and outward movement:</p> <ul style="list-style-type: none"> • Adjusting screw (41) has come loose and has loosened so far that valve spring (40) has little or no pre-tension left; • No or far too little oil present. The damper should show clear signs of oil leakage; • Leakage of oil between cylinder tube (17) and guide (122); • Too much wear between piston rod (16) and guide (122); • Faulty valve (39) or valve seat (38); • Valve seat (38) moves ; • Dirt between valve (39) and valve seat (38). 	

C	<p>Outward the damper only works over a part of the stroke:</p> <ul style="list-style-type: none"> Local wear of cylinder tube (17) 	
D	<p>Damper is lighter outward than inward:</p> <ul style="list-style-type: none"> Non return valve (13) on piston (12) leaks a bit, e.g. because of dirt or damage of valve seat of piston (12). Plastic ring for piston (64) is damaged. 	
E	<p>Damper does not work at all outward, but works properly inward:</p> <ul style="list-style-type: none"> Non return valve (13) on piston (12) is open, e.g. because of dirt or damage of valve seat of piston (12). Piston (12) has come loose. 	
F	<p>Diagram shows a sharp outward peak:</p> <ul style="list-style-type: none"> Damper hits a stop during the outward stroke: incorrect mounting on the test machine or the stroke of the machine has been set too large. 	
G	<p>Damper has free stroke in inward direction:</p> <ul style="list-style-type: none"> Too little oil, resulting in air in cylinder tube. Non return valve (5) in bottom valve opens with great difficulty. Damper for vertical use has been tested horizontally. Damper for horizontal use has been tested horizontally, but upside down, that is, the mark 'BELOW' facing up, or the mark 'ABOVE' facing down. Return tube (53) has not been mounted or is leaking. 	

<p>H</p>	<p>Damper is lighter inward than outward (for a damper that should be symmetrical):</p> <ul style="list-style-type: none"> • Non return valve (5) in bottom valve (4) is a bit leaky, e.g. because of dirt or damage of valve seat of bottom valve (4). • Oil leakage between cylinder tube (17) and bottom valve (4). 	
<p>I</p>	<p>Damper does not work at all inward, but works properly outward:</p> <ul style="list-style-type: none"> • Non return valve (5) in bottom valve (4) remains open. • Valve stop (7) of bottom valve (4) is loose. 	
<p>J</p>	<p>Diagram shows a sharp inward peak:</p> <ul style="list-style-type: none"> • Damper hits the stop during the inward stroke: incorrect mounting on the test machine or the stroke of the machine has been set too large. 	
<p>K</p>	<p>Diagram shows an inward peak and is tilted to one side:</p> <ul style="list-style-type: none"> • Too much oil in the damper. 	
<p>L</p>	<p>Diagram shows a rounded inward peak:</p> <ul style="list-style-type: none"> • Damper hits bellows (74) during the inward stroke: the damper has been mounted on the test machine incorrectly or the stroke of the machine has been set too long. 	

<p>M</p>	<p>Diagram rises steeply and shows vibrations in inward and / or outward direction:</p> <ul style="list-style-type: none"> • Piston (12) cannot move freely in cylinder tube (17). • Piston rod (16) is warped and cannot move freely in guide (122). <p>This phenomenon may also be caused by vibrations of the writing mechanism of the test machine, especially in case of dampers with an almost 'square' diagram.</p>	
<p>N</p>	<p>Diagram is 'square' inward and outward in lower and / or upper dead point:</p> <ul style="list-style-type: none"> • Piston (12) cannot move freely in tube (17). • Piston rod (16) is warped and cannot move freely in guide (122). 	
<p>O</p>		
<p></p>	<p>Damper has become heavier both inward and outward:</p> <ul style="list-style-type: none"> • Valve seat (38) has been displaced so that valve spring (40) has too much pre-tension, or is even blocked entirely. • Valve seat (38) is blocked up (partially). 	
<p>Q</p>	<p>Diagram shows the same amount of free stroke both inward and outward:</p> <ul style="list-style-type: none"> • Too much clearance of attachments. • Damper has not been mounted on the test machine properly. 	

<p>R</p>	<p>Top of diagram is tilted:</p> <ul style="list-style-type: none"> • Too soft or worn fixing rubbers have been mounted. 	
<p>S</p>	<p>Diagram is inconsistent inwards and outwards: it shows variation below the nominal value:</p> <ul style="list-style-type: none"> • Dirt in the damper. 	

Data sheet maintenance

Corrective maintenance instruction

1. General Information

This document is the certification to the requirements in Medha - MT18Br2 project.

2. Project and Spring Information

Customer:	Medha Servo Drives Pvt. Ltd. and EC Engineering Sp. z o.o.
Project:	MT18Br2
Technical specification, rev.:	MT18Br2 001470-03, rev. 3
Drawing, rev.:	MT18Br2_001449-2, rev. 3 (outer Spring) MT18Br2_001448-2, rev. 2 (inner Spring)

3. Visual inspection

The corrosion-inhibiting coating of coil springs can be damaged by falling rocks during service, handling or transport. These defects can cause corrosion damages bringing about incipient cracks and spring fractures. For this reason, coating defects must be located by visual inspection and professionally repaired as soon as possible.

4. Revision History of this document

Revision	Revision date	Description	Name
-	31.08.2021	First release	Sinan Gültekin

Operating Instruction

Semi-Permanent Coupler



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Dellner Couplers

Dellner Couplers					
0	2018-01-31	First Issue	T. Rink	J. Glimtö	M. Hååg
<i>Rev. No.</i>	<i>Rev. Date</i>	<i>Reason for issue</i>	<i>Prepared by</i>	<i>Checked by</i>	<i>Approved by</i>

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1 Safety Information

1.1 General Safety Precautions



WARNING: The use of solvents as cleaning agents and the use of lubricants can involve health and/or safety hazards. The manufacturers of the solvents and lubricants should be contacted for safety data. The recommended precautions and procedures of the manufacturers should be followed.



CAUTION: The use of an air jet, which must be less than 8 bar, to blow parts clean or to blow them dry after being cleaned with a solvent will cause particles of dirt and/or droplets of the cleaning solvent to be airborne. These conditions may cause skin and/or eye irritation.



CAUTION: When using an air jet do not direct it toward another person. Improper use of air jet could result in bodily injury.



CAUTION: Personal eye protection must be worn when undertaking work. This is especially important during disassembly of the buffer as loose parts and springs may fly out.



CAUTION: Retained air under pressure (even though air supply is cut-off) may cause gaskets and/or particles of dirt to blow when this device and/or any component part are removed from the equipment arrangement. Personal eye and ear protection must be worn and care taken to avoid possible injury when performing any work on this device and/or component part.

1.2 Heavy Equipment



CAUTION - Heavy equipment

The coupler and its included parts are very heavy. If these are not supported or lifted properly it could result in severe personal or equipment damage.

To avoid accidents, do the following:

1. Use a suitable lifting device when removing or installing heavy parts.
2. Make sure the coupler is supported only in solid areas.

1.3 Vehicle in Operation



DANGER – Vehicle in operation

Special precautions must be taken so that operation of the vehicle during coupling/uncoupling will not result in severe injury or death and/or damage to equipment.

To avoid accidents, do the following:

1. Make sure no one is in the vicinity of the vehicle before operation is started.
-

1.4 Moving Parts



CAUTION - Moving parts

When operated, some coupler parts are moving. Moving parts can cause personal injury.

To avoid accidents, do the following:

1. Keep hands etc. away from any moving parts when operating the coupler.
-

2 Normal Operation

2.1 General

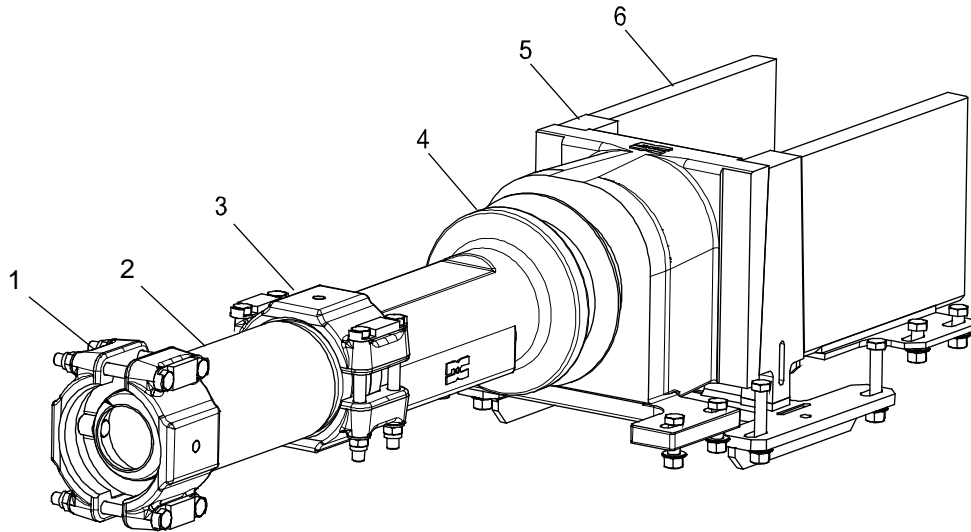


Fig. 1 Semi-Permanent Coupler

No.	Description	No.	Description
1	Socket joint	4	Draft gear
2	Tube	5	Locking wedge
3	Socket joint	6	Clamping device

2.2 Safety Precautions



Carefully read and follow safety instructions in section 1 before proceeding.

2.3 Coupling

1. Make sure that the semi coupler half (5) is equipped with the guide cone (9).

Note If a socket joint is being reused the screws (6), washers (3) and nuts (2) shall be replaced with new ones.

2. Grease the contact surfaces of the flanges and both socket joint halves (4 and 8) with Lagermeister 3000+.
3. Slowly bring cars together.

Note Make sure to align the two coupler halves accurately, both vertically and horizontally, before bringing the vehicles together.

4. Gently knock the socket joint halves (4 and 8) into place over the flange joint as shown in Fig. 2. Make sure that the guide pins on the socket joint halves are correctly positioned in corresponding recess in the guide cone (9).
5. Check that both socket halves are parallel within 2 mm, equal distance. If they are not parallel remove one of the socket joint halves and start the procedure again.
6. Apply Molykote 1000, to the screw threads and fit screws (6), lock washers (7) to the socket joint half (8).
7. Fit the washers (3) and nuts (2) to the socket joint (4) and tighten nuts (2) by hand, without tools.
8. Again check that both socket joint halves are parallel within 2 mm, equal distance and apply 60 Nm torque to the nuts in a crosswise pattern.
9. Verify that both sockets halves are still parallel and apply 120 Nm torque to the nuts continuing with the crosswise pattern.
10. Verify that both sockets halves are still parallel and apply the total 185 Nm torque to the nuts in a crosswise pattern. Repeat the sequence of torque nuts to 170Nm in a crosswise pattern until there is no further rotation of the nuts.

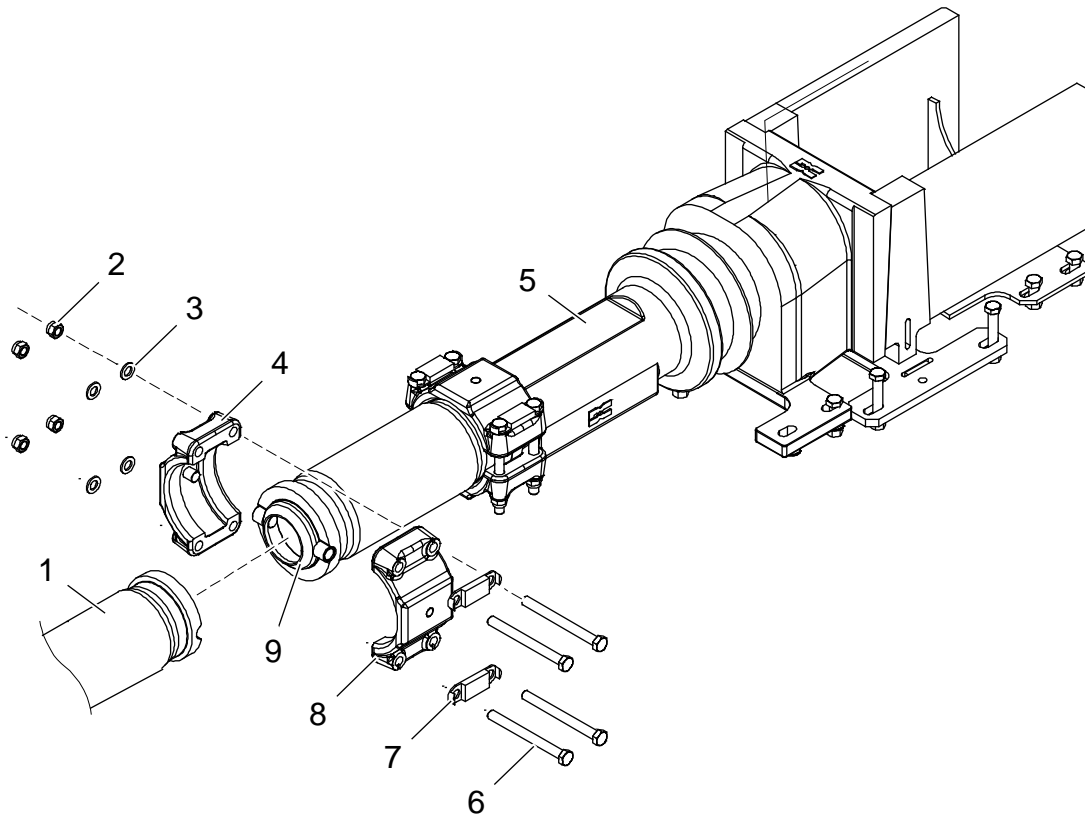


Fig. 2 Coupling/Uncoupling

No.	Description	No.	Description
1	Mating coupler	6	Screw
2	Lock nut	7	Lock washer
3	Washer	8	Socket joint half
4	Socket joint half	9	Guide cone
5	Semi-Permanent Coupler		

2.4 Uncoupling

1. Remove the socket joint halves (4 and 8) by removing the nuts (2), washers (3) and screws (6).
2. Separate *the cars*.

3 Troubleshooting

3.1 General

This section contains information for performing operating related troubleshooting on the coupler.

3.2 Troubleshooting Chart

Fault	Possible Cause	Operator Intervention
Will not couple/uncouple	Foreign material obstructing coupling/uncoupling.	Manually remove foreign material.
	Coupling details worn/rusty.	Check socket joint kit. Replace as required.
	Flanges will not catch, excessive height difference	Lift coupler half a bit more
Slack when coupled	Rear nut loose	Check rear nut. Replace as required.
	Rubber springs broken or exhausted	Check rubber springs. Replace as required.
Cannot absorb the draft and buff loads.	Exhausted or broken Rubber springs	Draft gear requires repair.

4 Emergency Operation

N/A.

5 List of figures

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Corrective Maintenance

Semi-Permanent Coupler



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1 Introduction

1.1 Cleaning

Make sure the coupler is thoroughly cleaned before any work is performed on it. Thus preventing contamination to reach internal parts of the coupler that could be damaged due to increased wear. Prior to assembling parts and mounting them on the coupler make sure that all parts and aligning surfaces on the coupler have been thoroughly cleaned in order to prevent malfunctions due to incorrect assembly and to assure correct pre-tension in screws.

1.2 Touch-up Painting

Damaged painted areas on the coupler must be repaired to prevent further deterioration. The coupler is painted with following during manufacturing:

Primer

Primer: Temacoat GPL-S Primer
Colour: TVT 4002 grey

Top Coat

Top coat: Duasolid 50 or polyurethane
Colour: RAL 9005, Black

Technical data and specifications for primer and top coat according to paint suppliers data sheet.

NOTE! Always read and follow instructions on warning label on cans.

Damages that may have occurred during assembly or in traffic can be retouched with normal synthetic paint (Type Servalack).

If the primer paint on the mechanical coupler front face is damaged, the front face shall be cleaned from dirt and rust, dried and protected with a thin layer of CTP D 350.

NOTE! Stainless steel parts, chrome plated, nickel plated surfaces or grounding connections shall not be painted.

The following surfaces are only painted with primer:

- Inside of socket joints
- Flanges for socket joints
- Machined surfaces for screws and nuts.

1.3 Remounting/Assembling

Remount/assemble parts of the coupler in opposite order of dismantling/disassembling unless otherwise stated in any of the relevant sections. Use only new fasteners as described in this chapter. Lubricate all parts during and after remounting with proper lubricant.

1.4 Fasteners

When assembling parts and when mounting parts on coupler always use new fasteners, such as screws, nuts, washers, roll pins, securing plates etc. Make sure - and confirm with the Parts List that all fasteners are of the same dimension and quality as the ones previously used on the device being replaced, overhauled or mounted on the coupler. Make sure that there are at least 2 threads from the screw protruding through the nut in screw/nut applications. Tighten screws to correct torque (if not specified, follow the screw suppliers recommendations). Recommended tightening torques are listed below.

1.4.1 Lubrication Threads

Use a brush and apply Molykote P 1000, to the first 4-5 screw threads in a very thin layer. The brush needs to be reeved around the screw to remove any excess layer of the anti seize paste. Make sure no anti seize paste gets between nuts and mating surface ensure correct torque.

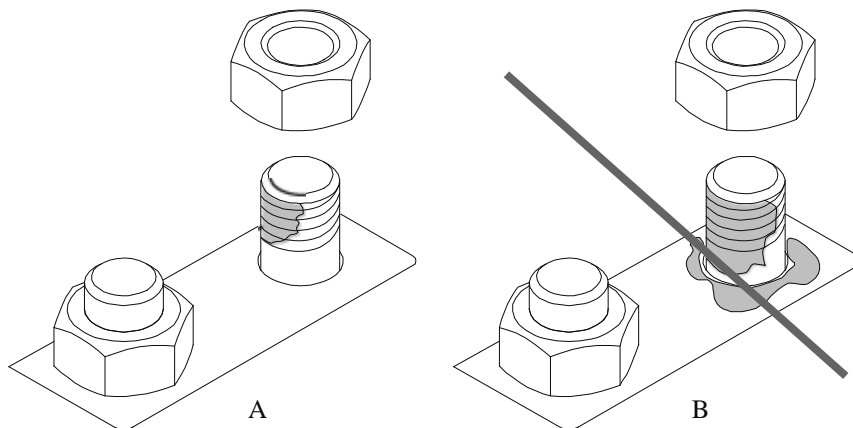


Fig. 1 Lubrication Threads

Item No.	Part Description	Item No.	Part Description
A	OK	B	Not Ok

1.4.2 Tightening Torques


In the table below the tightening torques ($\pm 5\%$) for lubricated fasteners are listed. Always lubricate with Molykote 1000 or equal unless Loctite should be applied. Zinc plated fasteners tensile strength 8,8 (ISO) grade 5 (SAE). Stainless steel fasteners tensile strength Class 70 and 80.


These tightening torques apply for all fasteners unless otherwise specified within the instructions.


	TORQUE			
	A2-70	8.8 and A4-80	10.9	12.9
Dimension	Nm	Nm	Nm	Nm
M6	6	8	10	12
M8	16	20	30	35
M10	30	40	60	70
M12	55	70	100	120
M16	130	170	250	300
M20	260	330	480	580
M24	450	580	800	1000
M30	900	1130	1500	1800
Dimension UNC	Nm	Nm		
1/4"	8	10		
5/16"	15	20		
3/8"	25	35		
7/16"	40	55		
1/2"	60	80		
9/16"	90	120		
5/8"	125	160		
3/4"	220	280		
7/8"	340	450		
1"	500	660		


2 Safety Information


2.1 General Safety Precautions

 **WARNING:** The use of solvents as cleaning agents and the use of lubricants can involve health and/or safety hazards. The manufacturers of the solvents and lubricants should be contacted for safety data. The recommended precautions and procedures of the manufacturers should be followed.

 **CAUTION:** The use of an air jet, which must be less than 8 bar, to blow parts clean or to blow them dry after being cleaned with a solvent will cause particles of dirt and/or droplets of the cleaning solvent to be airborne. These conditions may cause skin and/or eye irritation.

 **CAUTION:** When using an air jet do not direct it toward another person. Improper use of air jet could result in bodily injury.

 **CAUTION:** Personal eye protection must be worn when undertaking work. This is especially important during disassembly of the buffer as loose parts and springs may fly out.

 **CAUTION:** Retained air under pressure (even though air supply is cut-off) may cause gaskets and/or particles of dirt to blow when this device and/or any component part are removed from the equipment arrangement. Personal eye and ear protection must be worn and care taken to avoid possible injury when performing any work on this device and/or component part.

2.2 Heavy Equipment



CAUTION - Heavy equipment

The coupler and its included parts are very heavy. If these are not supported or lifted properly it could result in severe personal or equipment damage

To avoid accidents, do the following:

1. Use a suitable lifting device when removing or installing heavy parts.
 2. Make sure the coupler is supported only in solid areas.
-

2.3 Moving Vehicle



DANGER - Moving vehicle

Special precautions must be taken so that vehicle movement will not result in severe injury or death and/or damage to equipment.

To avoid accidents, do the following:

1. While working, engage the vehicle parking brake and apply stop blocks to the wheels of the vehicle.
-

2.4 Moving Parts



CAUTION - Moving parts

When operated, some coupler parts are moving. Moving parts can cause personal injury.

To avoid accidents, do the following:

1. Keep hands etc. away from any moving parts when operating the coupler.
-

3 Corrective Maintenance

3.1 Replacement of Semi-Permanent Coupler

3.1.1 Safety Precautions



Carefully read and follow safety instructions in section 2 before proceeding.

3.1.2 Special Tools/gauges

- Suitable Lifting Device
- Standard Toolkit.

3.1.3 Products

- Red torque seal (Stanadyne sealing lacquer)
- Molykote 1000.

3.1.4 Removal

1. Loosen the locking wedge (4) by removing screws (5), washers (10) and nuts (11).
2. Fit M16 screws to the holes (3) in the locking wedge (4).
3. Remove the locking wedge (4) from the vehicle by tightening the M16 screws.
4. Remove the screws (2), washers (12) and nuts (13) and carefully remove the draft gear (1) from the vehicle.
5. Remove the clamping device (6) by removing screws (7), washers (8) and nuts (9).

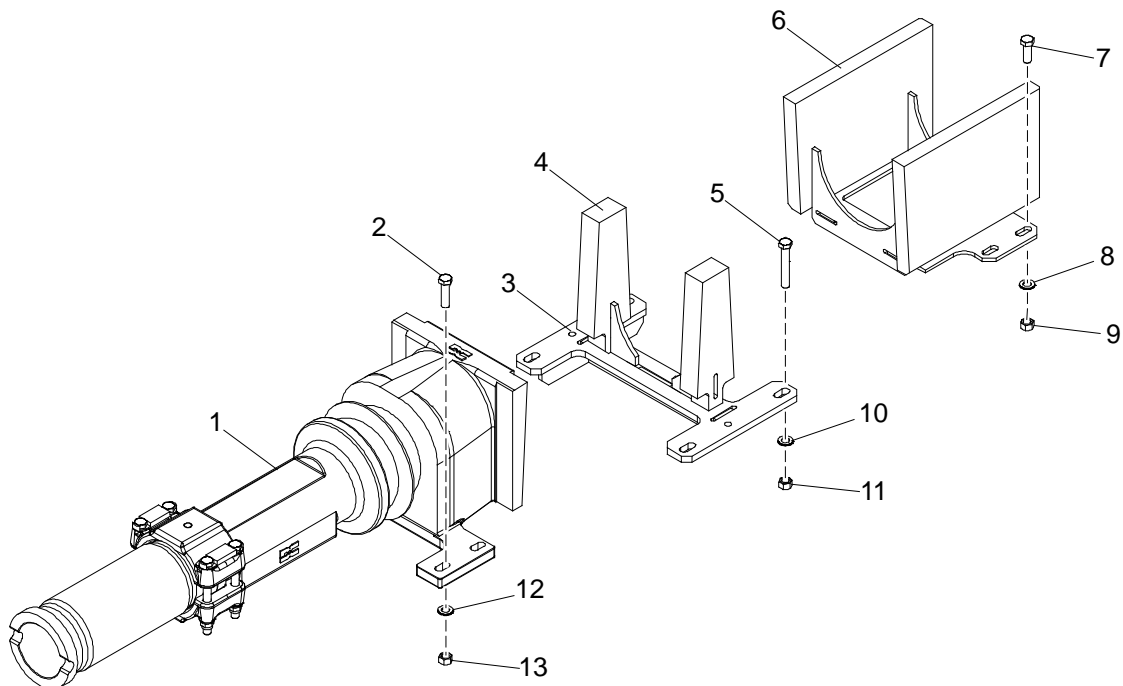


Fig. 2 Replacement of Semi-Permanent Coupler

No.	Description	No.	Description
1	Draft gear	8	Washer
2	Screw	9	Nut
3	M16 hole	10	Washer
4	Locking wedge	11	Nut
5	Screw	12	Washer
6	Clamping device	13	Nut
7	Screw		

3.1.5 Replacement

Replace all fasteners and rubber parts if applicable.

- Carefully fit the draft gear (1) to the vehicle using a suitable lifting device.
- Mount screws (2), washers (12) and nuts (13).
NOTE! Do not fully tighten the screws, only tighten the screws so that the draft gear is loosely fitted.
- Fit the clamping device (6) to the vehicle and mount screws (7), washers (8) and nuts (9).
NOTE! Do not fully tighten the screws, only tighten the screws so that the clamping device is loosely fitted.
- Make sure that the distance between the clamping device and draft gear is smaller than

the space needed by the locking wedge. This action provides a tight interface between the locking wedge and draft gear, and locking wedge and clamping device.

5. Fit the locking wedge (4) to the vehicle, push it upwards to fit it in between the draft gear (1) and clamping device (6). Mount screws (5), washers (10) and nuts (11). Tighten screws (5) to 170 Nm and mark screws with torque seal.
6. Fasten the draft gear: tighten the screws (2), washers (12) and nuts (13).
7. Fasten the clamping device: tighten the screws (7), washers (8) and nuts (9).

3.2 Replacement of Tube/Socket Joint

3.2.1 Safety Precautions



Carefully read and follow safety instructions in section 2 before proceeding.

3.2.2 Special Tools/Gauges

- Standard Toolkit.

3.2.3 Products

- Molykote 1000
- Gleitmo/Fuchs Lagermeister 3000+
- Torque seal (Stanadyne sealing lacquer).

3.2.4 Removal

Text within brackets () refers to Fig. 3.

1. Remove lock nuts (7), screws (3) and washer (6). Remove the socket joint upper (2) and socket joint lower (5) and carefully separate the Tube (1) and draft gear (4).

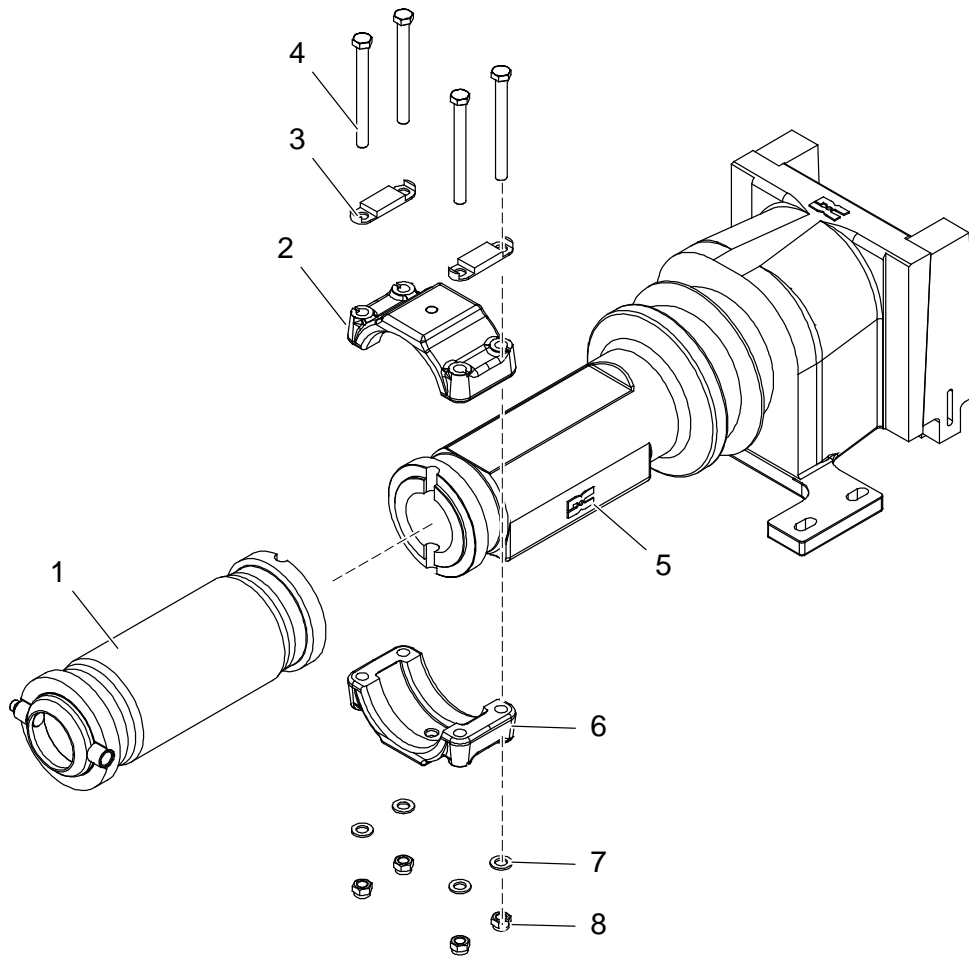


Fig. 3 Replacement of Tube/Socket Joint

No.	Description	No.	Description
1	Tube	5	Draft gear
2	Socket joint upper	6	Socket joint lower
3	Lock washer	7	Washer
4	Screw	8	Lock nut

3.2.5 Replacement

Replace all fasteners and rubber parts if applicable.

- Grease the contact surfaces or the flanges and both socket joint halves (2 and 6) with Lagermeister 3000+.
NOTE! Do not fill the drain hole in the lower socket joint with grease.
- Align the Tube flange and the draft gear flange and gently fit the socket joint halves (2 and 6). Make sure that the socket joint guide pin is correctly positioned in corresponding recess in the flanges.
- Apply Molykote 1000, to the screw threads and fit screws (4), Lock washer (3) and nuts (8). Tighten the nuts by hand.

4. Check that both socket joint halves are parallel within 2 mm and apply 60 Nm torque to the nuts in a crosswise pattern.
5. Verify that both sockets halves are still parallel and apply 120 Nm torque to the nuts continuing with the crosswise pattern.
6. Verify that both sockets halves are still parallel and apply the total 185 Nm torque to the nuts in a crosswise pattern. Repeat until 185 Nm is reached for all nuts.
7. Torque mark the screws (4) with torque seal.

3.3 Repair of Draft Gear

3.3.1 Safety Precautions



Carefully read and follow safety instructions in section 2 before proceeding.

3.3.2 Special Tools/Gauges

- Standard Toolkit
- Clamp, 169895.

3.3.3 Products

- Molykote 1000
- Gleitmo/Fuchs Lagermeister 3000+.

3.3.4 Removal

Text within brackets () refers to Fig. 4.

1. Remove the draft gear according to instruction 3.1.
2. Remove the two screws (3), securing plate (2) and key (1).
3. Place clamp 169895, against plate (6) and place assembly in a hydraulic press.
4. Compress the rubber springs (7) and (9) a few millimeters and dismount nut (4). Carefully release pressure and remove assembly from hydraulic press.
5. Remove washer (5), plate (6), spring (7), draw bar (10) and spring (9) from anchor (8).

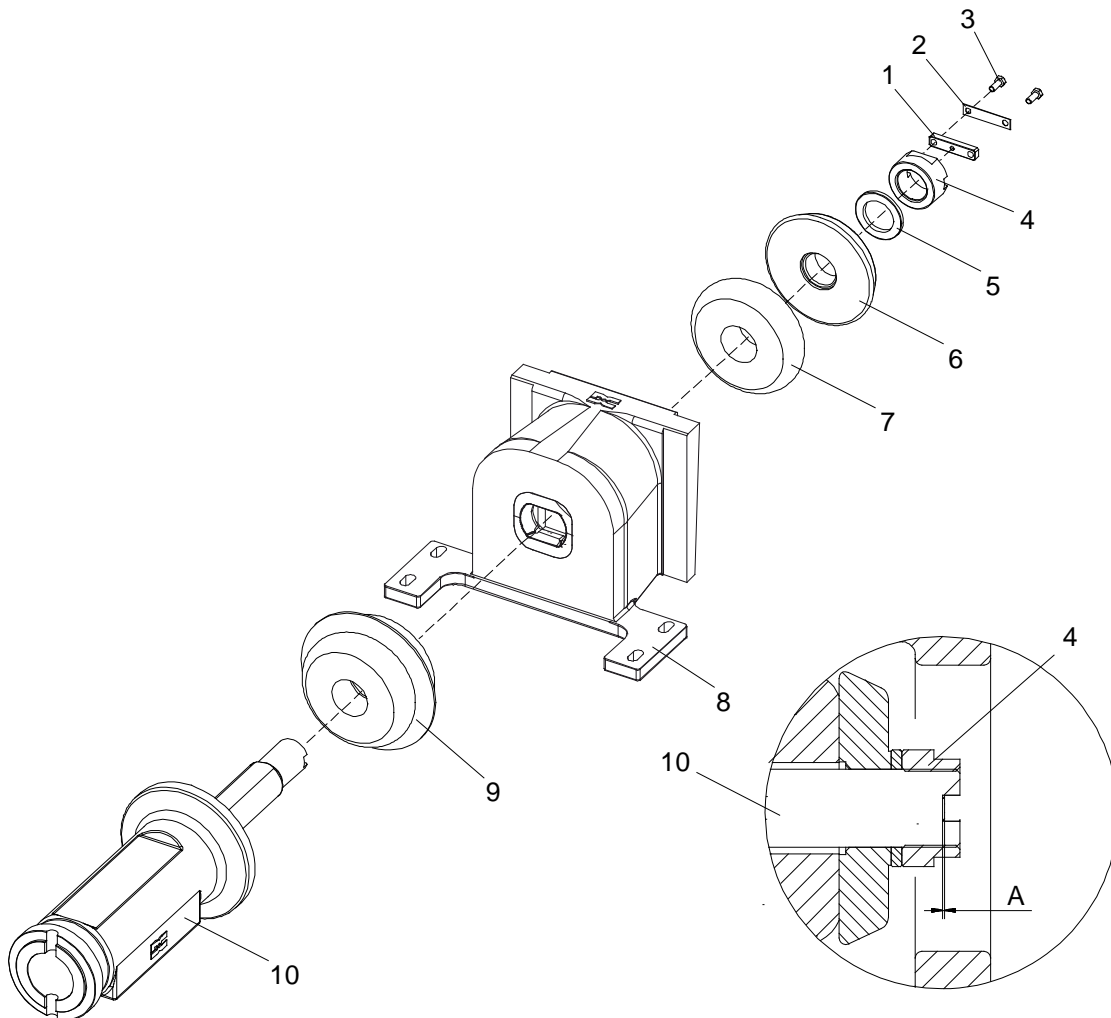


Fig. 4 Repair of Draft Gear

No.	Description	No.	Description
1	Key	6	Plate
2	Securing plate	7	Spring
3	Screw	8	Anchor
4	Nut	9	Spring
5	Washer	10	Draw bar

3.3.5 Replacement

Replace all fasteners and rubber parts if applicable.

1. Fit first spring (9) to draw bar (10).
2. Apply Lagermeister 3000+ to bushing inside anchor (8).
3. Fit the anchor (8) to the draw bar (10).

-
4. Fit the second spring (7) to the draw bar (10).
 5. Apply Lagermeister 3000+ to washer (5) and inner diameter of plate (6).
 6. Apply Molykote 1000 to nut (4). Fit plate (6), washer (5) and nut (4).
 7. Place clamp, 169895 against plate (6) and place assembly in a hydraulic press.
 8. Compress the elastomer spring package a few millimeters. Adjust the distance between the bottom of the key groove in the nut (4) and the bottom of the key groove in the draw bar (10). See Fig. 4, correct distance (A) is 1.5 ± 0.75 mm.
 9. Fit key (1), securing plate (2) and mount the screws (3). Bend two corners of the securing plate (2) up against screw heads to secure the screws (3).
 10. Carefully release pressure and remove assembly from hydraulic press.

4 Schematics

N/A.

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Preventive Maintenance

Semi-Permanent Coupler



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1 Introduction

1.1 Cleaning

Make sure the coupler is thoroughly cleaned before any work is performed on it. Thus preventing contamination to reach internal parts of the coupler that could be damaged due to increased wear. Prior to assembling parts and mounting them on the coupler make sure that all parts and aligning surfaces on the coupler have been thoroughly cleaned in order to prevent malfunctions due to incorrect assembly and to assure correct pre-tension in screws.

1.2 Touch-up Painting

Damaged painted areas on the coupler must be repaired to prevent further deterioration. The coupler is painted with the following during manufacturing:

Primer

Primer: Temacoat GPL-S Primer
Colour: TVT 4002 grey

Top Coat

Top coat: Duasolid 50 or polyurethane
Colour: RAL 9005, Black

Technical data and specifications for primer and top coat according to paint suppliers data sheet.

NOTE! Always read and follow instructions on warning label on cans.

Damages that may have occurred during assembly or in traffic can be retouched with normal synthetic paint (Type Servalack).

If the primer paint on the mechanical coupler front face is damaged, the front face shall be cleaned from dirt and rust, dried and protected with a thin layer of CTP D 350.

NOTE! Stainless steel parts, chrome plated, nickel plated surfaces or grounding connections shall not be painted.

The following surfaces are only painted with primer:

- Inside of socket joints
- Flanges for socket joints
- Machined surfaces for screws and nuts.

1.3 Remounting/Assembling

Remount/assemble parts of the coupler in opposite order of dismantling/disassembling unless otherwise stated in any of the relevant sections. Use only new fasteners as described in this chapter. Lubricate all parts during and after remounting with proper lubricant.

1.4 Fasteners

When assembling parts and when mounting parts on coupler always use new fasteners, such as screws, nuts, washers, roll pins, securing plates etc. Make sure and confirm with the Parts List that all fasteners are of the same dimension and quality as the ones previously used on the device being replaced, overhauled or mounted on the coupler. Make sure that there are at least 2 threads from the screw protruding through the nut in screw/ nut applications. Tighten screws to correct torque (if not specified, follow the screw suppliers recommendations). Recommended tightening torques are listed below.

1.4.1 Lubrication Threads

Use a brush and apply Molykote P 1000, to the first 4-5 screw threads in a very thin layer. The brush needs to be reeved around the screw to remove any excess layer of the anti seize paste. Make sure no anti seize paste gets between nuts and mating surface ensure correct torque.

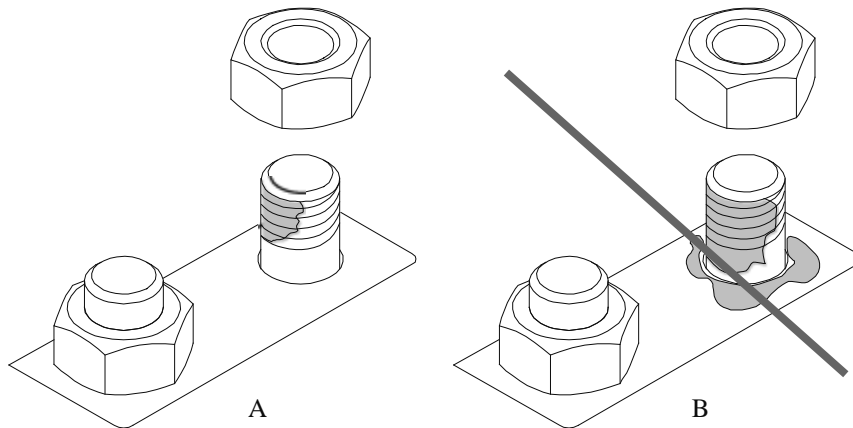


Fig. 1 Lubrication Threads

Item No.	Part Description	Item No.	Part Description
A	OK	B	Not Ok

1.4.2 Tightening Torques


In the table below the tightening torques ($\pm 5\%$) are listed for lubricated fasteners. Always lubricate with Molykote 1000 or equal unless Loctite should be applied. Zinc plated fasteners tensile strength 8,8 (ISO) grade 5 (SAE). Stainless steel fasteners tensile strength Class 70 and 80.


These tightening torques applies for all fasteners unless otherwise specified within the instructions.


	TORQUE			
	A2-70	8.8 and A4-80	10.9	12.9
Dimension	Nm	Nm	Nm	Nm
M6	6	8	10	12
M8	16	20	30	35
M10	30	40	60	70
M12	55	70	100	120
M16	130	170	250	300
M20	260	330	480	580
M24	450	580	800	1000
M30	900	1130	1500	1800
Dimension UNC	Nm	Nm		
1/4"	8	10		
5/16"	15	20		
3/8"	25	35		
7/16"	40	55		
1/2"	60	80		
9/16"	90	120		
5/8"	125	160		
3/4"	220	280		
7/8"	340	450		
1"	500	660		


2 Safety Information


2.1 General Safety Precautions

 **WARNING:** The use of solvents as cleaning agents and the use of lubricants can involve health and/or safety hazards. The manufacturers of the solvents and lubricants should be contacted for safety data. The recommended precautions and procedures of the manufacturers should be followed.

 **CAUTION:** The use of an air jet, which must be less than 8 bar, to blow parts clean or to blow them dry after being cleaned with a solvent will cause particles of dirt and/or droplets of the cleaning solvent to be airborne. These conditions may cause skin and/or eye irritation.

 **CAUTION:** When using an air jet do not direct it toward another person. Improper use of air jet could result in bodily injury.

 **CAUTION:** Personal eye protection must be worn when undertaking work. This is especially important during disassembly of the buffer as loose parts and springs may fly out.

 **CAUTION:** Retained air under pressure (even though air supply is cut-off) may cause gaskets and/or particles of dirt to blow when this device and/or any component part are removed from the equipment arrangement. Personal eye and ear protection must be worn and care taken to avoid possible injury when performing any work on this device and/or component part.

2.2 Heavy Equipment



CAUTION - Heavy equipment

The coupler and its included parts are very heavy. If these are not supported or lifted properly it could result in severe personal or equipment damage.

To avoid accidents, do the following:

1. Use a suitable lifting device when removing or installing heavy parts.
2. Make sure the coupler is supported only in solid areas.

2.3 Vehicle in Operation



DANGER – Vehicle in operation

Special precautions must be taken so that operation of the vehicle during coupling/uncoupling will not result in severe injury or death and/or damage to equipment.

To avoid accidents, do the following:

1. Make sure no one is in the vicinity of the vehicle before operation is started.
-

2.4 Moving Parts



CAUTION - Moving parts

When operated, some coupler parts are moving. Moving parts can cause personal injury.

To avoid accidents, do the following:

1. Keep hands etc. away from any moving parts when operating the coupler.
-

3 Preventive Maintenance

3.1 General

This chapter describes the scope of maintenance and service that is necessary in order to maintain performance and reliability of the automatic coupler. The following schedules and procedures must be properly accomplished for equipment warranty conditions to apply. This scheduled maintenance shall also assist in maintaining product performance over an extended period of time.

3.2 Maintenance Supplies

Lubricants and solvents to be used during maintenance and servicing are described in respective section. Do not use any other lubricants and solvents than the ones described in this manual, and on no other places on the coupler than the ones described. Manufacturer instructions for applying the lubricants, as well as safety instructions, are to be followed without exceptions.



Carefully read and follow safety instructions in section 2 before proceeding.

3.3 Maintenance Schedule

The following schedule describes the minimum recommended maintenance to be regularly performed on the couplers. More frequent maintenance of the coupler may be required if environmental or other conditions so dictate.

Activity	Interval (months)	Reference
Inspection	3	3.4
Cleaning	12	3.5
Lubrication	3	3.6
Replacement for overhaul	60-84	3.7

3.4 Inspection

3.4.1 Safety Precautions



Carefully read and follow safety instructions in section 2 before proceeding.

3.4.2 Special Tools/Gauges

- Standard Toolkit.

3.4.3 Products

- CTP D 350

3.4.4 Inspection every 3 month

Text within brackets () refers to Fig. 2.

1. Perform a general visual inspection of the complete coupler. Look for signs of damages and loose or missing parts. Check for signs of deformation, rust or damages. Rust has to be removed and the surface repainted, see section 1.2. Rusty untreated parts have to be cleaned and protected with a thin layer of CTP D350. With regards to stress of the material, repairs of deformations are not allowed unless sanctioned by Dellner Couplers.
2. Inspect the draft gear elastomer spring package (1) for significant wear, replace spring package if necessary.

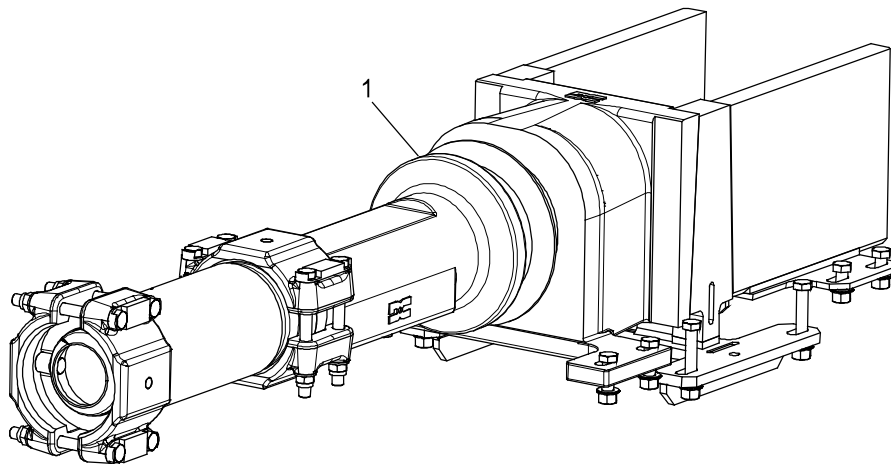


Fig. 2 Inspection of elastomer spring package

No.	Description	No.	Description
1	Elastomer spring package		

3.4.5 Inspection after uncoupling

1. Inspect the guide cone (1) and the guide cone interface (2) with regards to wear, damages on structure and/or paint.
2. Inspect socket joint (3), especially the insides and the socket joint interface (4) on center section with regards to wear, damages on structure and/or paint. Clean and grease contact surfaces of flanges and guide cone (1) with Stabyl LT 50 (for internal/external greasing).
3. Clean and grease the contact surfaces of the flanges on both socket joint halves (3) with a thin layer of Stabyl LT 50 (for internal/external greasing). Proper greasing of the flanges will guarantee low friction during assembly and a correct performance of the socket joints.

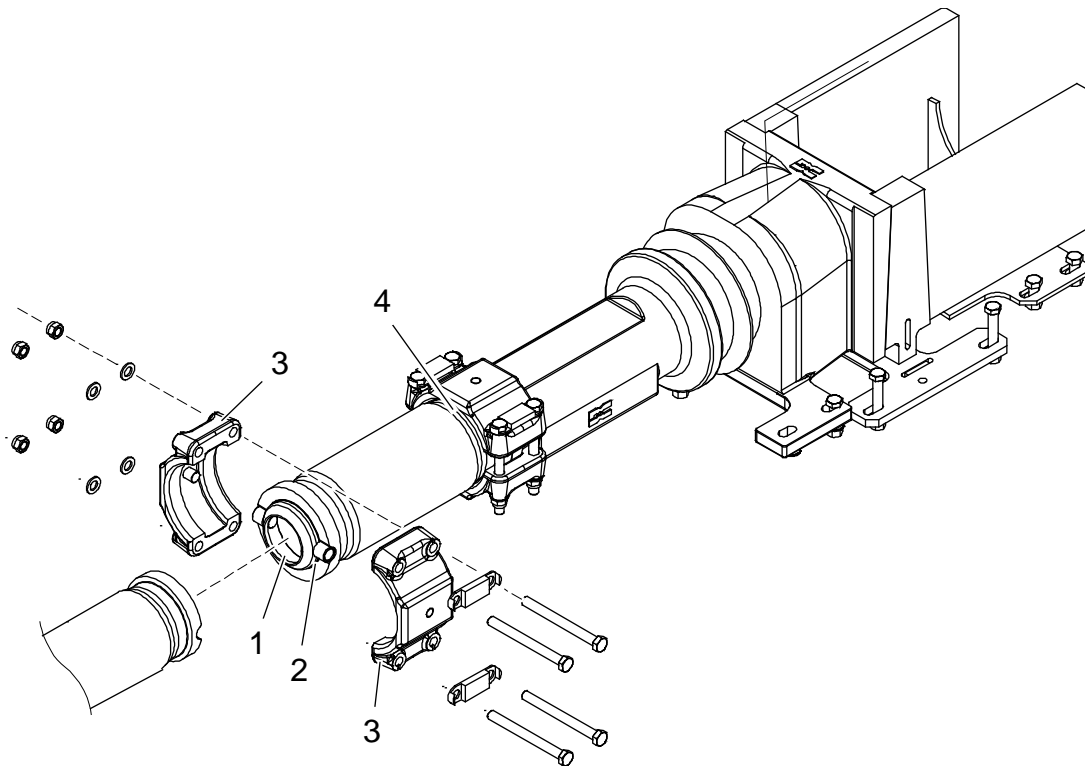


Fig. 3 Inspection after uncoupling

No.	Description	No.	Description
1	Guide cone	3	Socket joint
2	Guide cone interface	4	Socket joint interface

3.5 Cleaning

3.5.1 Safety precautions



Carefully read and follow safety instructions in section 2 before proceeding.

3.5.2 Special Tools/Gauges

- Clean lint free cloth.

3.5.3 Products

- Low aromatic white spirit.

3.5.4 Cleaning every 12 months

- Clean coupler thoroughly with water. Dry coupler with clean lint free cloths.
- Use a low aromatic white spirit or equivalent to remove excessive grease from the coupler.
- Lubricate the coupler according to chapter 3.6.

3.6 Lubrication

3.6.1 Safety Precautions



Carefully read and follow safety instructions in section 2 before proceeding.

3.6.2 Special Tools/Gauges

- Brush.

3.6.3 Products

- Gleitmo/Fuchs Lagermeister 3000+.

3.6.4 Lubrication every 3 months

Text within brackets () refers to Fig. 4.

1. Perform external greasing with Lagermeister 3000+. Use a brush or similar to apply the grease to visual mounting interfaces (1) on all socket joints.

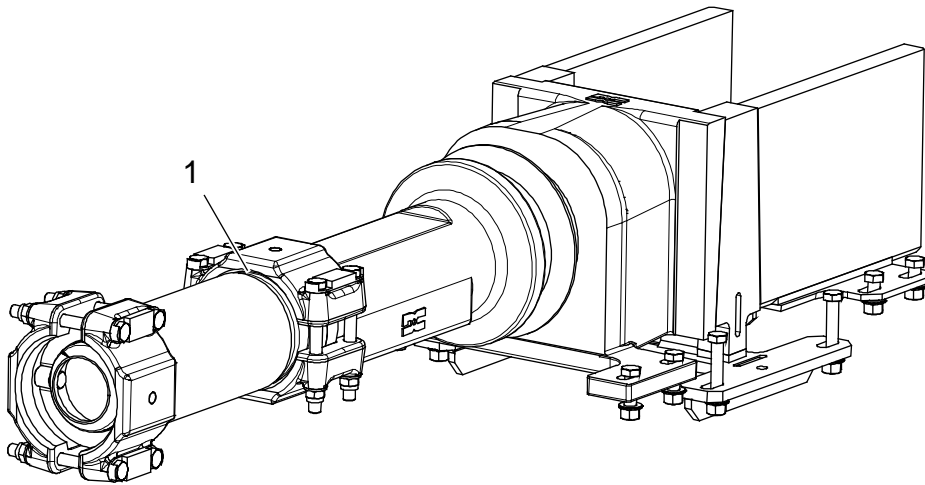


Fig. 4 Lubrication Chart

No.	Description
1	Visible mounting interfaces

3.7 Replacement for Overhaul

3.7.1 Safety Precautions



Carefully read and follow safety instructions in section 2 before proceeding.

3.7.2 Special Tools/gauges

- Suitable Lifting Device
- Standard Toolkit.

3.7.3 Products

- Red torque seal (Stanadyne sealing lacquer)
- Molykote 1000.

3.7.4 Removal

1. Loosen the locking wedge (4) by removing screws (5), washers (10) and nuts (11).
2. Fit M16 screws to the holes (5) in the locking wedge (6).
3. Remove the locking wedge (6) from the vehicle by tightening the M16 screws.
4. Remove the screws (2), washers (12) and nuts (13) and carefully remove the draft gear (1) from the vehicle.
5. Remove the clamping device (6) by removing screws (7), washers (8) and nuts (9).

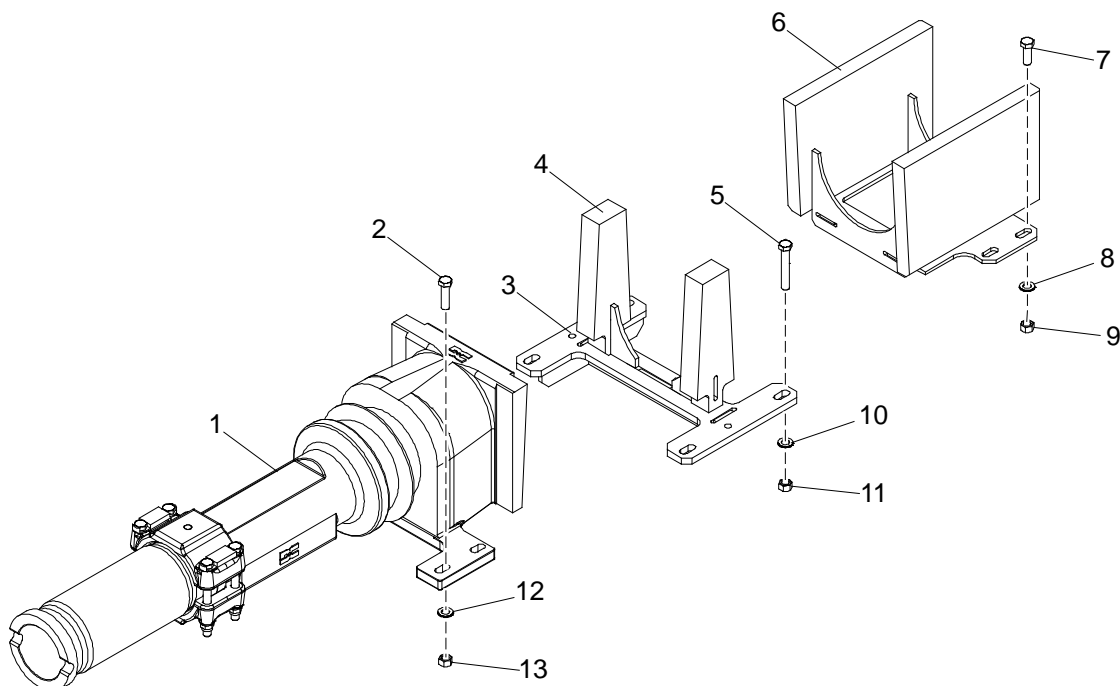


Fig. 5 Replacement of Semi-Permanent Coupler

No.	Description	No.	Description
1	Draft gear	8	Washer
2	Screw	9	Nut
3	M16 hole	10	Washer
4	Locking wedge	11	Nut
5	Screw	12	Washer
6	Clamping device	13	Nut
7	Screw		

3.7.5 Replacement

Replace all fasteners and rubber parts if applicable.

1. Carefully fit the draft gear (1) to the vehicle using a suitable lifting device.
2. Mount screws (2), washers (12) and nuts (13).
NOTE! Do not fully tighten the screws, only tighten the screws so that the draft gear is loosely fitted.
3. Fit the clamping device (6) to the vehicle and mount screws (7), washers (8) and nuts (9).
NOTE! Do not fully tighten the screws, only tighten the screws so that the clamping device is loosely fitted.
4. Make sure that the distance between the clamping device and draft gear is smaller than the space needed by the locking wedge. This action provides a tight interface between the locking wedge and draft gear, and locking wedge and clamping device.
5. Fit the locking wedge (4) to the vehicle, push it upwards to fit it in between the draft gear (1) and clamping device (6). Mount screws (5), washers (10) and nuts (11). Tighten screws (5) to 170 Nm and mark screws with torque seal.
6. Fasten the draft gear: tighten the screws (2), washers (12) and nuts (13).
7. Fasten the clamping device: tighten the screws (7), washers (8) and nuts (9).

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