/// E043642-0101-E00MUM

HRPV3 IR
PANTOGRAPH LX 3800 PN

Pantograph User / Maintenance Manual

ECO: **.**
Compiled: AJAY KUMAR
Checked: SEETHARAM K
Approved: PRASANNA SITARAM

Date: 08/11/2024 - Revision: A00
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
Confidential & Proprietary. All Rights Reserved.
© either Wabtec Corporation or one of its subsidiaries

Revision						
Issue	**Date**	**Description**	**ECO**	**Compiled**	**Checked**	**Approved**
A00	08/11/2024	New Release	.	AJAY KUMAR	SEETHARAM K	PRASANNA SITARAM
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// Table of Contents

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// 1.GENERAL DESCRIPTION

1.1 INTRODUCTION

This document pertains to Pantograph LX 3800 PN (25 kV AC).

The Pantograph is mounted on the roof of the vehicle using four insulators and height of the system is maintained as per the technical requirements.

The purpose of the Pantograph is to collect 25 kV AC under the catenary system and to carry it to the line on the roof when the vehicle travelling with the designed speed of 200 kmph.

The Pantograph is designed for the bidirectional use and each joint of the collector is connected using appropriate shunts.

The Pantograph is operated and controlled from operator cabin by means of pneumatic control unit (PCU).

1.2 PURPOSE OF THIS DOCUMENT

This document contains information about the current collector system, Pantograph LX 3800 PN used in the Indian Railways.

This document gives information about the operational procedures, each component's bill of material, installation, adjustments, controls, and maintenance procedures.

Procedures must be carried out with precaution to allow satisfactory operation before commissioning.

The maintenance procedures are provided to support the maintenance personnel, which contains all the necessary information for the preventive maintenance and corrective maintenance of the Pantograph system by personnel skilled in domain knowledge of electrical and mechanical for breakdown, repairs and replacement and maintenance of the components.

It is operator's responsibility to follow the procedures to ensure better safety and service life of the device.

All the procedures should be followed in their entirety and should not be carried out partially.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

1.3 USER SAFETY INFORMATION

DANGER!

High voltage, Risk of serious burns or death.

- Disconnect the catenary power supply, before starting maintenance activities on the roof.
- The power supply should be disconnected before the operations of defective component replacement.
- The power supply can be restored to put the device back in operation.
- Certain operations can be carried out under the catenary. Do not climb on the roof, make sure there is no current and it is earthed.
- It should be impossible for any third person to restore the power supply during the operation.

Risk of injury or death, Risk of Pantograph structural damage.

- In case of manipulation with Overhead crane, always use 3 Slings for installing or removing the Pantograph.
- Damage of Pantograph may occur if the Pantograph is not secured properly or handled dangerously.
- All the procedures should be followed in their entirety and should not be carried out partially.
- Safety instruction for detailed maintenance procedures in this manual must be followed

WARNING!

Not following the safety instructions may cause physical injuries.

- Please follow the safety procedures and instructions as applicable to the site.

Risk of Pantograph damage or incorrect function.

- The maintenance procedures should be carefully carried out by the personnel qualified in the domains of mechanical and electrical.
- The personnel, assigned to work on maintenance procedures are required to have good knowledge about the system, particularly in the area of technical information given in this manual.
- For replacing the defective components, the components should be either new or have undergone a preliminary testing at the workshop.

NOTICE!

Risk of Pantograph damage.

- Lowered Pantograph must not be raised by lifting the joint of Lower Arm and Upper Arm.
- Raise the Pantograph on vehicle to the maximum extension, only if it is under OHL.
- Risk of Lower Rod deformation. Recheck of setup is required after such event.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Important notice.

- Images used in this manual are for illustration purpose only. Some parts might be missing or might be varying slightly from the actual component.
- Dimensions in this manual are for reference only.

Fasteners reuse.

- Never reuse CS Washers and Stop Nuts.
- Other types of fasteners in general can be reused but WABTEC recommends replacement of them as well.

1.4 SAFETY PRECAUTIONS

1.4.1 FOREWORD

These rules are integral parts of this maintenance user manual and have the purpose of providing necessary notions to the personnel involved in maintenance operations, in order to avoid injuries, damages and environmental pollution.

The safety rules are subject to improvement by the Operator or by the Authority in charge of using and maintaining the vehicle. In particular, factors not known at the time of release (e.g. real operating conditions, available tools, skill of personnel, etc.) must be taken into due account when carrying out the operations.

Furthermore, the Operator cannot forget the legal prescriptions in force at the time of use of the vehicle, however notion of sound judgment is applicable under all the circumstances. All the practices that can put at risk the safety of personnel, driver and passengers must be avoided.

This manual must be easily accessible to all the involved personnel for immediate reference. Before undertaking any actions, the personnel must gain knowledge of the content of this manual. It is mandatory that the personnel are aware of the legal requirements concerning the safety and health at work and the prevention of accidents. The personnel must have the necessary basic knowledge in the field of operations (mechanics, pneumatics, hydraulics, etc.)

WABTEC cannot be held responsible for any accidents, damages or environmental pollution caused by these prescriptions being not applied, or by improper use of the product or of the tools.

1.4.2 PRELIMINARY OPERATIONS

The vehicle must be stopped and secured with adequate means in order to prevent spontaneous and unexpected moving.

WARNING: Some operations on the unit can make it completely ineffective and make the vehicle free to move.

Put clear and evident signs that a maintenance action is being undertaken (e.g. signs on driver's desks or on control panels) in order to prevent undue interference by others.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Prior to doing any actions, make sure that it will not represent a risk for someone else possibly working on another part of the vehicle.

Prior to accessing the pneumatic or hydraulic parts, make sure the pressure is vented to atmosphere. While dismounting elements, take care of possible residual pressure.

Prior to accessing the electric parts, make sure the power is duly switched off.

In general, cleanliness must be guaranteed to avoid contamination by dust, dirt, and external agents.

1.4.3 PERSONAL SAFETY

The working place must be adequately prepared in order to remove all possible obstacles and hindrances.

While moving heavy parts, personnel must use adequate lifting tools (jacks, lifter, winch, etc.) and wear suitable protective shoes and gloves.

For operations under the vehicle, personnel must wear protective helmet.

For operations on the roof, personnel must be secured with adequate means to prevent falling down (safety belts, etc.). The vehicle must be located on a catenary-free portion of the track.

Before dismounting any parts, carefully read the technical documentation in order to get acquainted on possible risks like pressure or loaded springs. In this case wear protective goggles.

WARNING! The safety warning label could be missing.

While manipulating chemicals like lubricants, grease, solvents, etc. carefully follow the manufacturer’s prescriptions. In any case, avoid breathing the vapour and avoid contact with skin and eyes. Wear protective gloves, goggles, and filter-mask.

When using flammable substances (lubricants, solvents, etc.), adopt all possible precautions to avoid the risk of fire. Do not smoke. Do not use heat sources or un-contained flames. Do not develop sparks. Keep the room ventilated. Store as prescribed by the manufacturer.

While cleaning or drying parts, do not use high-pressure air jets. (Maximum 0.5 bar compressed air pressure shall be used).

While cleaning, do not use salt water.

While cleaning filters or cooler fins, use adequate air aspirator.

Prior to undertaking any actions on parts that are hot (disks, pads, coolers, etc.), make sure the temperature is at acceptable level. In case, wait until the item has cooled down or use suitable protection.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

For any operations, use the appropriate tool. Tools must be kept in optimum conditions. Tools that are worn-out or damaged represent a risk.

While testing the components, never exceed the maximum operating pressure limits.

Should some liquid (lubricant, coolant, solvents) be spread on the floor, clean the area as soon as possible and take precautions to avoid slipping.

1.4.4 FUNCTIONAL SAFETY

Product safety can only be guaranteed if genuine spare parts are used. Any other materials can prejudice functionality and safety.

Make sure that the air used to supply the system externally (e.g. through the air service point group) is dry and free from dirt and debris. The air supply quality MUST be class 3-3-2 according to ISO 8573-1; otherwise, the devices will be damaged.

After any maintenance operations, make sure that the component and the complete system have been restored to their perfect functionality.

After any maintenance operations, restore all the original conditions, especially the protection devices (locks, lead-wires, etc.) on components, system, and vehicle.

1.4.5 ENVIRONMENTAL SAFETY

During handling of lubricants, solvents and other substances that may be harmful for the environment, take all the precautions to avoid dispersion.

All the applicable law requirements must be respected when disposing of substances that may pollute the environment (lubricants, batteries, coolant, etc.).

1.5 GENERAL MAINTENANCE RULES

1.5.1 FOREWORD

These norms have the purpose of providing the main notions to maintenance staff on servicing and overhauling the system and its parts, in order to prevent damages or malfunctions. An incorrect maintenance may seriously jeopardise the functionality of the item and the safety of the system.

The prescribed operations must be carried out as scheduled in the maintenance plan. WABTEC cannot be held responsible for any consequence of not having performed the prescribed operation as and when scheduled.

1.5.2 SCHEDULE

In the maintenance plan, two types of intervals are indicated: cumulated mileage and elapsed time. They are linked by the applicable mission profile, and the one occurring first must be respected. This is due to the fact that some parts degrade over time and not over travelled distance.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

1.5.3 TOOLING

All tools must be kept in optimum conditions. Do not employ any tools for an improper use, as this could damage the items and produce debris and particles.

Do not use chromate tools, as chrome debris could get detached and contaminate the equipment. Whenever prescribed, use exclusively the specific tools.

1.5.4 EXTERNAL CLEANING

Prior to proceeding in any operations like dismounting, perform a thorough external cleaning of the component. Unless otherwise specified, only adequate cleaning agents can be used, in terms of compatibility, dielectric strength and environmental impact.

Prior to any installation, make sure the system piping is free from particles that may influence the correct operations (debris, contaminants, etc.).

1.5.5 INSPECTION

The purpose of the inspection is to discover, by visual check, possible anomalies like:

- Damages caused by external agents such as ballast hit etc.
- Air or liquid leakages
- Oxidation or corrosion
- Cracks in rubber parts (hoses, bellows, belts, etc.)
- Clogging/dirt in filters, etc.
- Loosened bolts and screws.
- Lack of labels, connections, fixing or locking items, etc.
- Any visual damages to cables and connectors due to excessive higher and lower temperature and humidity.
- Seizure of mechanical parts due to corrosion or lack of lubrication.

These operations must be carried out in optimum light conditions.

1.5.6 FUNCTIONAL CHECK

Its purpose is to verify the functionality of the equipment by testing it and verifying the effects at system level.

Refer section 8.6.5 for functional test details.

1.5.7 REMOVAL OF COMPONENTS

Operations must be carried out according to the specific instructions under section /// 8. In general, take care to the following points:

- Before dismounting, take careful note of the position of all connections attached to the component, so that the original conditions can be restored when re-installing the component itself.
- Put adequate protection to the exposed portion of the connections that have been detached, in order to prevent ingress of contaminating parts.
- Avoid any possible mechanical stress to avoid damage to the equipment and to its fixing support.
- Special care need to be taken while handling Insulators.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

1.5.8 RE-INSTALLATION OF COMPONENTS

Operations must be carried out according to the specific instructions under section /// 8 In general, take care to the following points:
Prior to re-installation, equipment must be functionally checked as per section 8.6.5;
All connections must be cleaned to avoid contamination.
Replace all rubber seals, spreading a thin layer of grease.
Once removed, seals (static, dynamic, rotating) cannot be reused but must be exchanged.

1.5.9 STORAGE OF DEVICES

Pantograph

It is possible outside storage
In case of prolonged storage (more than 3 months) it is necessary to:

- Storing indoors area. (No rain, snow, …)
- Protect the Pantograph (in particular rubber end stops) against direct sunlight. The rubber parts will have longer life, if protected against UV light.
- Carbon strips should be protected by appropriate packaging to avoid cracks and breakage.
- Lubricate the Pantograph parts according to maintenance procedures.
- Apply grease [B01] to free threaded ends of screw connections for protection.
- Check the Pantograph according to plan of maintenance 8.3.

If Pantograph has been stored in low temperature for a longer period, it is necessary to carry out a functional test in order to verify whether joints are not seized-up before installation.
Before installation after prolonged storage is necessary to:

- Check if the Pantograph is able to reach maximum extension.
- Check if the lowering is smooth and without any shocks.
- Check tightness of the pneumatic connections

PCU

PCU must be stored only inside.

1. Check the PCU according to plan of maintenance 8.3

1.6 GENERAL OVERHAUL RULES

1.6.1 SAFETY PRECAUTIONS

- The device must be maintained when and as prescribed by WABTEC. In case of doubt, stop the maintenance and consult the manufacturer for clarification.
- This manual must be easily accessible to all responsible personnel for immediate reference. Personnel must be informed of the content of this manual before undertaking any actions.
- WABTEC cannot be held responsible for any accidents, damage or environmental pollution caused due to non-compliance of these recommendations, or by any incorrect use of the products and tools.
- Only authorised personnel must carry out installation and maintenance related activities.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

- WABTEC recommends use of only OEM spare parts to guarantee product reliability, performance, and safety. Warranty shall become NULL & VOID if unauthorised spare parts are used.
- Unless it will undoubtedly be demonstrated that an exclusive original WABTEC spare parts have been used, WABTEC will not be held responsible for any loss of functionality of products and system neither for any damages and/or malfunctioning of such products.
- It is the responsibility of the operator, who carries out the work, to make sure that all regulations pertaining to Safety and environment at the workplace are respected.
- For any maintenance related activities, appropriate tools must be used. Ensure proper condition of the tool before its usage. Avoid usage of broken / worn-out / chromated tools.
- Prior to proceeding with any operations perform a thorough external cleaning of the component. Unless otherwise specified, only recommended cleaning agents can be used, in terms of compatibility, dielectric strength and environmental impact.
- Special care should be taken while handing contact grease, May irritate eyes. Prolonged or repeated skin contact may cause irritation. Inhalation of oil mist or vapors from material at high temperatures may irritate respiratory passages
- Before dismounting any parts, carefully read the maintenance instructions in order to get acquainted on possible risks like pressure or loaded springs. In such cases wear appropriate PPEs.

WARNING! The safety warning label could be missing.

- Operations must be carried out according to the specific instructions. In general, take care to the following points:
  - The workplace must be clean, and the parts should be placed on a soft surface to avoid damages.
  - Special care must be taken when removing Seals, O-rings, Diaphragms and Circlips in order to avoid damages to their seats and grooves.
  - Clean carefully all the parts that do not have to be exchanged.
  - Check for signs of wear or other damage.
  - While re-fitting rubber seals and diaphragms, do not torque or bend them.
  - Respect the specified tightening torques for bolts, nuts, and screws.
  - Use only prescribed lubricants and avoid use of substances not compatible with the product.
  - When gluing is prescribed, clean carefully all the involved surfaces.

- After any maintenance operations, make sure that the product and the complete system has been restored to their acceptable functionality.
- After any maintenance operations, restore all the original conditions, especially the protection devices (locks, lead-wires, etc.) on components, system, and vehicle.
- The disposal must be done according to rules in force at the End-user premises and to the law in force in the Country where the overhaul is performed.
- For each operation wear the appropriate PPE (Personal Protective Equipment), in order to avoid personal injuries and items damaging.
- The following documentation is purely descriptive. This document is intended for skilled maintenance staff, who have been trained on product performance, assembly, dis-assembly, and testing.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

- WABTEC shall not in any way be responsible, for any direct or indirect damages and / or defects and / or any harmful consequence when overhaul activities of the item are done outside WABTEC workshop and anyway by not specialized and authorized personnel.

NOTE. For consumables like sealants, greases and similar, please refer to the single product safety datasheet.

NOTE. WABTEC reserves the right to modify its equipment or the content of this manual at any time without giving any communication.

1.6.2 SAFETY CONDITIONS

- For unassembled rubber parts (i.e. O-rings, Diaphragms, Seals, Gaskets, Flexible connections, etc.) consider the International Standard ISO 2230:2002 - Rubber products - Guidelines for storage.
- All the spare parts must be stored in their original packaging in a ventilated room and not exposed to humidity, dust, temperature shocks and direct source of heat such as boilers, radiators, and direct sunlight. The ambient temperature and humidity values of the storage area must be within -10°C and +25°C and the relative humidity must be within range of 10% and 65%.
- If the storage is below 15°C, handle carefully all the stored products 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.
- Rubber parts, if out of their original packaging, must be kept in black bags, to avoid ingress of light. If out of their original packaging, equipment must be protected against bad weather and light (UV).
- Rubber parts should be protected from light sources, direct sunlight or intense artificial light having a high UV ray.
- Precautions should be taken to protect products from all sources of ionizing radiation likely to cause damage to the products. As ozone is particularly deleterious to rubber, storage rooms should not contain any equipment that can generate ozone, such as mercury lamps or high-voltage electrical equipment giving rise to electrical sparks or silent electrical discharges. Combustion gases and organic vapours should be excluded from storage rooms, as they may give rise to ozone via photochemical processes.
- The system and products shall be fully isolated from welding and related activities
- During the storage of heavy equipment verify that integrity of packaging in order to ensure the overlap.
- Rubber should be stored free from superimposed tensions and compressive stresses or other causes of deformation. Pay attention to the storage if products are packaged in a strain-free condition.
- Take care that the packaging is protected from rodents.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

- Since rubber parts age out even in optimum storage conditions, the following rules must be followed for equipment either stored on-the-shelf or mounted on inoperative vehicles:
- Pneumatic equipment must be overhauled according to the prescription of the maintenance plan from the date of manufacture or of last overhaul.
- Prior to installation on the vehicle, the equipment must be functionally checked according to the applicable procedure if the date of manufacture or last overhaul dates. (refer Sec 8.3 for maintenance plan)
    - The equipment must undergo a functional test according to the applicable procedure. If the functional test fails, the product must be overhauled and then a functional test must be performed before installing it on the system.
    - If the component has not been used for more than the overhaul/ replacement periodicity, it must be overhauled and then tested with the applicable functional test before the installation on the system or replaced with a new one if overhaul is not foreseen for the component.
- No component can be used if the prescription above is not followed. The disposal must be done according to the applicable regulations.
- All outlet / inlet devices must be adequately protected (plugs or scotch) against dust and must be removed only at the time of installation.

1.7 WARRANTY

For every WABTEC product supplied, it provides a warranty for proper and correct manufacture within the scope of the contractual and delivery terms.

Pantograph must be operated/assembled/disassembled only by the trained personnel. Otherwise, any warranty in accordance with the delivery terms may become null and void.

Warranty is applicable as per contract terms.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

1.8 WARNING MESSAGES

Messages and warning symbols are useful to have a clear focus of something strictly related to the maintenance actions, so they are reported, if foreseen, before every action. Messages and warning symbols in this document are as follows:


High voltage


Rotating parts


Pressurised vessel


Flammable materials


Handle with care


Risk of crushing


Generic risk


Hot surface


PINCH POINT

1.9 ASSEMBLIES INVOLVED

SL NO.	DESCRIPTION	PART NUMBER
1	Pantograph LX3800 PN	E043642-0101
2	Pneumatic Control Unit (PCU)	FT0052511-101**

** Tentative Part number

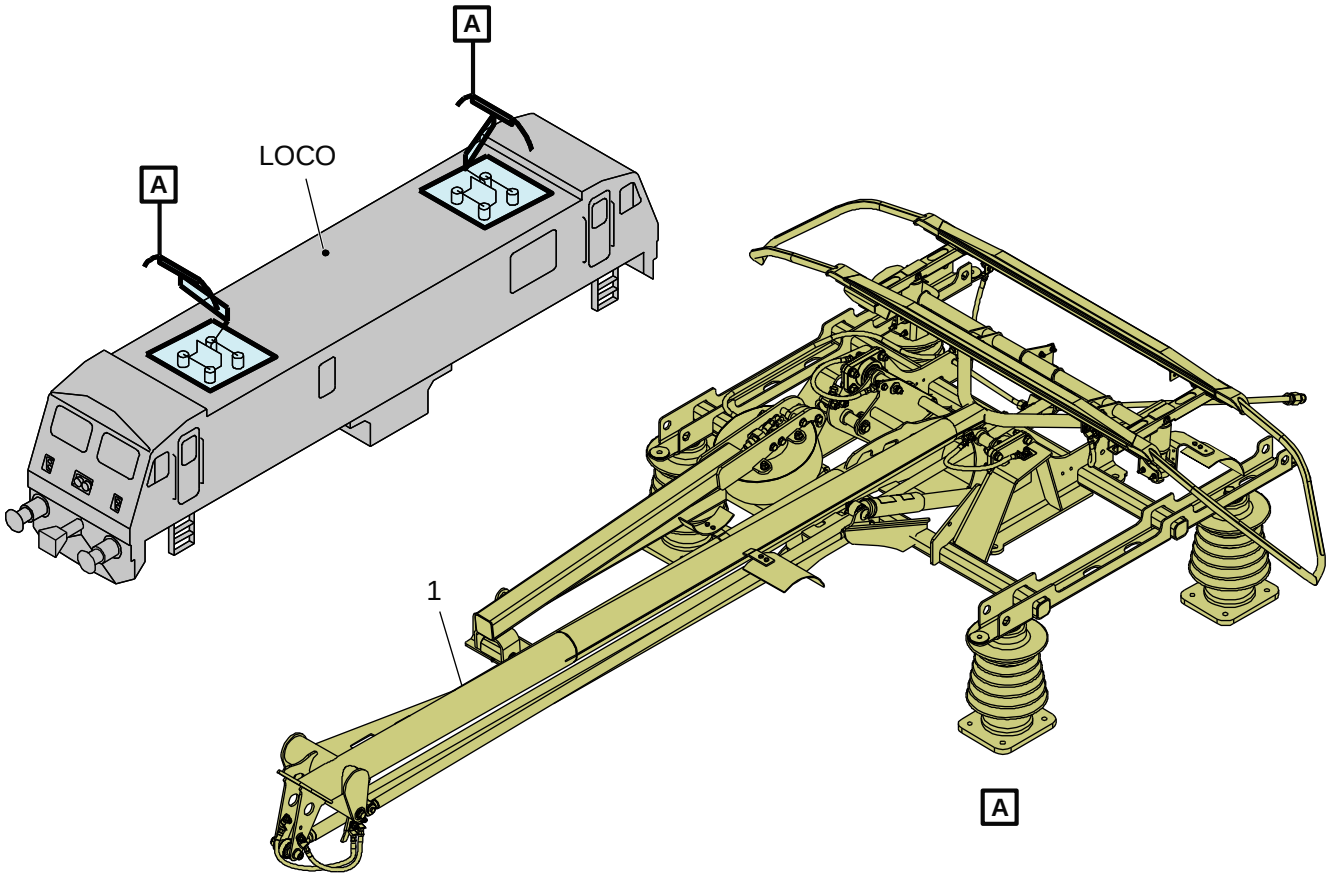
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

1.10 ABBREVIATIONS

ABBREVIATION	FULL NAME
AC	Alternating Current
CS	Carbon Steel
DC	Direct current
DIA	Diameter
FT	Faiveley Transport
HD	Head
HEX	Hexagonal
HPG	High Performance Grease
HSHC	Hexagon socket Head Cap Screws
HV	High Voltage
ID	Internal Diameter
ISO	International Standards Organization
kV	Kilo-Volts
mm	Millimetre
Nm	Newton Meter
OEM	ORIGINAL EQUIPMENT MANUFACTURER
OHL	Overhead Line
OHV	Overhead Valve
PCU	Pneumatic Control Unit
PN	Part Number
PPE	Personal Protective Equipment
PR	Pressure
PS	Pressure Switch
QTY	Quantity
SOC	Socket
SS	Stainless Steel
UV	Ultraviolet

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// 2.APPLICATIONS



Note: Insulators are shown for illustration purpose.

Figure 1– Pantograph ISO VIEW

ITEM NO.	DESCRIPTION	PART NUMBER	QTY
1.	Pantograph LX 3800 PN	E043642-0101	1

The Pantograph is operated by a Pneumatic Balancing System consist of a Pneumatic Bellows, supplied with air from an Air Pressure controller.

Due to the air supply to the Bellows, a torque is created on the hinges of the Lower Arm through a Cam-Chain Mechanism.

Force required for maintaining contact of head assembly with the OHL is constant within the complete length of Pantograph extension and helps to eliminate differences in OHL position.

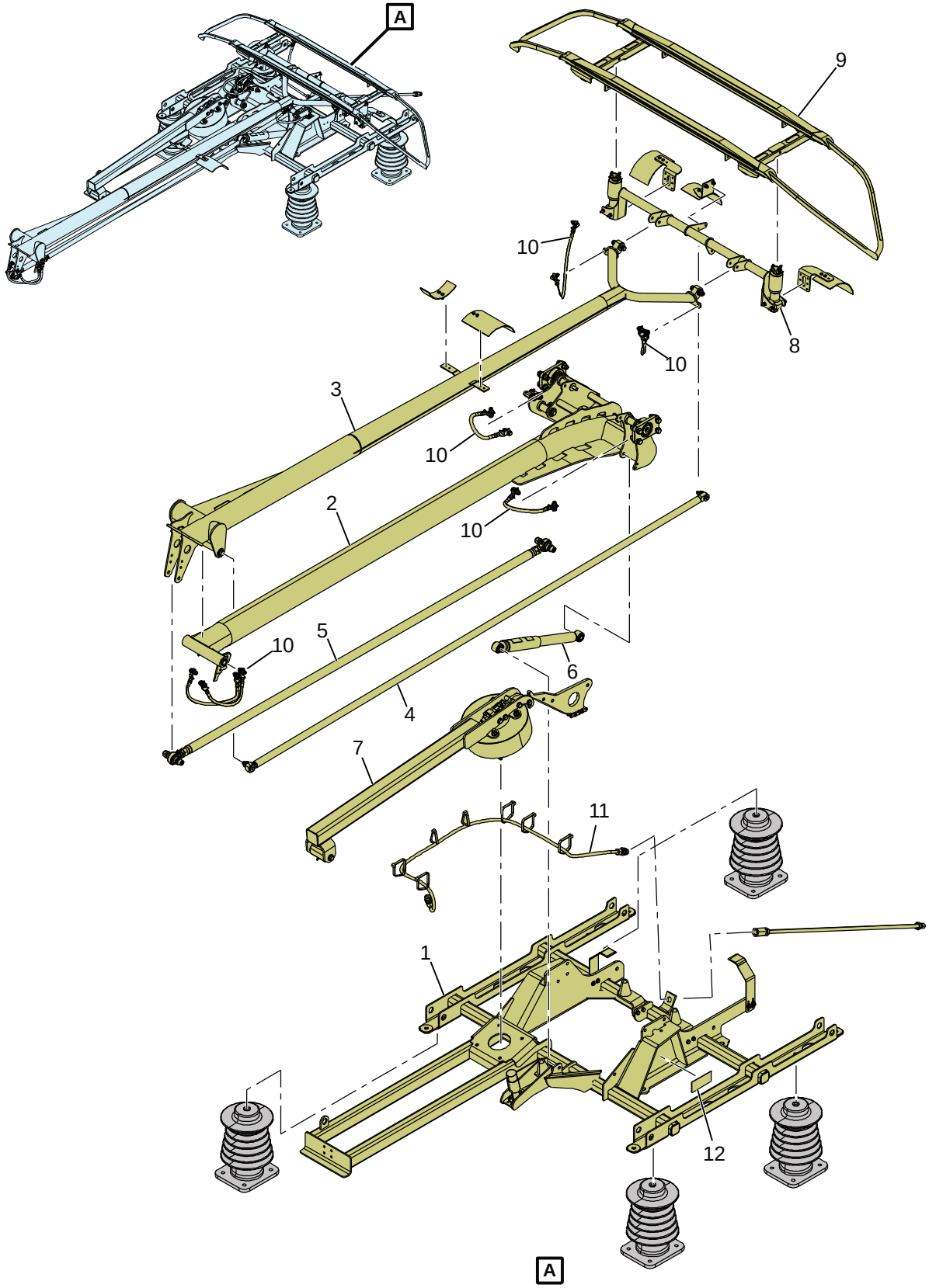
The pressure is adjusted using a pressure regulator from the operator cabin.

Each locomotive consists of two Pantograph on each end facing of the roofs No.1 and No. 2 end in the directions as shown in Figure 1.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// 3.SYSTEMS SPECIFICATIONS AND DESCRIPTION

3.1 DESCRIPTION OF LX3800 PN PANTOGRAPH



Note: Insulators are shown for illustration purpose.

Figure 2 – Overview of LX3800 PN Pantograph

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Item no	Description	Part Number	Qty
1	Frame Assembly	VE043666-0101	1
2	Lower Arm Assembly	VE043658-0101	1
3	Upper Arm Assembly	VE043661-0101	1
4	Upper Rod Assembly	XE043655-0101	1
5	Lower Rod Assembly	XE043674-0101	1
6	Damper Assembly	FT0072490-111	1
7	Pneumatic Balancing System	VE043670-0101	1
8	Collector Shoe Suspension	VE043716-0101	1
9	Collector Head	VE043044-0104	1
10	Flexible Connection Set	E044062-0102	1
11	Air Piping Assembly	VL100074-0116	1
12	Identification Label	FT0053911-099	1
13	Pneumatic Control Unit	FT0052511-101**	1

** Tentative Part number

Pantograph is pneumatically operated and has two basic positions:

- Extended (Service) position
- Housed position.

Extended (service) position is achieved using air bellows, spring-cam-chain system which is controlled by pneumatic control units (PCU).

Pantograph system includes a mechanical structural frame, hinged (joint) system, pneumatic balancing system, collector head and control systems, refer to Figure 2.

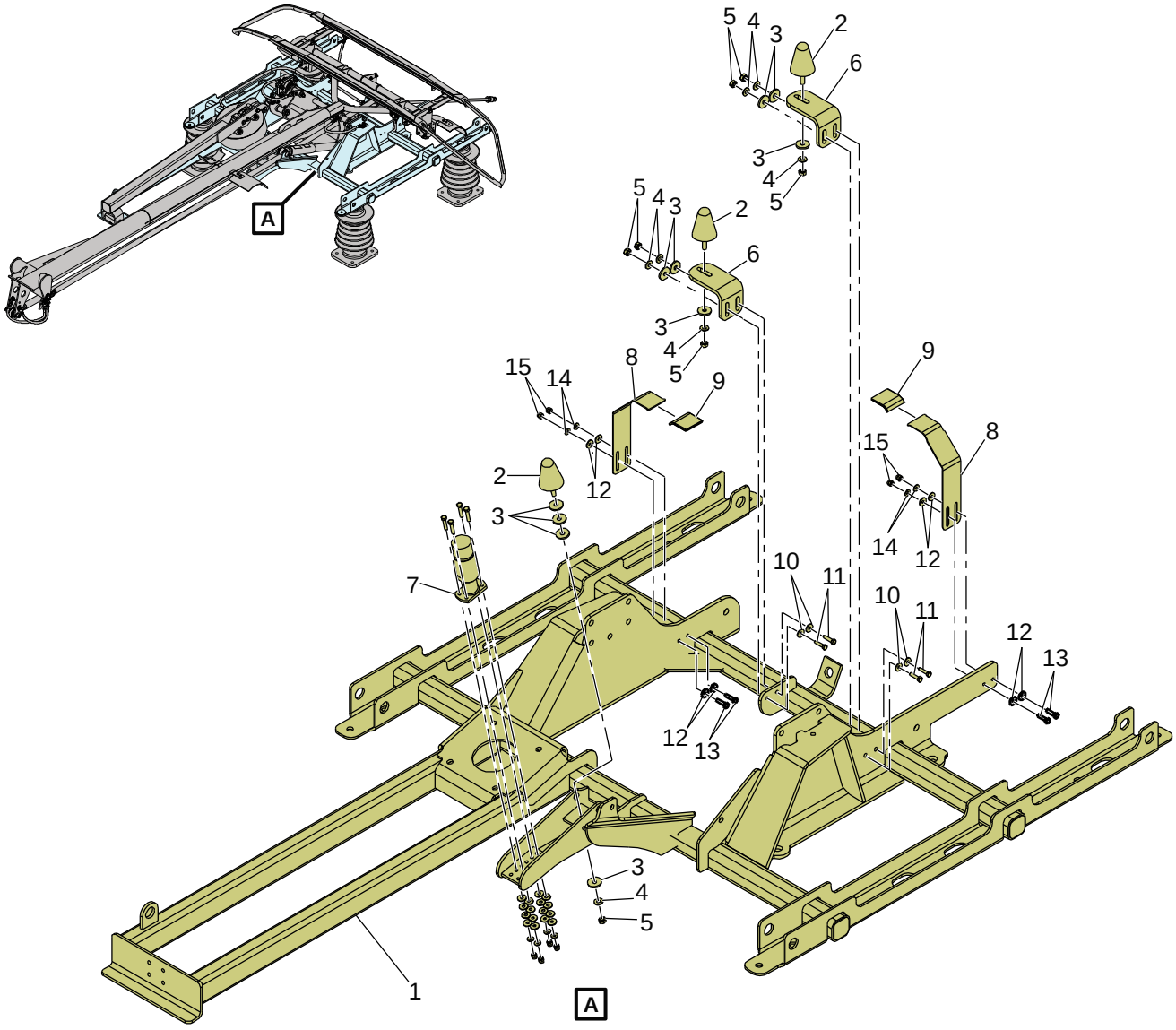
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2 DETAIL PARTS CATALOGUE

3.2.1 FRAME ASSEMBLY

Frame Assembly is made of steel welded profiles. The Rigid Frame Supports the Hinged (Joint) Systems, Pneumatic Balancing Systems and Electric Connection points, refer to Figure 3.

Rigid Assembly of the Frame (1) consists of welded profile components, Elastic Stop End (2) and Supports (6).



Note: Insulators are shown for illustration purpose.

Figure 3 – Frame Assembly

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

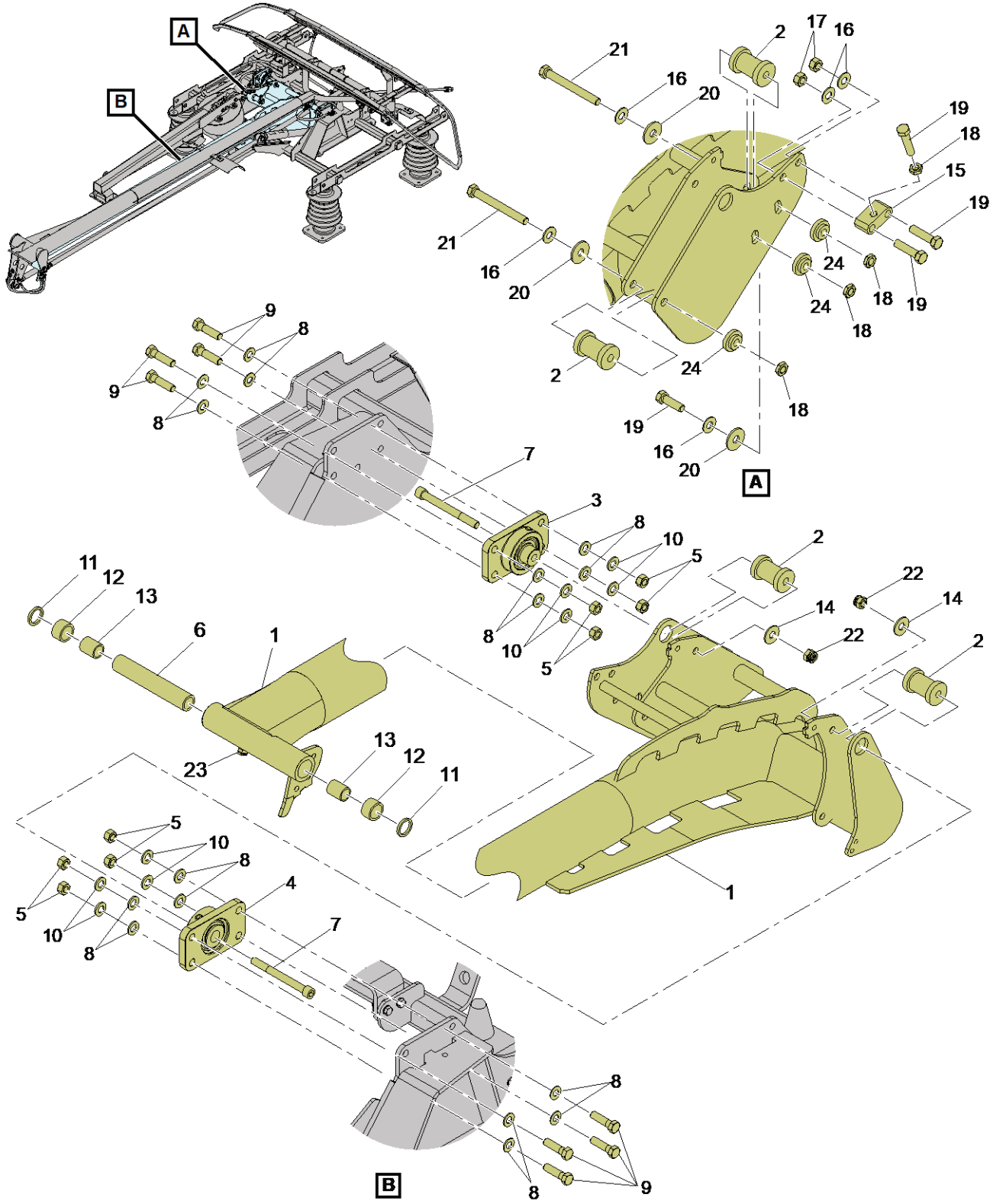
Item No	Description	Part Number	Qty
1	Frame	VE043667-0101	1
2	Elastic Stop End	5190140-000	3
3	Plain Washer ISO7094	FT0030004-053	10
4	CS Washer,8-18-1.4 NFE25-511	FT0030004-017	7
5	Hexagon Nut ISO4032	FT0030002-003	7
6	Support	YE043704-0001	2
7	Endstop on Spring	VE044022-0101	1
8	Flexible Endstop - Front	XE044030-0001	2
9	Shrink Tube	0007367	0.1m
10	Plain Washer ISO7089	FT0030004-003	4
11	H Screw M8x30 -8.8 Geomet 500B	FT0030006-013	4
12	Washer_ISO7093-1	FT0030003-018	8
13	H Screw ISO 4017	FT0030005-040	4
14	CS Washer,6-14-1.3	FT0030003-022	4
15	Prevailing Torque Hexagon Nut	FT0030001-019	4

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.2 LOWER ARM ASSEMBLY

The Lower Arm Assembly is a part of Hinged (Joint) System and made of larger diameter steel tubing which has a T-Shaped end arrangement, refer to Figure 4.

The Lower Arm Assembly acts as the pivot for the Upper Arm and houses bearing assemblies.



Note: Insulators are shown for illustration purpose.

Figure 4 – Lower Arm Assembly

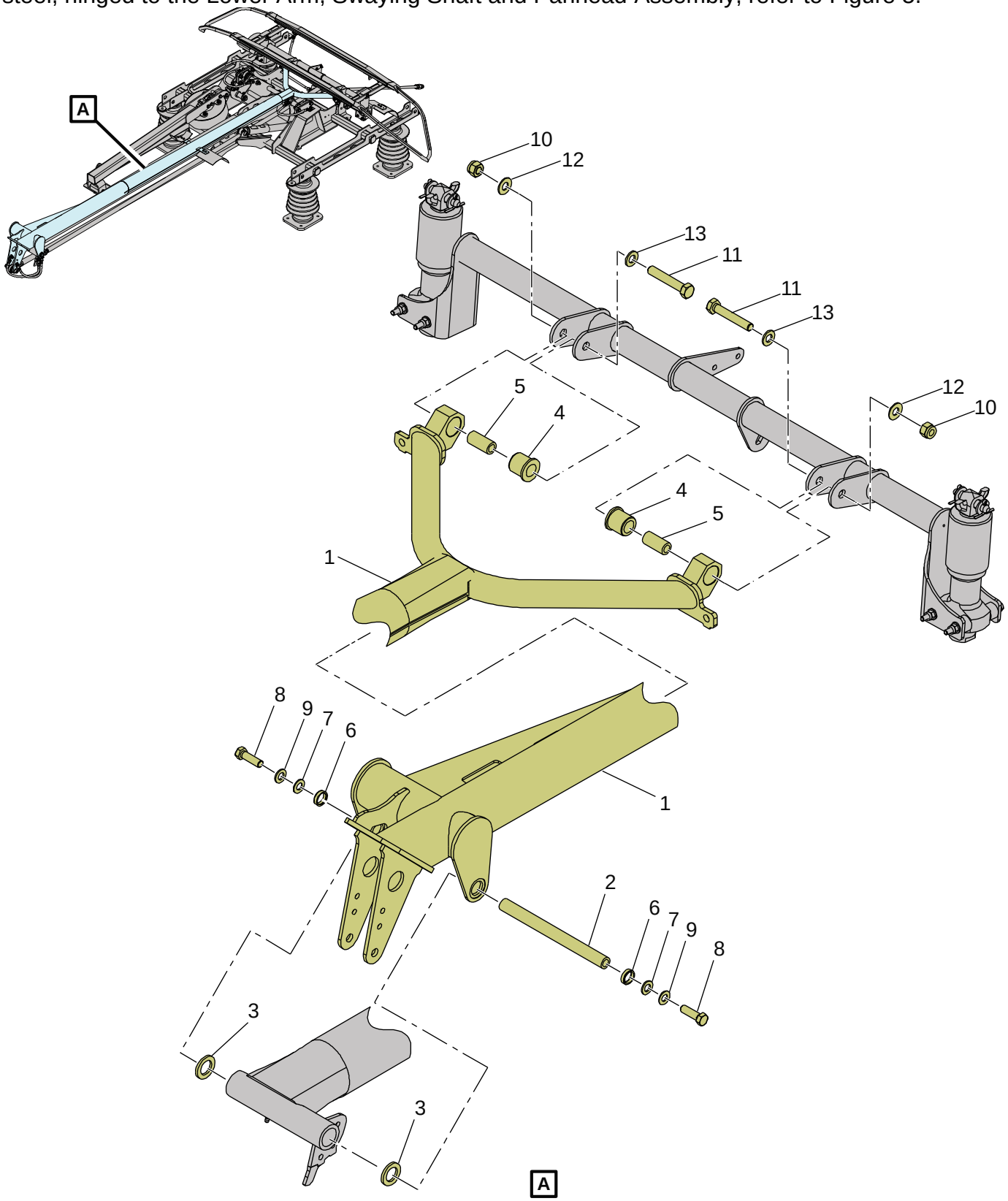
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Item No	Description	Part Number	Qty
1	Lower Arm	VE043659-0101	1
2	Spacer	YE040137-0001	4
3	Bearing Housing Assembly	E043628-0201	1
4	Bearing Housing Assembly	E043628-0101	1
5	Hexagon Nut, M12-10	N2601200-082	8
6	Spacer	YE040132-0001	1
7	HSHC Screw M12 X 120 CL 10.9	FT0030030-023	2
8	Plain Washer ISO7089	FT0030004-005	17
9	Hex. Bolt M12 x 45, 10.9	S1001245-082	8
10	CS Washer 12-24-1.8	3362200-082	8
11	Seal Ring	4900124-000	2
12	Needle Socket	4960413-000	2
13	Inner Ring	4960443-000	2
14	Washer-M12	FT0030031-014	2
15	End Stop Support	YE043690-0001	1
16	CS Washer, 12-27-1.8	FT0030004-065	5
17	Hex. Nut - ISO4032	FT0030001-030	2
18	Hexagon Nut ISO4035	FT0030001-021	4
19	Hex. Hd Screw - M12x50	FT0030005-066	4
20	Plain Washer ISO7093-1	FT0030004-058	3
21	Hex Hd Screw - M12x110	FT0030005-067	2
22	Hex Stop Nut M12	FT0042411-004	2
23	Grease Lubricator	M01268	1
24	Spacer	XE044077-0001	3

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.3 UPPER ARM ASSEMBLY

The Upper Arm Assembly is a part of Hinged (Joint) System. The Upper Arm Assembly made of steel, hinged to the Lower Arm, Swaying Shaft and Panhead Assembly, refer to Figure 5.



Note: Insulators are shown for illustration purpose.

Figure 5 – Upper Arm Assembly

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

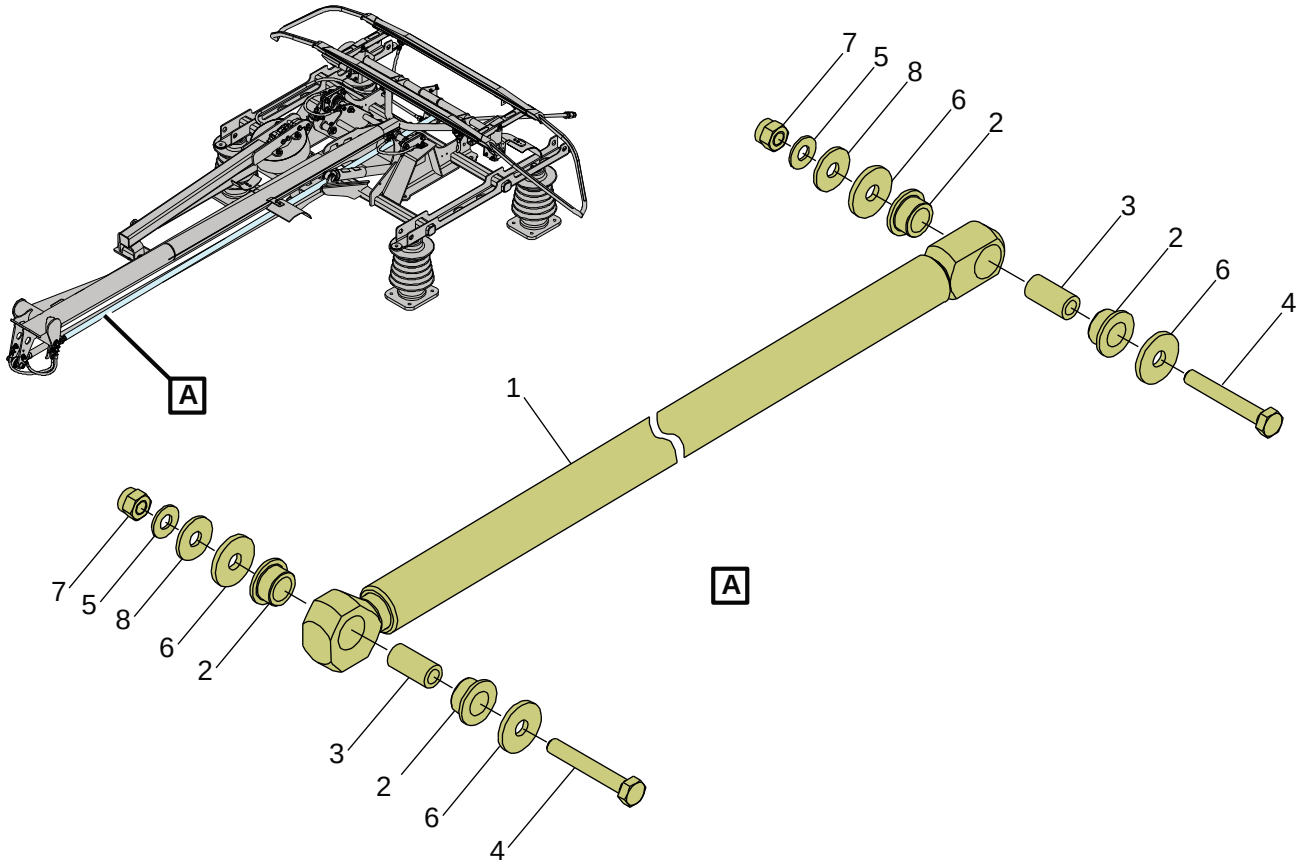
Item no	Description	Part Number	Qty
1	Upper Arm	VE043662-0101	1
2	Axle	YE040131-0001	1
3	Washer	YE040133-0001	2
4	Bush	YE038872-001	2
5	Spacer Bush	YE039982-0001	2
6	Clamping Ring	ED449525_1	2
7	Washer-M12	FT0030031-014	2
8	H Screw ISO 4017	FT0030006-025	2
9	CS Washer,12-24-1.8	FT0030004-023	2
10	Prevailing Torque Hexagon Nut	FT0030001-025	2
11	Hexagonal Screw	FT0030005-069	2
12	CS Washer,10-22-1.6	FT0030003-032	2
13	Plain Washer ISO7089	FT0030003-035	2

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.4 UPPER ROD ASSEMBLY

The Upper Rod Assembly is a part of Hinged (Joint) System and assembled onto one end of the Upper Arm Assembly and other end onto the Swaying Shaft, refer to Figure 6.

The Upper Rod Assembly supports the Panhead to maintain parallelism against the collecting surface.



Note: Insulators are shown for illustration purpose.

Figure 6 – Upper Rod Assembly

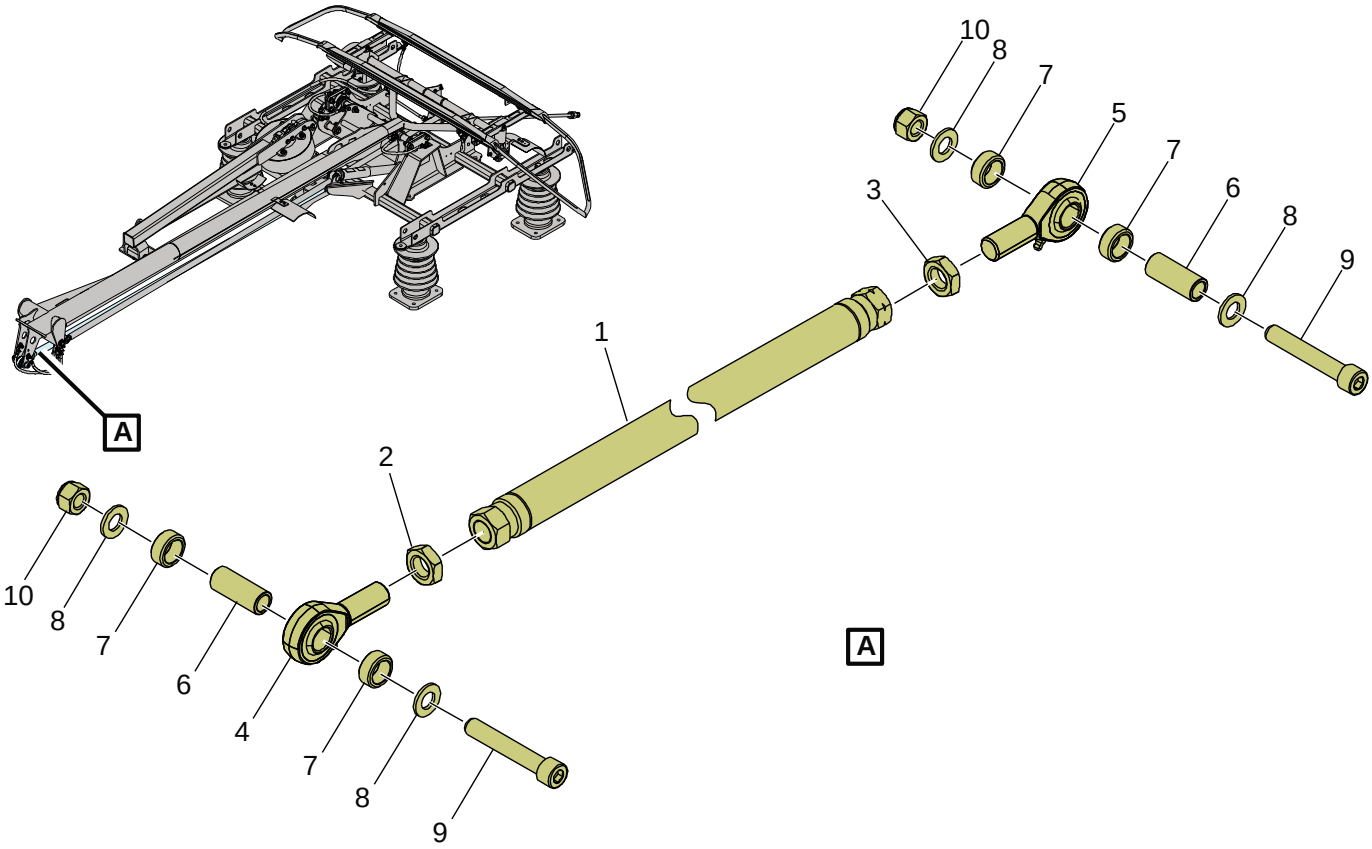
Item no	Description	Part Number	Qty
1	Upper Rod	XE043656-0101	1
2	Nylon Ring	YE040217-0001	4
3	Spacer	YE040218-0001	2
4	H Screw ISO 4017	FT0030006-030	2
5	CS Washer,8-18-1.4 NFE25-511	FT0030004-017	2
6	Plain Washer ISO7094	FT0030004-053	4
7	Prevailing Torque Hexagon Nut	FT0030002-024	2
8	Washer_ISO7093-1	FT0030004-013	2

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.5 LOWER ROD ASSEMBLY

The Lower Rod Assembly is a part of Hinged (Joint) System and assembled onto one end of the Frame and other end onto the Lower Arm, refer to Figure 7.

The Lower Rod restricts angular movement of the Lower Arm after some set angle,which tends to raise the Upper Arm Assembly.



Note: Insulators are shown for illustration purpose.

Figure 7 – Lower Rod Assembly

Item no	Description	Part Number	Qty
1	Lower Rod	XE043676-0101	1
2	Nut M20X1.5 Left	M20X1,5/3	1
3	Nut M20X1.5	M20X1,5/4	1
4	Bearing Eye Left	OKO LOZISKOVE/7	1
5	Bearing Eye Right	OKO LOZISKOVE/8	1
6	Bushing	YL100737-0001	2
7	Bushing	YL100738-0001	4
8	Washer ϕ15 ISO 7089, A2	15/4	4
9	Screw M14X90, ISO 4762, A2	M14X90/1	2
10	Nut M14 A4-80	M14/5	2

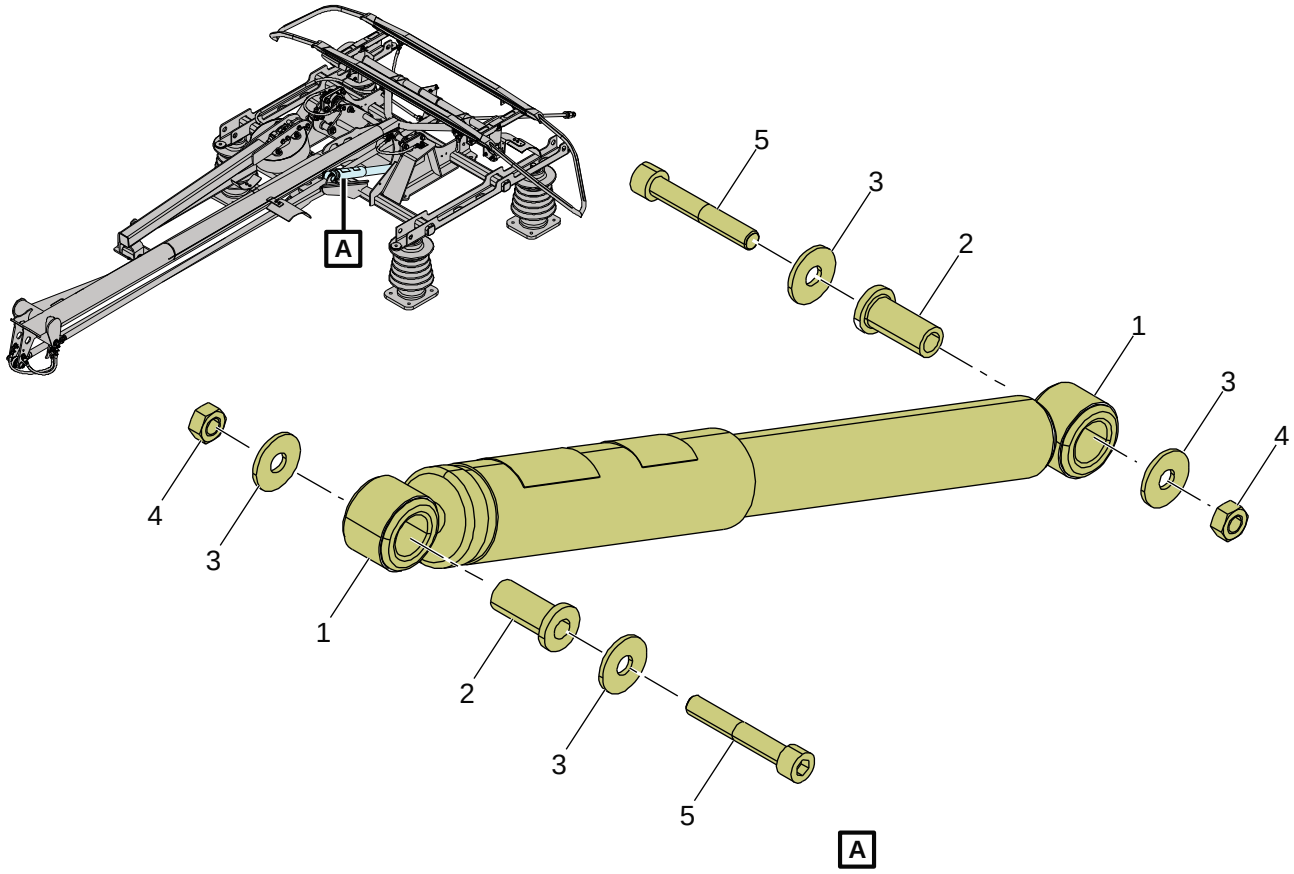
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.6 DAMPER ASSEMBLY

Damper Assembly creates link between the Frame and Lower Arm and restricts the additional play, refer to Figure 8.

Damper ensures high quality of current transfer.

Damper operates as a single acting unit on the Hinged (Joint) System during its downward movements.



Note: Insulators are shown for illustration purpose.

Figure 8 – Damper Assembly

Item no	Description	Part Number	Qty
1	Damper	VE042801-0101	1
2	Bague Plate	YE040297-0001	2
3	Plain Washer	FT0030004-014	4
4	PREVAILING TORQUE HEX NUT M10	FT0042411-005	2
5	HSHC Screw	1801065-082	2

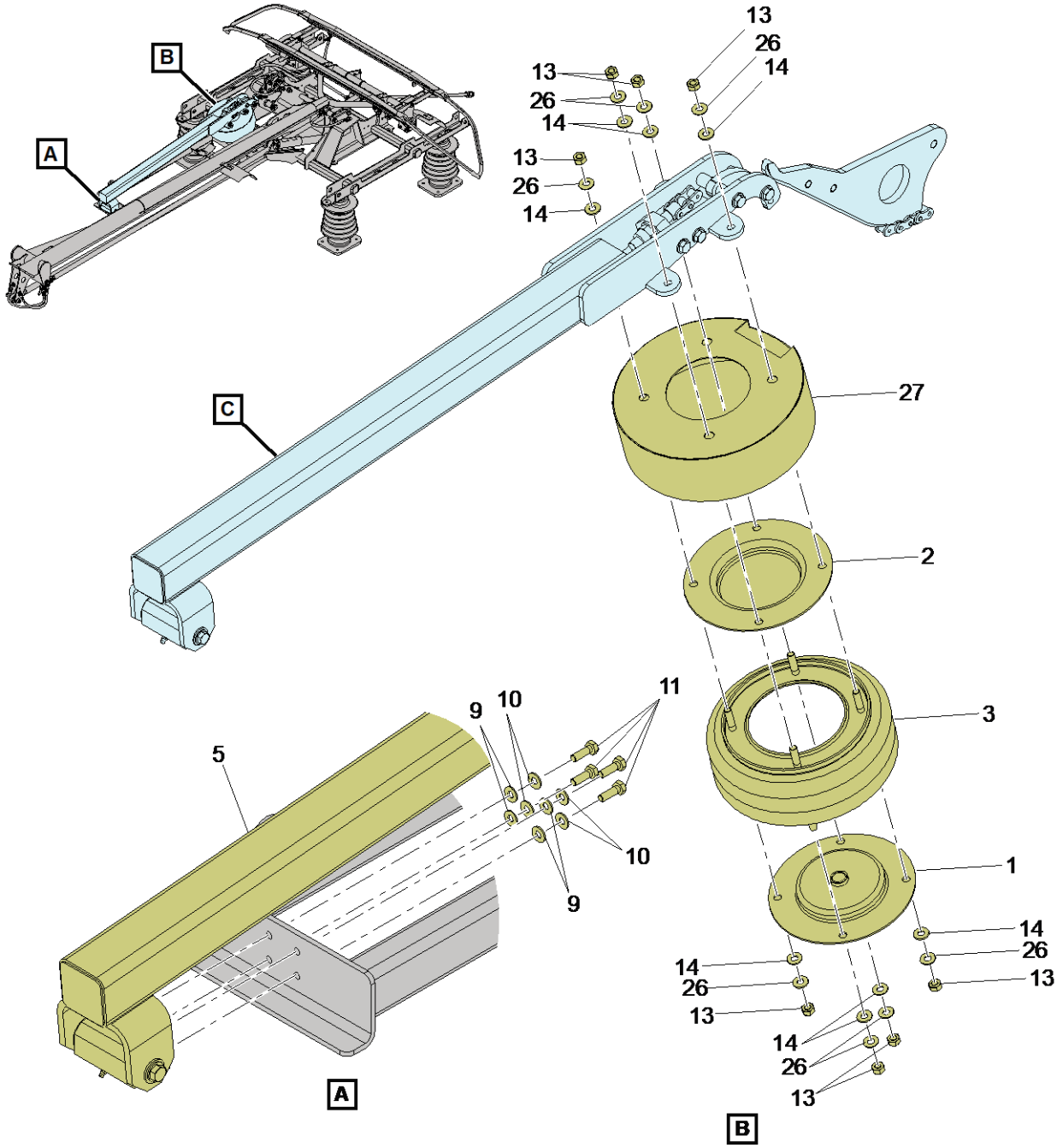
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.7 PNEUMATIC BALANCING SYSTEM

Pneumatic Balancing System consists of the air cushion that induces torque, acting on the Lower Arm through the Cam / Chain System.

Pneumatic Balancing System is mounted on one side of the Frame, refer to Figure 9.

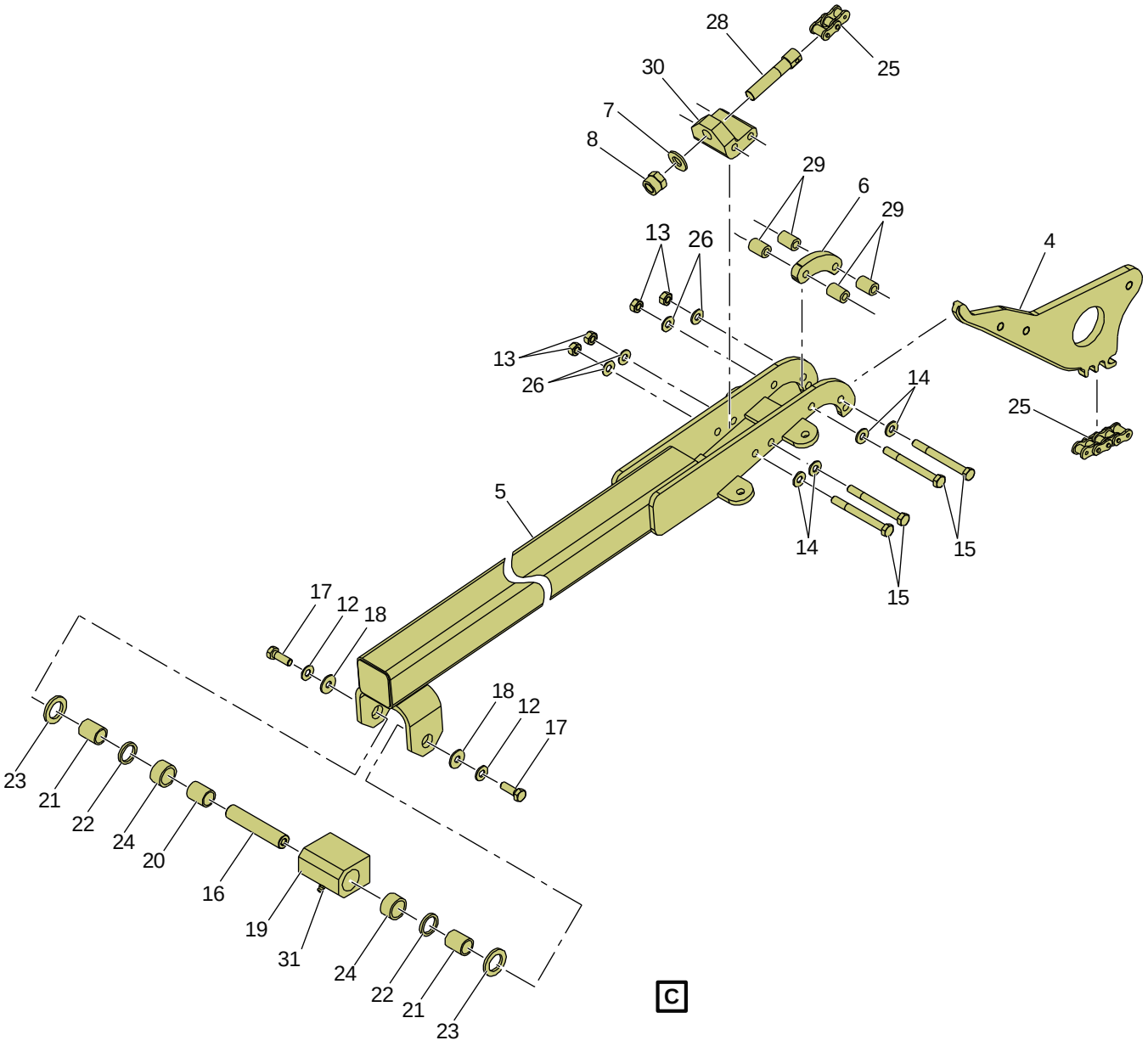
Function of the Pneumatic Balancing is to balance the Hinged (Joint) System and ensure there is always constant contact force against the Overhead Line (OHL).



Note: Insulators are shown for illustration purpose.

Figure 9 – Pneumatic Balancing System (Sheet 1 of 2)

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited



Note: Insulators are shown for illustration purpose.

Figure 9 – Pneumatic Balancing System (Sheet 2 of 2)

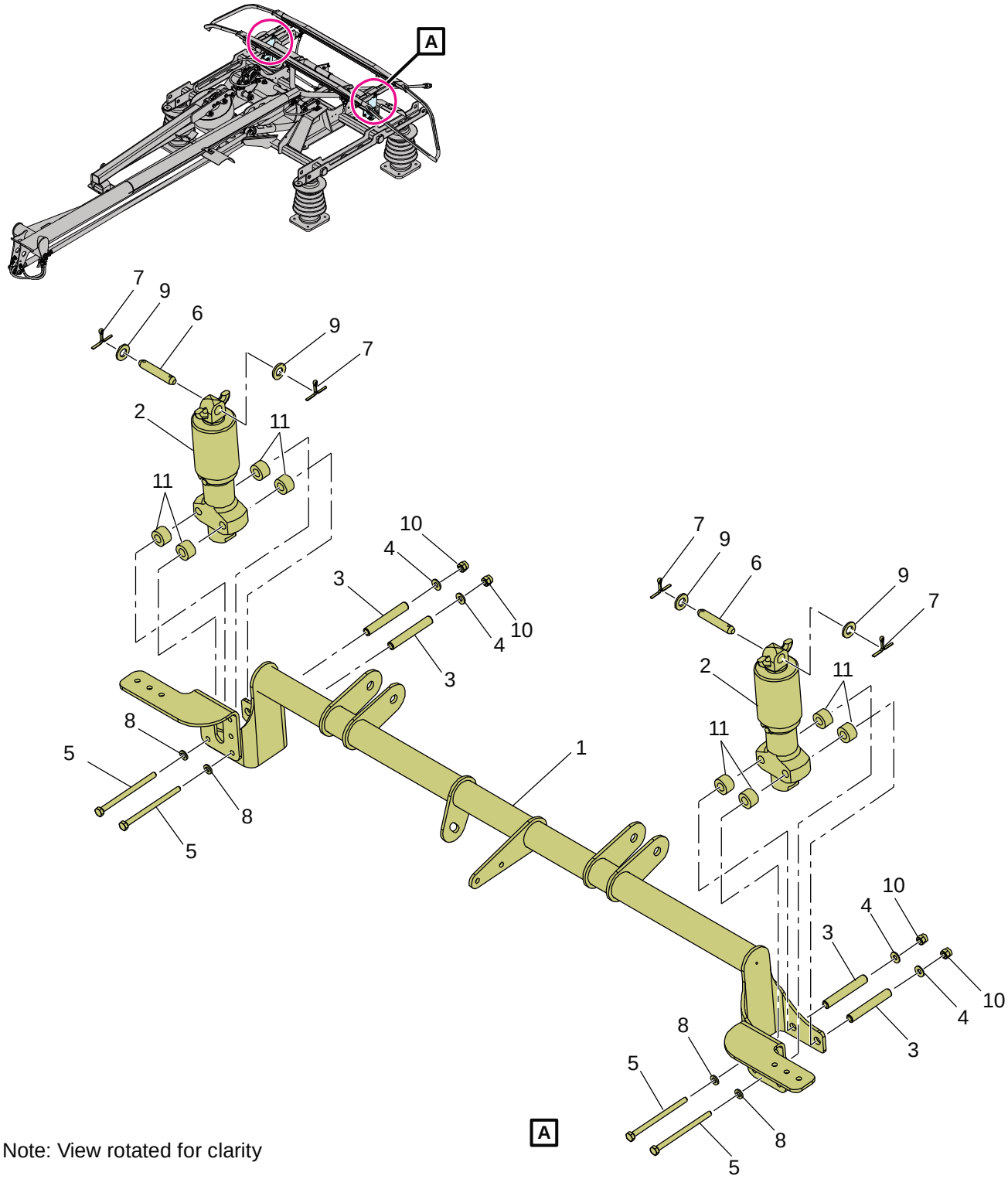
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Item no	Description	Part Number	Qty
1	Flange (air input)	FT0077457-101-D	1
2	Hanging plate	FT0077253-001-D	1
3	Bellows Semi Assy	YE039985-0001	1
4	Cam	E044073-0001	1
5	Balancing Arm	VE043671-0101	1
6	Nose	YE044076-0001	1
7	Plain Washer, M16	3221600-082	1
8	M16, 8 Stop Nut	2931603-080	1
9	Washer M8	3220508-000	4
10	CS Washer 8-18-1.4	3360801-000	4
11	M8X25 Hex Screw, SS	1300825-000	4
12	CS Washer,10-22-1.6	3361001-000	2
13	Hexagonal Nut M10-6 ISO 4032	2501000-082	12
14	Washer M10, 100HV	3221000-082	12
15	Hex. Hd Bolt - M10x100	YE069670-0060	4
16	Axle	YE040942-0001	1
17	M10x30 Hexagon Bolt	1301030-000	2
18	Washer, L10	3241001-000	2
19	Base	XE043707-0001	1
20	Spacer	YE040944-0001	1
21	Inner Ring	4960443-000	2
22	Seal Ring	4900124-000	2
23	Washer	YE040133-0001	2
24	Needle Socket	4960413-000	2
25	Chain	L100099-0102	1
26	CS Washer 10-22-1.6	3361000-082	12
27	Bellow Cover	XE042962-0002	1
28	Screw	YE040950-0001	1
29	Spacer	XE044074-0001	4
30	Support	XE044075-0001	1
31	Grease Lubricator	M01268	1

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.8 COLLECTOR SHOE SUSPENSION ASSEMBLY

Collector Shoe Suspension acts as cushion for the Collector Head which takes care of the misalignment of the Overhead Line (OHL), as well as misalignment caused during the vehicle movement, refer to Figure 10.



Note: View rotated for clarity

Note: Insulators are shown for illustration purpose.

Figure 10 – Collector Shoe Suspension Assembly

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Item no	Description	Part Number	Qty
1	Swaying Shaft	E043125-0102	1
2	Spring Box Mounted	E043130-0101	2
3	Centering	E043307-0001	4
4	CS Washer, 6-14-1.3	FT0030004-016	4
5	Hex. Screw, M6 x 90, 8.8	FT0030006-063	4
6	Axle	E042357-0001	2
7	Split Pin 3.2-22, ISO1234 A2	3113222-000	4
8	Plain Washer ISO7089	FT0030004-001	4
9	Plain Washer ISO7089	FT0030004-004	4
10	Prevailing Torque Hexagon Nut	FT0030002-023	4
11	Spacer	E043134-0001	8

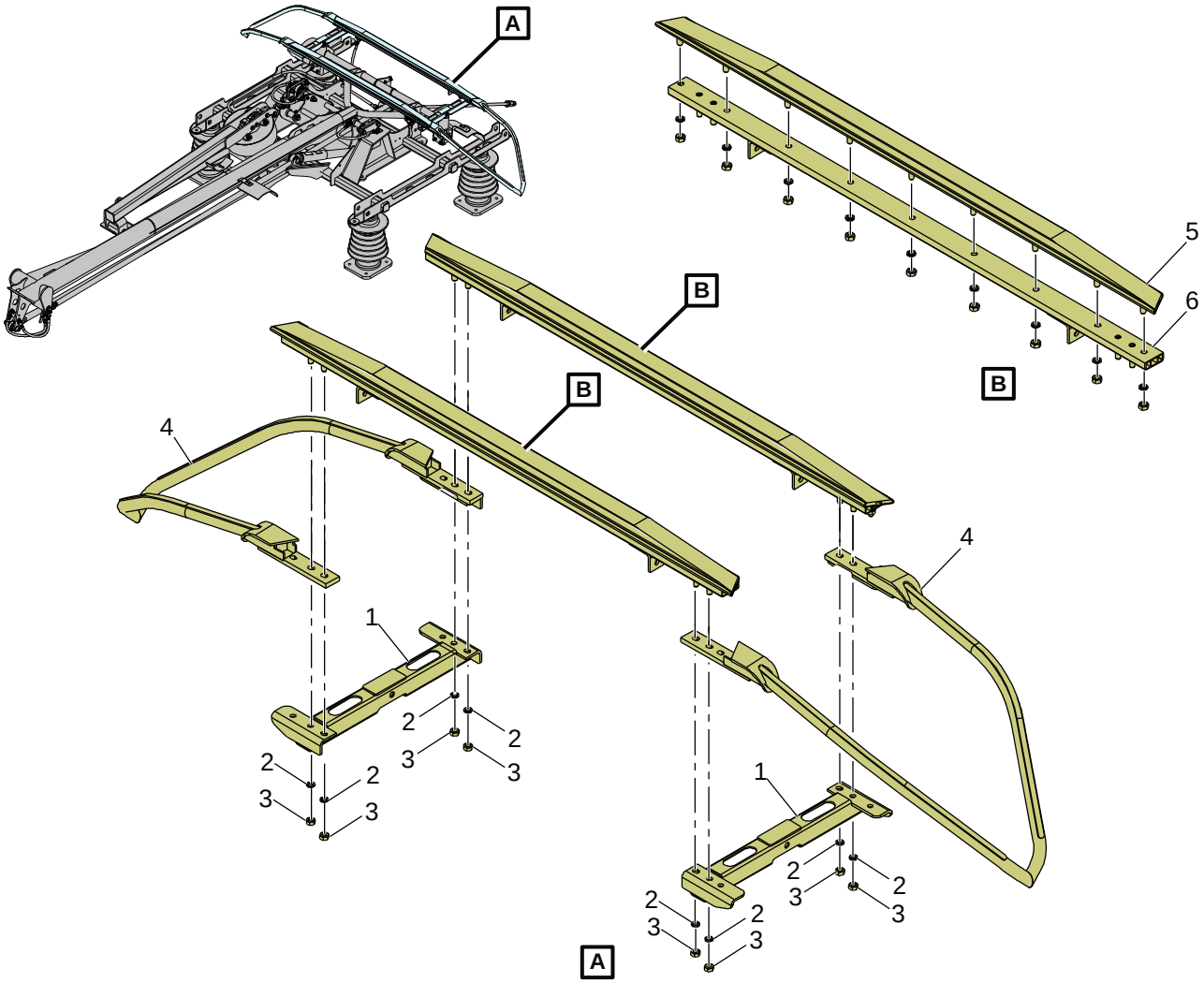
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.9 COLLECTOR HEAD

Collector Head is a part of Collector Head Assembly, consists of Collector Head, Collector Shoe, Collector Shoe Suspension and Swaying Shaft Assembly with hinged joints which consists of Upper and Lower Arm Assemblies and Upper and Lower Rod Assemblies,

Collector Shoe Frame consists of two Carbon Strips and assembled on the support Frame and Horns on each side.

Carbon strips are connected to the upper arm by copper flexible connections, to transfer the current on the Pantograph structure. refer to Figure 11.



Note: Insulators are shown for illustration purpose.

Figure 11 – Collector Head

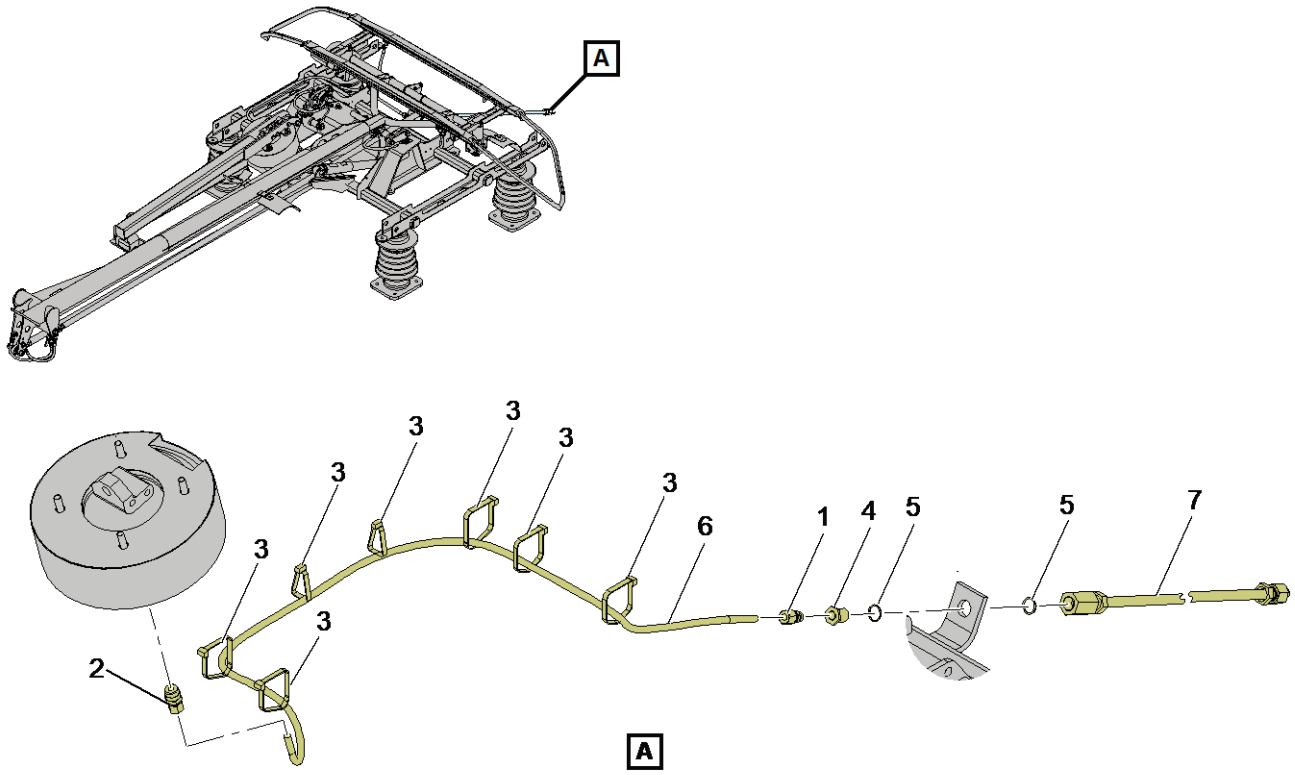
Item no	Description	Part Number	Qty
1	Strip Support	FT0053911-113	2
2	CS Washer	FT0030003-030	8
3	Prevailing Torque Nut	FT0030001-024	8
4	Bearing	FT0053911-112	2
~~5~~	Carbon Strip	FT0074495-100	2
6	Carbon Strip Support	FT0074365-101	2

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.10 AIR PIPING ASSEMBLY

The Insulated Hose Assembly is a part of Air Supply System and provides compressed air supply to the Balancing System, refer to Figure 12.

The Union Double is a component, which couples with Pneumatic Connection between the source and Pipe Assembly, refer to Figure 12.



Note: Insulators are shown for illustration purpose.

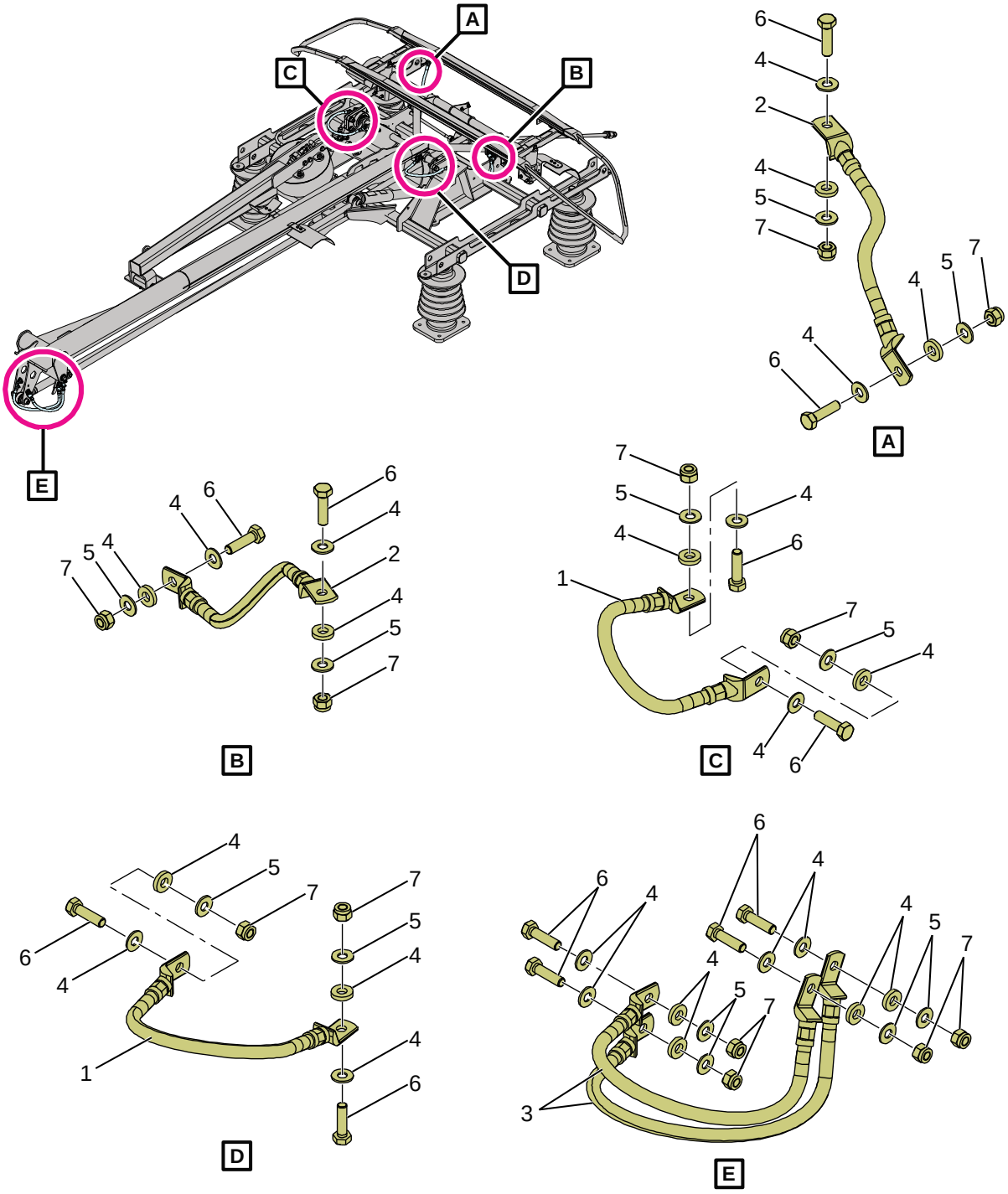
Figure 12 – Air Piping Assembly

Item no	Description	Part Number	Qty
1	Male Stud Coupling	5314112-000	1
2	Male Stud Coupling	5314114-000	1
3	Collar	4731153-001	9
4	Crossing Bulkhead 1/4 F GZ"	5315602-001	1
5	Dia 20 Flat Seal	TESNENI/15 4407	2
6	Tube (RILSAN) - TRUBKA 10x8/1	FT0052511-014	2m
7	Insulated Hose Assembly	E043116-SET24	1

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.11 FLEXIBLE CONNECTION SET

Flexi Connections / Shunts are the Copper core connection and flexes between the Collector Head and Upper Arm Assembly and from Upper Arm Assembly to Lower Arm Assembly and from Lower Arm Assembly to Frame Assembly thus ensuring continuous flow of the power from the Collector Head to the Frame, refer to Figure 13.



Note: Insulators are shown for illustration purpose.

Figure 13 – Flexible Connection

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Item no	Description	Part Number	Qty
1	Flexible Connection	VE038875-105	2
2	Flexible Connection	VE038875-106	2
3	Flexible Connection	VE038875-108	2
4	Washer M8	3220508-000	24
5	CS Washer 8-18-1.4	3360801-000	12
6	Hex. bolt M8x30	1300830-000	12
7	Stop Nut, M8	2930805-000	12

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.12 IDENTIFICATION LABEL - PANTOGRAPH

Identification label defines the company logo, Part Number and Serial Number for identification, refer to Figure 14.

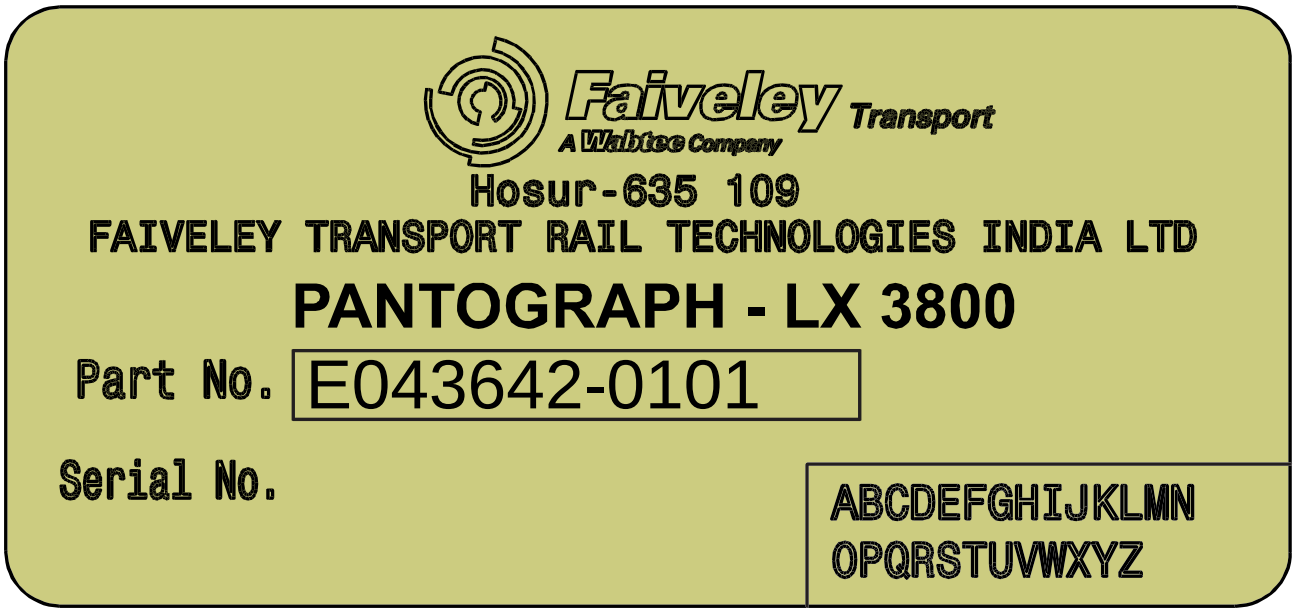


Figure 14 – Identification Label (Example)

Item no	Description	Part Number	Qty
1	NAME PLATE	FT0053911-099	1

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.12.1 ID NUMBERING

ID-Plate for the LX3800 PN Pantograph is inscribed on the Frame Assembly, refer to Figure 15.

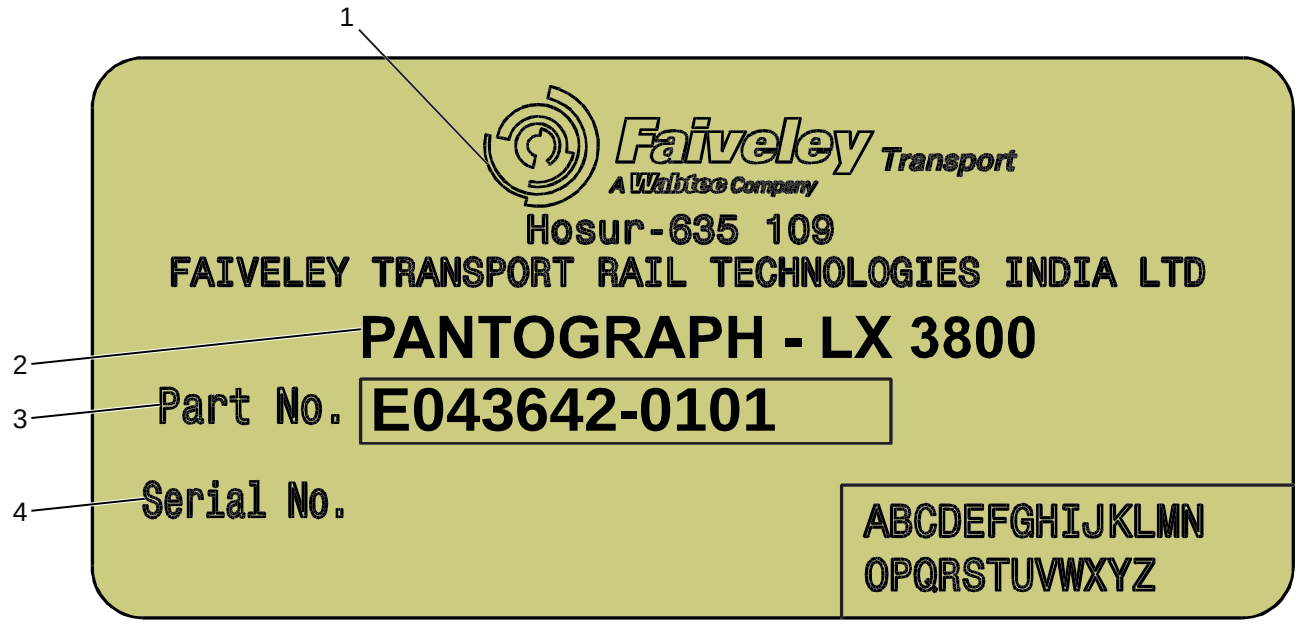


Figure 15 – ID Numbering (Example)

Item no	Description
1	MANUFACTURER'S LOGO
2	TYPE OF PANTOGRAPH
3	FT ID NUMBER
4	SERIAL NUMBER / YEAR OF MANUFACTURING
5	REVISION OF ASSEMBLY

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.13 PNEUMATIC CONTROL UNIT (PCU)

Pantograph extension is controlled by the Pneumatic Drive, which is supplied with compressed air from the Pneumatic Control Unit (PCU).

Pneumatic Control unit (PCU) is placed inside of the vehicle and is connected to the compressed air, refer to Figure 16.

The Air filter always to be towards downside and Safety Valve upside when mounted. Function of the Pneumatic Control Unit (PCU) is to keep a constant pressure in the Pneumatic Drive.

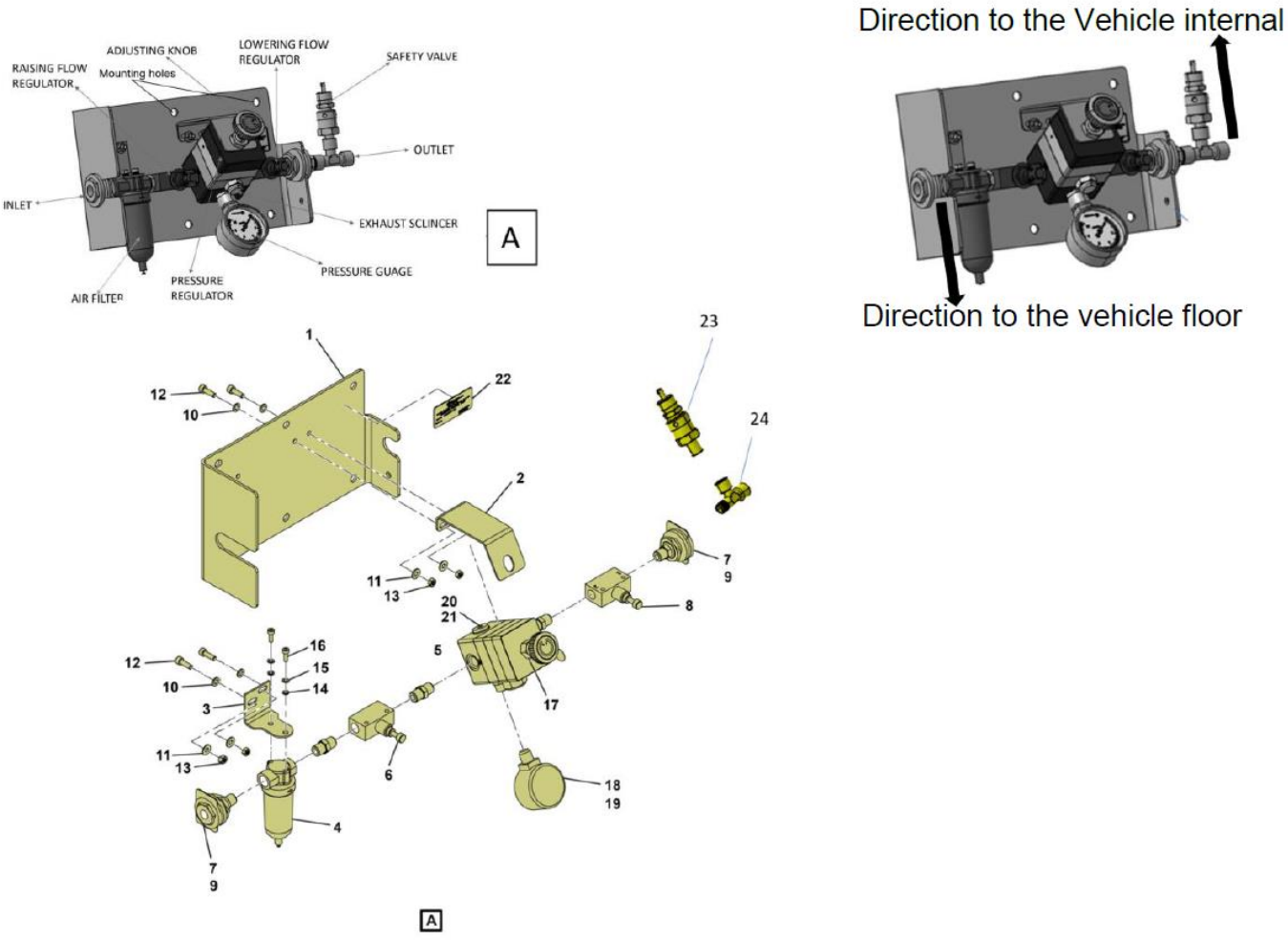


Figure 16 – Pneumatic Control Unit

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Item no	Description	Part Number	Qty
1	BASE PLATE	FT0053911-032	1
2	REGULATOR BRACKET	FT0053911-033	1
3	WALL MOUNTING BRACKET FILTER	FT0053911-034	1
4	FILTER G-1/4" 5 MICRON MANUAL DRAIN	FT0053911-035	1
5	PRESSURE REGULATOR G1/4"	FT0053911-036	1
6	FLOW REGULATOR G1/4" UNI-DIRECTIONAL	FT0053911-037	2
7	BULKHEAD G1/4"	FT0053911-038	2
8	NIPPLE R1/4"	FT0053911-039	5
9	PLAIN WASHER M20 200HV	FT0053911-040	4
10	PLAIN WASHER M5	FT0053911-041	5
11	CONTACT WASHER M5	FT0053911-042	4
12	BOLT M5 X 16 LONG	FT0053911-043	4
13	HEX NUT M5	FT0053911-044	4
14	PLAIN WASHER M4	FT0053911-045	2
15	SPRING WASHER M4	FT0053911-046	2
16	BOLT M4 X 16 LONG	FT0053911-047	2
17	HEX NUT M12x1.5 FINE PITCH	FT0053911-058	1
18	PRESSURE GAUGE	FT0053911-049	1
19	CONNECTOR REDUCER	FT0053911-050	1
20	SCREW PLUG	FT0053911-051	1
21	SEALING WASHER	FT0053911-052	1
22	NAME PLATE	FT0053008-005	1
23	G1/4" TEE LATERAL MALE	FT0053911-030	1
24	POPPET VALVE (SAFETY VALVE)	FT0053911-054**	1

** Tentative Part number

NOTE:

Total allowable air flow consumption at PCU level including all joints, bleed port, diaphragm and breather/ exhaust port of pressure regulator and pressure safety valve are 5.1 lpm max (when inlet set pressure is 8 - 10 bar & outlet set stabilized pressure is 4.8 - 5.1 bar).

Pressure safety valve set cracking pressure: 5 - 5.2Bar (crack off pressure will be ~1.6 bar lower than cracking pressure).

Soap solution or any form of solution are not permitted to be used on bleed port, breather/exhaust port, quick exhaust pilot vent, safety valve in the PCU. This may cause malfunction of pressure regulator; this method is however applicable for checking leakages only on the PCU joints.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.2.14 IDENTIFICATION LABEL - PCU

Identification label defines the company logo, Part Number and Serial Number for identification, refer to Figure 17.

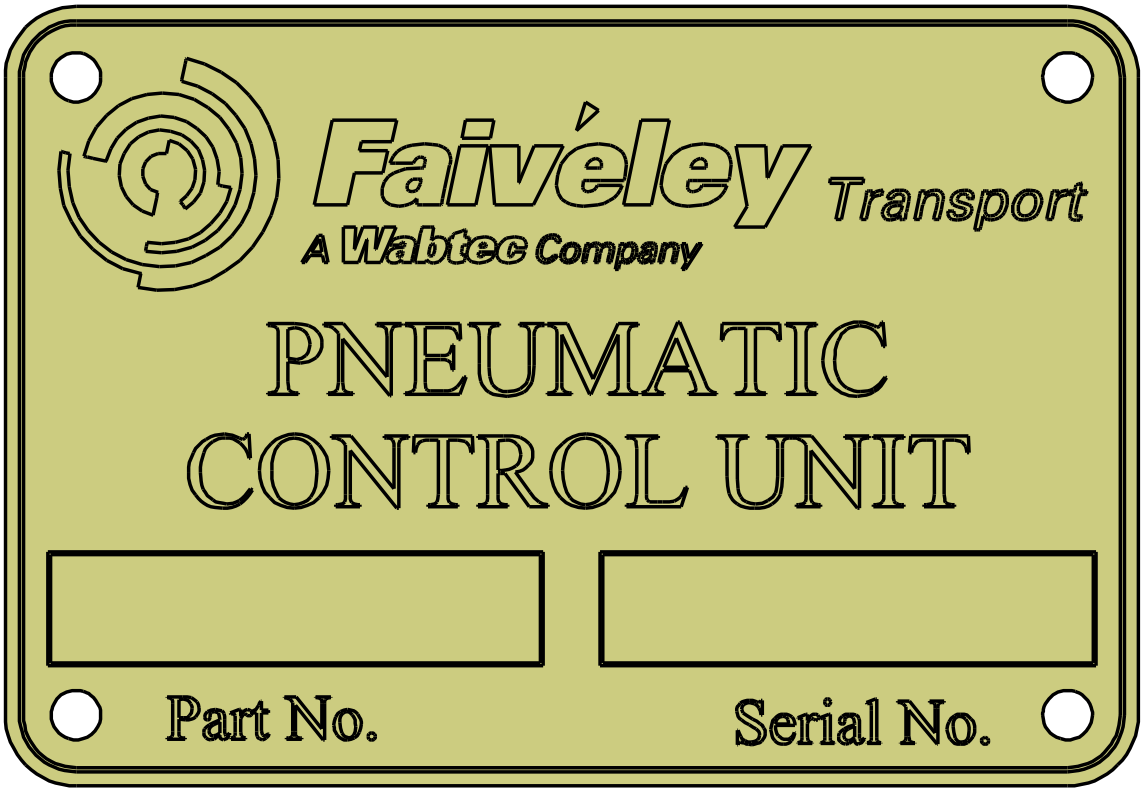


Figure 17 – Identification Label (Example)

Item no	Description	Part Number	Qty
1	NAME PLATE	FT0053008-005	1

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.3 TECHNICAL DATA FOR LX3800 PN

3.3.1 TECHNICAL SPECIFICATIONS

Weight	
Insulator	(Insulators are not in Wabtec scope of supply)
Collector Head	15 kg
TOTAL (Without insulators and PCU)	200 ± 10 kg
Pneumatic Control Unit (PCU)	3.5±1 kg
Nominal static force	
For 25 kV AC, OHV	70 N
Pressure in Pneumatic Circuit	
Maximum	10 bar
Minimum	6 bar
The air supply shall have the following characteristics	
Dry air, Max. Dew point	-10°C at 9 bars
	-26°C at 5 bars
De-oiled air	max = 10 mg / m^3
General requirement	80 µm filtered air
Needed for Pressure Regulator	5 µm filtered air
Nominal Operational Voltage	25 kV AC
Consumed current at 25 kV AC	
Max. Standstill Current	80 A
Nominal Current	600 A
Vehicle Max. Speed	200 km/h

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Working Temperature Range (on Roof Equipment)	
Minimum	0 °C
Maximum	70 °C
Working Temperature Range (under Roof equipment)	
Minimum	0°C
Maximum	50 °C
Raising and Lowering Time	
Raising Time	max. 15 s
Lowering Time	max. 20 s

3.3.2 PANTOGRAPH EXTENSIONS DIMENSIONS

- Maximum Extension D4: 3800 mm
- Maximum Functional height D3: 3600 mm
- Minimum Functional height D2: 150 mm
- Lowered Pantograph D1: 655±5 mm

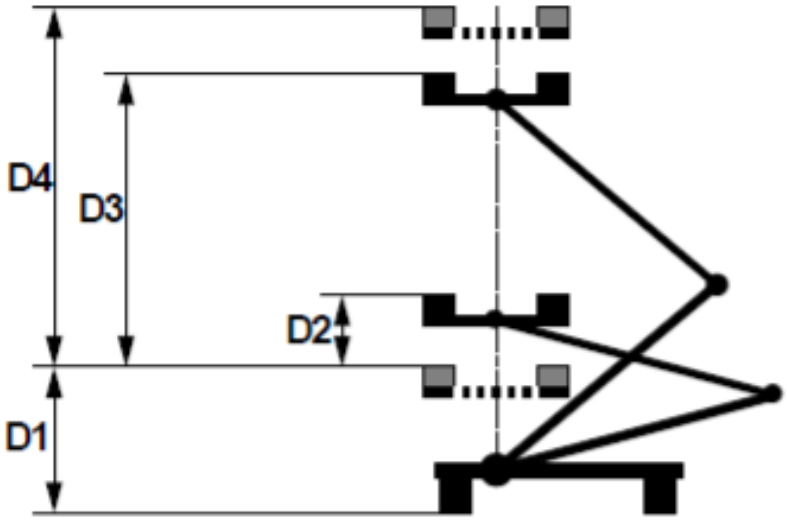


Figure 18 – Pantograph Extensions

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

3.3.3 COLLECTOR HEAD ENVELOP DIMENSIONS

- Length L: 2030 (0 /-10) mm
- Height H: 316 (±5) mm

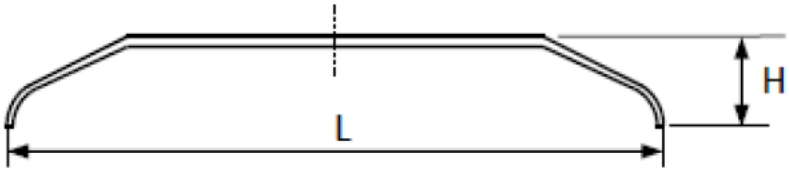


Figure 19 – Collector Head Envelop Dimensions

3.3.4 CARBON STRIPS

- Number of carbon strips: 2
- Type of material: Metallized carbon
- Wearing length: 1049 mm
- Wearing height: 14 mm (wearing part)
- Wearing width: 33 mm
- Horns: Welded Stainless Steel.

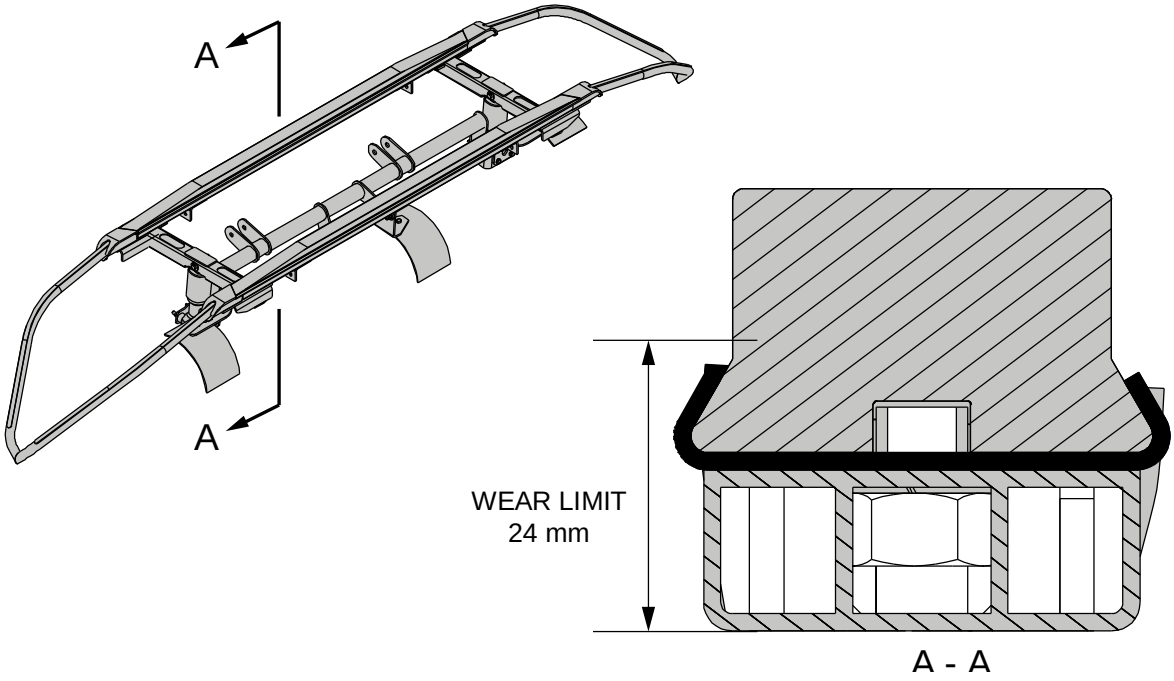


Figure 20 – Carbon Strips Condemning Limit

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// 4.OPERATIONS

4.1 PNEUMATIC CONTROL UNIT (PCU)

The Pantograph extension is controlled by Pneumatic Drive and is supplied with compressed air from the Pneumatic Control unit (PCU), refer to Detail Parts Catalogue Section 3.2.13.

Pneumatic Drive gives energy to raise the Pantograph, while the own weight causes the Pantograph to lower it. Pressure Regulator is required for controlling the pressure for correct setting of contact force.

Pneumatic Control Unit (PCU) is placed inside the vehicle and connected to the compressed air.

Pneumatic Control Unit (PCU) allows the following functions:

- Command for extending Pantograph.
- Maintain constant pressure in the pneumatic bellow.
- Filtering of air supplied in the pneumatic regulator.
- Control the speed of Pantograph during raising / lowering.
- To regulate the level of pressure within a system, preventing it from building higher than a pre-defined pressure.

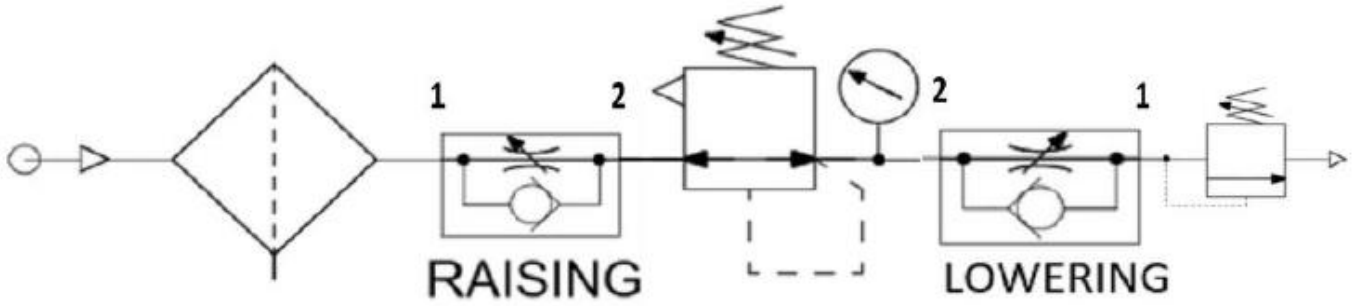


Figure 21 – Pneumatic control unit (PCU)

4.2 AIR SUPPLY SYSTEM

The Insulated Hose Assembly (E043116-SET24) provides Compressed Air supply to the Pneumatic Balancing System (VE043670-0101) through Pneumatic Connection (VL100074-0116).

Pneumatic Connection (VL100074-0116) is set of Air Pipes, Fittings and attaching Collars installed on Pantograph Structure.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

4.3 HINGED (JOINT) SYSTEM

Hinged (Joint) system allows vertical movement of the Collecting Head from the Frame assembly.

Hinged (Joint) system includes:

- One T-shaped Lower Arm, made of large diameter steel tubing and when rotated on the Frame, transmits the torque generated by the Balancing System.
- One lower Rod, made of steel with a smaller diameter, hinged to a fixed point of the rigid Frame.
- One Upper Arm, made of steel and hinged to the Lower Arm and Collector Head Shaft.
- One Swaying Shaft, swivels on the Upper Arm.
- One Adjusting Rod with one end hinged to Lower Arm and the other to the Swaying Shaft.
- All the main articulations are fitted with sealed ball or plain bearings.
- Each articulation is protected against current damages by means of flexible shunts.

4.4 PNEUMATIC BALANCING SYSTEM

Key function of a pneumatic balancing system is to balance the joint system and to ensure a constant contact force against the overhead line (OHL).

Pneumatic balancing assembly (adjusting rod + swaying shaft) maintains the current collecting head horizontal within the whole collecting area.

Pneumatic Balancing System (VE043670-0101) consists of Air Bellows that induce torque acting on the Lower Arm Assembly (VE043658-0101) through the Cam / Chain system, refer to Detail parts catalogue section 3.2.7.

Pneumatic Balancing System is mounted on one side of Frame assembly (VE043666-0101).

4.5 ACTUATION SYSTEM

The Pantograph extension is controlled by the Air Bellows and Cam systems.

Air Bellow is fed with air which when expands, results in actuating the Cam and Chain mechanism which in-turn raises the Collector Head through the hinged system.

Lowering is caused by gravity and the lowering speed is controlled by limiting the bleeding Air flow and by the Damper System.

4.6 COLLECTOR HEAD DAMPER SYSTEM

Collector Head Damper System is a single acting Damper which comes into action during the downward movement of the hinged system, refer to Detail parts Catalogue Section 3.2.8.

Collector Head Damper system also improves the quality of current collection.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

4.7 COLLECTOR HEAD

Function of Collector Head is to maintain constant sliding on the Catenary and to provide the best possible current collection, refer to Detail Parts Catalogue Section 3.2.9.

4.8 START- UP INSTRUCTIONS

Before start-up, check the below mentioned points:

- Check insulating distances onto the vehicle, according to the Technical Data, refer to section 3.3.
- Make sure that the screw connection of the high voltage connection is properly fastened and well-greased.
- Check the contact pressure of the Pantograph, according to the Technical Data, refer to Section 3.3.
- Check the Collector Head so that it can turn freely from the horizontal position.
- Make sure that Carbon Strips are parallel to the overhead wire.
- Make sure that the raising and lowering times are in accordance with the Technical Data, refer to section 3.3.
- Make sure that the Upper Arm rests on the End Stoppers.

WARNING: Attention-No one is allowed underneath the Pantograph while adjusting.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

4.9 PRINCIPLES OF CORRECT USE

The Pantograph is not intended for the following handling or functional applications (deformation of the curve of the static force with respect to Pantograph extension would probably occur which would result in deterioration of quality of current collection):

NOTE:

Incorrect Handling or Use	Risk
Pantograph handling other than, the mentioned using 4 sling handling holes.	Deformation of a component of Pantograph structure.
Lowered Pantograph must not be raised by lifting joint of lower arm and upper arm. Raise the Pantograph on train to the maximum extension only if it is under OHL.	Danger of lower rod deformation, re-check set up is required after such event.
Delivery of compressed air that has not been dried, filtered, and cleaned from oil.	Disturbance of static force pneumatic regulation (PCU damaging).
Command for retracting Pantograph during its upward movement (shortly after giving command for Pantograph)	It is necessary to prevent such operation as impact in Pantograph structure takes place after contact with the bottom stop (minimum interval between both commands is 2 seconds).

DANGER!
High voltage, Risk of serious burns or death.

Disconnect the power supply, before starting maintenance activities on the roof.

Risk of injury or death.

Risk of Pantograph structural damage.

- In case of manipulation with overhead crane, always use 4 slings for installing or removing Pantograph.
- Dangerous handling or damage of Pantograph if the Pantograph is not secured properly.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

4.10 GENERAL PNEUMATIC SCHEMATIC

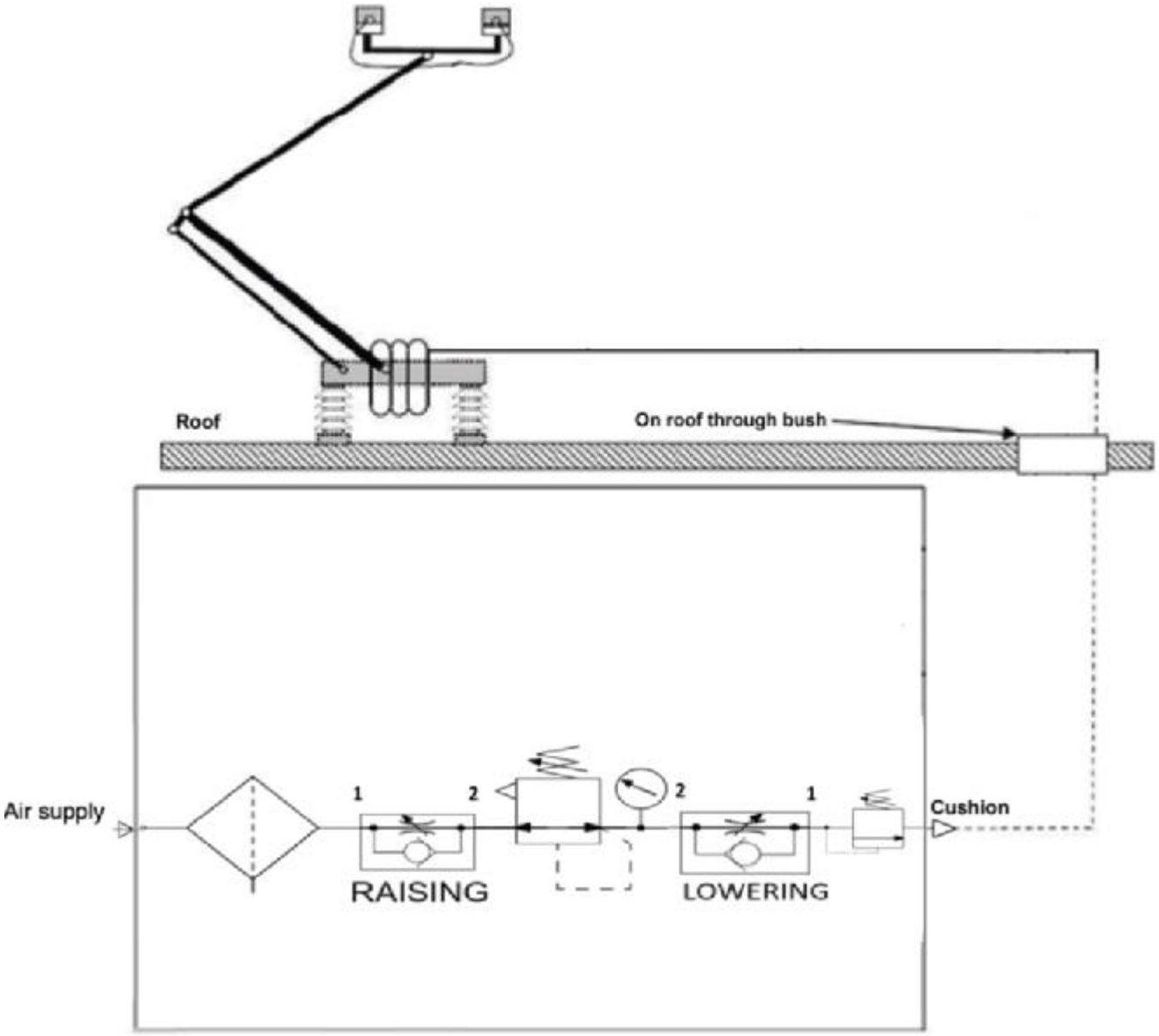
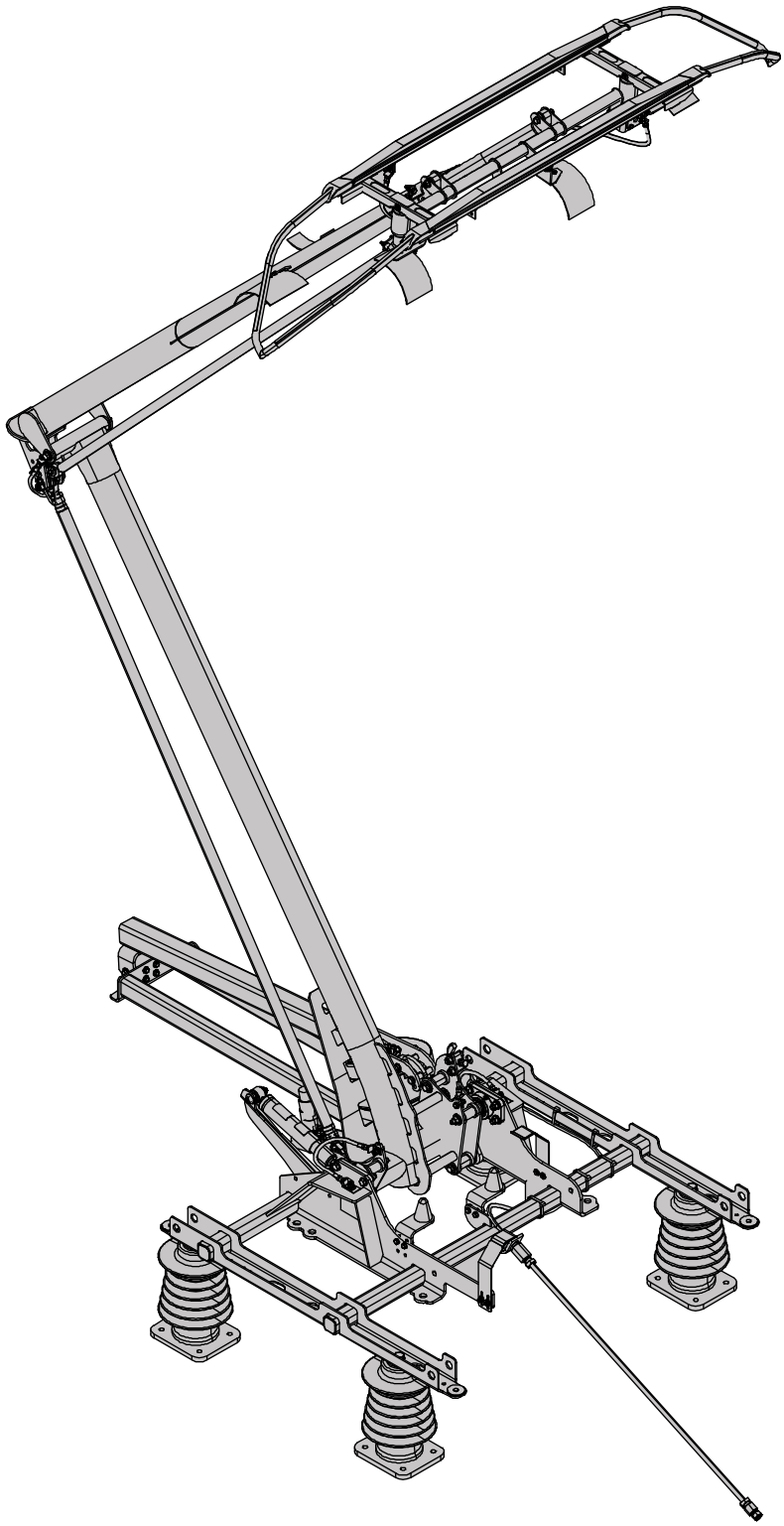


Figure 22 – General Pneumatic Schematic

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// 5.WORKING PRINCIPLES

5.1 PANTOGRAPH EXTENSION



Note: Insulators are shown for illustration purpose.

Figure 23 – Pantograph Extended View

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Pantograph is a pneumatically operated Air Bellow system and intended to extend to certain height to reach the overhead line (OHL) and apply a force of 70 N against the supply line for positive connectivity, refer to Figure 23.

- Pneumatic Control Unit (PCU) is fitted in the operator cabin. Before extending the Pantograph for function, certain start-up check must be fulfilled as per Section 4.8.
- Actuation system expands the Bellow to advance the Cam and Chain mechanism which is assembled with the Hinged System.
- Hinged system raises the Lower Arms and Upper Arms with support of Lower Rods.
- Upper Rods are adjusted to ensure the parallelism of the Collector Head.
- Collector Head is raised to the desired height against the overhead line (OHL) at 70 N force for positive engagement

The dynamic behaviour of the Pantograph is determined with two levels of suspensions and are joined with the Damper. This system can guarantee high quality of current transfer.

- The First suspension level is implemented using Pneumatic Bellows during which the Pneumatic Control Unit (PCU) should ensure to maintain constant pressure in the bellows, independently to the level of extension of the Pantograph.

- The Second suspension level is implemented using Collector Springs.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

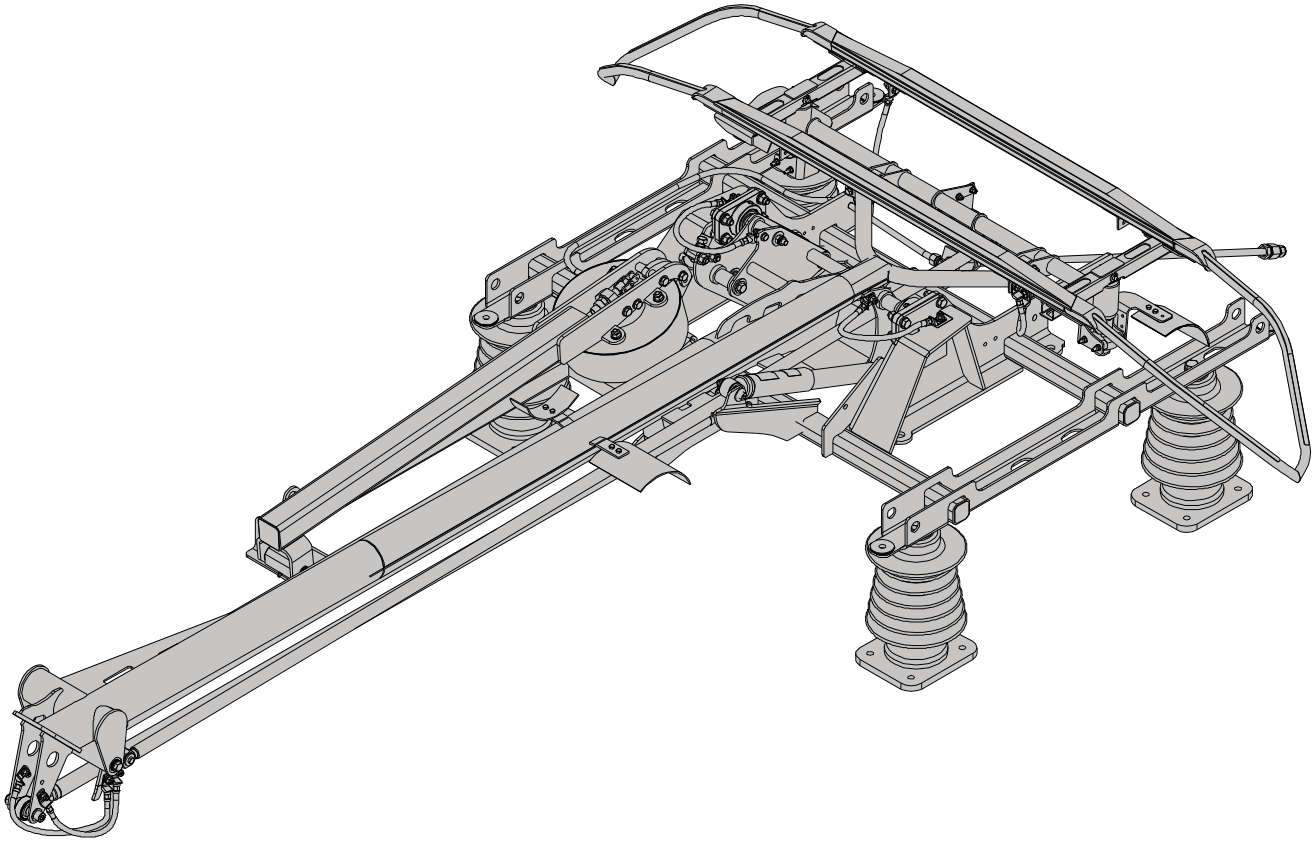
5.2 PANTOGRAPH RETRACTING COMMAND

Command for Pantograph retraction is received from the control cabin by reactivation (Activation of the second coil) of the main supply valve. This will allow air expelling from the bellows through Pneumatic Control Unit (PCU). The Pantograph then moves downward until it is completely rested or until seated on end stopper.

5.3 PANTOGRAPH LOWERING

Pantograph is lowered by gravity and Damper, refer to Figure 24.

- When the pressure supply is stopped at Actuation System, Pantograph will start falling due to its self-weight.
- Speed of lowering must be controlled in order to protect the components and is achieved by slowly bleeding the input supply.
- Lowering Speed can also be reduced by Damper and restricts free falling of the assembly.



Note: Insulators are shown for illustration purpose.

Figure 24 – Pantograph Lowered Position

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// 6.TROUBLE SHOOTING

6.1 TROUBLE SHOOTING PLAN

Defect		Possible Reason	Troubleshooting Reference
Carbon Strips	1. Difference in wear between individual bands 2. There is apparent difference in wear between 2 bands of the same collector	Adjustment of upper rod, collector horizontal position	Refer to Section 8.6.8.1
		Flexible connections restrict free movement of the collector head	Refer to Section 8.10.16, 8.10.17 and 8.10.15.
		Joint of suspension and collector head support is stuck	Refer to Section 8.9.1.4 Refer to Section 8.6.10
	1. Quick wear force is too low (arcing / sparking) force is too high (OHL raising)	Static force setting is too low / high	Refer to Section 8.6.5.
		Static force curve is out of tolerance-lower rod setting	Refer to Section 8.6.5.3.
		Damper defect	Refer to Section 8.9.1.5.
	2. Overheating Carbon and glue degradation	Static Force setting is too low / high.	Refer to Section 8.6.5.
		Poor contact of Flexible Connections	Refer to Section 8.10.16, 8.10.17 and 8.10.15.
		Electric conductive Grease on the terminals of Flexible Connections is missing	Refer to Section 8.6.10
		Adjustment of Upper Rod, Collector horizontal position	Refer to Section 8.6.5.

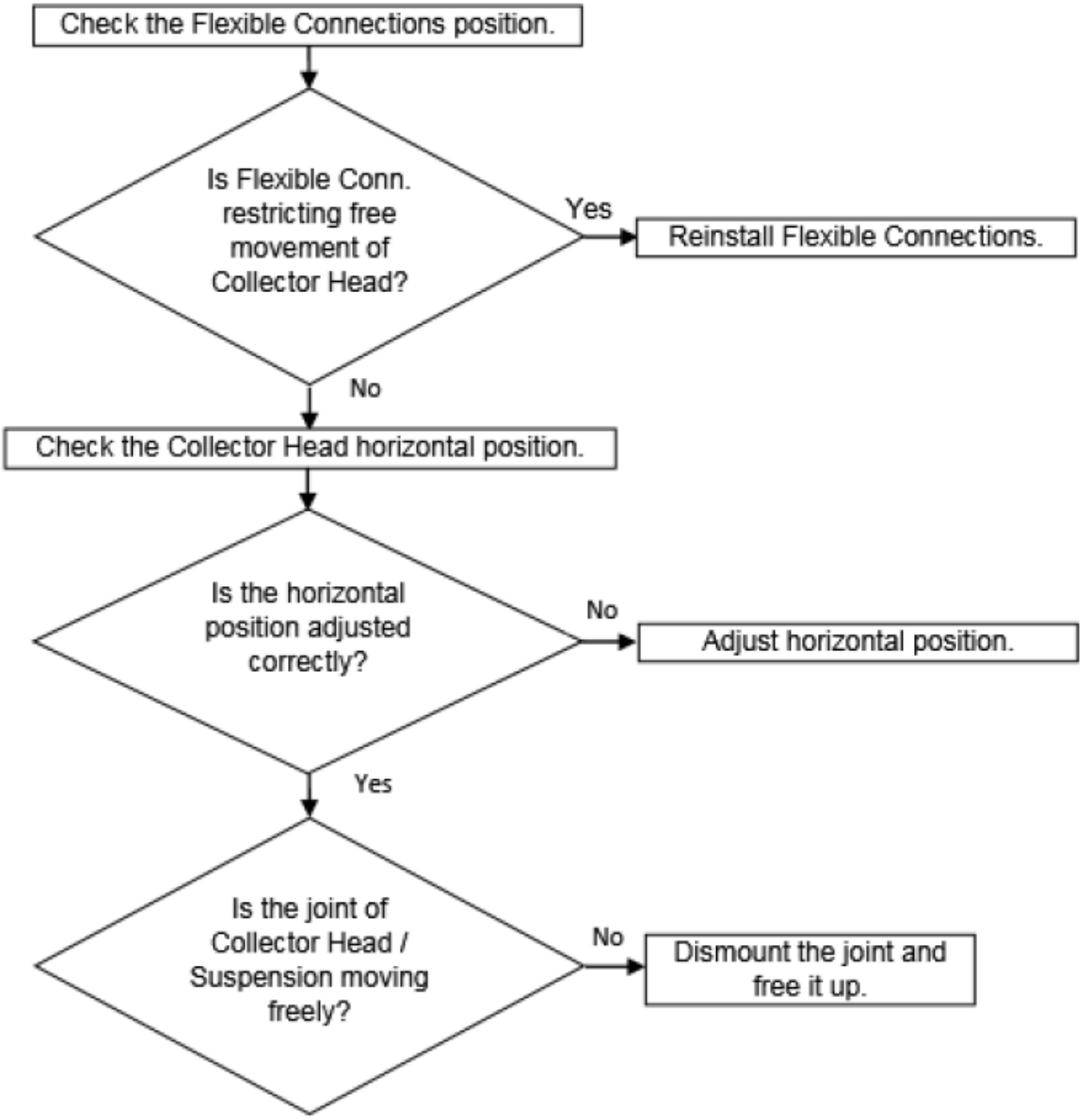
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Defect		Possible Reason	Troubleshooting Reference
Pantograph Extending	3. Blocked in resting Position	No or too low pressure in Pneumatic system	-
		PCU is in closed position	-
		PCU Pressure Regulator's incorrect Setting	Refer to Section 8.6.5.4.
		Blocked / Damaged Damper	Refer to Section 8.9.1.5.
	4. Too slow	Too low pressure in Pneumatic System	-
		Blocked PCU Air Flow Regulator	-
		Pneumatic System leakage	Refer to Section 8.6.7
		Clogged PCU Air Filter	Refer to Section 8.7.2
		PCU Pressure Regulator incorrect setting.	Refer to Section 8.6.5.4.
		Damper defect	Refer to Section 8.9.1.5.
		Lower Arm / Upper Arm Joint bearings damaged	Refer to Section 8.9.2.4.
		Lower Arm / Frame Joint Bearings damaged	Refer to Section 8.9.2.3
	5. Too fast	PCU Pressure Regulator incorrect Setting	Refer to Section 8.6.5.4.
Pantograph Retracting	6. Too slow	PCU Pressure Regulator incorrect Setting	Refer to Section 8.6.5.4.
		Damper defect	Refer to Section 8.9.1.5.
		Lower Arm / Upper Arm Joint bearings damaged	Refer to Section 8.9.2.4.
		Lower Arm / Frame Joint bearings damaged	Refer to Section 8.9.2.3
	7. Too fast	PCU Pressure Regulator incorrect Setting	Refer to Section 8.6.5.4.
		Damper defect	Refer to Section 8.9.1.5.
	8. Impacts on End stop	End stop setting End stop deformation	Refer to Section 8.7.3.
Quick wear of Flexible Connections		Wrong length or incorrect installation of terminals, incorrect OHL voltage	Refer to Section 8.10.16, 8.10.17 and 8.10.15.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

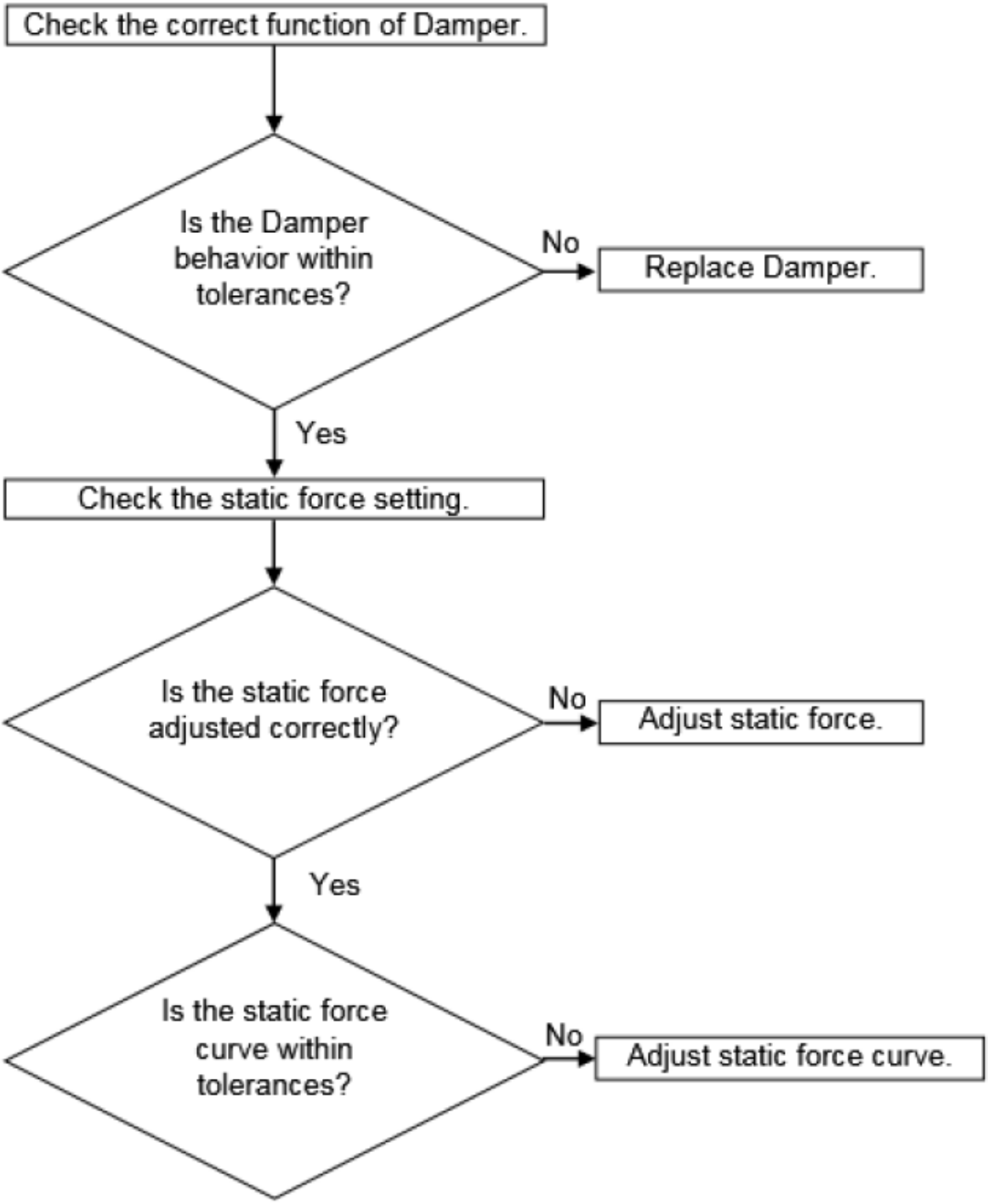
6.2 CORRECTIVE ACTIONS-PROCEDURES IN FLOW CHARTS

6.2.1 DIFFERENCE IN WEAR OF CARBON STRIPS



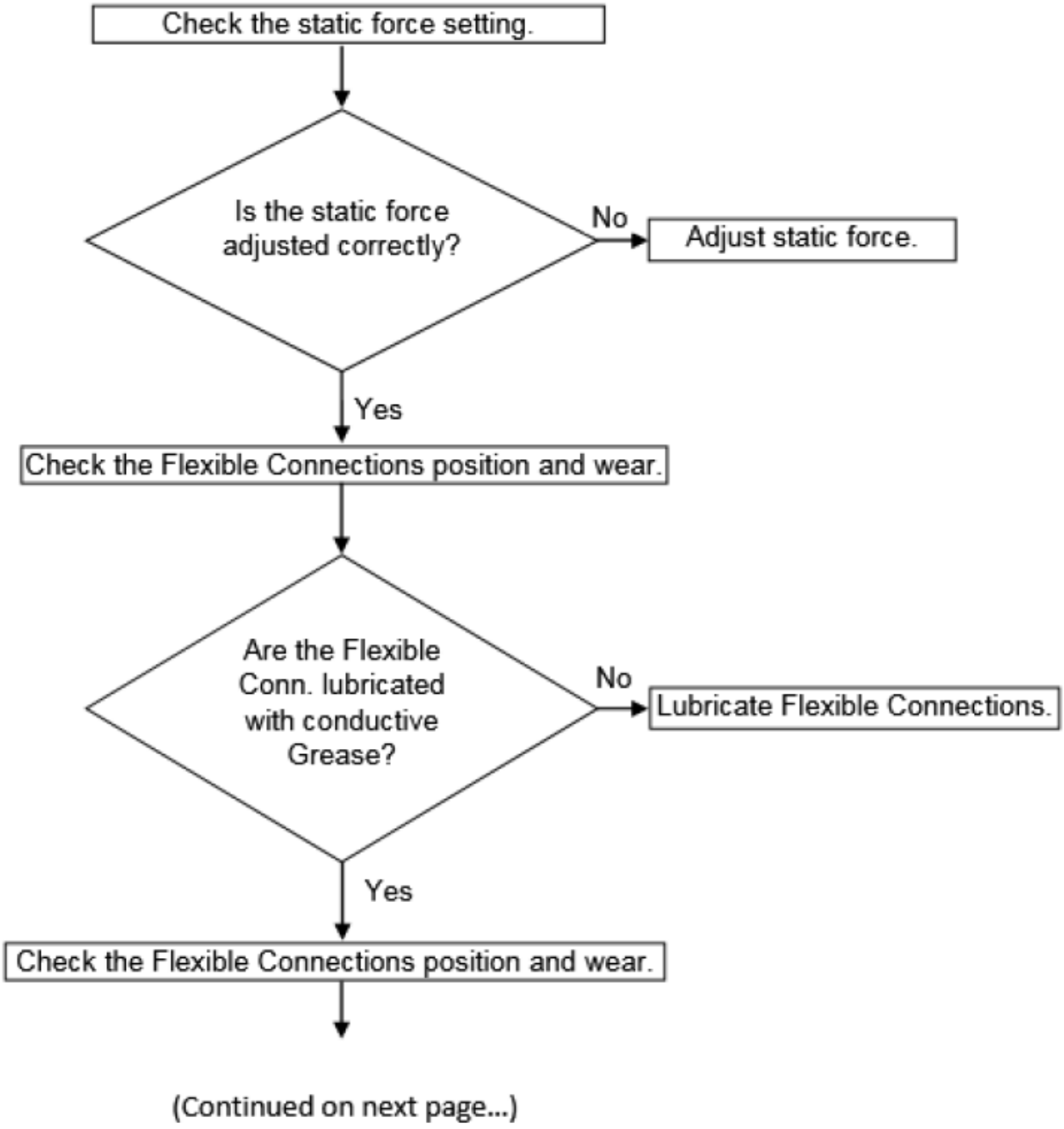
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.2 QUICK WEAR OF CARBON STRIPS



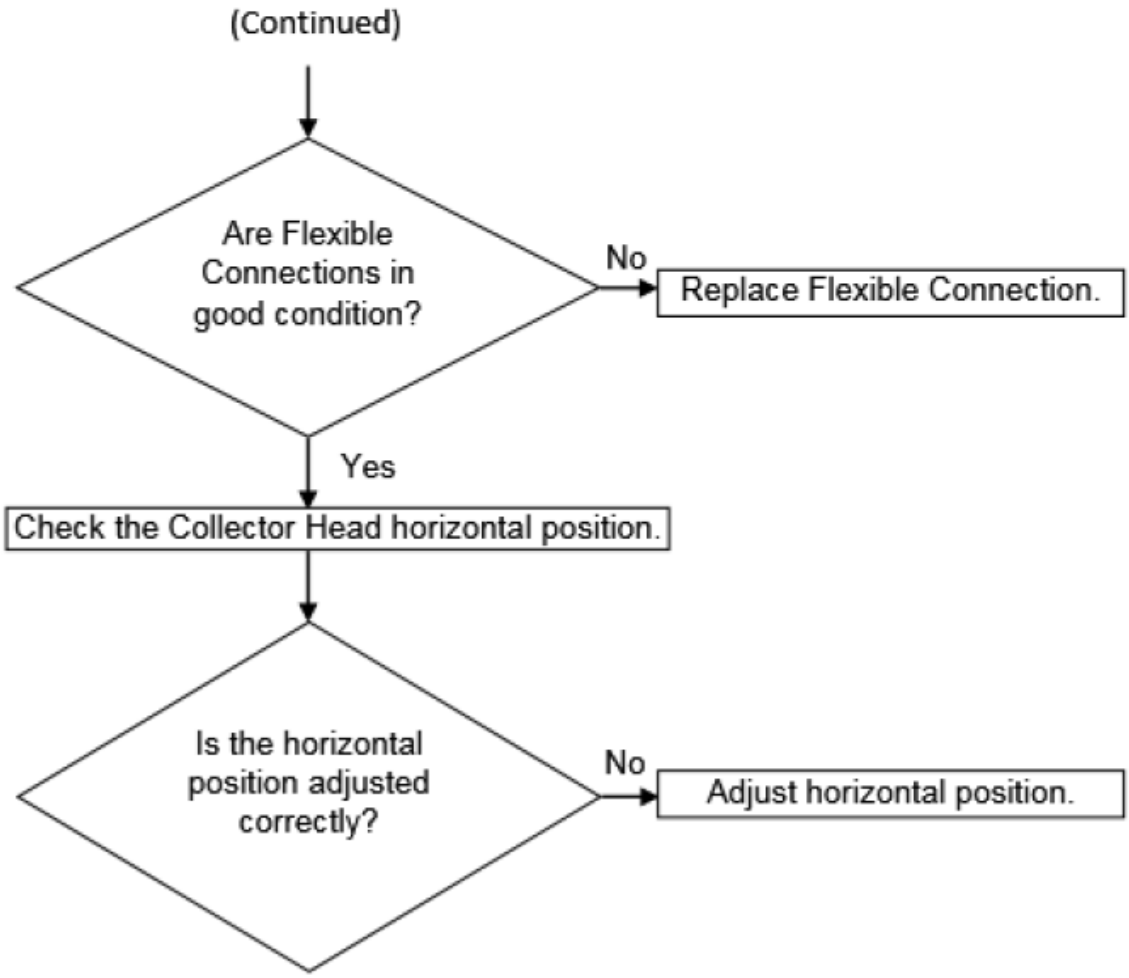
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.3 CARBON STRIPS OVERHEATING



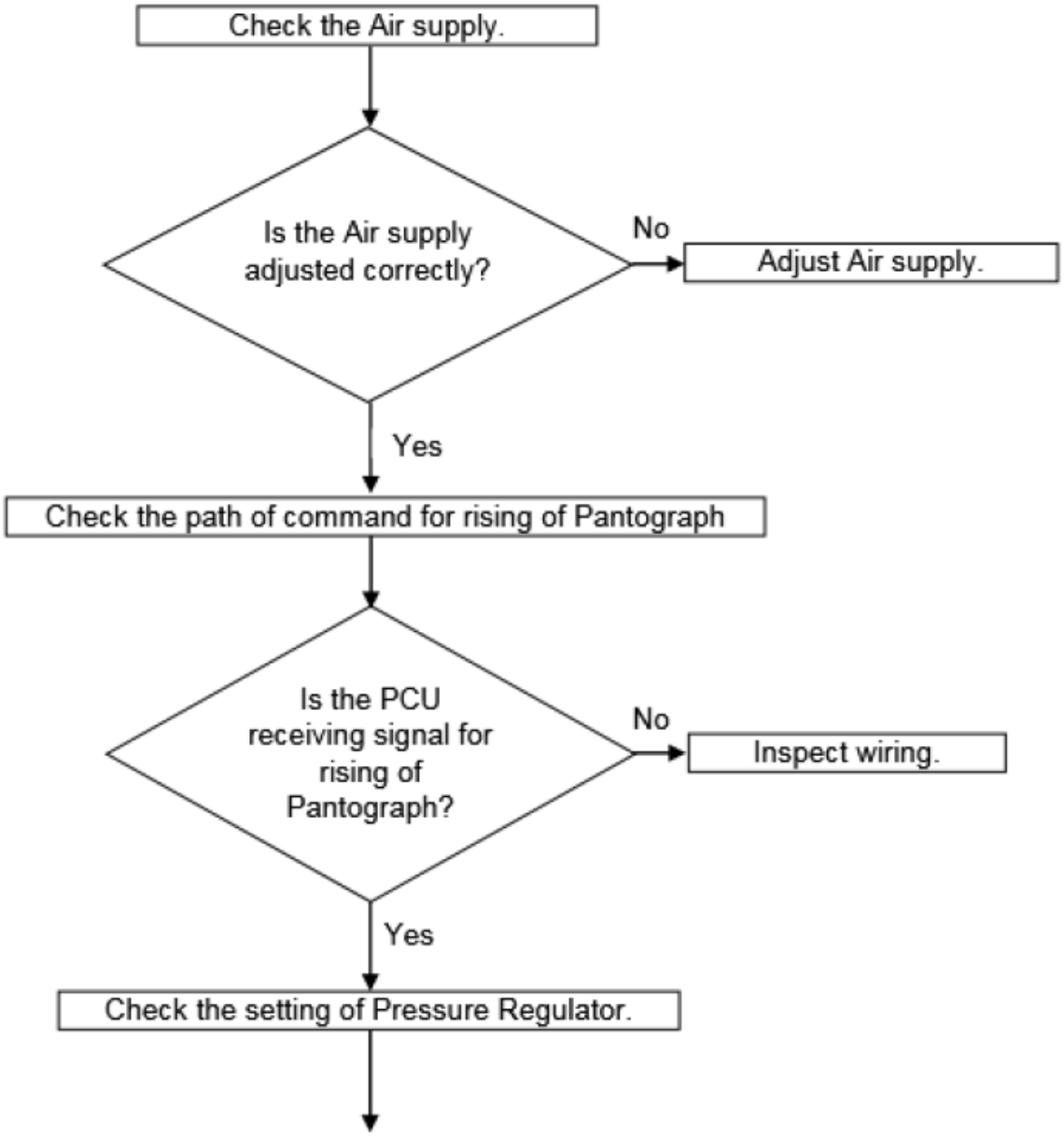
(Continued on next page...)

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited



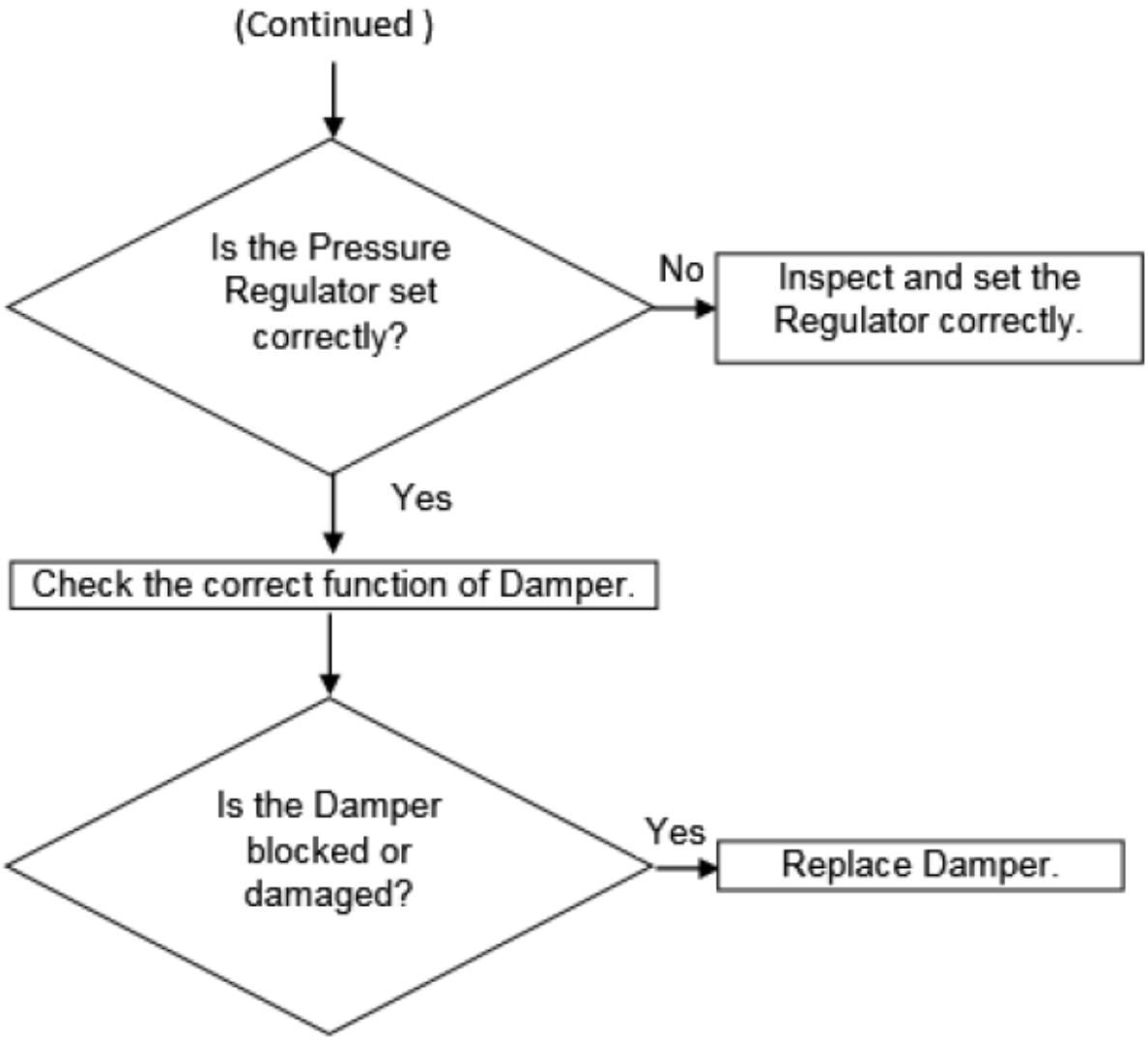
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.4 PANTOGRAPH BLOCKED IN FOLDED POSITION



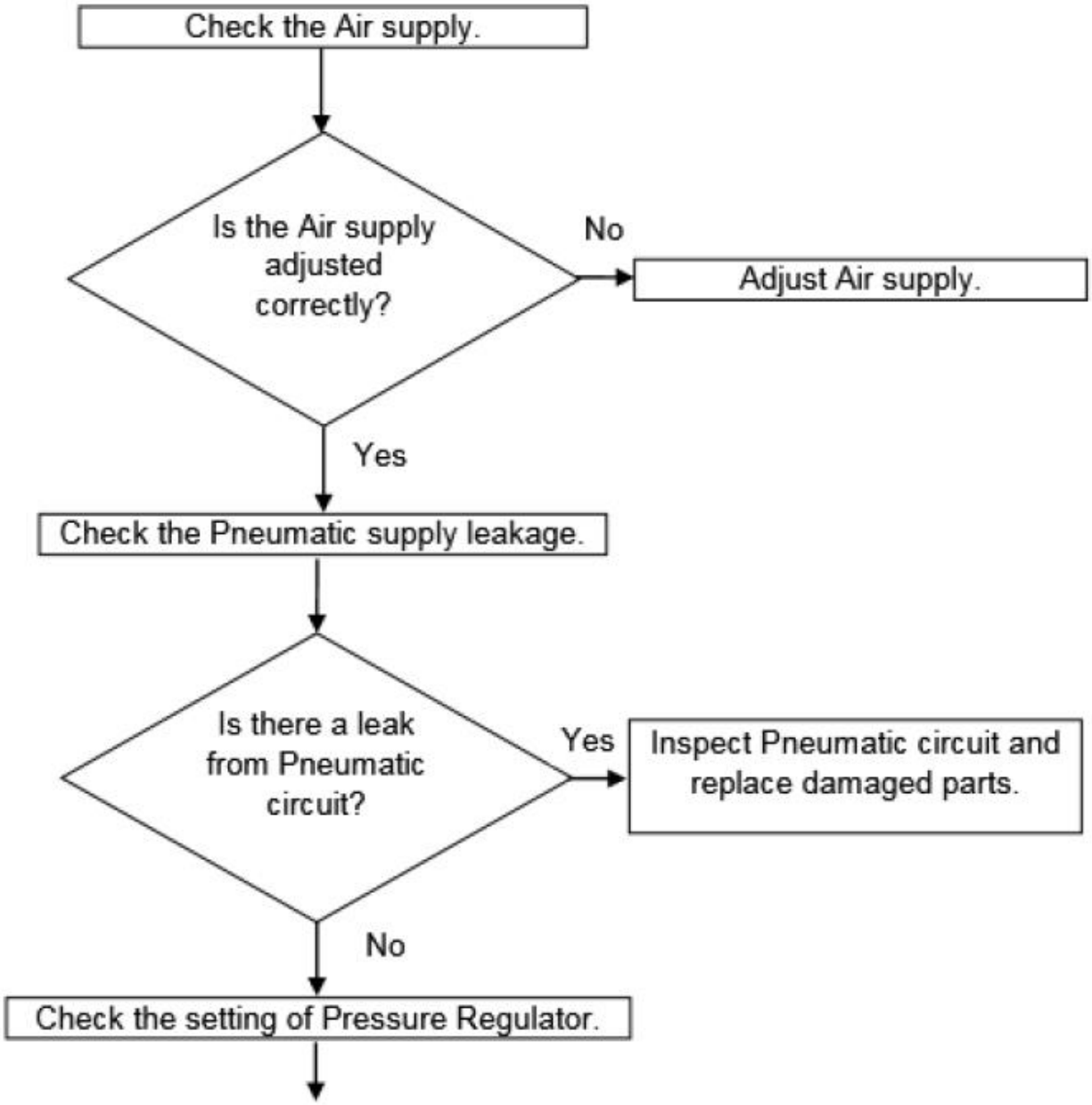
(Continued on next page ....)

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited



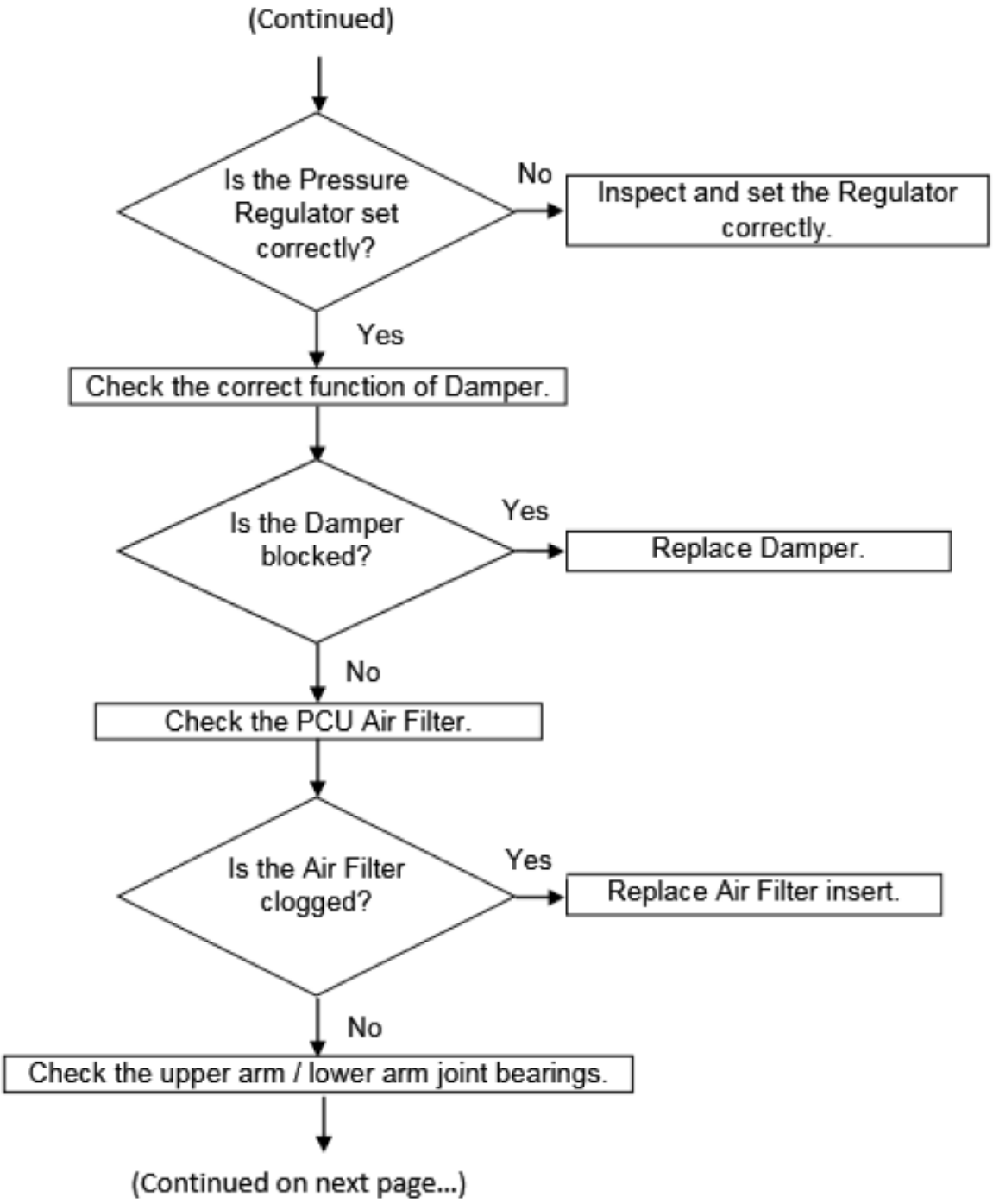
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.5 PANTOGRAPH EXTENDING TOO SLOW

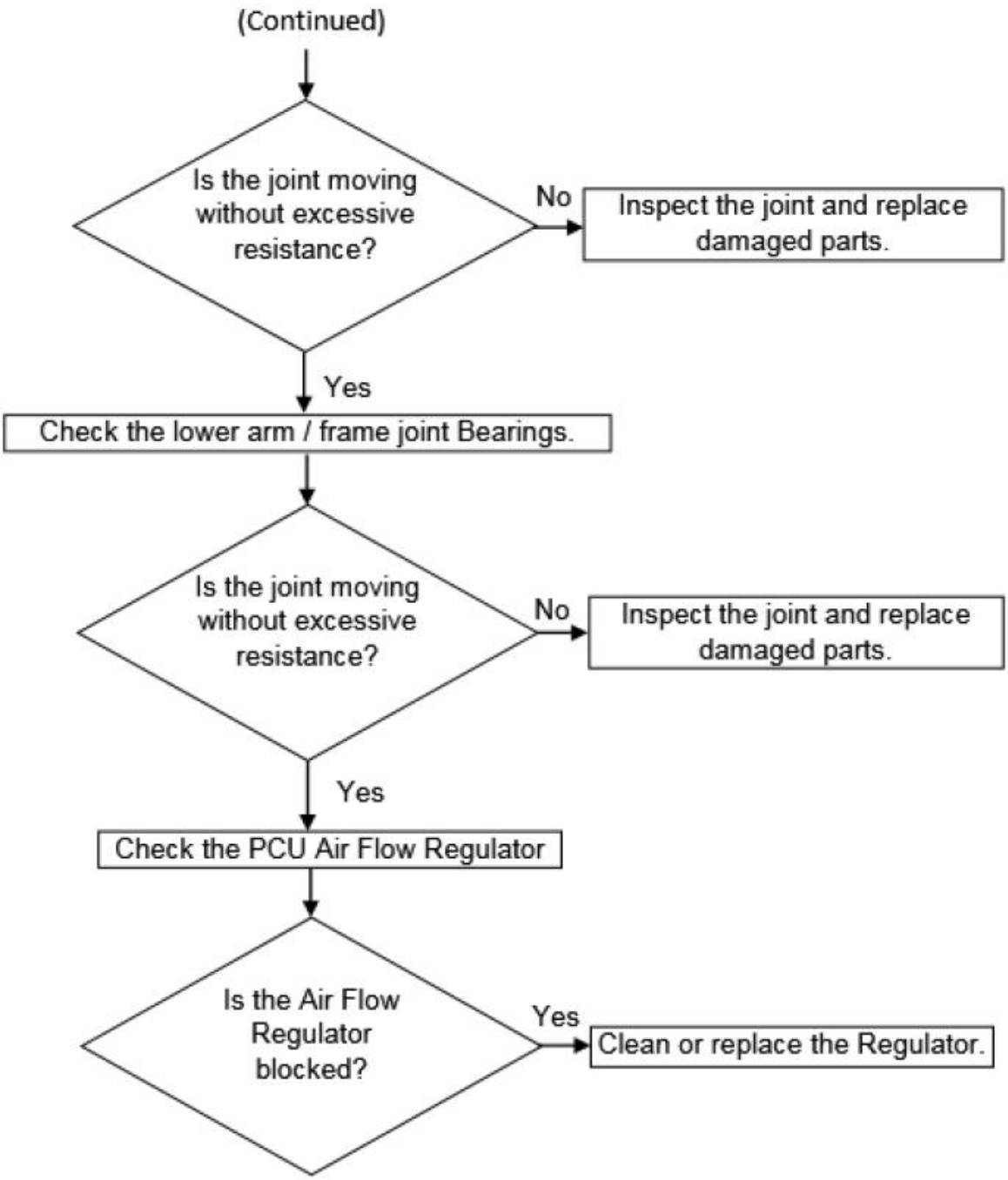


(Continued on next page...)

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

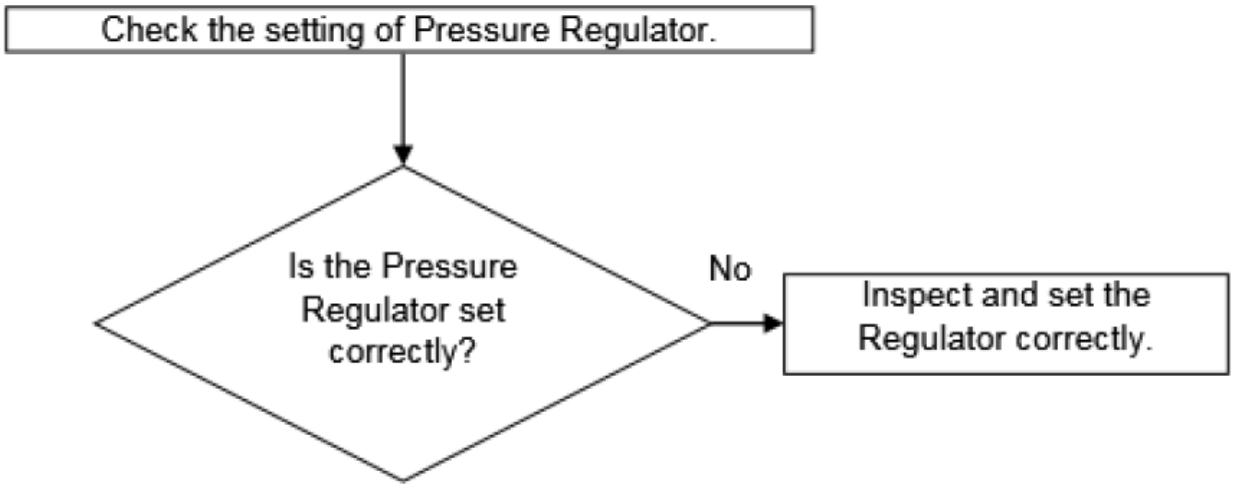


FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited



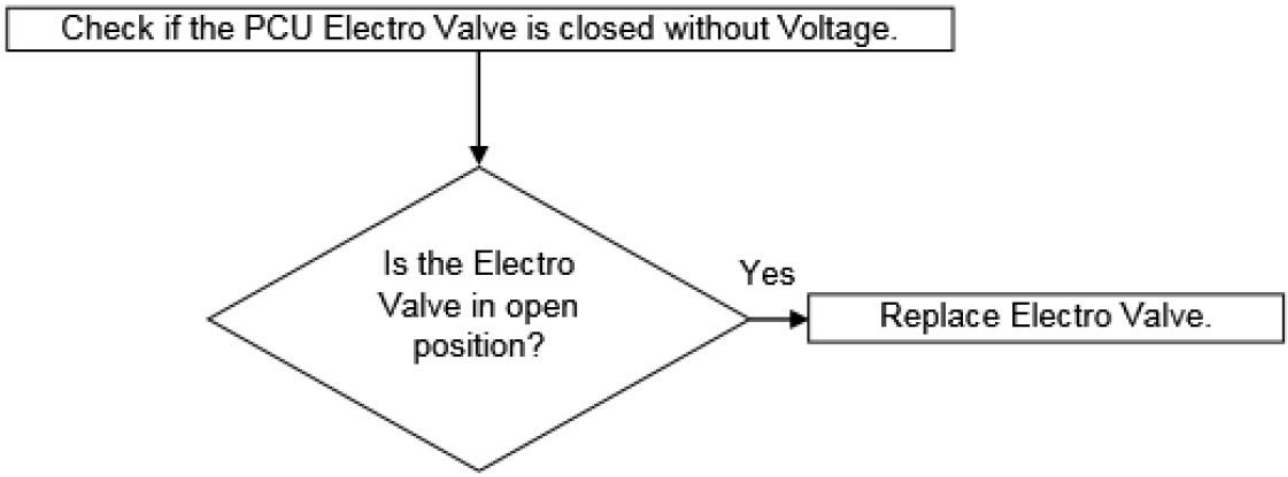
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.6 PANTOGRAPH EXTENDING TOO FAST



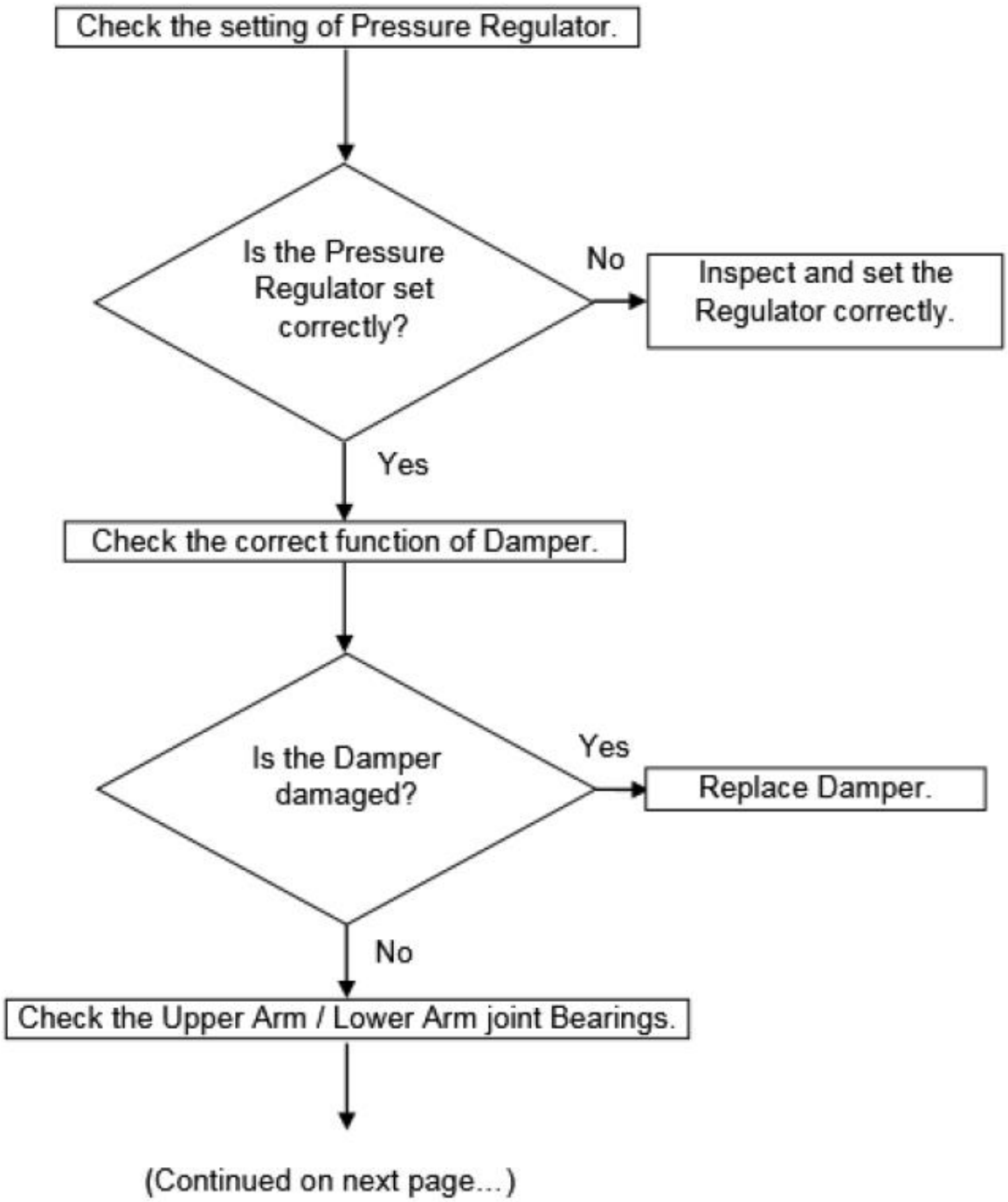
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.7 PANTOGRAPH BLOCKED IN EXTENDED POSITION



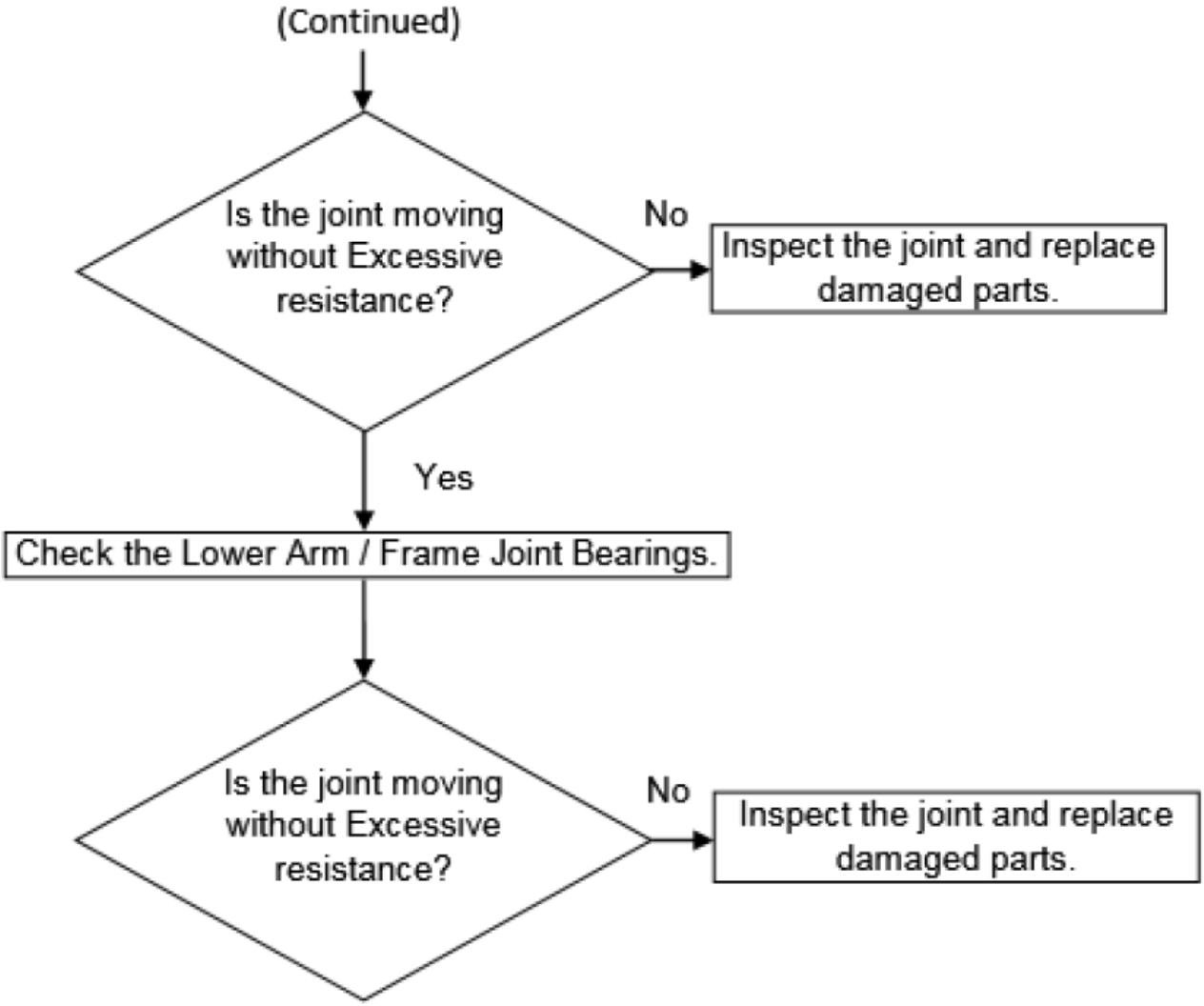
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.8 PANTOGRAPH RETRACTING TOO SLOW



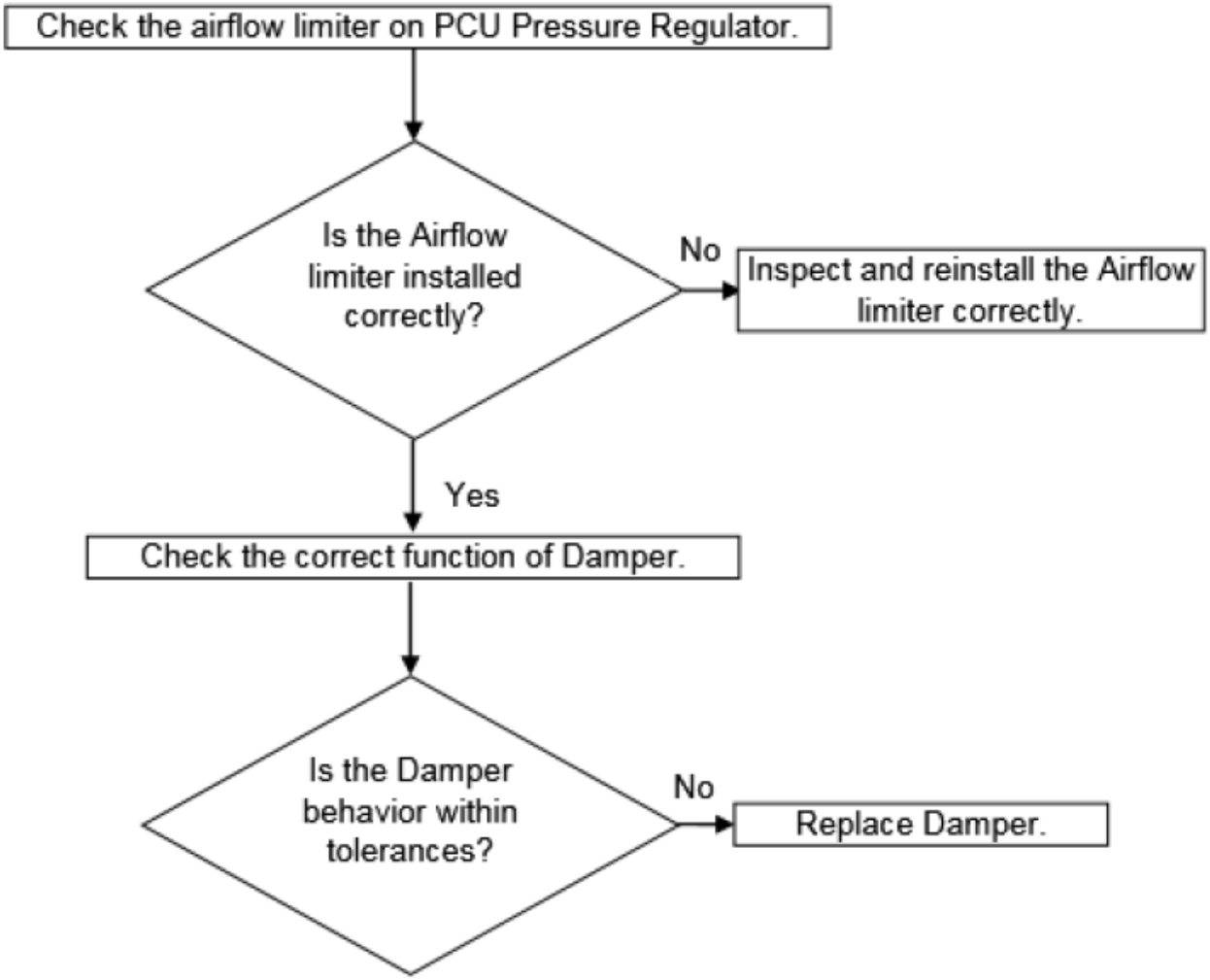
(Continued on next page...)

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited



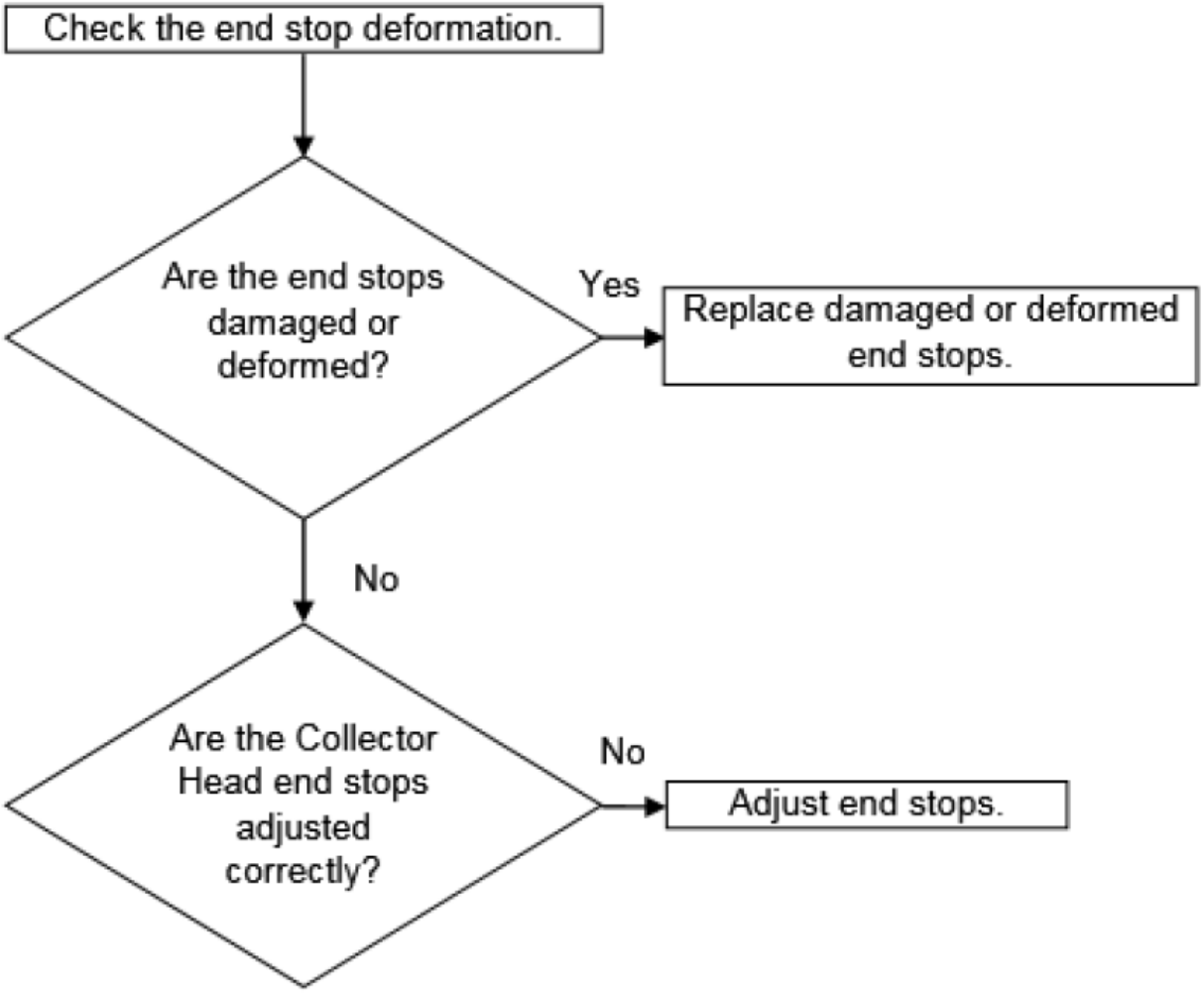
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.9 PANTOGRAPH RETRACTING TOO FAST



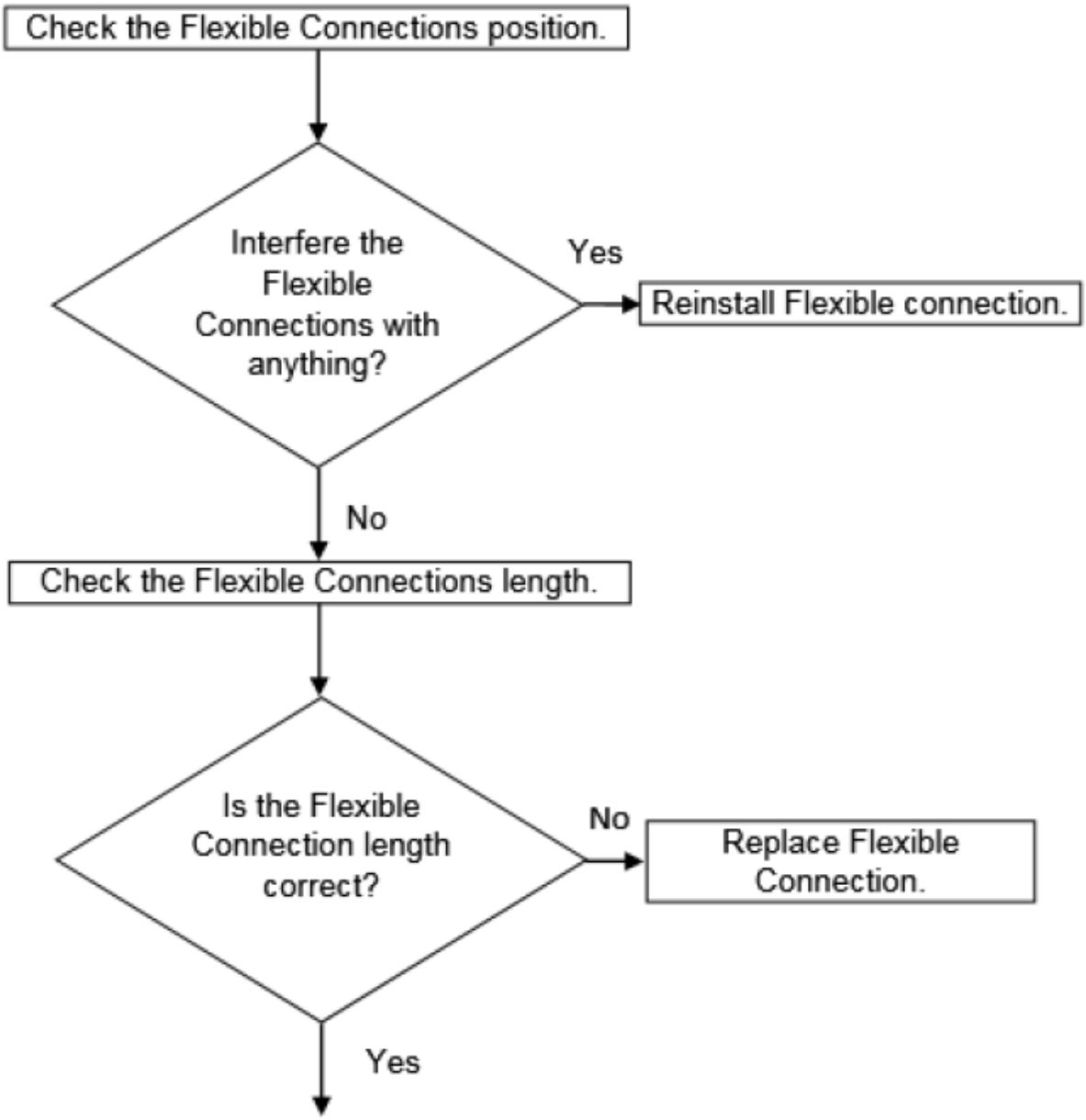
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.10 PANTOGRAPH IMPACTS ON END STOPS



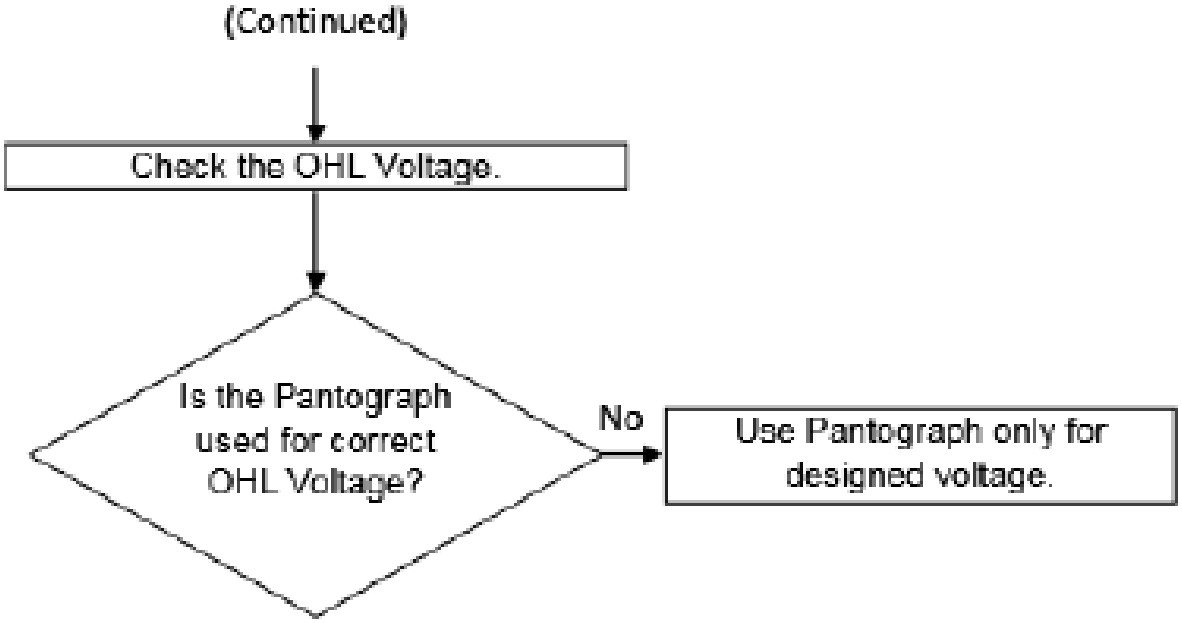
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

6.2.11 QUICK WEAR OF FLEXIBLE CONNECTIONS



(Continued on next page...)

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited



FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// 7.SPECIAL TOOLS AND CONSUMABLES

7.1 WORKSHOP INFRASTRUCTURE REQUIREMENTS

Sl No	Description	Characteristics / Reference	Brief description of usage
1	Forklift	Minimum lifting capacity 300 kg	Pantograph transporting
2	Overhead crane	Minimum lifting capacity 300 kg	Pantograph lifting / transporting
3	3 Slings	Minimum load capacity 150 kg each	For hanging Pantograph on crane
4	Digital spirit level	Local supply	Check Collector Head horizontally
5	Stopwatch	Local supply	Measuring of Raising / Lowering time
6	Vernier Caliper	150 mm maximum, local supply	Dimensions measuring
7	Rope	Local supply	Limiting Pantograph extension
8	Allen key (Hex key) set	3-10 mm, local supply	-
9	Flat Spanners set	8-30 mm, local supply	General Screws / Nuts releasing tightening
10	Socket Wrench set	8-30 mm, local supply	General Screws / Nuts releasing Tightening
11	Torque Wrenches	Adjustable in range, 4.5 Nm-100 Nm	Tightening of screws and Nuts to specified torque
12	Screwdriver	Local supply	Hose clamps removal / tightening
13	Pliers	Local supply	Split Pin removal
14	Air supply	10 bar, dry, de-oiled, filtered, for full details of Technical Specification, refer to 3.3.1.	Pantograph and PCU workshop operation and testing.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

7.2 TORQUE TABLES

NOTE:

Important notice:

- Always follow the instructions for tightening torque, given in respective maintenance procedure.
- For other cases, use the tightening torque from the tables below.

7.2.1 STEEL FASTENERS WITH CORROSION PROTECTION GEOMET 500 A (B) OR ELECTRO-ZINC (CLASS D OR C)

Sl No	Thread size	Tightening torque [Nm] according to the type of washers used	
		Plain Washer	CS Washer
1	M4	2.3	3
2	M5	4.6	6
3	M6	8	10
4	M8	20	25
5	M10	38	49
6	M12	67	87
7	M14	106	138
8	M16	165	215

Table 1 - Tightening Torque Table

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

7.2.2 STAINLESS STEEL FASTENERS MADE OF A2-70 OR A4-70

Sl No	Thread size	Tightening torque [Nm] according to the type of washers used	
		Plain Washer	CS Washer
1	M4	2	2.5
2	M5	4	5
3	M6	7	9
4	M8	17	22
5	M10	34	44
6	M12	59	77
7	M14	93	120
8	M16	144	187

Table 2 - Tightening Torque Table

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

7.3 LIST OF MATERIALS

Further information for used materials or components, refer to section 8.7 to 8.10.

Location	Name	Drawing Number / Manufacturer	Reference Sections	Remarks (Parts obligatory to be replaced/quantity)
[M01]	Pantograph	E043642-0101	8.8.1	1
[M02]	Frame	VE043667-0101	8.10.10	1
[M03]	Lower Arm End Stop	E043642-SET2	8.7.3.1	1
[M04]	Upper Arm End Stop	E043642-SET3	8.7.3.2	1
[M05]	Collector Head End Stop	E043642-SET4	8.7.3.3	2
[M06]	Insulated Hose Assembly	E043116-SET24	8.9.1.6	1
[M07]	Lower arm	VE043659-0101	8.10.13	1
[M08]	Lower arm / frame joint	E043642-SET6	8.9.2.3	1
[M09]	Lower arm / upper arm joint	E043642-SET7	8.9.2.4	1
[M10]	Upper arm	VE043662-0101	8.10.14	1
[M11]	Upper arm / shaft joint	E043642-SET8	8.9.2.8	1
[M12]	Lower rod	XE043676-0101	8.10.11	1
[M13]	Lower rod / frame joint	E043642-SET9	8.9.2.6	1
[M14]	Lower rod / upper arm joint	E043642-SET10	8.9.2.7	1
[M15]	Upper rod	XE043656-0101	8.10.12	1
[M16]	Upper rod / Swaying shaft joint	E043642-SET11	8.9.2.2	1
[M17]	Upper rod / lower arm joint	E043642-SET12	8.9.2.1	1
[M18]	Flexible connection long-1	E043642-SET13	8.10.16	2
[M19]	Flexible connection long-2	E043642-SET14	8.10.17	2
[M20]	Flexible connection short	E043642-SET15	8.10.15	2
[M21]	Collector head	E043642-SET20	8.10.4	1
[M22]	Swaying Shaft	E043125-0102	8.10.6	1
[M23]	Strip Support	FT0053911-113	8.10.5	2
[M24]	Suspension	E043642-SET16	8.9.1.4	2
[M25]	Horn and Carbon strip support	E043642-SET17	8.10.8	2
[M26]	Carbon strip	E043642-SET18	8.7.1	1
[M27]	Aerofoils	E043642-SET19	8.10.1	1
[M28]	Bellows	E043642-SET21	8.9.1.3	1
[M29]	Bellows arm	E043642-SET22	8.10.3	1
[M30]	Bellow cover	XE042962-0002	8.9.1.2	1
[M31]	Cam	E043642-SET23	8.10.2	1
[M32]	Chain	E043642-SET24	8.10.9	1
[M33]	Damper assembly	FT0072490-111	8.9.1.5	1
[M34]	Air pipes	E043642-SET25	8.9.1.1	1
[M35]	Pneumatic control unit	FT0052511-101**	8.8.2	1
[M36]	Air filter	FT0053911-035	8.9.1.9	1
[M37]	Filter Element/Insert	FT0053911-115	8.7.2	1
[M38]	Pressure regulator	FT0053911-036	8.9.1.7	1

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Location	Name	Drawing Number Manufacturer	Reference Sections	Remarks (Parts obligatory to be replaced/quantity)
[M39]	Safety Valve	FT0053911-054**	8.9.2.5	1
[M40]	Flow Regulator	FT0053911-037	8.9.1.8	2
[M41]	Pressure Gauge	FT0053911-049	8.7.6	1
[M42]	Suspension Spring	E043642-SET26	8.10.7	1

** Tentative Part number

Table 3 – List of Materials

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

7.4 LIST OF CONSUMABLES

Location	Purpose of use	Place of use	Consumable		Distributor or Manufacturer	Cross-reference (Section No.)
			Name / Trademark	Material No		
[B01]	Greasing	Ball bearings Sliding bearings Shaft Balancing sling Damper shaft Mechanical parts Visible threads	ALPHALUB LGEP2	BEARING GREESE	WABTEC	Refer to Section 1.5.9, 8.6.10, 8.9.1.4, 8.9.1.5, 8.9.2.1 to 8.9.2.4 , 8.9.2.6 to 8.9.2.8, 8.10.3, 8.10.4, 8.10.11, 8.10.15 to 8.10.17 and 9.2.1
[B02]	Greasing	Conductive surfaces (Copper band)	HPG CONTACTAL	HPG GRESE	WABTEC	Refer to Section 8.6.4, 8.6.10, 8.7.1, 8.10.15 to 8.10.17
[B03]	Greasing	Chain Housing with bearings	CHAIN AND ROPE LUBE SPRAY	BEARING GREESE	WABTEC	Refer to Section 8.6.10, 8.9.1.3 and 8.10.9
[B04]	Air leak detection spray	Pneumatic Connections	METAFLUX 70-14	SPRAY/1 / SOAP SOLUTION	-	Refer to Section 8.6.7, 8.6.9, 8.7.2, 8.7.6, 8.8.1, 8.9.1.1 to 8.9.1.3, 8.9.1.6 to 8.9.1.9 and 8.10.3
[B05]	Greasing	Air filter sealing ring	SPIREL 269	TUK MAZACI/18	WABTEC	Refer to section 8.7.2
[B06]	Greasing	Bearings	AEROSHELL	BEARING GREESE	WABTEC	Refer to section 8.1 and 8.6.10

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

7.5 LIST OF SPECIAL TOOLS, DEVICES AND JIGS

Location.	Device Name	Type of description	Distributor or Manufacturer	Conditions for use	Remarks	Cross-reference (Section No.)
[W01]	Vernier Caliper	-	WABTEC	-	Carbon Strip thickness check	Refer to Section 8.6.2
[W02]	Testing Device	151SMC-lite	WABTEC	-	Contact force checking	Refer to Section 8.6.5
[W03]	Telescopic Support	HI 101810	WABTEC	-	To keep Pantograph Expanded	Refer to Section 8.7.1 and 8.7.3
[W04]	Rope (Cord)	-	WABTEC	-	To limit Pantograph extension for testing	Refer to Section 8.6.5.2, 8.6.7, 8.6.8, and 8.6.8.1
[W05]	Pneumatic Auxiliary Source	-	WABTEC	-	-	-

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// 8.MAINTENANCE

8.1 INSTRUCTIONS

This section is intended for the operators of the vehicle. It describes planned maintenance of individual Pantograph parts. The checking plan is intended for the information only. The Operator of the vehicle should adopt the intervals to the real specific conditions.

This chapter contains all the information necessary for the installation, adjustment, and controls to be applied at the time of acceptance of the Pantographs. These procedures must be carried out with precaution to allow the satisfactory operation before commissioning.

The corrective maintenance procedures are support for the maintenance personnel. It contains all the information necessary for breakdown repairs and component replacement of the Pantograph System by personnel skilled in electrical and mechanical. It is Operators responsibility to follow the procedures to ensure better safety and service life of the device.

The preventive maintenance procedures are support for the maintenance personnel. It contains all the information necessary for preventive maintenance of the Pantograph system, by personnel skilled in electrical and mechanical. It is the operator’s responsibility to follow the procedures and their periodicity, to ensure the better safety and service life of the device.

All the procedures should be followed in their entirety and should not be carried out partially.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

WARNING!

IMPORTANT

OBSERVE SAFETY INSTRUCTIONS AND PROCEDURES SPECIFIED FOR THE GIVEN INSTALLATION SITE AND OPERATION

- It is recommended to position the carriage on a section of rails without OHL before inspection, lubrication, adjustment or repair, if possible.

- Some maintenance operations may be carried out even under OHL. However, make sure that ELECTRIC POWER SUPPLY IS DISCONNECTED from OHL and always before climbing on the roof, make sure that any third person must not connect power supply to the OHL.

- Some maintenance operations must be carried out during Pantograph upward movement. In such case, it is necessary to adopt all required safety measures.

WARNING!

IMPORTANT

MOUNTING AND DISMOUNTING

- The Pantograph must be disconnected from Air supply (Pipe Assembly) for the purpose of mounting and dismounting.
- The Vehicle has to be off-trolley wire or the trolley wire must be earthed.
- All Screws, Nuts and Washers have to be cleaned and degreased before mounting. If some of them are damaged, they have to be replaced with new ones.
- All movable connections have to be greased using Aeroshell Grease 6 [B06].
- It is recommended to indicate the mutual position of dismounted parts for easier reassemble and subsequent adjustment.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.2 MAINTENANCE LEVEL

Maintenance level	Distance Interval	Time Interval	Tolerance	Activity
A1 (TI)	-	45 Days	10%	Service check
A2 (IA)	-	3 Months	10%	Service check
B1 (IB)	-	6 Months	10%	Service check
C1 (IC)		270 Days	10%	Service check / Replacement
D1 (ID)	Depends on running conditions (150000 km/loco)	1 Year	10%	Carbon Strip replacement
E1 (TOH)		24 Months	10%	Service check
IOH	-	6 Years	10%	Intermediate Overhaul
POH	-	12 Years	10%	Periodical Overhaul
-	-	12 Years	-	Safety Valve
-	-	4 Years	-	Pressure Gauge
Replacement in every 12 years, functional check to be done every 2 years				

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.3 MAINTENANCE PLAN

Documentation Of Maintenance			Interval	Maintenance Levels							
Sl.No	Measure	Cross Reference (Section No)		Service Check						Overhaul	
				A1 (TI)	A2 (IA)	B1 (IB)	C1 (IC)	D1 (ID)	E1 (TOH)	IOH	POH
1	Inspection of collector head (measurement of carbon strip)	8.6.2	50000 km		•	•	•	•	•	•	•
2	Check of lifting and lowering times.	8.6.6	3M		•	•	•	•	•	•	•
3	Inspection of contact force.	8.6.5	3M		•	•	•	•	•	•	•
4	Visual inspection of flexible connections.	8.6.4	3M		•	•	•	•	•	•	•
5	Visual inspection of end stops.	8.6.3	6M			•	•	•	•	•	•
6	Check of collector head horizontal position.	8.6.8	270 Days				•	•	•	•	•
7	Check of pneumatic parts of Pantograph for tightness.	8.6.7	270 Days				•	•	•	•	•
8	Lubrication.	8.6.10	270 Days				•	•	•	•	•
9	Replacement of air filter insert	8.7.2	270 Days				•	•	•	•	•
10	Replacement of carbon strips	8.7.1	12M / (150000 km/Loco)					•	•	•	•
11	Functional check of pressure regulator	8.7.4	12M					•	•	•	•
12	Functional check of safety valve	8.7.5	12M					•	•	•	•
13	Replacement of lower arm end stop	8.7.3.1	2 Years						•	•	•
14	Replacement of upper arm end stops	8.7.3.2	2 Years						•	•	•
15	Replacement of collector head end stops	8.7.3.3	2 Years						•	•	•
16	Replacement of air pipes	8.9.1.1	2 Years						•	•	•
17	Replacement of pressure gauge	8.7.6	4 Years								
18	Replacement of Bellow Cover	8.9.1.2	6 Years							•	•
19	Replacement of bellows	8.9.1.3	6 Years							•	•

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Documentation Of Maintenance			Interval	Maintenance Levels							
Sl.No	Measure	Cross Reference (Section No)		Service Check						Overhaul	
				A1 (TI)	A2 (IA)	B1 (IB)	C1 (IC)	D1 (ID)	E1 (TOH)	IOH	POH
20	Replacement of suspension	8.9.1.4	6 Years							•	•
21	Replacement of damper assembly	8.9.1.5	6 Years							•	•
22	Replacement of insulated hose assembly	8.9.1.6	6 Years							•	•
23	Dismounting of pneumatic control unit for Overhaul.	8.8.2	6 Years							•	•
24	Replacement of pressure regulator	8.9.1.7	6 Years							•	•
25	Replacement of flow regulator	8.9.1.8	6 Years							•	•
26	Replacement of air filter	8.9.1.9	6 Years							•	•
27	Dismounting of Pantograph from train for Overhaul	8.8.1	12 Years								•
28	Replacement of upper rod / lower arm joint	8.9.2.1	12 Years								•
29	Replacement of upper rod / swaying shaft joint	8.9.2.2	12 Years								•
30	Replacement of lower arm / frame joint	8.9.2.3	12 Years								•
31	Replacement of lower arm / upper arm joint	8.9.2.4	12 Years								•
32	Replacement of Safety Valve	8.9.2.5	12 Years								•
33	Replacement of lower rod / frame joint	8.9.2.6	12 Years								•
34	Replacement of lower rod / upper arm joint	8.9.2.7	12 Years								•
35	Replacement of upper arm / shaft joint	8.9.2.8	12 Years								•

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.4 MUST CHANGE COMPONENTS

Must Change Components				
Sl.No	**Description**	**Part Number**	**Interval / Loco**	**Reference Section**
1	Carbon Strips / Collecting Strip	FT0074495-100	150000 km	Refer to Section 8.7.1
2	Filter Element (5 Microns)	FT0053911-115	270 Days	Refer to Section 8.7.2
3	Lower Arm End Stop	E043642-SET2	2 Years	Refer to Section 8.7.3.1
4	Upper Arm End Stops	E043642-SET3	2 Years	Refer to Section 8.7.3.2
5	Collector Head End Stops	E043642-SET4	2 Years	Refer to Section 8.7.3.3
6	Air Pipes	E043642-SET25	2 Years	Refer to Section 8.9.1.1
7	Bellows	E043642-SET21	6 Years	Refer to Section 8.9.1.3
8	Suspension	E043642-SET16	6 Years	Refer to Section 8.9.1.4
9	Damper Assembly	FT0072490-111	6 Years	Refer to Section 8.9.1.5
10	Insulated Hose Assembly	E043116-SET24	6 Years	Refer to Section 8.9.1.6

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.5 PREVENTIVE MAINTENANCE PROCEDURE

Following inspections should be carried out after locomotive is brought under isolated condition from the Overhead Catenary (OHE) (OHE dead and earthed and isolator in locked condition).

8.5.1 MAINTENANCE AT TI AND IA 3 MONTHS

- Inspection of Collector Head (measurement of carbon strip). Refer to Section 8.6.2.
- Check of lifting and lowering times. Refer to Section 8.6.6.
- Inspection of Contact Force. Refer to Section 8.6.5.
- Visual inspection of Flexible Connections. Refer to Section 8.6.4.

8.5.2 MAINTENANCE AT IB 6 MONTHS

- Inspection of Collector Head (measurement of carbon strip). Refer to Section 8.6.2.
- Check of lifting and lowering times. Refer to Section 8.6.6.
- Inspection of Contact Force. Refer to Section 8.6.5.
- Visual inspection of Flexible Connections. Refer to Section 8.6.4.
- Visual inspection of End Stops. Refer to Section 8.6.3.

8.5.3 MAINTENANCE AT IC 270 DAYS

- Inspection of Collector Head (measurement of carbon strip). Refer to Section 8.6.2.
- Check of lifting and lowering times. Refer to Section 8.6.6.
- Inspection of Contact Force. Refer to Section 8.6.5.
- Visual inspection of Flexible Connections. Refer to Section 8.6.4.
- Visual inspection of End Stops. Refer to Section 8.6.3
- Check of Collector Head Horizontal Position. Refer to Section 8.6.8.
- Check of Pneumatic Parts of Pantograph for tightness. Refer to Section 8.6.7.
- Lubrication. Refer to Section 8.6.10.
- Replacement of Air Filter Insert. Refer to Section 8.7.2.

8.5.4 MAINTENANCE AT ID 1 YEAR

- Inspection of Collector Head (measurement of carbon strip). Refer to Section 8.6.2.
- Check of lifting and lowering times. Refer to Section 8.6.6.
- Inspection of Contact Force. Refer to Section 8.6.5.
- Visual inspection of Flexible Connections. Refer to Section 8.6.4.
- Visual inspection of End Stops. Refer to Section 8.6.3
- Check of Collector Head Horizontal Position. Refer to Section 8.6.8.
- Check of Pneumatic Parts of Pantograph for tightness. Refer to Section 8.6.7.
- Lubrication. Refer to Section 8.6.10.
- Replacement of Air Filter Insert. Refer to Section 8.7.2.
- Replacement of Carbon Strips. Refer to Section 8.7.1.
- Functional Check of Pressure Regulator. Refer to Section 8.7.4
- Functional Check of Safety Valve. Refer to Section 8.7.5

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.5.5 MAINTENANCE AT TOH 2 YEARS

- Inspection of Collector Head (measurement of carbon strip). Refer to Section 8.6.2.
- Check of lifting and lowering times. Refer to Section 8.6.6.
- Inspection of Contact Force. Refer to Section 8.6.5.
- Visual inspection of Flexible Connections. Refer to Section 8.6.4.
- Visual inspection of End Stops. Refer to Section 8.6.3
- Check of Collector Head Horizontal Position. Refer to Section 8.6.8.
- Check of Pneumatic Parts of Pantograph for tightness. Refer to Section 8.6.7.
- Lubrication. Refer to Section 8.6.10.
- Replacement of Air Filter Insert. Refer to Section 8.7.2.
- Replacement of Carbon Strips. Refer to Section 8.7.1.
- Functional Check of Pressure Regulator. Refer to Section 8.7.4
- Functional Check of Safety Valve. Refer to Section 8.7.5
- Replacement of Lower Arm End Stop. Refer to Section 8.7.3.1.
- Replacement of Upper Arm End Stops. Refer to Section 8.7.3.2.
- Replacement of Collector Head End Stops. Refer to Section 8.7.3.3.
- Replacement of Air Pipes. Refer to Section 8.9.1.1.

8.5.6 MAINTENANCE AT IOH 6 YEARS

- Inspection of Collector Head (measurement of carbon strip). Refer to Section 8.6.2.
- Check of lifting and lowering times. Refer to Section 8.6.6.
- Inspection of Contact Force. Refer to Section 8.6.5.
- Visual inspection of Flexible Connections. Refer to Section 8.6.4.
- Visual inspection of End Stops. Refer to Section 8.6.3
- Check of Collector Head Horizontal Position. Refer to Section 8.6.8.
- Check of Pneumatic Parts of Pantograph for tightness. Refer to Section 8.6.7.
- Lubrication. Refer to Section 8.6.10.
- Replacement of Air Filter Insert. Refer to Section 8.7.2.
- Replacement of Carbon Strips. Refer to Section 8.7.1.
- Functional Check of Pressure Regulator. Refer to Section 8.7.4
- Functional Check of Safety Valve. Refer to Section 8.7.5
- Replacement of Lower Arm End Stop. Refer to Section 8.7.3.1.
- Replacement of Upper Arm End Stops. Refer to Section 8.7.3.2.
- Replacement of Collector Head End Stops. Refer to Section 8.7.3.3.
- Replacement of Air Pipes. Refer to Section 8.9.1.1.
- Replacement of Pressure gauge. Refer to Section 8.7.6
- Replacement of Bellow cover. Refer to Section 8.9.1.2
- Replacement of Bellows. Refer to Section 8.9.1.3.
- Replacement of Suspension. Refer to Section 8.9.1.4
- Replacement of Damper. Refer to Section 8.9.1.5.
- Replacement of Insulated hose assembly. Refer to Section 8.9.1.6
- Dismounting of Pneumatic Control Unit for Overhaul. Refer to Section 8.8.2.
- Replacement of Pressure Regulator. Refer to Section 8.9.1.7.
- Replacement of Flow Regulator. Refer to Section 8.9.1.8.
- Replacement of Air Filter. Refer to Section 8.9.1.9.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.5.7 MAINTENANCE AT POH 12 YEARS

- Inspection of Collector Head (measurement of carbon strip). Refer to Section 8.6.2.
- Check of lifting and lowering times. Refer to Section 8.6.6.
- Inspection of Contact Force. Refer to Section 8.6.5.
- Visual inspection of Flexible Connections. Refer to Section 8.6.4.
- Visual inspection of End Stops. Refer to Section 8.6.3
- Check of Collector Head Horizontal Position. Refer to Section 8.6.8.
- Check of Pneumatic Parts of Pantograph for tightness. Refer to Section 8.6.7.
- Lubrication. Refer to Section 8.6.10.
- Replacement of Air Filter Insert. Refer to Section 8.7.2.
- Replacement of Carbon Strips. Refer to Section 8.7.1.
- Functional Check of Pressure Regulator. Refer to Section 8.7.4
- Functional Check of Safety Valve. Refer to Section 8.7.5
- Replacement of Lower Arm End Stop. Refer to Section 8.7.3.1.
- Replacement of Upper Arm End Stops. Refer to Section 8.7.3.2.
- Replacement of Collector Head End Stops. Refer to Section 8.7.3.3.
- Replacement of Air Pipes. Refer to Section 8.9.1.1.
- Replacement of Pressure gauge. Refer to Section 8.7.6
- Replacement of Bellow cover. Refer to Section 8.9.1.2
- Replacement of Bellows. Refer to Section 8.9.1.3.
- Replacement of Suspension. Refer to Section 8.9.1.4
- Replacement of Damper. Refer to Section 8.9.1.5.
- Replacement of Insulated hose assembly. Refer to Section 8.9.1.6
- Dismounting of Pneumatic Control Unit for Overhaul. Refer to Section 8.8.2.
- Replacement of Pressure Regulator. Refer to Section 8.9.1.7.
- Replacement of Flow Regulator. Refer to Section 8.9.1.8.
- Replacement of Air Filter. Refer to Section 8.9.1.9.
- Dismounting and mounting of Pantograph from train for Overhaul. Refer to Section 8.8.1.
- Replacement of Upper Rod / Lower Arm joint. Refer to Section 8.9.2.1.
- Replacement of Upper Rod / Swaying Shaft joint. Refer to Section 8.9.2.2.
- Replacement of Lower Arm / Frame joint. Refer to Section 8.9.2.3
- Replacement of Lower Arm / Upper Arm joint. Refer to Section 8.9.2.4.
- Replacement of Safety Valve. Refer to Section 8.9.2.5
- Replacement of Lower Rod / Frame joint. Refer to Section 8.9.2.6.
- Replacement of Lower Rod / Upper arm Refer to Section 8.9.2.7.
- Replacement of Upper Arm / Shaft joint. Refer to Section 8.9.2.8.

.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6 INSPECTION AND ADJUSTMENTS

8.6.1 INSPECTION OF PANTOGRAPH

Visually inspect the entire Pantograph E043642-0101 for missing components and physical damages.

8.6.2 INSPECTION OF COLLECTOR HEAD

Check the free movement of collector head for few millimeters in the indicated direction, refer to Figure 25.
Press the suspension with hand and check manually the function of suspension.

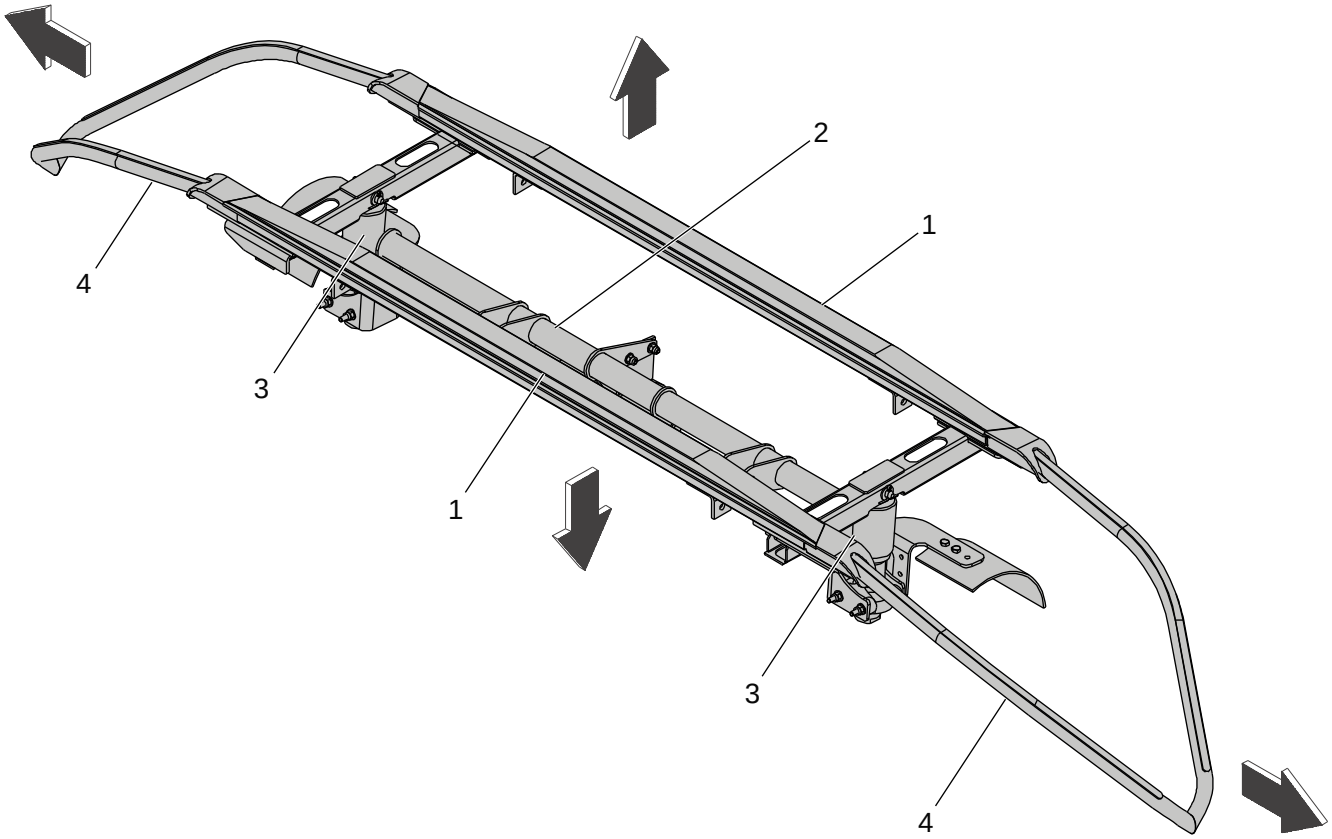


Figure 25 – Inspection of collector head

Item No	Description	Part Number	Qty
1	Carbon Strip	FT0074495-100	2
2	Swaying Shaft	E043125-0102	1
3	Spring Box Mounted	E043130-0101	2
4	Bearing	FT0053911-112	2

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Carbon Strips

Check the mounting Screws condition.

Check visually that Carbon Strips have no grooves, cracks (especially lengthwise) or Edges having significant shocks (Impact of a depth and length of more than 0.5 mm of Carbon Strip).

Check visually whether the wearing of the Carbon Strip is even.

Check visually whether the surface of the strip is continuous, not rough and free from burr, having a thickness of 0.5 mm. File the burr off by hand file, if required.

Measure the wear of carbon Strips using a vernier caliper [W01], refer to Figure 27.

NOTE.

- If Carbon Strips achieve the lowest thickness of 24 mm, then the Carbon Strips must be replaced. For replacement, refer to Section 8.7.1.
- Always replace both, the Carbon Strips and its retaining Screws and Safety nuts.

Measurement of the Carbon Strip abrasion:

Measure the Carbon Strips from side, using vernier caliper [W01], if Carbon Strips are thinner than 24 mm, it is necessary to replace the Carbon Strips.

Carbon Strips satisfy the requirements when the measured dimension “A” is larger than 24 mm, refer to Figure 27.

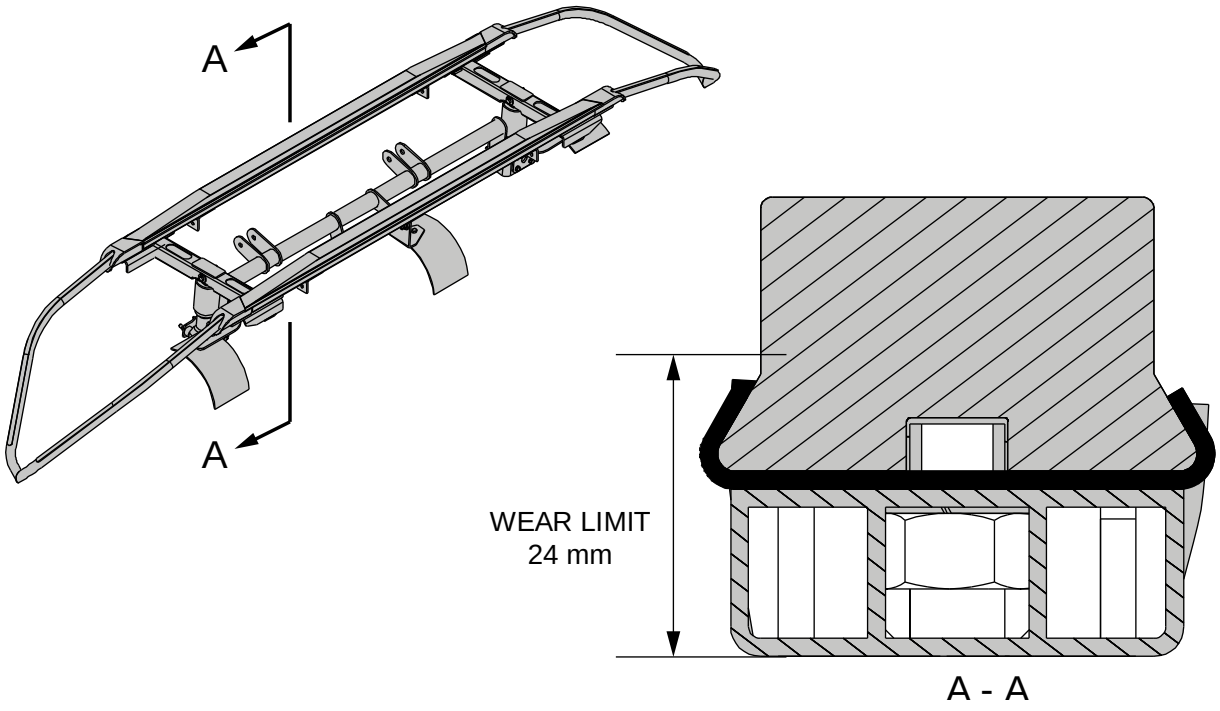


Figure 26 – Carbon Strip Measurement

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

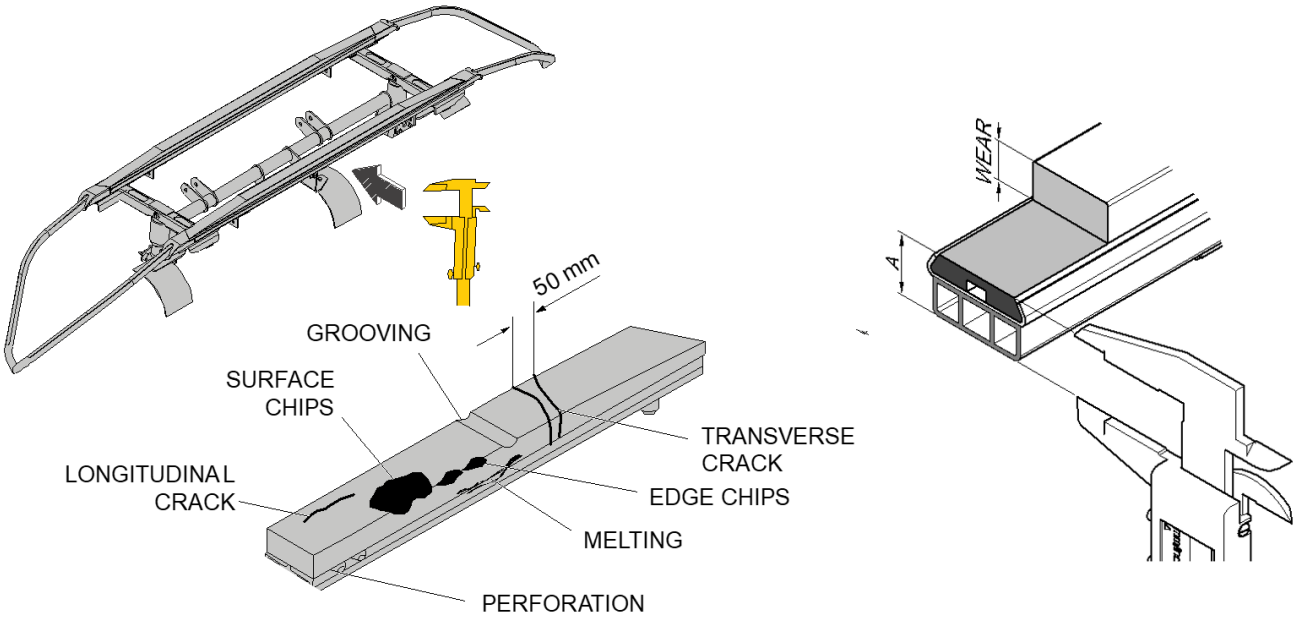


Figure 27 – Carbon Strip and Vernier Caliper

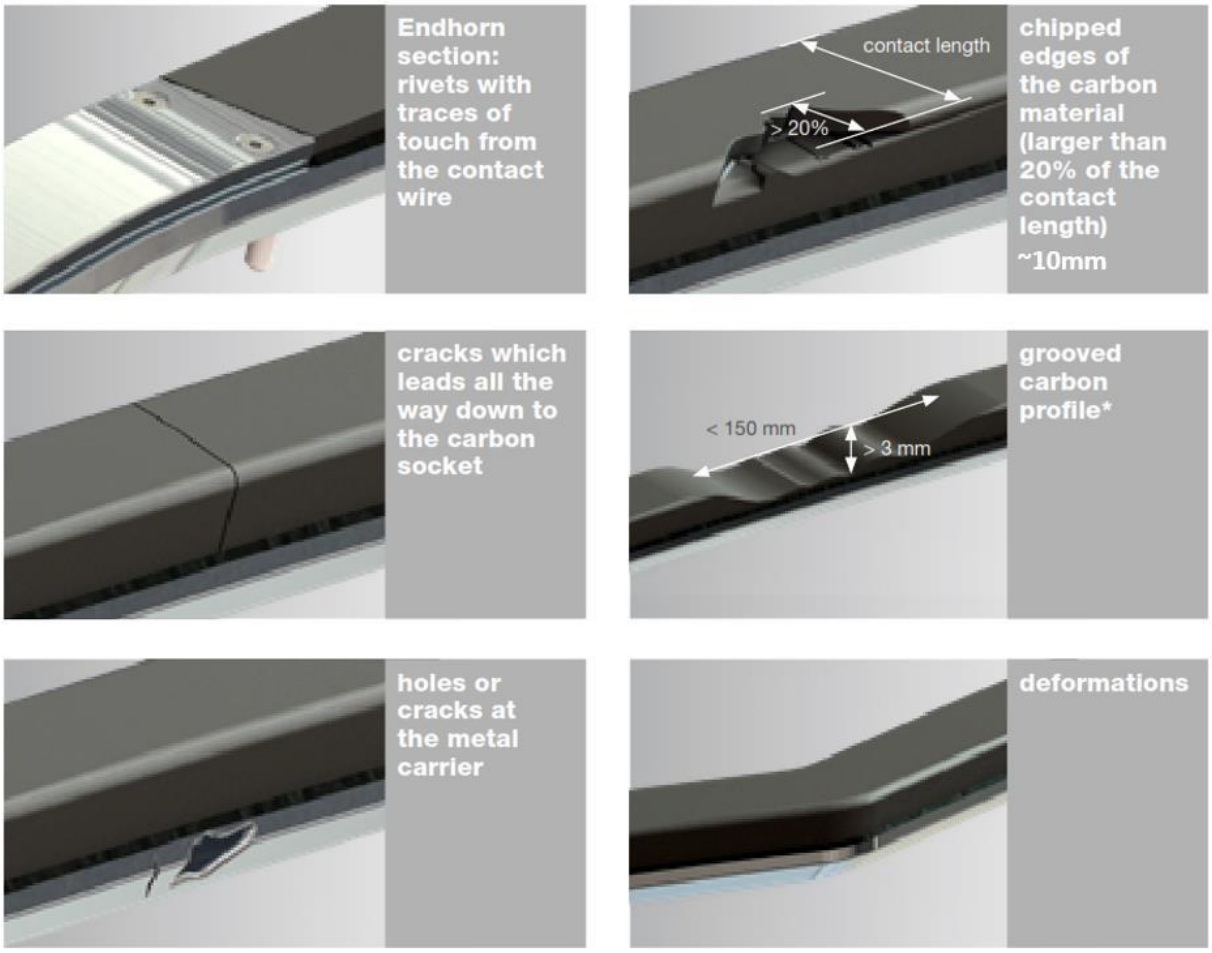


Figure 28 – Replacement Criteria

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Acceptance and Replace Criteria for carbon strip:

Replace: Carbon strip to be replaced in any one of the strip crack size width noticed above 0.25mm.

If the depth of crack on the carbon strip, (measure from bottom) is less than 24mm then carbon strip to be replaced.

- Check with feeler gauge, to measure the crack size (width) if 0.25mm gauge passes through the crack reject and replace with new carbon strip.
- If wear limit reaches 24mm from bottom of carbon strip, carbon strip to be replaced.
- **Please note, always carbon strip to be replaced in pair.**

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Rework procedure for slightly damaged Carbon Strips

Use flat 6” flat smooth cut-2 file and emery sandpapers of grit size of 220 to 320 to smooth and sand the surface of carbon strip as in the direction shown in fig below.

Direction of Filling

- Flat 6" Inch (Kennedy) smooth File Cut-2

- Emery sheet (Sandpaper) - 220 to 320 grit size

Tools for rework of Carbon Strip

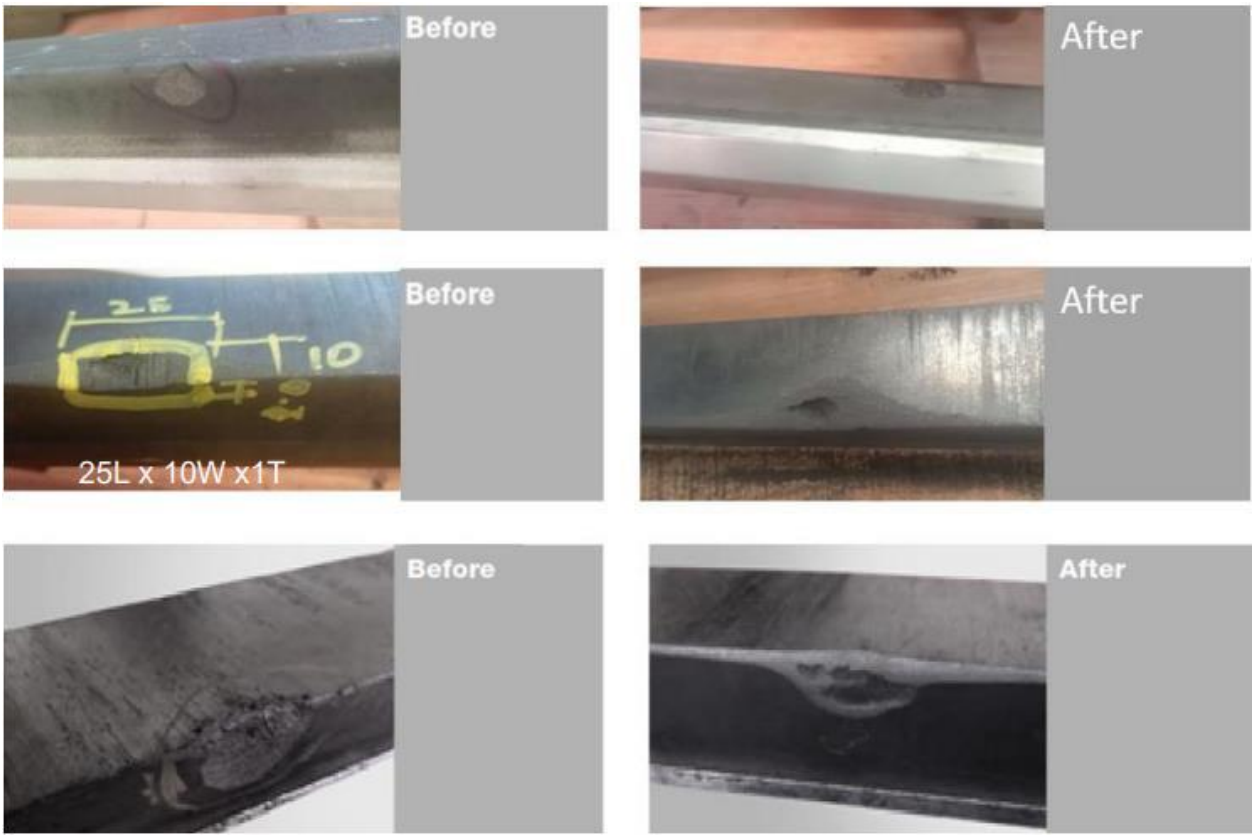


Figure 29 – Examples of Rework of Carbon Strip

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Horns

Check and make sure that there are no cracks present on the Horns.

Check the no cracks and marks of impact in the Horns.

Horn shall be replaced:

- If hole from arcing.
- If surface is seriously damaged.

Horn is deformed. If necessary, replace the Horn. For replacement of Horn, refer to Section 8.10.8

Check the mounting Screws condition.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.3 VISUAL INSPECTION OF END STOPS

Perform a Visual Inspection, replace damaged or worn-out stops.
If necessary, replace End Stops according to section 8.7.3.

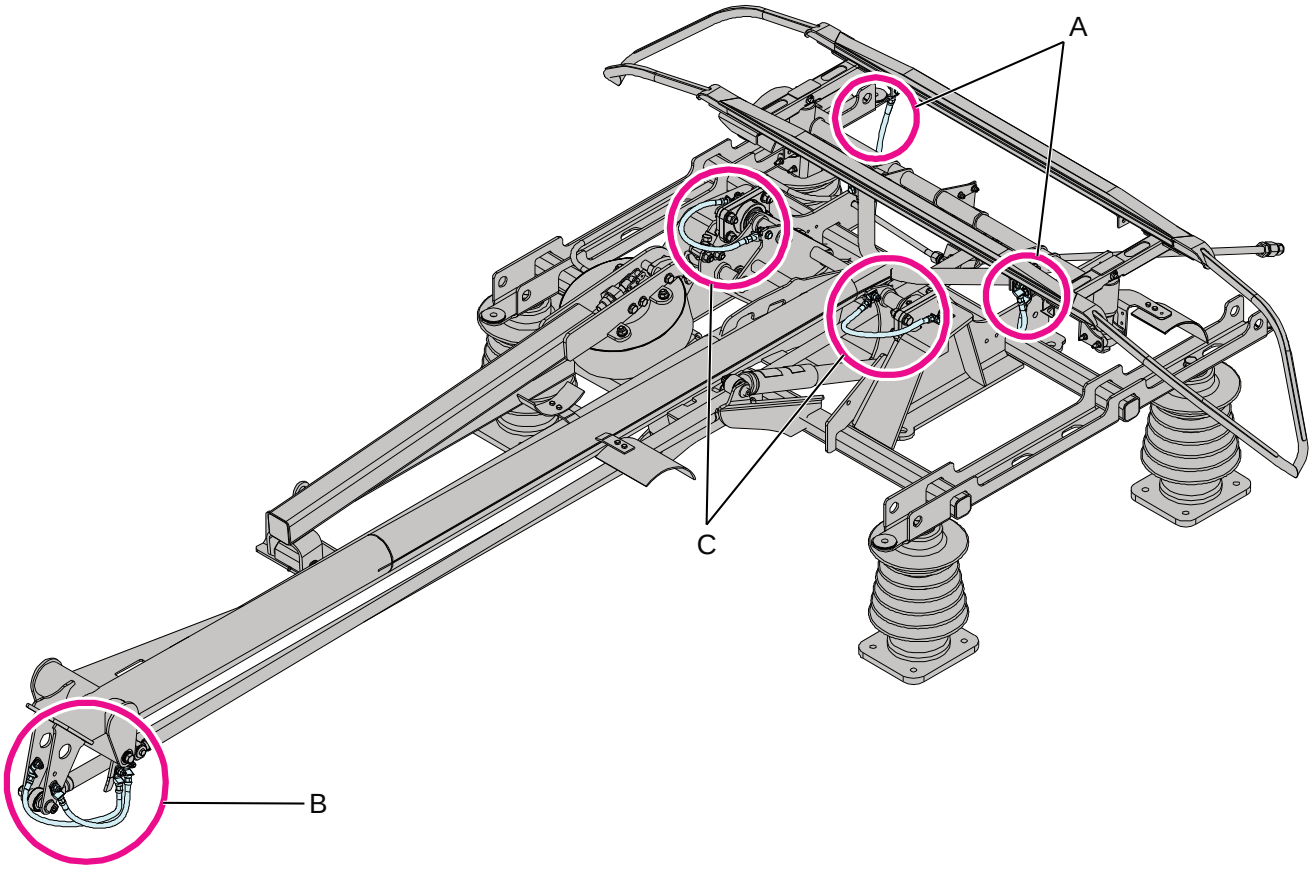
8.6.4 VISUAL INSPECTION OF FLEXIBLE CONNECTIONS

NOTE. Risk of Pantograph Damage

The condition of the Flexible Connectors is the major factor, influencing the Service life of the bearings. Pay maximum attention to their inspection.

Check the tightening of Screws and Screws on the Carbon Strips. Check the condition of the Flexible Connections as follows:

- Collector Shoe – Upper Arm (2 pcs) (Figure 30, Position A)
- Upper Arm – Lower Arm (2 pcs) (Figure 30, Position B)
- Lower Arm – Frame (2 pcs) (Figure 30, Position C)



Note: Insulators are shown for illustration purpose.

Figure 30 – Visual inspection of flexible connections

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Damaged Connections like frayed, ripped etc. must be replaced immediately. Replace the Flexible Connection if the number of broken Strands per Carbon Strip is > 20.

Make sure that the contact surfaces of all the parts of Pantograph and Connections are perfectly clean during replacement of the Flexible Connections.

Each Flexible Connection on contact surfaces must be lubricated with Grease before mounting with CONTACTAL HPG Grease [B02].

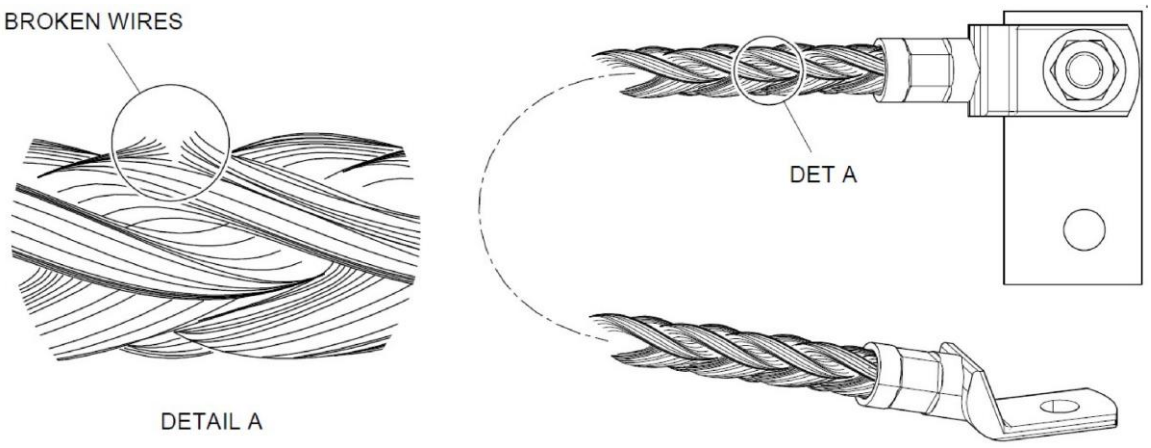


Figure 31 – Flexible Connections Damage

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.5 INSPECTION OF CONTACT FORCE

This procedure should be carried out generally with Pantograph on the roof and without dismounting (even partially). Carry out this procedure with replacement of Collector Shoes (Carbon Strips).

Measurement of Contact Force:

- Manual measurement is applicable in cases when it is necessary to check contact force on the roof of the vehicle. For example, regular checking of contact force during preventive maintenance cycles.
- Manual measurement is not enough to use after replacing some key components of Pantograph.
- In this case, it is necessary to use automatic measurement with the help of computer system and Dynamometer. Manual measurement does not give complete picture of Pantographs behaviour for final adjustments.

Type of Measurement	Reason of Measurement	Position of Pantograph
Manual Measurement	Adjusting Contact Force after installation of Pantograph on the roof or within service operation	On the roof
Measurement with 151 SMC-lite [W02]	Adjusting Pantograph behavior after replacement of key components (Arms, Rods, Frame, Cam, Bellow)	On workbench

Manual Measurement:

- Hang weight m = 7 kg (See technical specification–Nominal values) in the entire Collector Shoe.
- Check that Pantograph will rise, lower or stay at the same position, if we release Pantograph from any position between 150 mm and 3600 mm (Refer to Figure 32).
- If Pantograph will rise or lower set different pressure on regulator in Pneumatic Control Unit. See height adjustment of Pantograph as per Section 8.6.5.4.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

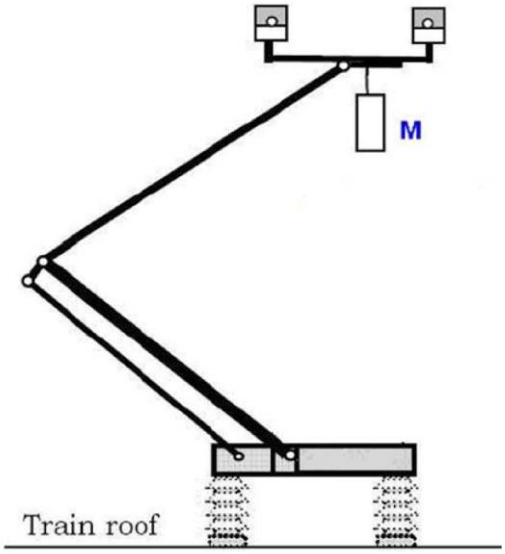


Figure 32 – Manual Measurement

Using Computer Set with 151SMC-lite:

Allows precise reading of Static Force values and real Static Force Characteristic. Making possible Pantograph adjustments.

Measurement with 151SMC-lite is realized with disconnected Damper.

Measurement with 151SMC-lite is described in document: SMC-manual_2015-01, refer to section 9.5.

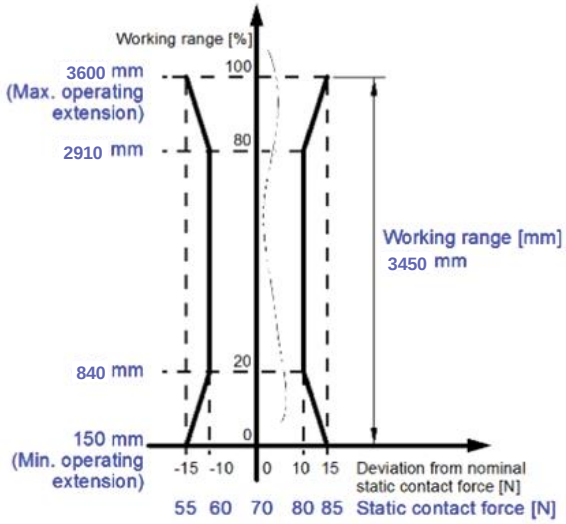


Figure 33 – Static Characteristic of Contact Forces

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.5.1 **STATIC CURVE EVALUATION**

- If you are out of tolerance in Area A (upper part of curve). Adjust the Lower Rod length, refer to Figure 36 and section 8.6.5.3.
- If you are out of tolerance in Area B (full curve is moved-bad contact force in all development), refer to Figure 37 and Section 8.6.5.4.
- If you are out of tolerance in Area C. Reposition the Cam segment, refer to Figure 35 and Section 8.6.5.2.

This adjustment is very sensitive and changes overall shape of the curve.

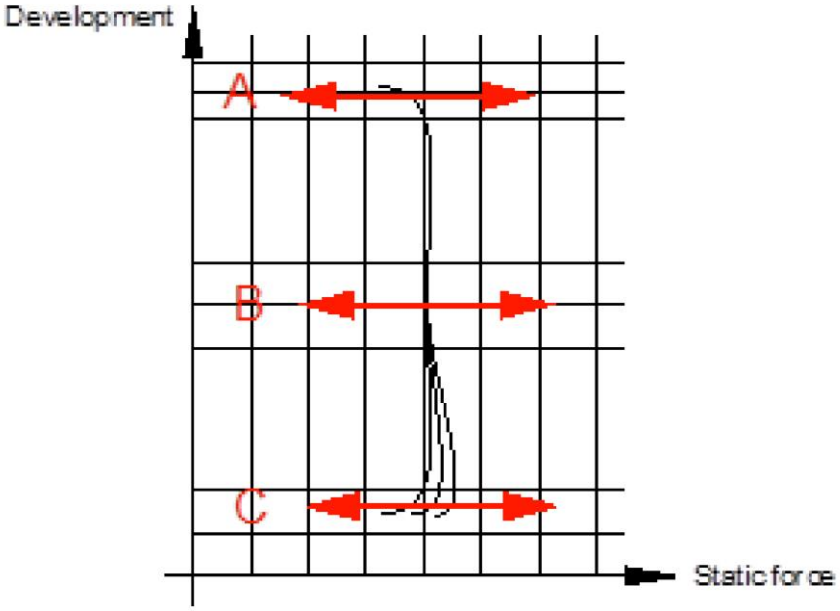
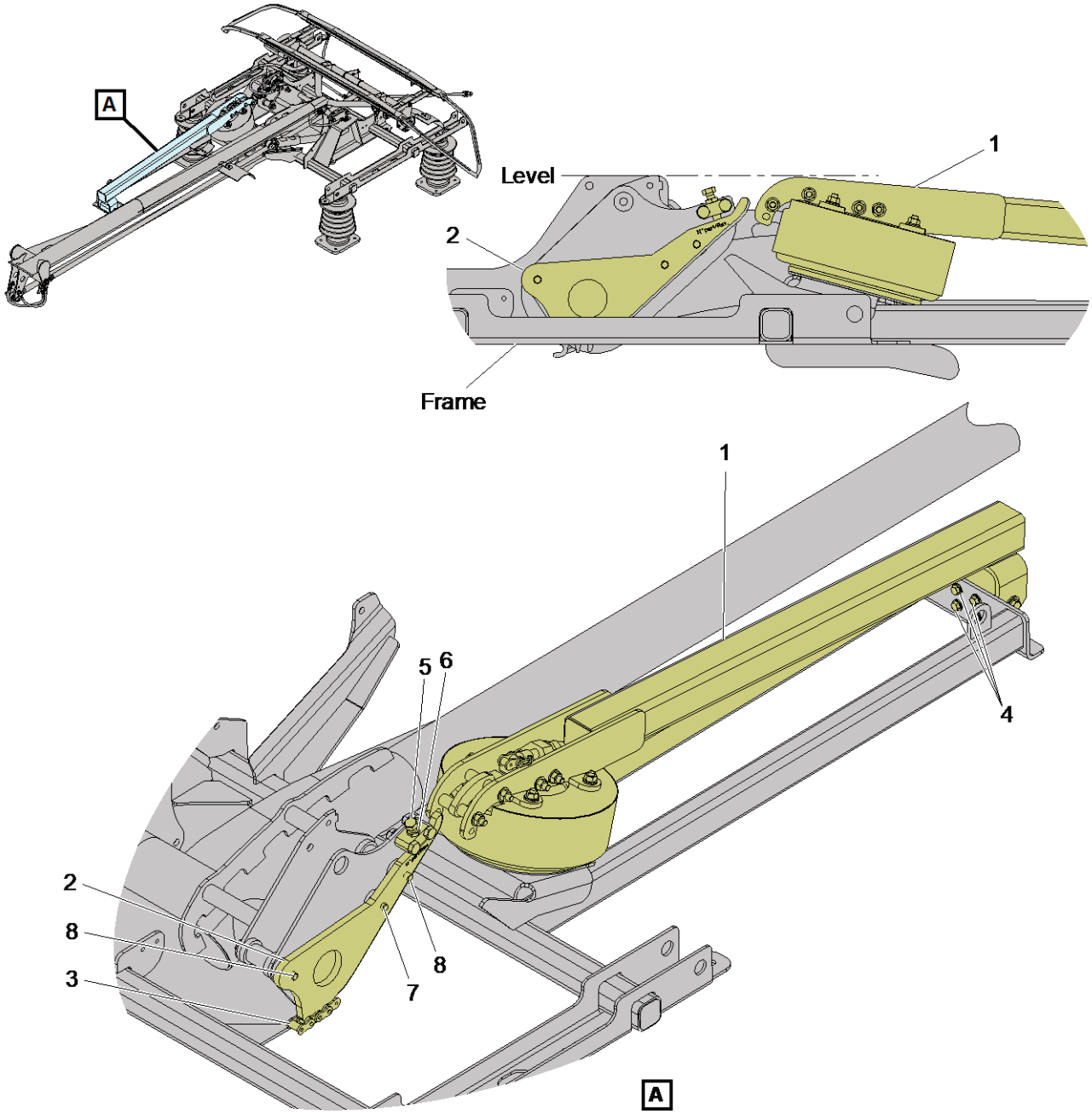


Figure 34 – Static Curve Evaluation

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.5.2 STATIC CONTACT FORCE PRE-ADJUSTING



Note: View rotated for clarity

Note: Insulators are shown for illustration purpose.

Figure 35 –Static Contact Force Pre-Adjusting

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Item No	Description	Part Number	Qty
1	Bellows Arm	VE043671-0101	1
2	Cam	VE044073-0001	1
3	Chain	YL100099-0102	1
4	Hex Screw	1300825-000	4
5	Hex. Hd Screw	FT0030005-066	3
6	Hex. Nut	FT0030001-021	1
7	Hex Screw	FT0030005-051	1
8	Hex Screw	FT0030005-067	2

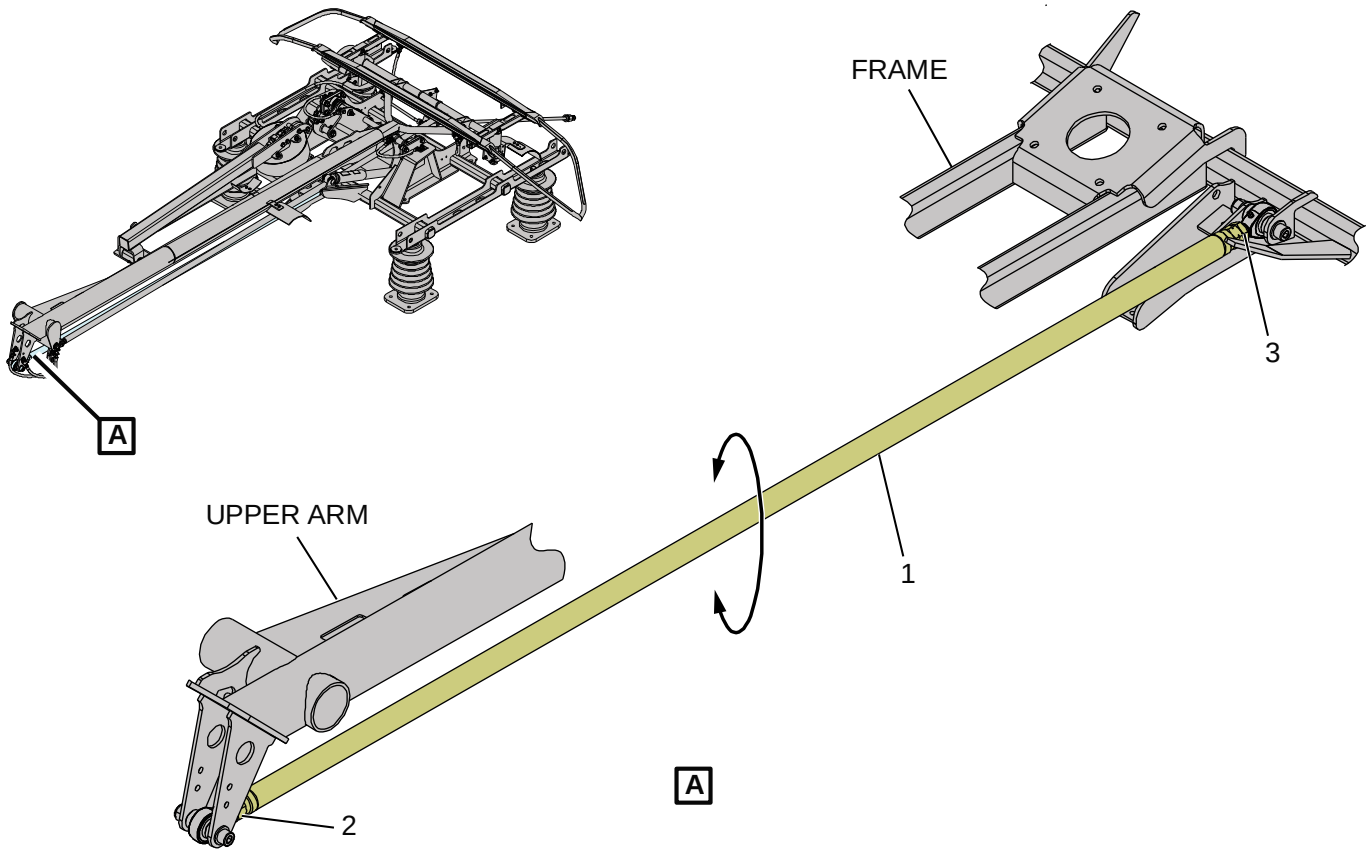
This procedure must be necessarily provided before adjustment of Lower Rod.

For item numbers mentioned below in bracket, refer to Figure 35

- Pantograph must be equipped with new Carbon Strips.
- Move the Pantograph to lowered position and secure by Rope [W04].
- Give command to raise the Pantograph.
- Verify that Bellows Arm (1) is straight with Cam (2) in lowered position (Bellows pressurized).
- Remove the Securing Rope [W04].
- Check the Chain moves freely and straight on Cam, during Raising and Lowering of Pantograph (Bellows pressurized).
- If Shoulder of Bellows (1) and Chain (3) are not straight with Cam (2), correct its position by means of releasing Screws (4).
- Verify that the upper edge of Bellows Arm (1) is in the same horizontal level as upper edge of Frame.
- If not, release complete pressure in Pneumatic Balancing and correct position of upper edges by releasing or tightening the Nut (6). Pressurize and check again.
- Setting of Cam (2).
  - Hang weight 7 kg in the centre of Swaying Shaft.
  - Slightly release Nuts (7) and (8).
  - Pressurize the Shoulder of Bellows.
  - Tighten or release adjusting Screw (5), to stay let the Pantograph stay in the position approx. from 0.9 to 1 m height.
  - Move Pantograph to extension of 810 mm and verify its balance, refer to Figure 37.
  - If Pantograph is not in balance, move the Pantograph up, slightly tighten or release adjusting Screw (5) and (6).
  - Verify balance of Pantograph in extension from 0.9 to 1m, if Pantograph is not in balance, repeat the procedure until the balancing of Pantograph is achieved.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.5.3 LOWER ROD ADJUSTING



Note: Insulators are shown for illustration purpose.

Figure 36 – Lower Rod Adjusting

Item No	Description	Part Number	Qty
1	Lower Rod	XE043676-0101	1
2	Hex Nut	M20x1.5/3	1
3	Hex Nut L	M20x1,5/4	1

For item numbers mentioned below in bracket, refer to Figure 36

- Release the two Counter Nuts (2) and (3).
- Turn the Lower Rod (1) to achieve desired length.
- Tighten the two Counter Nuts (2) and (3) to secure the adjusted length.
- Tighten two Counter Nuts (2) and (3) to a torque of 50 Nm.
- Do the Contact Force inspection, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.5.4 ADJUSTING STATIC CONTACT FORCE

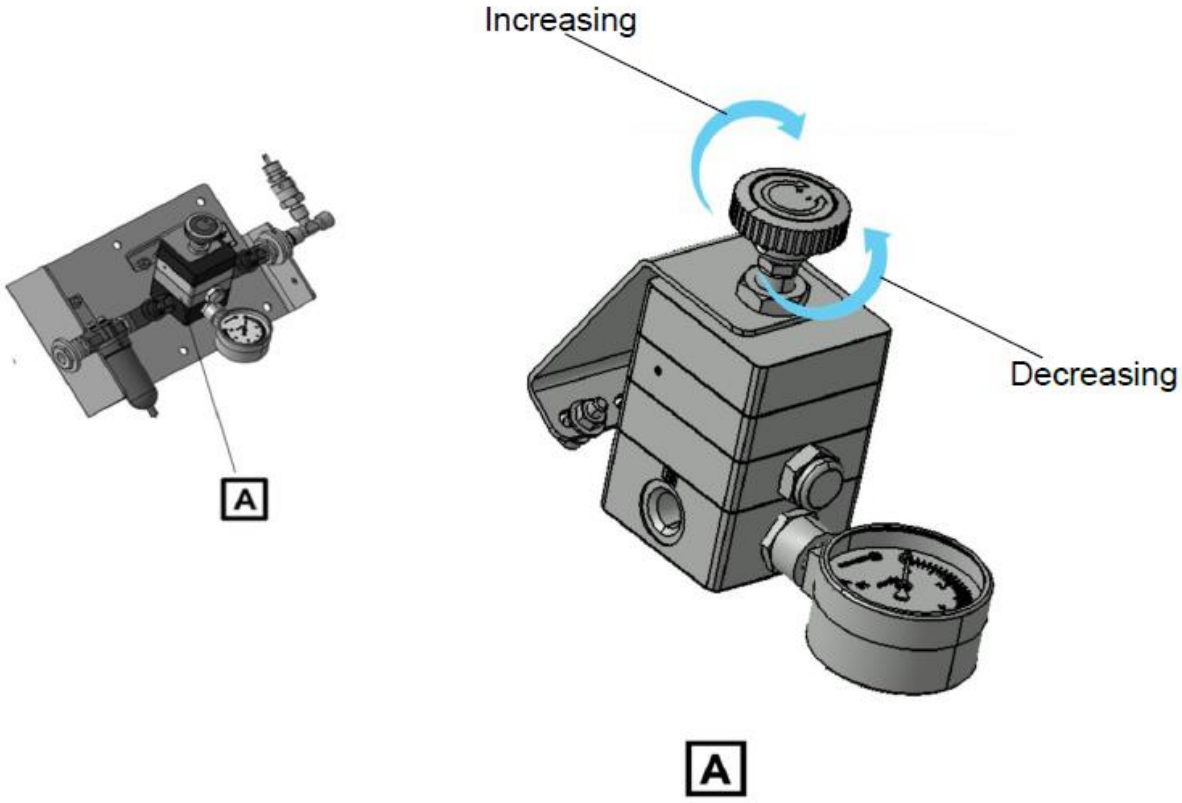


Figure 37 – Adjusting Static Contact Force

Pressure regulators are pneumatic devices, that have a function of reducing and increasing the air pressure.

In causes, as described in previous Section, it is necessary to adjust Contact Force of Pantograph. Increasing or decreasing the Contact Force is done by Regulator which is placed on Pneumatic Control Unit, refer to Figure 37.

IMPORTANT NOTE • The Pantograph and PCU, when delivered together, usually require no adjustments to the Pressure Regulator.

In the factory, once the static force is achieved, a torque mark is applied to the adjusting knob. However, if the Pantograph and PCU are not dispatched as a pair, there's a risk that the 7kg load may not withstand. This is because the static force for the Pantograph is set at a different pressure.

- Adjustments to Pressure Regulator Knob only if defined 70N static force are not met.
- Static force Adjustment:
- Hang 7Kg load in the middle of swaying shaft.
- If Pantograph is lowering, Rotate the Adjusting knob precisely in clockwise direction until it stabilises. (Increasing air pressure)
- If Pantograph is raising, Rotate the Adjusting knob precisely in anticlockwise direction until it stabilises (decreasing air pressure) Once the setting is completed tighten the Locking nut of PRV and repeat the checking one time to ensure the setting is not disturbed.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.5.5 ADJUSTING RAISING & LOWERING SPEED OF PANTOGRAPH

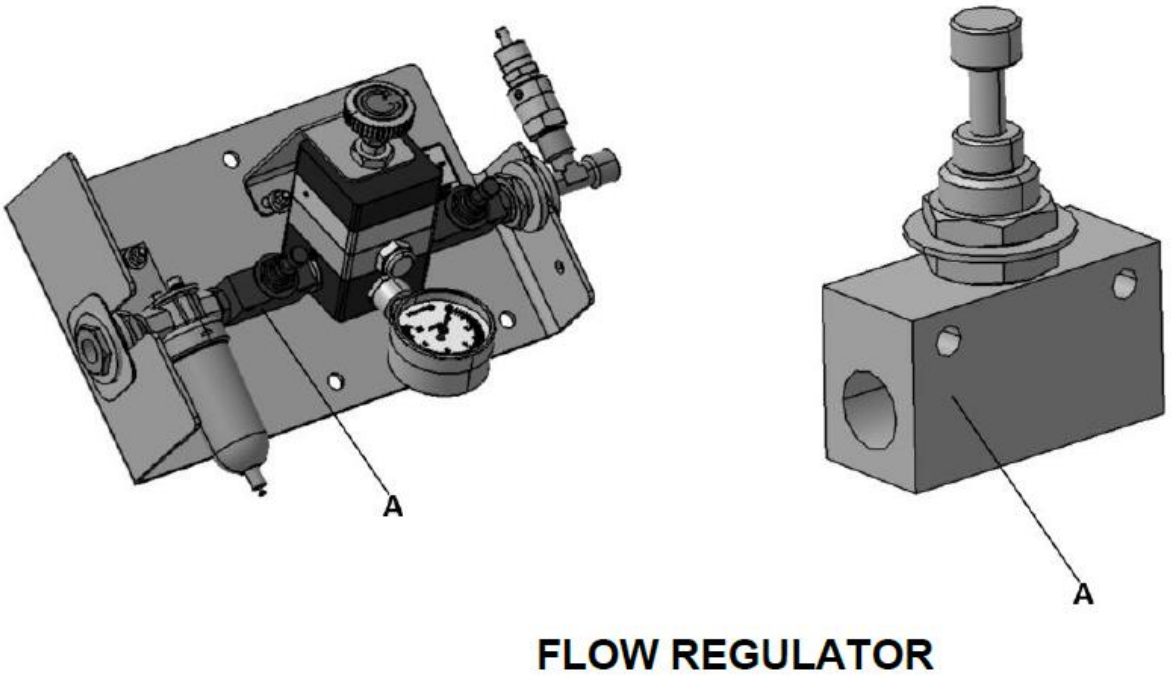


Figure 38 – Adjusting Raising & Lowering Speed Of Pantograph

Flow Regulators used for adjusting the Raising & Lowering speed of Pantograph **ADJUSTING KNOB** Pneumatic flow regulator is a form of flow control that regulates the speed of compressed air within a pneumatic system.

- There are two Flow regulators used in PCU for Raising and Lowering speed control Raising Flow Regulator is used to control the raising time of Pantograph.
- To reduce the raising time of Pantograph, rotate the Adjusting Knob precisely in anticlockwise (means Pantograph raise fast).
- To increase the raising time of Pantograph, rotate the Knob precisely clockwise (means Pantograph raise slowly) Lowering Flow Regulator is used to control the lowering time of Pantograph.
- To reduce the lowering time of Pantograph, rotate the adjusting knob precisely in anticlockwise, (means Pantograph lower fast).
- To increase the lowering time of Pantograph, rotate the adjusting knob precisely in clockwise, (means Pantograph lower slowly) Once the setting is completed hand tighten the Locking nut of Flow regulator and repeat the checking one time to ensure the setting is not disturbed.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.6 CHECK OF LIFTING AND LOWERING TIME

Check the raising and lowering times of the Pantograph.

Use stopwatch to measure the time movement of the Pantograph.

- Raising time – Max. 15 Seconds.
- Lowering time – Max. 20 Seconds.

The rise from housed height to maximum working height shall be achieved in time not exceeding 15 Seconds **from the moment Pantograph starts to rise**.

The lowering of the Pantograph from maximum working height shall be achieved in time not exceeding 20 Seconds **from the moment Pantograph starts to lower**.

8.6.7 CHECK OF PNEUMATIC PARTS OF PANTOGRAPH FOR TIGHTNESS

Air tightness test of Pantograph Pneumatic Components:

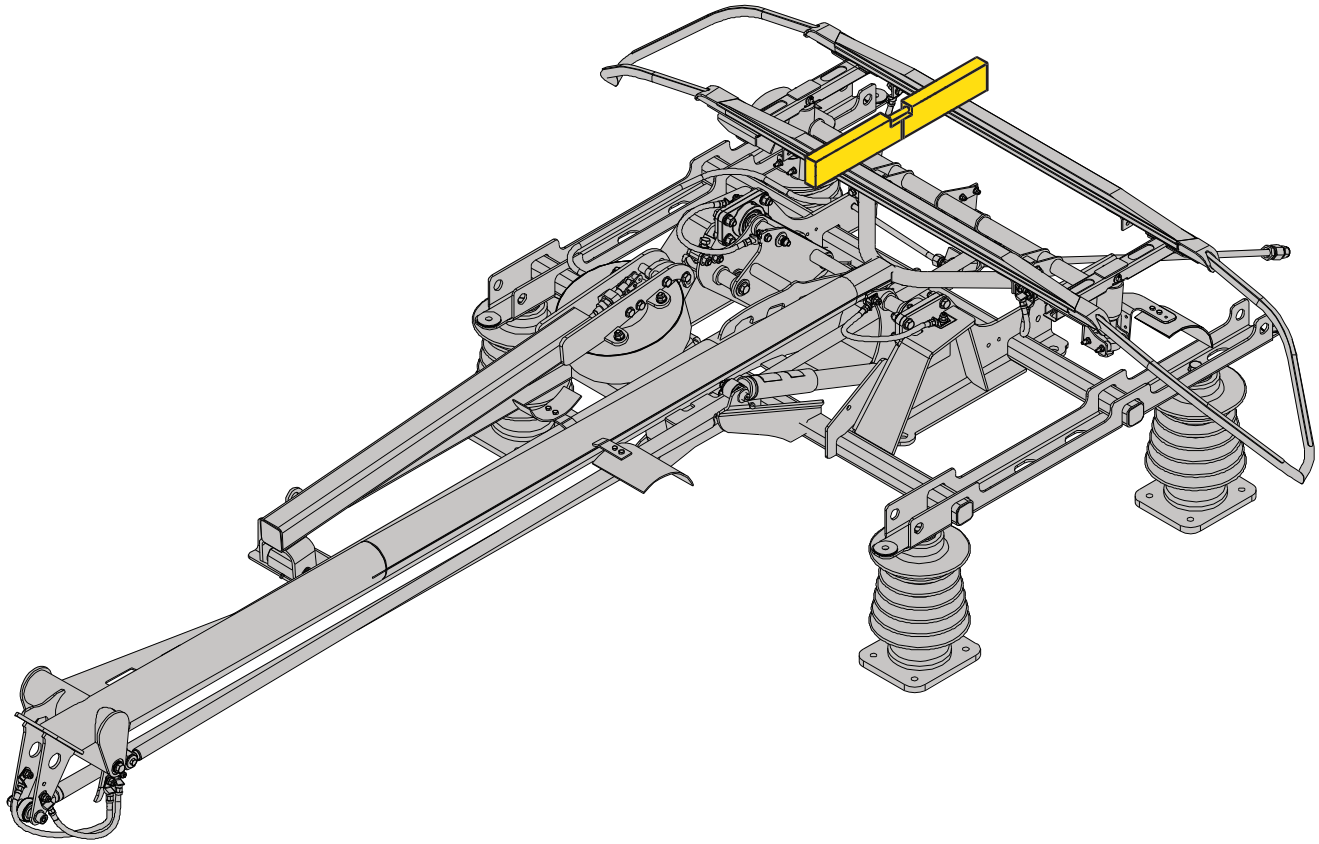
- Let the Pneumatic Circuit of Pantograph be under Pressure (Pantograph in raised position or secured in lowered position by Rope [W04]).
- Cover the Pneumatic Components with Air-leak Detection Spray [B04] and check the leakage.

Air tightness test of Pneumatic Unit:

- Let Pneumatic Unit be under pressure.
- Cover the Pneumatic Components with Air-leak Detection Spray [B04] and check the leakage.
- Using soap solution or any other form of solution on the bleed port, breather/exhaust port, quick exhaust pilot vent, and safety valve in the PCU is not permitted. This method could cause a malfunction of the pressure regulator. However, it is applicable for checking leakages only on the PCU joints.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.8 CHECK OF COLLECTOR HEAD HORIZONTAL POSITION



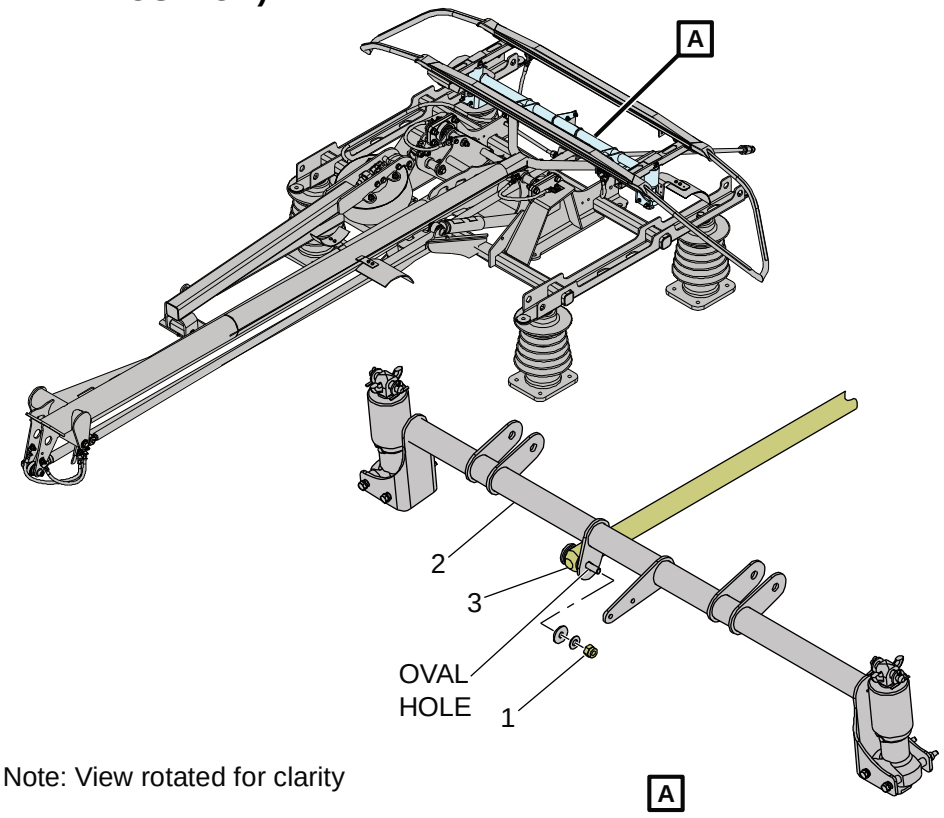
Note: Insulators are shown for illustration purpose.

Figure 39 – Check of Collector Head Horizontal Position

- Pantograph must be completely assembled.
- Static contact force must be adjusted properly, refer Section 8.6.5.
- Release nut (1).
- Put Spirit Level on Collector Head Assembly, refer to Figure 39.
- Place 7KG load on Carbons Strip on rear side and front side to check, which will be mounted on Collector Head then, Rise the Pantograph to a height of about 0.5,1,1.5,2,2.5,3 and 3.4 m using Pneumatic pressure and keep the Pantograph in this position using Rope [W04]. (note: both rear and front to be tested separately by hanging 7 kg load)
- Check Spirit Level should maintain 5° to 10° in all heights on both side while the 7kg load is hanged shows horizontal position. If not, Adjust Swaying Shaft Assembly according to section 8.6.8.1.
- Lower the Pantograph and remove the Rope [W04].

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.8.1 ADJUSTING SWAYING SHAFT ASSEMBLY (COLLECTOR HEAD HORIZONTAL POSITION)



Note: View rotated for clarity

Note: Insulators are shown for illustration purpose.

Figure 40 – Adjusting Swaying Shaft Assembly

Item No	Description	Part Number	Qty
1	Hex Nut	2930803-082	1
2	Swaying Shaft	E043125-0102	1
3	Upper Rod	XE043656-0101	1

For item numbers mentioned below in bracket, refer to Figure 40.

- Pantograph must be completely assembled.
- Static Contact Force must be adjusted properly, refer Section 8.6.5.4.
- Release Nut (1) and Place 7KG load on Carbons Strip on rear side and front side to check, which will be mounted on collector head then, Rise the Pantograph to a height of about 0.5,1,1.5,2,2.5,3 and 3.4 m using Pneumatic pressure and keep the Pantograph in this position using Rope [W04]. (Note: both rear and front to be tested separately by hanging 7 kg load)
- Adjust the position of Swaying Shaft Assembly with help of oval hole provided in the swaying shaft, which connects upper rod and swaying shaft (2) until Spirit Level (5° to 10° to be maintained in all heights on both side while the 7kg load is hanged shows horizontal position, refer to Figure 40.
- Tighten the Nut (1) to a torque of 24 Nm.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

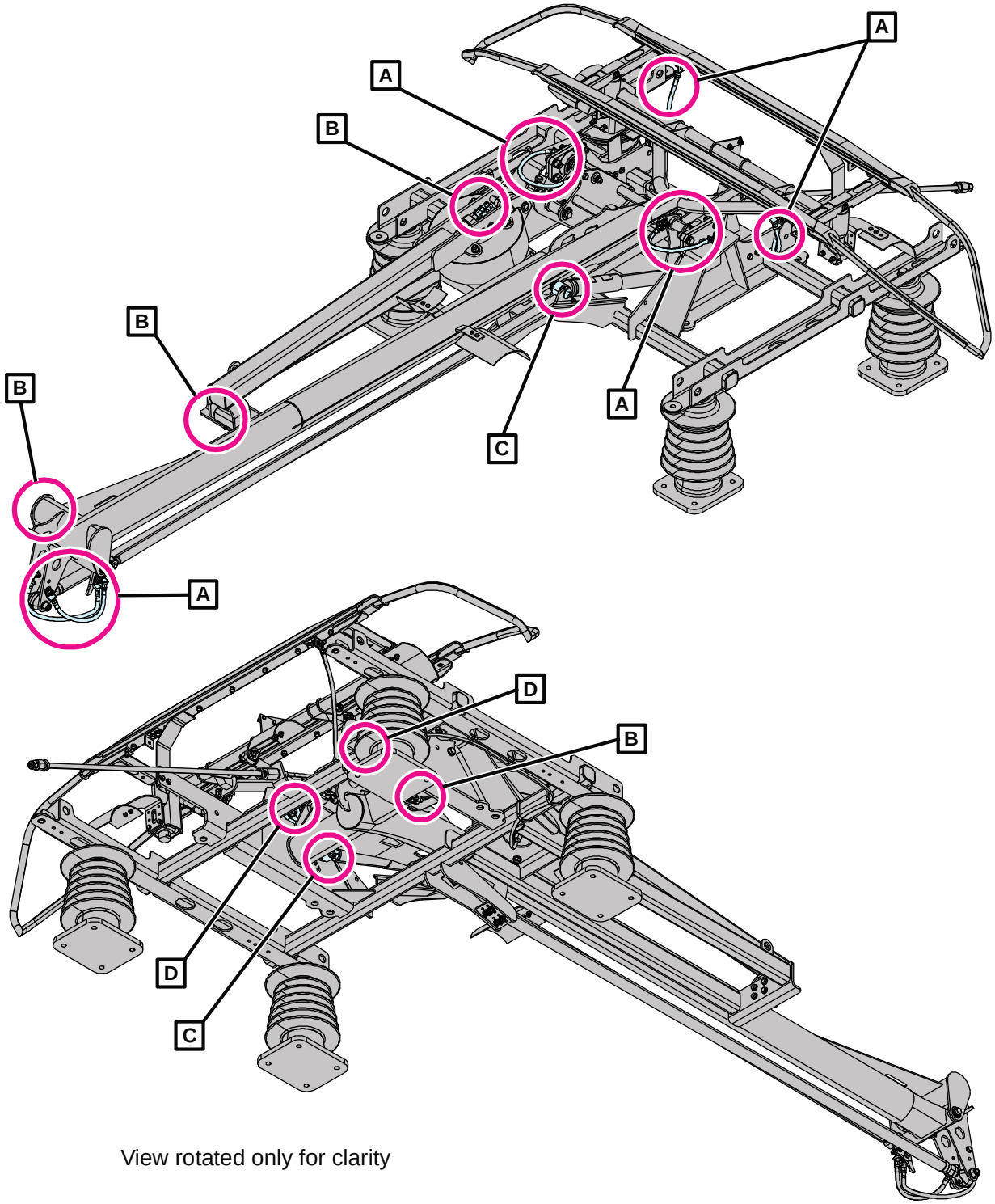
8.6.9 PNEUMATIC CHECKING

- Check the tightness of Pneumatic Connections.
    a. Secure the Pantograph in lower position.
    b. Pressurize the Pantograph.
    c. Apply the Air leak Detection Spray [B04] to Pneumatic Connections which were dismounted during replacement.
    d. Using soap solution or any other form of solution on the bleed port, breather/exhaust port, quick exhaust pilot vent, and safety valve in the PCU is not permitted. This method could cause a malfunction of the pressure regulator. However, it is applicable for checking leakages only on the PCU joints.

- Check the Static Contact Force, according to Section 8.6.5.
- Verify the horizontal position of Collector Head, according to Section 8.6.8.
- Verify the Raising and Lowering time, according to Section 8.6.6.
- Supply Pantograph with compressed air in its full upward and downward movement and verify that the Pantograph rises and lowers evenly without bumps or snagging while operating it manually.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.6.10 LUBRICATION



View rotated only for clarity

Note: Insulators are shown for illustration purpose.

Figure 41 – Lubrication Points

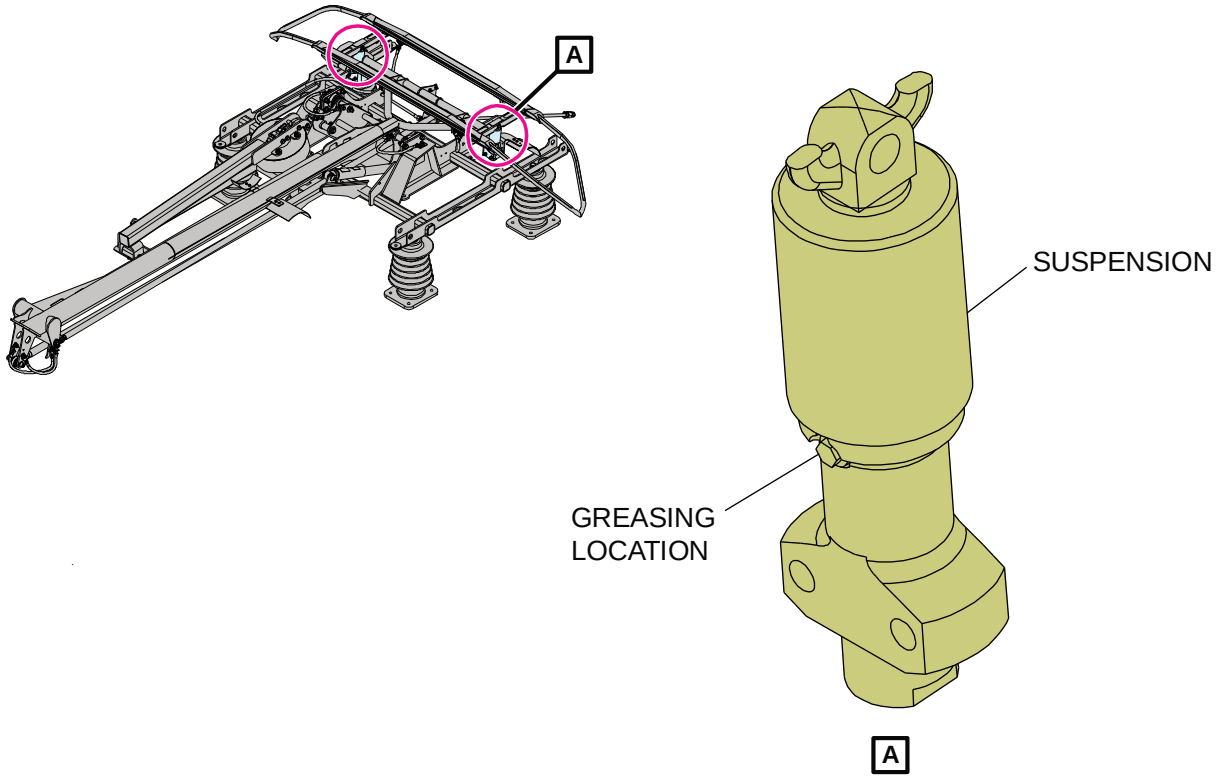
Unless specified otherwise, Aeroshell Grease 6 [B06] is used for lubrication. The moving parts of the Pantograph which are not supported on the bearings must be lubricated every 6 months or after each longer down time as follows:

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

- Lubricate the Contact Surfaces (Detail A) of the Flexible Connections with CONTACTAL HPG Grease [B02].
- Lubricate the Chain (Detail B) with "Chain and Rope Lube Spray" [B03].
- Lubricate the Damper Joints (Detail C) with Grease [B01].
- Lubricate the Bearings (Detail D) as per below.
    - Lubricate Bearings with Grease through the lubricating Nipple till the Grease starts to leak through the gap between plastic cover and metal part.
    - Lubricate all visible parts inside the Housing including the Safety Ring.
    - Perform the 1x Raising and Lowering of the Pantograph.
    - Lubricate the Bearings again.
    - Perform the 3x Raising and Lowering of the Pantograph.
    - Refer to Figure 41 for all Lubrication Points.
- Lubricate all visible Screws and Nuts with Grease [B01].

Note: Chain must be clean of dust and dirt before lubrication.

- In case, when Flexible Connections are mounted, apply conductive CONTACTAL HPG Grease [B02] between mating surfaces of Flexible Connection and base of the Pantograph, refer to Figure 41.
- Use Brush to apply the Grease at the appropriate places, refer to Figure 41.
- Lubricate the two Pins of the Connection of Suspension Units and support of the Collector Head with Grease [B01] according to Figure 42.
- Unscrew and remove Lubricator and Washer, then Lubricate grease [B01] to the suspension through lubricating Nipple according to Figure 42.



Note: Insulators are shown for illustration purpose.

Figure 42 – Lubrication on collector head

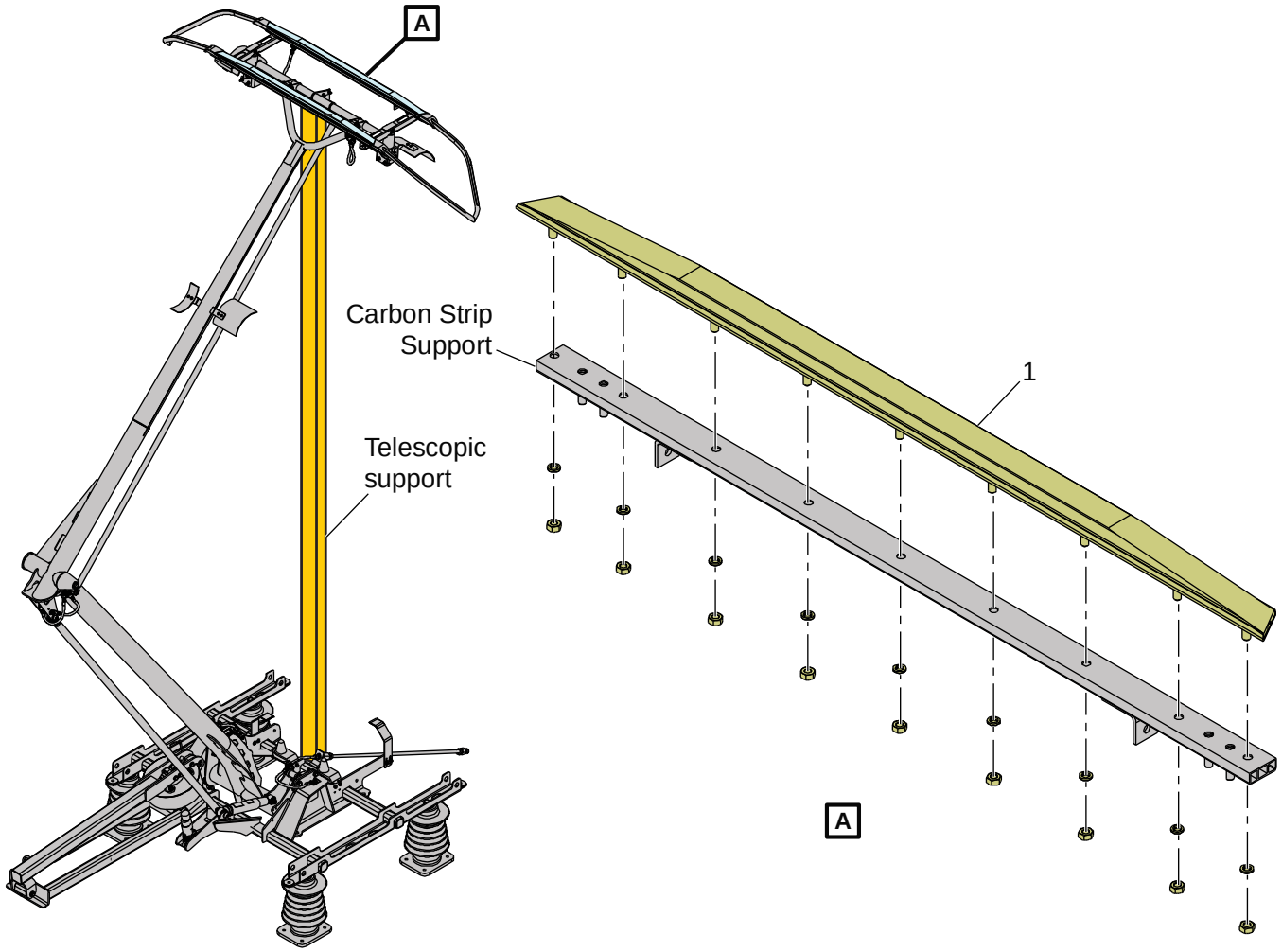
FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.7 ON-CAR REMOVAL AND REPLACEMENT PROCEDURES

8.7.1 REPLACEMENT OF CARBON STRIPS

Carbon Strips replacement frequency

Actual mileage of carbon strip replacement heavily depends on running conditions and decision for replacement should be based on regular checking, refer to Section 8.6.2 rather than at fixed 150000 km.



Note:

1. Nut and Washer is a child part of Carbon Strip (1).
2. Insulators are shown for illustration purpose.

Figure 43 – Replacement of carbon strips

Location	Item No	Description	Part Number / Set Number	Qty
M26	**Carbon strips**		**E043642-SET18**	**1**
	1	Carbon strip	FT0074495-100	2

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE. For item numbers mentioned below in bracket, refer to Figure 43.

Follow the instructions as mentioned below for removal of the Carbon strips:

- Expand the Pantograph manually to around 500 mm.
- Insert a Telescopic Support [W03] between the frame and swaying shaft to secure Pantograph expand, refer to Figure 43.
- Remove the four nuts and four washers on each side of carbon strip (1).
- Take out the carbon strip (1) from strip support.

Follow the instructions as mentioned below for installation of the Carbon Strips:

- For installation prepare E043642-SET18 [M26], refer to List of materials Section 7.3.
- Brush the mating surfaces of the carbon strip and strip support and lubricate them with conductive CONTACTAL HPG Grease [B02].
- Place the carbon strip (1) on the strip support, refer to Figure 43.
- Install the four nuts and four washers and tighten them to a torque of 9.5 Nm.
- Remove the Telescopic Support [W03] and lower the Pantograph.

Follow the instructions as mentioned below for checking the Carbon strips:

- Use the force meter and perform an orientation checking of Static Force.
- Attach the force meter at the centre of the shaft.
- Raise the Pantograph.
- Measure the Contact Force, according to section 8.6.5.
- In case of difference in values re-calibrate the Pantograph.
- Verify the horizontal position of Collector Head, according to section 8.6.8.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.7.2 REPLACEMENT OF AIR FILTER INSERT

Make sure that Pneumatic unit is without Air Pressure.

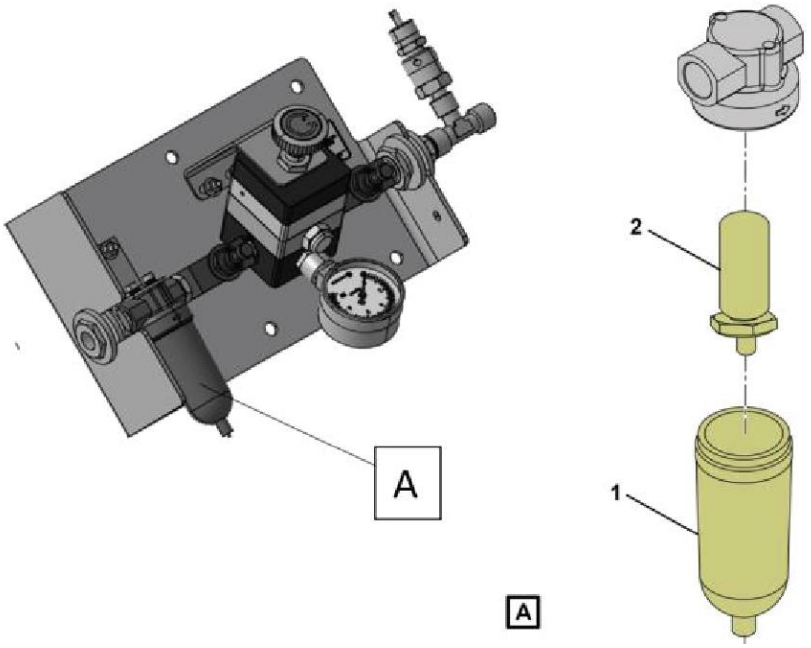


Figure 44 – Replacement of Air Filter Insert

Location	Item No	Description	Part Number / Set Number	Qty
M37	**Air Filter Element**		**FT0053911-115**	-
Not part of set	1	Air Filter Cover	-	-
M37	2	Filter Element (with O-RING)	FT0053911-115	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 44.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Air Filter Insert:

- Remove the Air Filter Cover (1). Rotate the Air filter cover anticlockwise to remove.
- Remove the Air Filter Insert (2). Rotate the filter insert anticlockwise to remove and remove O-ring on air filter inset and the air filter cover.

Follow the instructions as mentioned below for installation of the Air Filter Insert:

- For installation prepare FT0053911-115 [M37], refer to list of materials in section 7.3.
- Install the Air Filter Insert (2) with the O-ring and O-ring to be lubricated with Grease Spirel 269 [B05].
- Install O-ring on the Air Filter Cover (1) lubricate with Grease Spirel 269 [B05].
- Install the Air Filter Cover (1) and tighten it to a torque of 4.5 Nm.

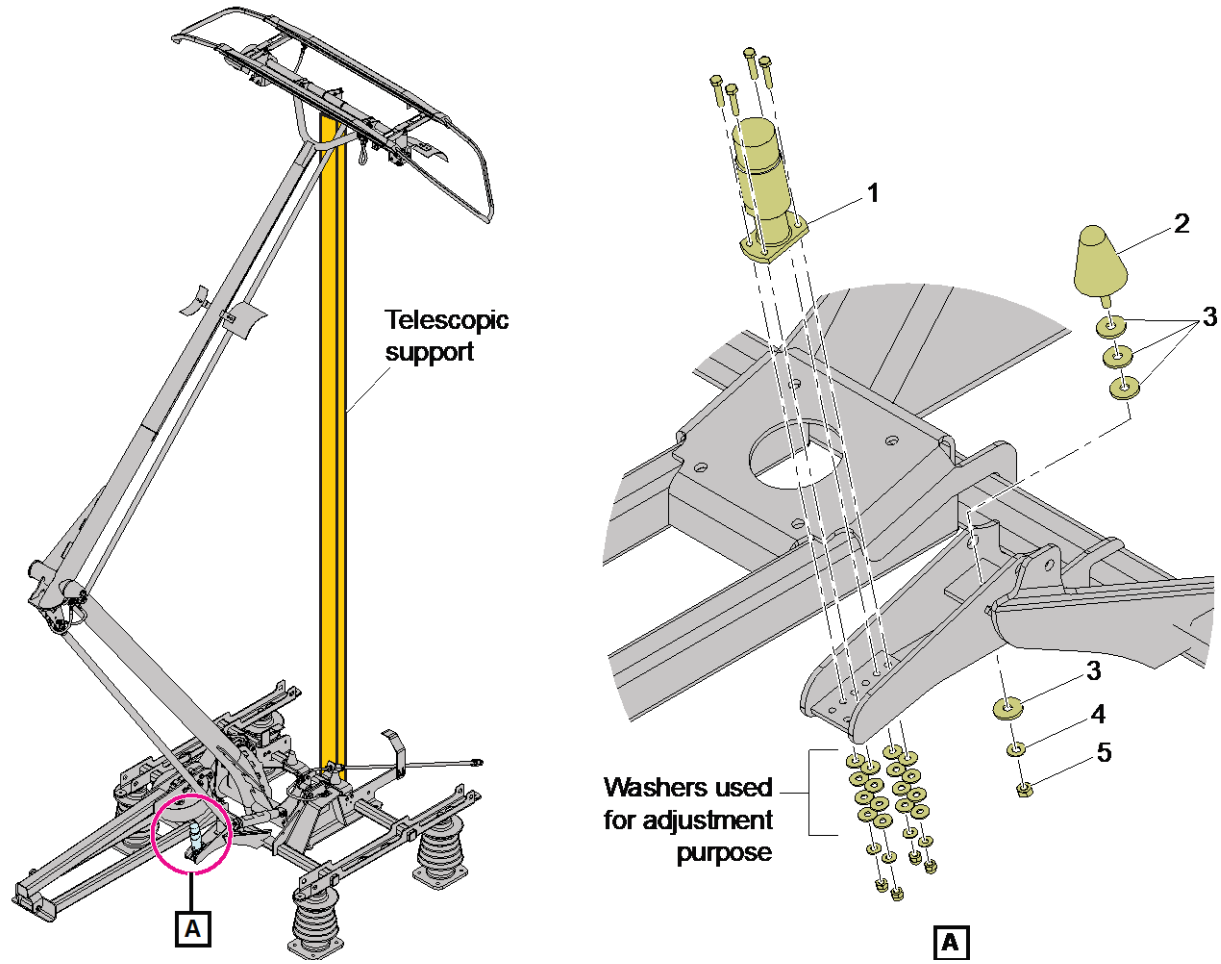
Follow the instructions as mentioned below for checking the Air Filter Insert:

- Check the tightness of Pneumatic Connections.
- Secure the Pantograph in lowered position.
- Pressurize the Pantograph at 3.8bar.
- Apply the Air Leak Detection Spray [B04] on the Pneumatic Connections.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.7.3 REPLACEMENT OF END STOPS

8.7.3.1 REPLACEMENT OF LOWER ARM END STOP



Note: Insulators are shown for illustration purpose.

Figure 45 – Replacement of Lower Arm End Stop

Location	Item No	Description	Part Number / Set Number	Qty
M03	**Lower Arm End Stop**		**E043642-SET2**	1
	1	Endstop on Spring	VE044022-0101	1
	2	Elastic Stop End	5190140-000	1
	3	Plain Washer ISO7094	FT0030004-053	4
	4	CS Washer ,8-18-1.4 NFE25-511	FT0030004-017	1
	5	Hexagon Nut ISO4032 M8 - 8	FT0030002-003	1

For item numbers mentioned below in bracket, refer to Figure 45.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Lower Arm End Stop:

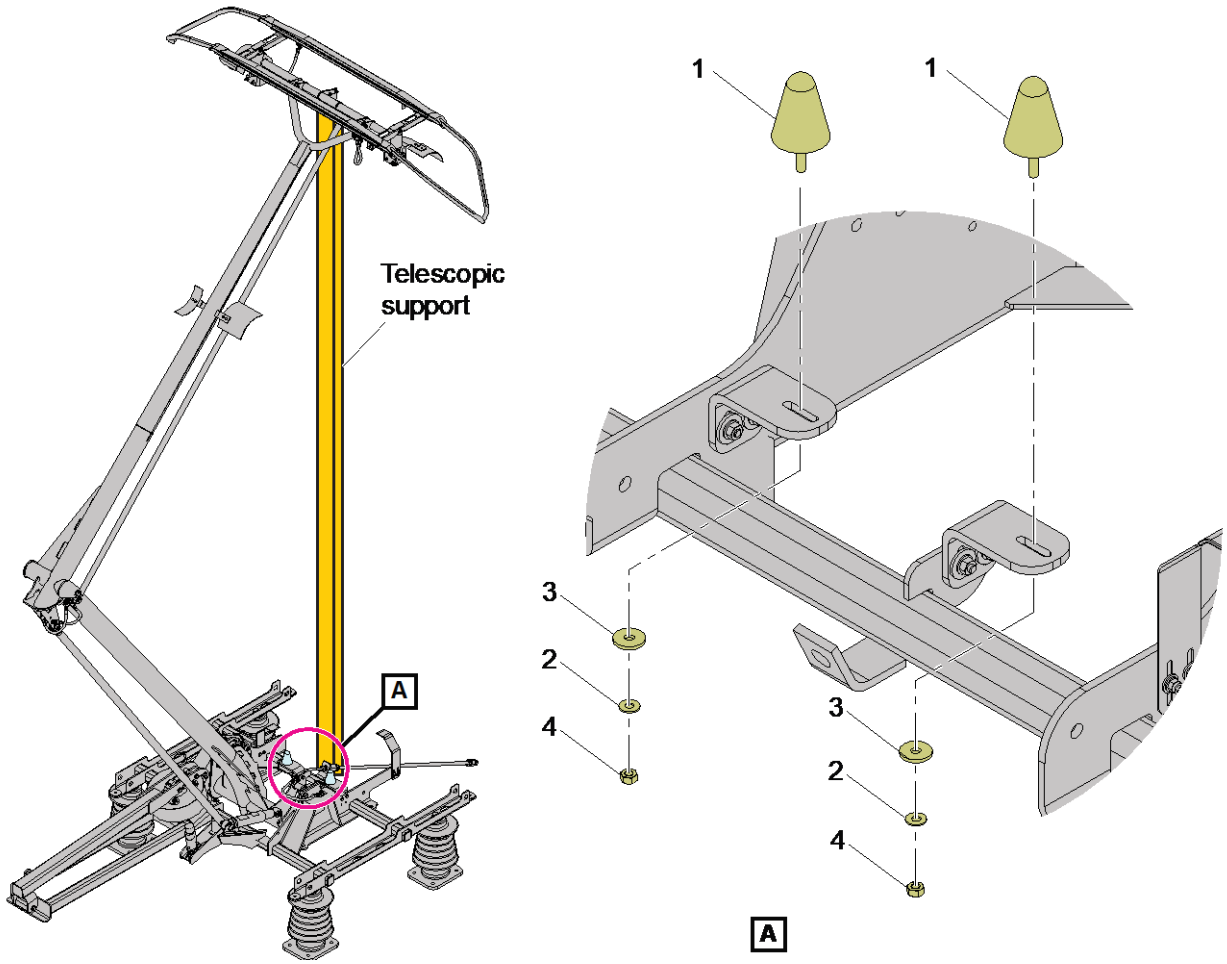
- Expand the Pantograph manually to around 500 mm.
- Insert a Telescopic support [W03] between the Frame and Swaying shaft to secure the Pantograph expand.
- Remove Endstop on Spring (1) by removing relevant fasteners.
- Remove the Nut (5), CS Washer (4) and Plain Washer (3).
- Remove the Plain Washers (3) and Elastic Stop End (2). Count the number of Plain Washers (2) to use the same number during installation.

Follow the instructions as mentioned below for installation of the Lower Arm End Stop:

- For installation prepare E043642-SET2 [M03], refer to List of materials Section 7.3.
- Install the Elastic Stop End (2) with Plain Washers (3). Install same number of Plain Washers (3) dismantled during removal.
- Install the Plain Washer (3), CS Washer (4) and Nut (5) and tighten it to a torque of 20 Nm.
- Install and secure Endstop on Spring (1) with installing relevant fasteners.
- Remove the Telescopic Support [W03] and lower the Pantograph.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.7.3.2 REPLACEMENT OF UPPER ARM END STOPS



Note: Insulators are shown for illustration purpose.

Figure 46 – Replacement of Upper Arm End Stops

Location	Item No	Description	Part Number / Set Number	Qty
M04	**Upper Arm End Stop**		**E043642-SET3**	1
	1	Elastic Stop End	5190140-000	2
	2	CS Washer, 8-18-1.4 NFE25-511	FT0030004-017	2
	3	Plain Washer ISO7094	FT0030004-053	2
	4	Hexagon Nut ISO4032 M8 - 8	FT0030002-003	2

NOTE: For item numbers mentioned below in bracket, refer to Figure 46.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Upper Arm End Stops:

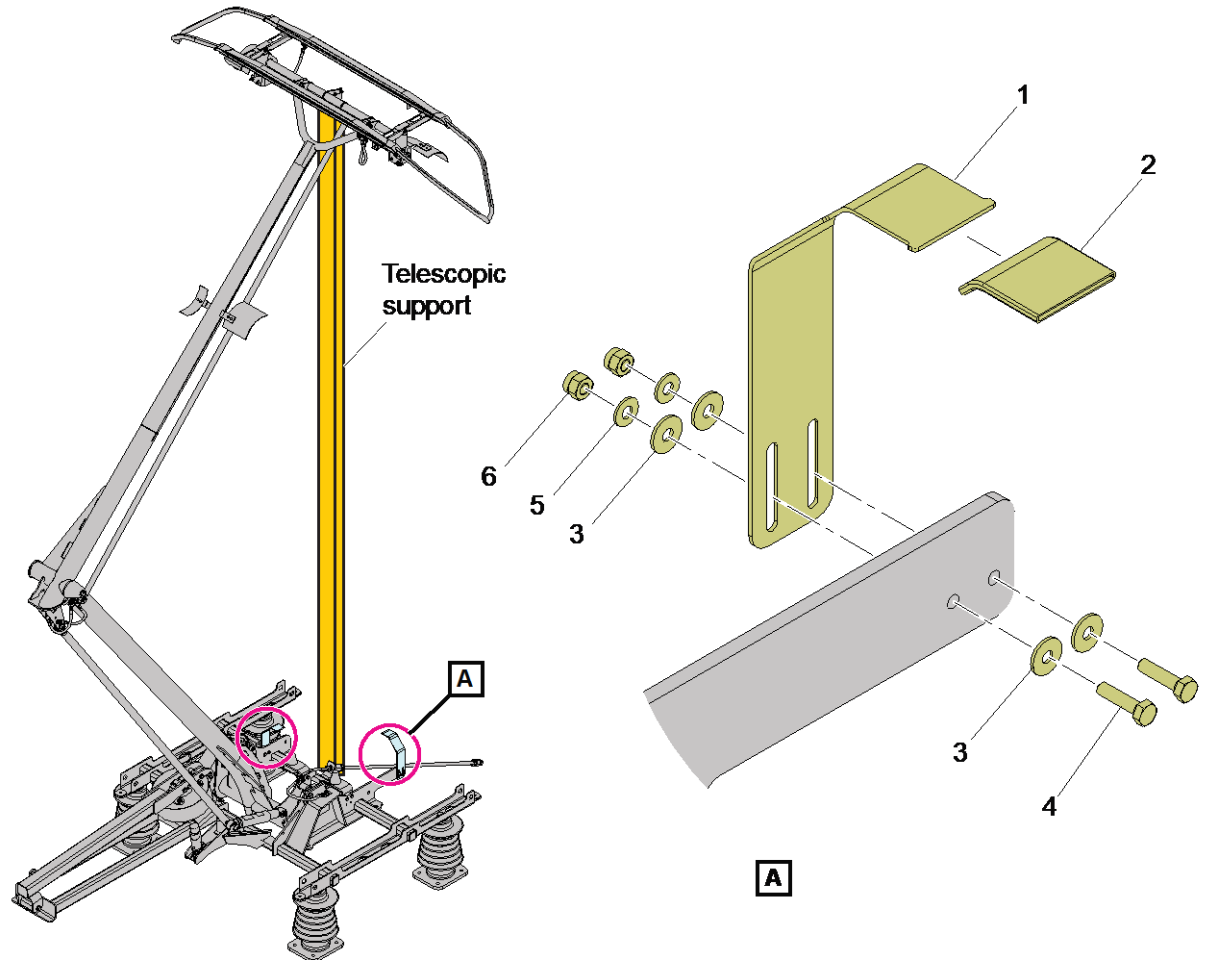
- Expand the Pantograph manually to around 500 mm.
- Insert a Telescopic Support [W03] between the Frame and Swaying Shaft to secure the Pantograph expand.
- Remove the two Nuts (4), two Plain Washers (3) and two CS Washers (2).
- Remove the two Elastic Stop Ends (1) from the Frame.

Follow the instructions as mentioned below for installation of the Upper Arm End Stops:

- For installation prepare E043642-SET3 [M04], refer to List of materials Section 7.3.
- Install the two Elastic Stop Ends (1) to the Frame.
- Install the two CS Washers (2), two Plain washers (3) and two Nuts (4) and tighten it to a torque of 20 Nm.
- Remove the Telescopic Support [W03] and lower the Pantograph.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.7.3.3 REPLACEMENT OF COLLECTOR HEAD END STOPS



Note: Insulators are shown for illustration purpose.

Figure 47 – Replacement of Collector Head End Stops

Location	Item No	Description	Part Number / Set Number	Qty
M05	**Collector Head End Stops**		**E043642-SET4**	2
	1	Flexible Endstop - Front	XE044030-0001	1
	2	Shrink Tube	0007367	0.05m
	3	Plain Washer	FT0030003-018	4
	4	Hex. Screw	FT0030005-040	2
	5	CS Washer	FT0030003-022	2
	6	Prevailing Torque Hex. Nut	FT0030001-019	2

NOTE: For item numbers mentioned below in bracket, refer to Figure 47.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Collector Head End Stops:

- Expand the Pantograph manually to around 500 mm.
- Insert a Telescopic Support [W03] between the Frame and Swaying shaft to secure the Pantograph expand.
- Remove two Hex Screws (4) with four Plain Washers (3), two CS Washers (5) and two Hex. Nuts (6).
- Remove Flexible Endstop – Front (1) along with Shrink Tube (2) from frame.
- If necessary, remove Shrink Tube (2) from Flexible Endstop – Front (1) using screwdriver (Do not damage component).

Follow the instructions as mentioned below for installation of the Collector Head End Stops:

- For installation prepare E043642-SET4 [M05], refer to List of materials Section 7.3.
- If removed, install Shrink Tube (2) to Flexible Endstop – Front (1).
- Install Flexible Endstop – Front (1) along with shrink tube (2) to frame
- Secure Flexible Endstop – Front (1) to frame with two Hex Screws (4), four Plain Washers (3), two CS Washers (5) and two Hex. Nuts (6).
- Tighten two Hex. Nuts (6) to a torque of 10.4 Nm.
- Remove the Telescopic Support [W03] and lower the Pantograph.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.7.4 FUNCTIONAL CHECK OF PRESSURE REGULATOR

Refer to section 8.6.5.4 (Adjustment of static contact force), to check function of pressure regulator.

8.7.5 FUNCTIONAL CHECK OF SAFETY VALVE ON BENCH

The functional check of safety valve must be carried out Offtrain. Below is the procedure to perform the functional check offtrain.

8.7.5.1 OFF TRAIN TESTING

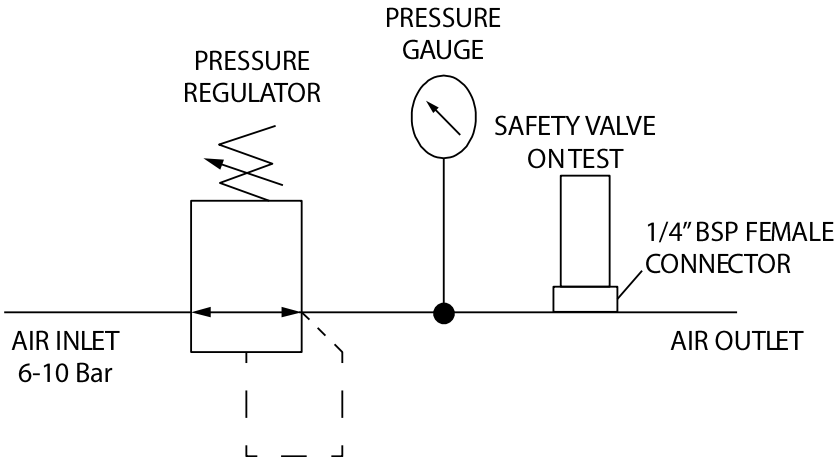


Figure 48 – Safety Valve, Test Bench

- Remove the safety valve from PCU according to section 8.9.2.5.
- Install safety valve on the test bench as shown above on 1/4" BSP female connector using adjustable spanner.
- Ensure pressure regulator is set at a pressure of 4 Bar.
- Supply air pressure of 6 to 10 Bar at inlet.
- Make incremental increase in pressure value by rotating the nut on pressure regulator.
- Record the pressure at which the safety valve at which the safety valve commences to blow ref: 3.2.13 Note.
- Continue increasing the pressure through pressure regulator. The valve will continue to blow and then ‘pop’ fully open.
- Close inlet pressure. Open outlet sufficiently to drop the regulator pressure, pressure gauge, and when the safety valve stops blowing, i.e. resets, close outlet.
- Repeat the above steps for three times noting the pressure each time.
- Open Outlet and drain system.
- Remove valve from 1/4" BSP female connector using adjustable spanner and seal port to prevent entry of foreign matter.
- Ensure the sealing wire and seal are in place.
- In case of anomaly the valve must be replaced.
- Re-install the safety valve to the PCU according to section 8.9.2.5.

Do not tamper with or modify the valve. Faulty valves must be replaced.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.7.6 REPLACEMENT OF PRESSURE GAUGE

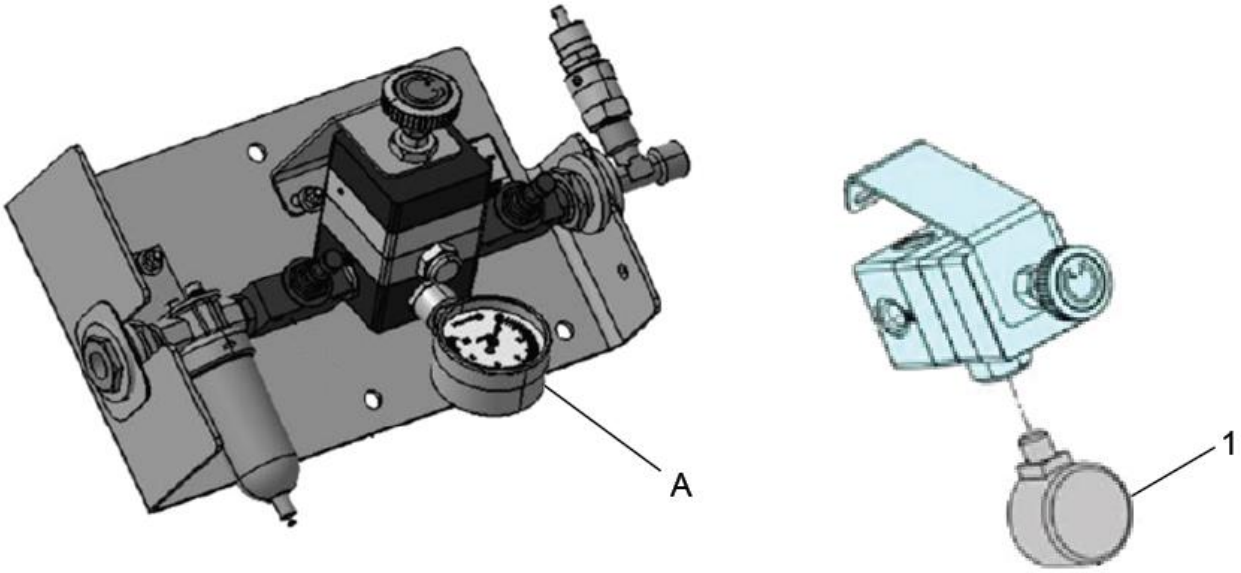


Figure 49 – Replacement of Pressure Gauge

Location	Item No	Description	Part Number / Set Number	Qty
M41	**Pressure Gauge**		**FT0053911-049**	-
	1	Pressure Gauge	FT0053911-049	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 49.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Pneumatic Control Unit Pressure Gauge:

- Remove the Pneumatic Control Unit (PCU) from vehicle, according to Section 8.8.2.
- Unplug Connectors, if necessary.
- Unscrew and remove the Pressure Gauge (1) from Pressure Regulator using adjustable wrench.

Follow the instructions as mentioned below for installation of the Pneumatic Control Unit Pressure Gauge:

- For installation prepare FT0053911-049 [M41], refer to List of materials Section 7.3.
- Install Pressure Gauge (1) to Pressure Regulator using adjustable wrench.
- Tighten the Pressure Gauge (1) to a torque of 10 Nm.

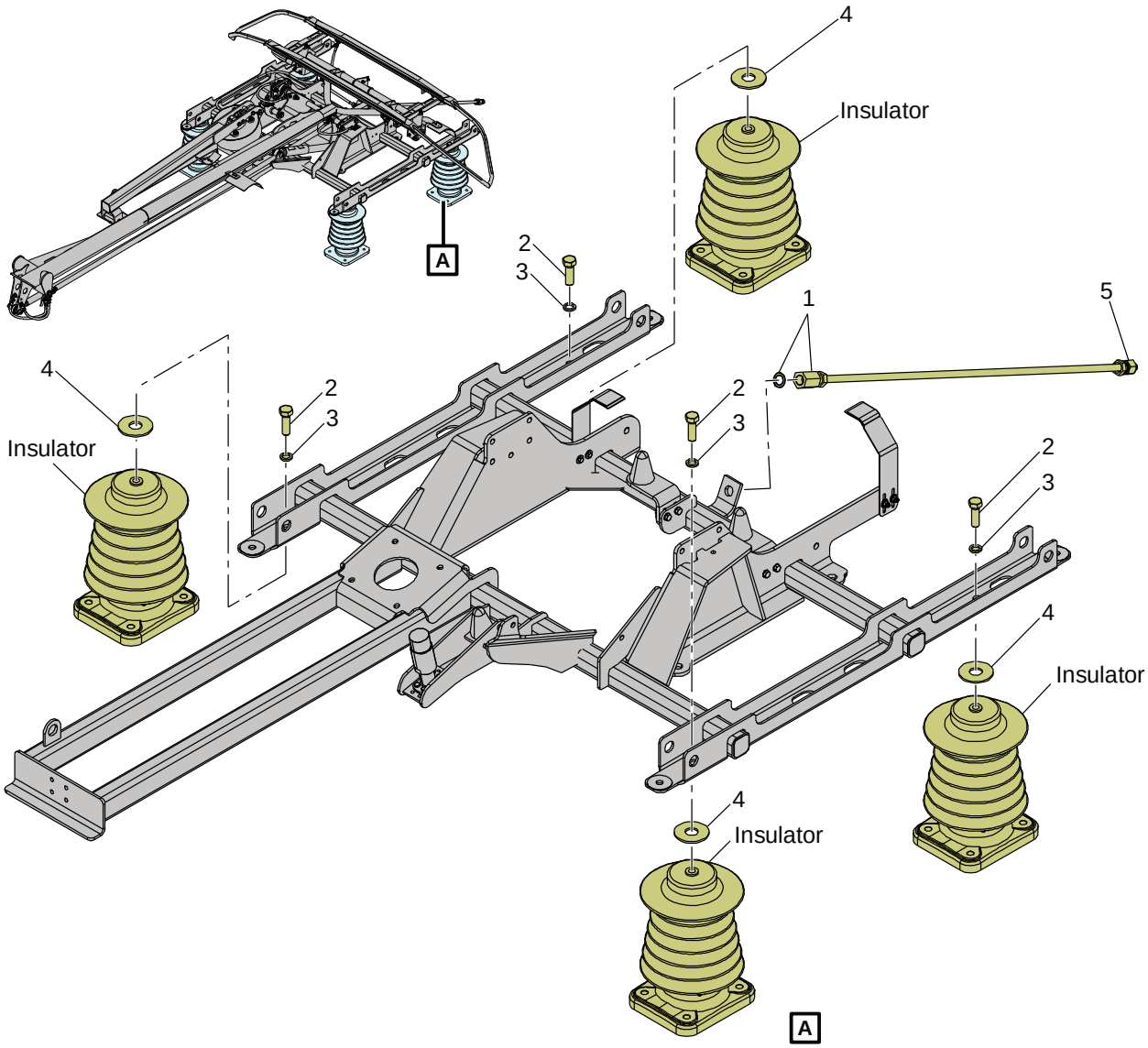
Follow the instructions as mentioned below for checking the Pneumatic Control Unit Pressure Gauge:

- Check the tightness of Pneumatic Connections.
  - Secure the Pantograph in lowered position.
  - Pressurize the Pantograph at 3.8bar.
  - Apply the Air-leak Detection Spray [B04] on the Pneumatic Connections, which were mounted.
- Using soap solution or any other form of solution on the bleed port, breather/exhaust port, quick exhaust pilot vent, and safety valve in the PCU is not permitted. This method could cause a malfunction of the pressure regulator. However, it is applicable for checking leakages only on the PCU joints.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.8 REMOVAL AND INSTALLATION FOR OVERHAUL

8.8.1 REMOVAL AND INSTALLATION OF PANTOGRAPH FROM VEHICLE



Note: Insulators and attaching hardware are shown for illustration purpose. Cap nut (5) not shown for clarity.

Figure 50 – Removal and Installation of Pantograph

Location	Item No	Description	Part Number / Set Number	Qty
M01	**Pantograph**		**E043642-0101**	1
Not part of set	1	Insulated hose assembly	E043116-SET24	1
	2	Hex screw	Not Wabtec scope of supply	-
	3	Nord - Lock Washer		-
	4	Spacer		-
	5	Cap Nut		-

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: For item numbers mentioned below in bracket, refer to Figure 50.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

Follow instructions as mentioned below for removal of Pantograph from vehicle:

- Move the Pantograph to lowered position.
- Disconnect the high voltage outputs from the Frame.
- Release the Cap nut (5) from vehicle.
- Release the Nut and flat seal on insulated hose assembly (1) and disconnect insulated hose assembly (1).
- Fix the transport slings at the 4 handling points on the Frame, refer to Section 9.1.
- Remove the four Screws (2), four Nord Lock Washers (3) and four Spacers (4) from the Insulator (not Wabtec scope of supply).
- Lift the Pantograph and place it on the Support or Test bench with Caution.
- Fix the Pantograph on its Support or on the Test bench.
- Remove the Transport Slings.
- Temporarily place the sets four Screws (2), four Nord Lock Washers (3) and four Spacers (4) to the Insulators (not Wabtec scope of supply) to avoid any damage or loss of them.

Follow instructions as mentioned below for installation of Pantograph to vehicle:

- For installation prepare E043642-0101 [M01], refer to List of materials Section 7.3.
- Fix the Transport Slings at the 4 handling points of the Frame, refer to Section 9.1.
- Remove the sets of four Screws (2), four Nord Lock Washers (3) and four Spacers (4) from the Insulator (not Wabtec scope of supply).
- Lift the Pantograph structure and place the Pantograph gently on the Insulators (not Wabtec scope of supply).
- Install four Screws (2), four Nord Lock Washers (3) and four Spacers (4), to fix the Pantograph structure to the Insulators.
- Tighten the Screws (2) to a torque of 100 Nm.
- Remove the Transport Slings.
- Connect the one side of insulated hose assembly (1) into Pantograph.
- Connect other side Cap Nut (5) into vehicle.
- Tighten the Nuts on insulated hose assembly (1) and fitting (5) to a torque of 55 Nm.
- Connect the high voltage outputs of the Frame.

Follow the instructions as mentioned below for checking the Pantograph:

- Check the tightness of Pneumatic Connections.
- Secure the Pantograph in lowered position and pressurize it.
- Apply the Air Leak Detection Spray [B04] on the Pneumatic Connections.
- Check Raising and Lowering of Pantograph according to section 8.6.6.
- Measure the Contact Force, according to section 8.6.5.
- In case of difference in values re-calibrate the Pantograph.
- Verify the horizontal position of Collector Head, according to section 8.6.8.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.8.2 REMOVAL AND INSTALLATION OF PCU FROM VEHICLE

NOTE: Dismounting and mounting of Pneumatic Control Unit (PCU) from vehicle for Overhaul to replace of the whole PCU or selected parts at workshop.

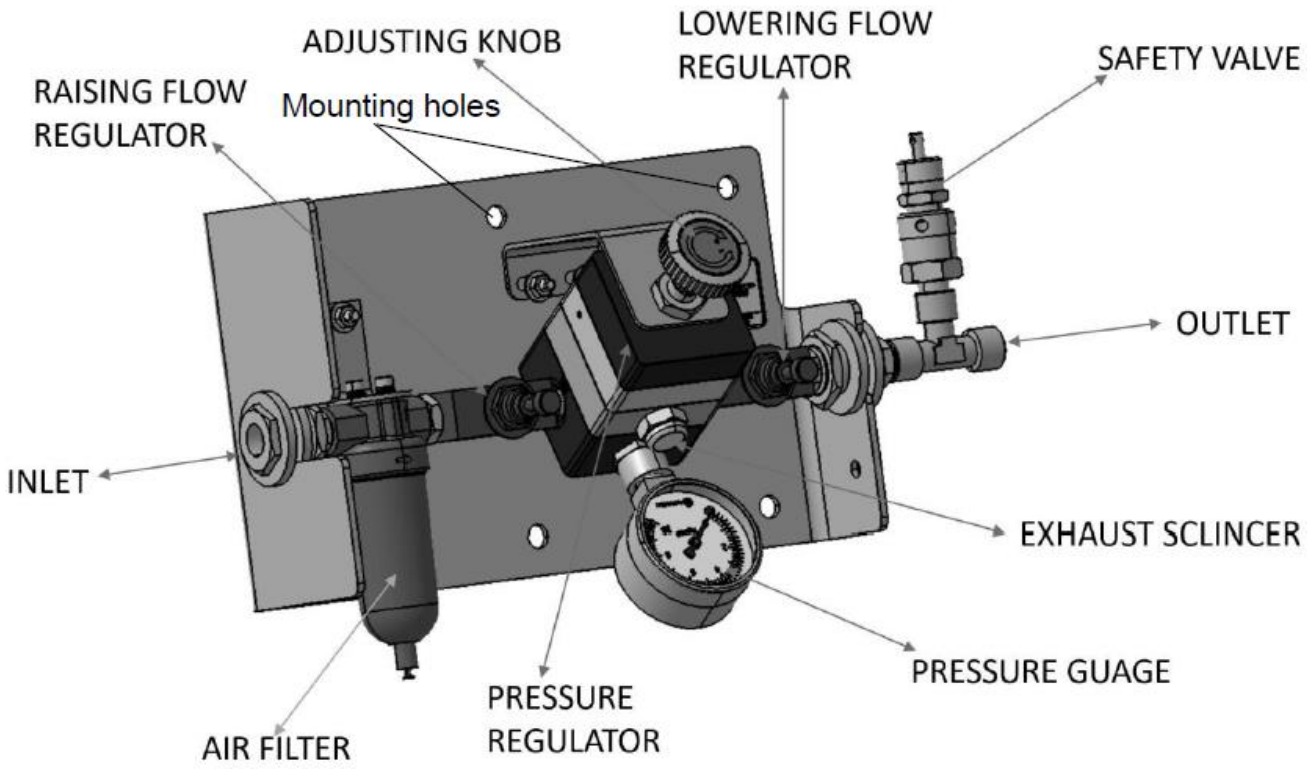


Figure 51 – Removal and Installation of Pneumatic Control Unit (PCU)

Location	Item No	Description	Part Number / Set Number	Qty
M35	**Pneumatic control unit**		**FT0052511-101****	-
	1	Pneumatic control unit	FT0052511-101**	1

** Tentative Part number

For item numbers mentioned below in bracket, refer to Figure 51.

Follow the instructions as mentioned below for removal of the Pneumatic PCU from vehicle:

- Disconnect Air Inlet and Air Outlet
- Unscrew the Screws from Mounting Holes, which is used to fasten the PCU (1) to the Vehicle.

Follow the instructions as mentioned below for installation of the Pneumatic PCU to vehicle:

- For installation prepare FT0052511-101** [M35], refer to List of materials Section 7.3.
- Install the new or repaired PCU (1) to the vehicle with Screws through Mounting holes and connect the Air Inlet and Air Outlet.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9 OVERHAUL MAINTENANCE

WARNING!

- For this task, requires special training, Tools, Fixtures and Custom Kits.
- On this Pantograph alone, the Overhaul Maintenance is conducted in following two stages:
  a. Intermediate Overhaul (IOH) Maintenance
  b. Periodic Overhaul (POH) Maintenance
- For disassembly a practical lifting device must be available. Use soft spans, textile belts or similar belts to raising and placing to avoid damages to the Pantograph. Textile belt is to be put on within the range of the gravity centre.

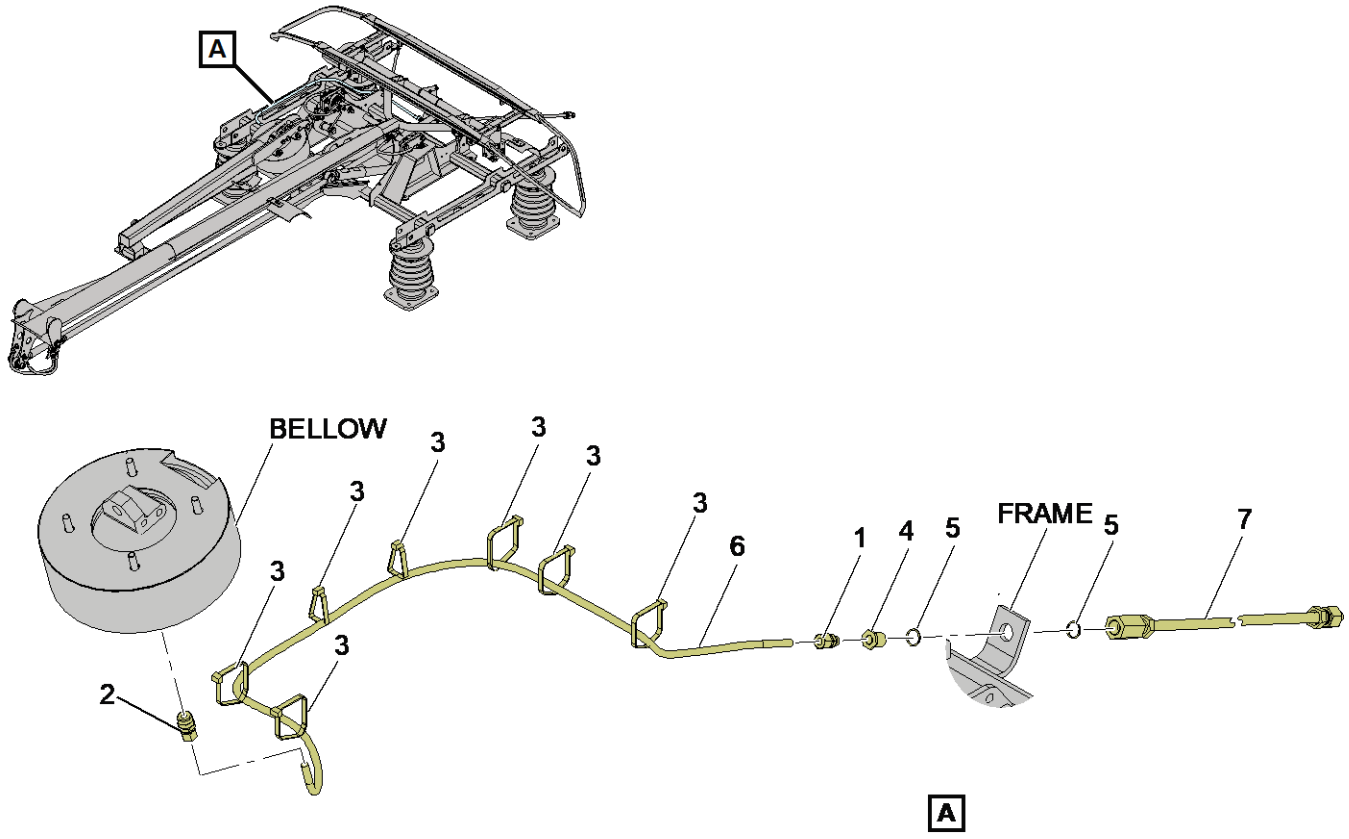
8.9.1 INTERMEDIATE OVERHAUL (IOH)

WARNING!

- The Pantograph should be removed from the Locomotive to perform Intermediate Overhaul (IOH) Maintenance, as per section 8.9.1.
- The Intermediate Overhaul (IOH) Maintenance is performed at the Customer end shed or Workshop.
- During Intermediate Overhaul (IOH) Maintenance all the Must Change components must be replaced, as per Section 8.4.
- The Intermediate Overhaul (IOH) Maintenance should be carried out along with TI, IA, IB and IC Maintenance.
- Inspect the other components as per Sections 8.6, if required remove and replace.
- Perform necessary adjustments and tests for better functioning of the system, as per Section 8.6.
- The Intermediate Overhaul (IOH) Maintenance Must change components must be procured from Wabtec / Faiveley Transport.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.1.1 REPLACEMENT OF AIR PIPES



Note: Insulators are shown for illustration purpose.

Figure 52 – Replacement of Air Pipes

Location	Item No	Description	Part Number / Set Number	Qty
M34	**Air Pipes**		**E043642-SET25**	1
	1	Male Stud Coupling	5314112-000	1
	2	Male Stud Coupling	5314114-000	1
	3	Collar	4731153-001	9
	4	CROSSING BULKHEAD 1/4 F GZ"	5315602-001	1
	5	DIA 20 FLAT SEAL	TESNENI/15 4407	2
	6	Tube (RILSAN) - TRUBKA 10x8/1	FT0052511-014	2M
Not part of set	7	Insulated hose assembly	E043116-SET24	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 52.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

Follow the instructions as mentioned below for removal of the Air Pipes:

- Cut and remove nine collars (3), which secures Rilsan Tube (6) to Frame.
- Pull out and remove Rilsan Tube (6) one end is connected to male stud coupling (1) and other end is connected to male stud coupling (2).
- Separate Rilsan Tube (6) from Pantograph.
- Unscrew and remove male stud coupling (1) from Crossing Bulkhead (4).
- Unscrew and remove male stud coupling (2) from Pneumatic Balancing System.
- Unscrew and remove Crossing Bulkhead (4) from Frame.
- Separate two Flat Seal (5) and Air Pipe (7) from frame.

Follow the instructions as mentioned below for installing the Air Pipes:

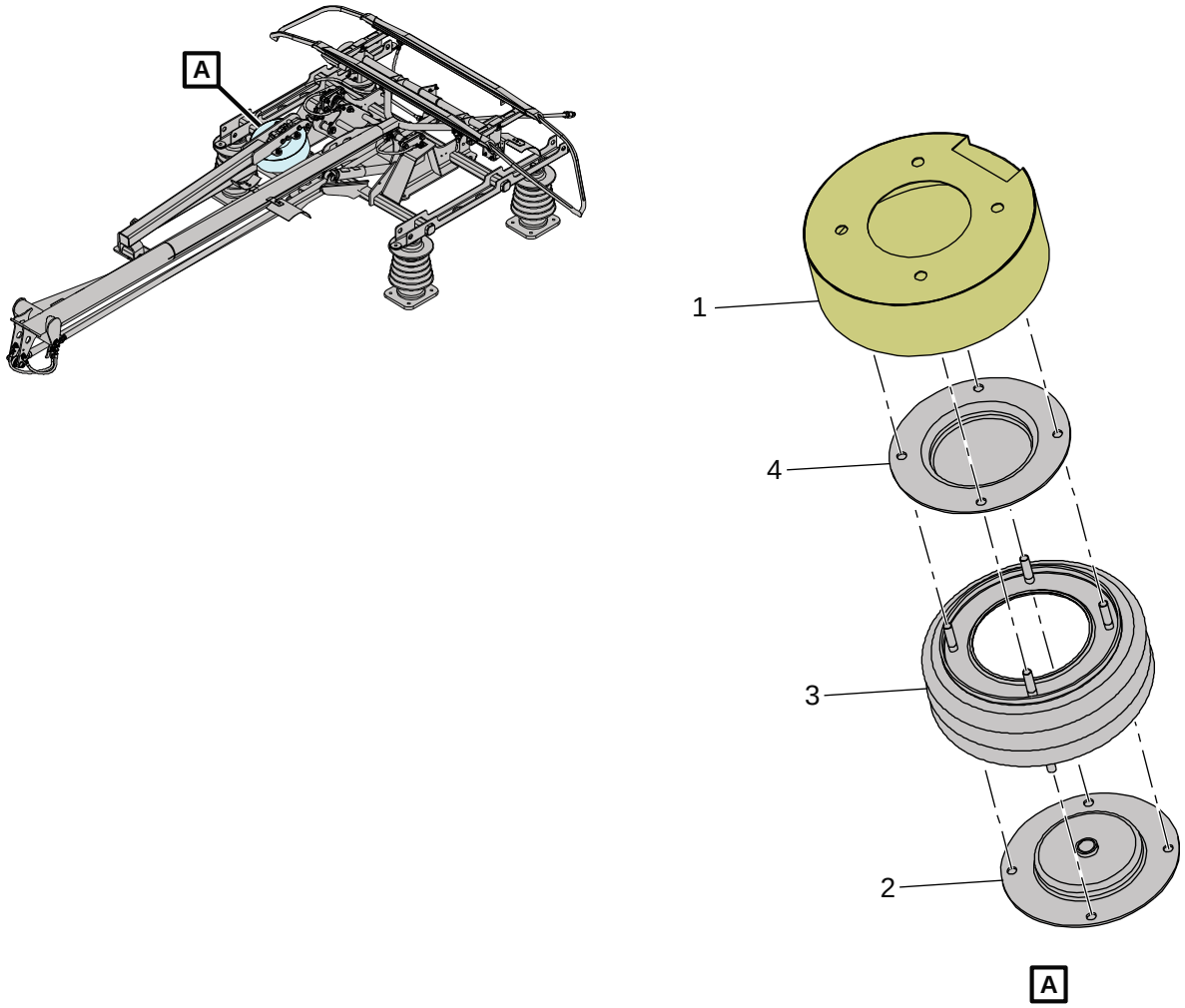
- For installation prepare E043642-SET25 [M34], refer to List of materials Section 7.3.
- Install Crossing Bulkhead (4) and Flat Seal (5) to Frame.
- Tighten Crossing Bulkhead (4) to a torque of 20 Nm.
- Install Flat Seal (5) and Air Pipe (7) to Frame.
- Install male stud coupling (1) to Crossing Bulkhead (4).
- Install male stud coupling (2) to Pneumatic Balancing System.
- Tighten the male stud coupling (1) and (2).
- Guide the Rilsan Tube (6) to Frame to its position.
- Insert one end of Rilsan Tube (6) to male stud coupling (1) and other end to male stud coupling (2).
- Secure Rilsan Tube (6) to Frame using nine collars (3).

Follow the instructions as mentioned below for checking the Air Pipes:

- Check the tightness of Pneumatic Connections.
    - Secure the Pantograph in lowered position.
    - Pressurize the Pantograph at 3.8bar.
    - Apply the Air-leak Detection Spray [B04] to Pneumatic Connections, which were dismounted during replacement.
- Verify pneumatic connection do no obstruct Raising and Lowering of Pantograph.
- Verify the Raising and Lowering times, according to Section 8.6.6.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.1.2 REPLACEMENT OF BELLOW COVER



Note: Insulators are shown for illustration purpose.

Figure 53 – Replacement of Bellow Cover

Location	Item No	Description	Part Number	Qty
M30	**Bellow Cover**		**XE042962-0002**	-
	1	Bellow Cover	XE042962-0002	1
Not part of set	2	Plate with Air inlet	FT0077457-101-D	1
	3	Bellow Assy	YE039985-0001	1
	4	Hanging Plate	FT0077253-001-D	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 53

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

Follow the instructions as mentioned below for removal of the Bellow Cover:

- Remove the Bellows, according to Section 8.9.1.3.
- Remove the Air Inlet (2) from Pneumatic Balancing.
- Remove Bellow Assembly (3) and Hanging Plate (4) and Separate Upper Cover (1).

Follow the instructions as mentioned below for installing the Bellow Cover:

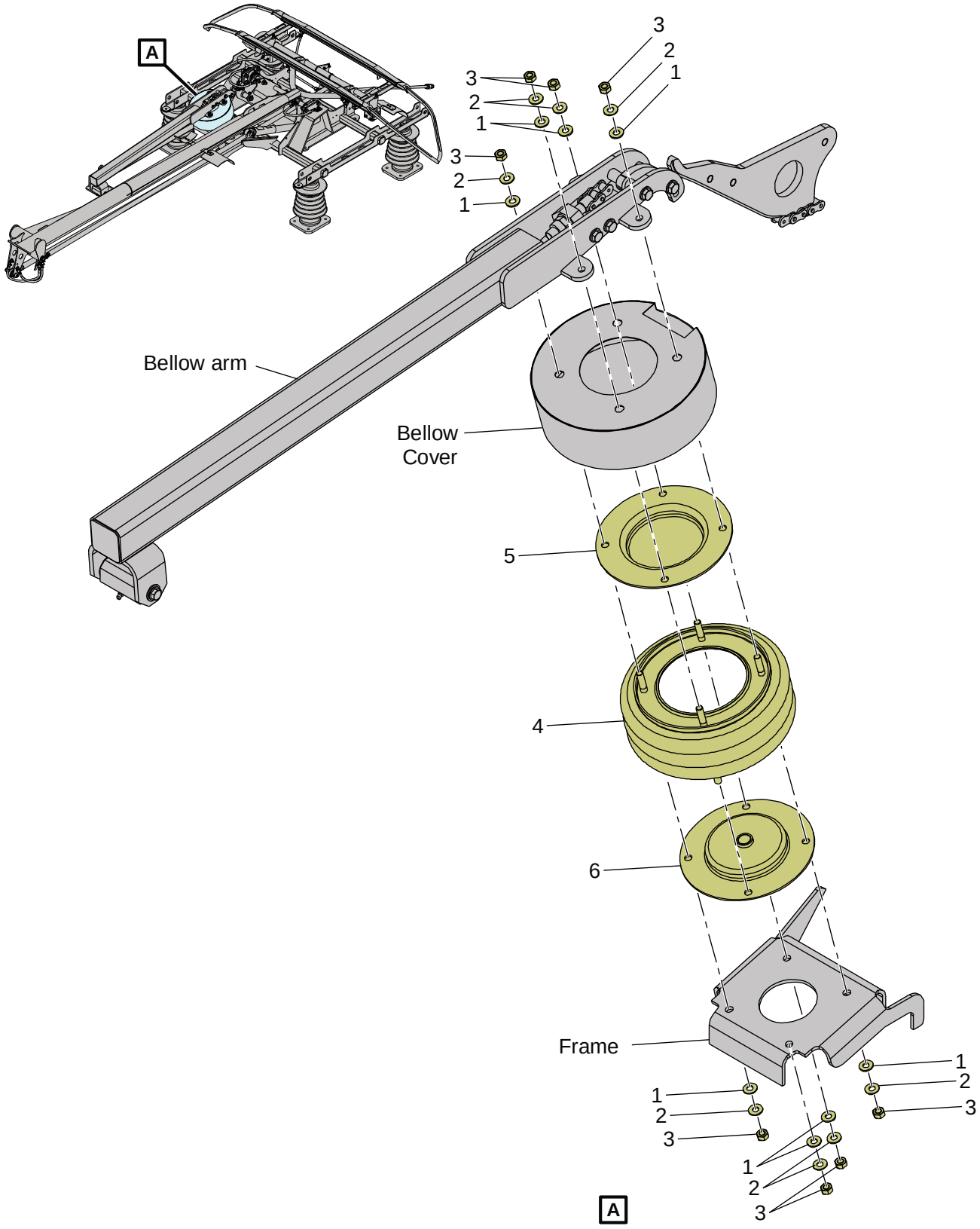
- For installation prepare XE042962-0002 [M30], refer to List of materials Section 7.3.
- Place the Hanging Plate (2), Bellow Assembly (3) and Air Inlet (4) to Upper Cover (1).
- Secure Bellows, according to Section 8.9.1.3.

Follow the instructions as mentioned below for checking the Bellow Cover:

- Check the tightness of the Pneumatic Connections.
    - Secure the Pantograph in lowered position.
    - Pressurize the Pantograph at 3.8bar.
    - Apply the Air-leak Detection Spray [B04] to Pneumatic Connections, which were dismounted during replacement.
- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.1.3 REPLACEMENT OF BELLOWS



Note: Insulators are shown for illustration purpose.

Figure 54 – Replacement of Bellows

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Location	Item No	Description	Part Number / Set Number	Qty
M28	**Bellows**		**E043642-SET21**	1
	1	Washer	3221000-082	8
	2	CS Washer	3361000-082	8
	3	Hex Nut	2501000-082	8
	4	Bellow Assembly	YE039985-0001	1
	5	Hanging Plate	FT0077253-001-D	1
	6	Plate with Air inlet	FT0077457-101-D	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 54

Follow the instructions as mentioned below for removal of the Bellows:

- Remove the Pneumatic connections from bellows, according to Section 8.9.1.1.
- Remove eight Nuts (3), eight Washers (2) and (1) from both upper and bottom side of Pneumatic Balancing.
- Remove Bellow Assembly (4) with hanging plate (5) and Air Inlet (6) from Bellows Arm.
- Remove the Upper Cover and separate the Bellow Assembly (4), hanging plate (5) and Air Inlet (6).

Follow the instructions as mentioned below for installation of the Bellows:

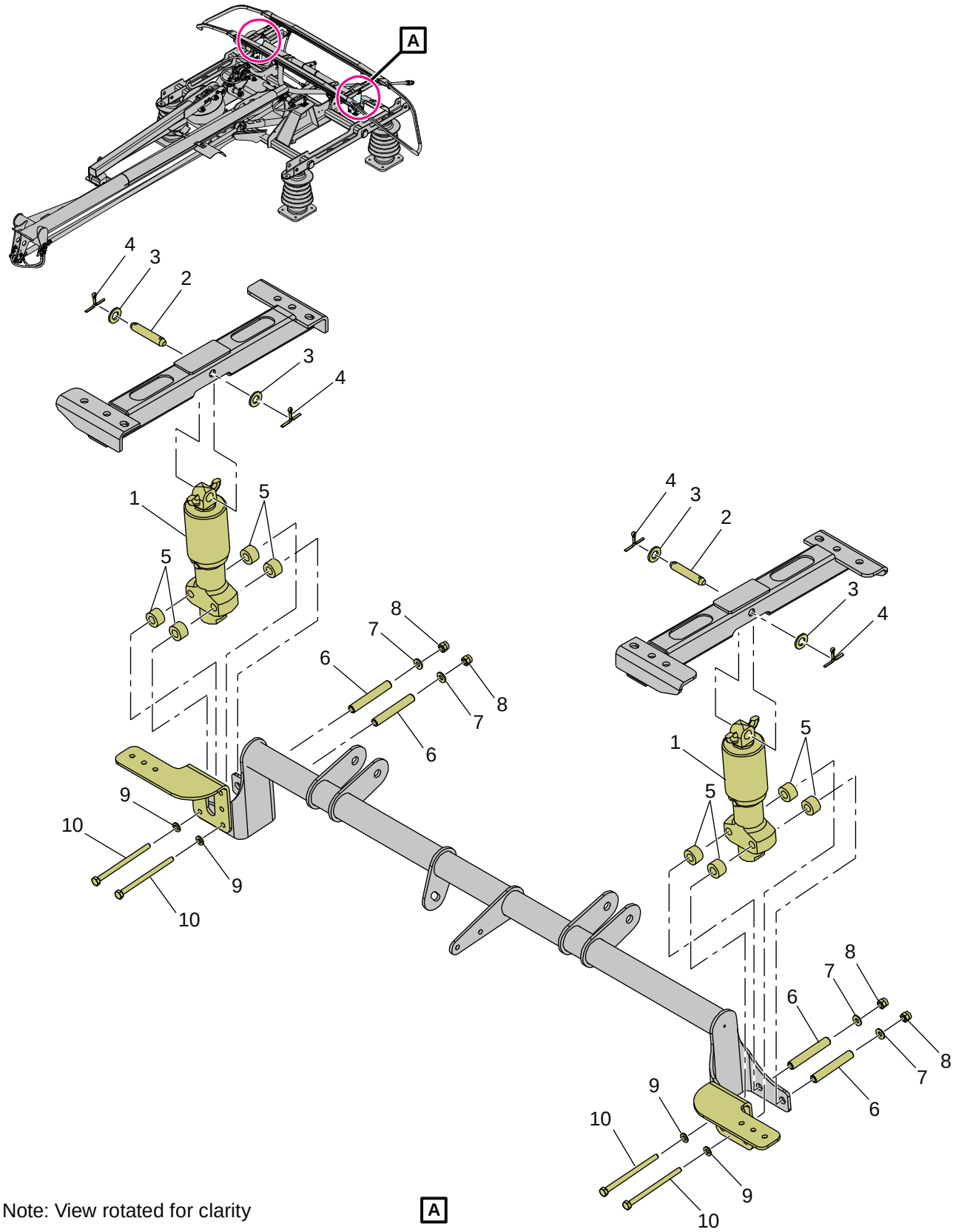
- For installation prepare E043642-SET21 [M28], refer to List of materials Section 7.3.
- Lubricate Bellow Assembly (4) and mating surfaces of hanging plate (5) and Air Inlet (6) with "Chain and Rope Lube Spray" [B03].
- Place the Bellow Assembly (4), hanging plate (5) and Air Inlet (6) to Upper Cover.
- Install Upper Cover with Bellow Assembly (4), hanging plate (5) and Air Inlet (6) to Frame
- Secure bottom side of the Pneumatic Balancing to Frame using four Washers (1), four CS Washers (2) and Nuts (3).
- Secure the upper side of the Pneumatic Balancing to bellows arm with four Nuts (3), four CS Washers (2) and four Washers (1).
- Tighten the Nuts (3) to a torque of 20 Nm.
- Install the Pneumatic connections to bellows, according to Section 8.9.1.1.

Follow the instructions as mentioned below for checking the Bellows:

- Check the tightness of the Pneumatic Connections.
  - Secure the Pantograph in lowered position.
  - Pressurize the Pantograph at 3.8bar.
  - Apply the Air-leak Detection Spray [B04] to Pneumatic Connections, which were dismounted during replacement.
- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.1.4 REPLACEMENT OF SUSPENSION



Note: View rotated for clarity A

Note: Insulators are shown for illustration purpose.

Figure 55 – Replacement of Suspension

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Location	Item No	Description	Part Number / Set Number	Qty
M24	**Suspension**		**E043642-SET16**	**2**
	1	Spring Box Mounted	E043130-0101	1
	2	Axle	E042357-0001	1
	3	Plain Washer	FT0030004-004	2
	4	Split Pin	3113222-000	2
	5	Spacer	E043134-0001	4
	6	Centering	E043307-0001	2
	7	CS Washer	FT0030004-016	2
	8	Prevailing Torque Hexagon Nut	FT0030002-023	2
	9	Plain Washer	FT0030004-001	2
	10	Hex. Screw M6x20	FT0030006-063	2

NOTE: Pantograph is equipped with two Suspension, one on each side of Swaying Shaft. Replacement of one Suspension is described, but both Suspension are mounted similarly.

NOTE: For item numbers mentioned below in bracket, refer to Figure 55.

Follow the instructions as mentioned below for removal of the Suspension:

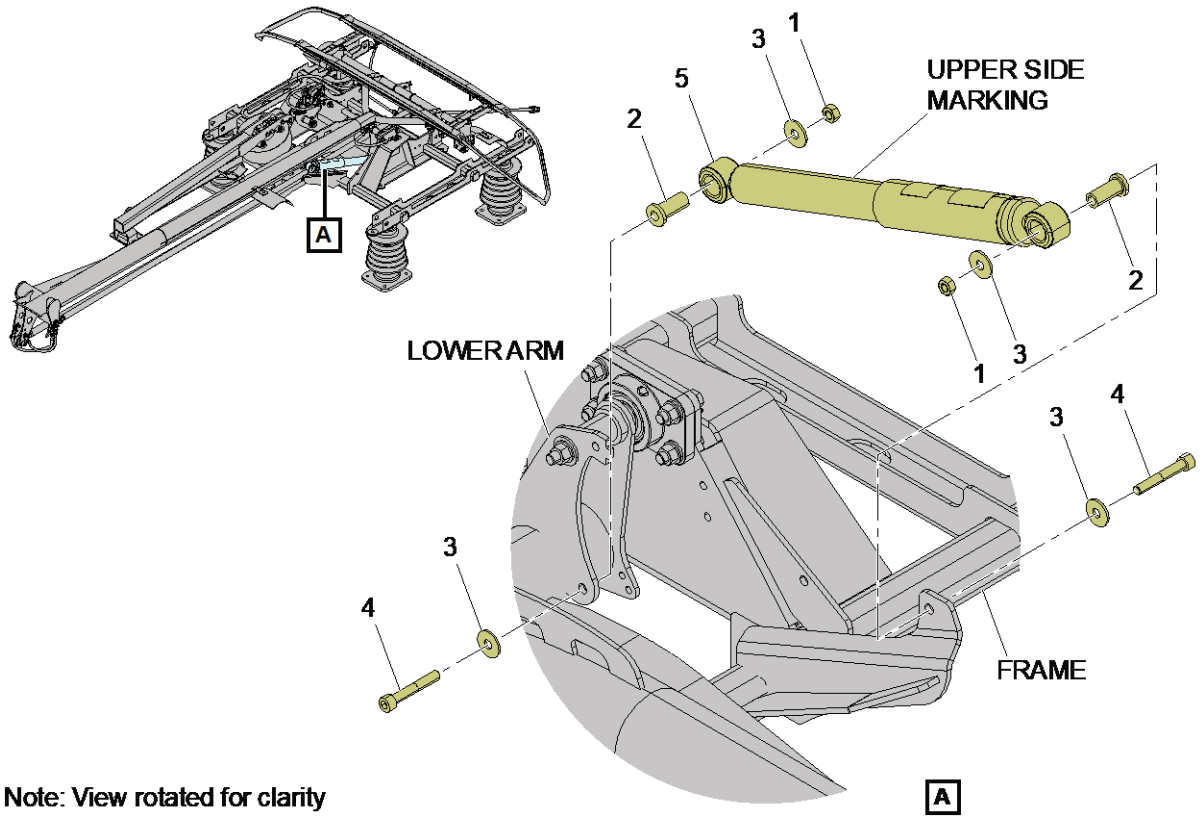
- Lower the Pantograph and secure it.
- Straighten legs of Split Pin (4) and remove with Washer (3) on both locations.
- Remove the Axle (2).
- Remove two Nuts (8), two CS Washers (7) and two Screws (10) with two Washers (9).
- Pull-out the Centering (6) and remove the two Brackets.
- Remove the Suspension Unit (1) and four Spacers (5) from Swaying Shaft.

Follow the instructions as mentioned below for installation of the Suspension:

- For installation prepare E043642-SET16 [M24], refer to List of materials Section 7.3.
- Install the Suspension Unit (1) along with four Spacers (5) to Swaying Shaft.
- Install two Brackets and Insert the Centering (6) on both ends.
- Install two Screws (10) with two Washers (9), two CS Washers (7) and two Nuts (8).
- Tighten the Nuts (8) to a torque of 10.4 Nm.
- Lubricate the axle (2) with Grease [B01].
- Insert the Washer (3) with Axle (2) on both sides of Suspension.
- Insert the Split Pin (4) and bend the legs of Split Pin (4) on both suspensions.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.1.5 REPLACEMENT OF DAMPER ASSEMBLY



Note: Insulators are shown for illustration purpose.

Figure 56 – Replacement of Damper Assembly

Location	Item No	Description	Part Number / Set Number	Qty
M33	**Damper Assembly**		**FT0072490-111**	1
	1	PREVAILING TORQUE HEX NUT M10	FT0042411-005	2
	2	BAGUE PLATE	YE040297-0001	2
	3	Plain Washer	FT0030004-014	4
	4	HSHC Screw	1801065-082	2
	5	Damper	VE042801-0101	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 56.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Damper Assembly:

- Lower the Pantograph and secure it.
- Remove the two Nuts (1) with Washers (3) from both ends of Damper (5).
- Remove the two Screws (4) with two Washers (3) and remove the Damper (5)
- Push out bague plate (2) from Damper (5).

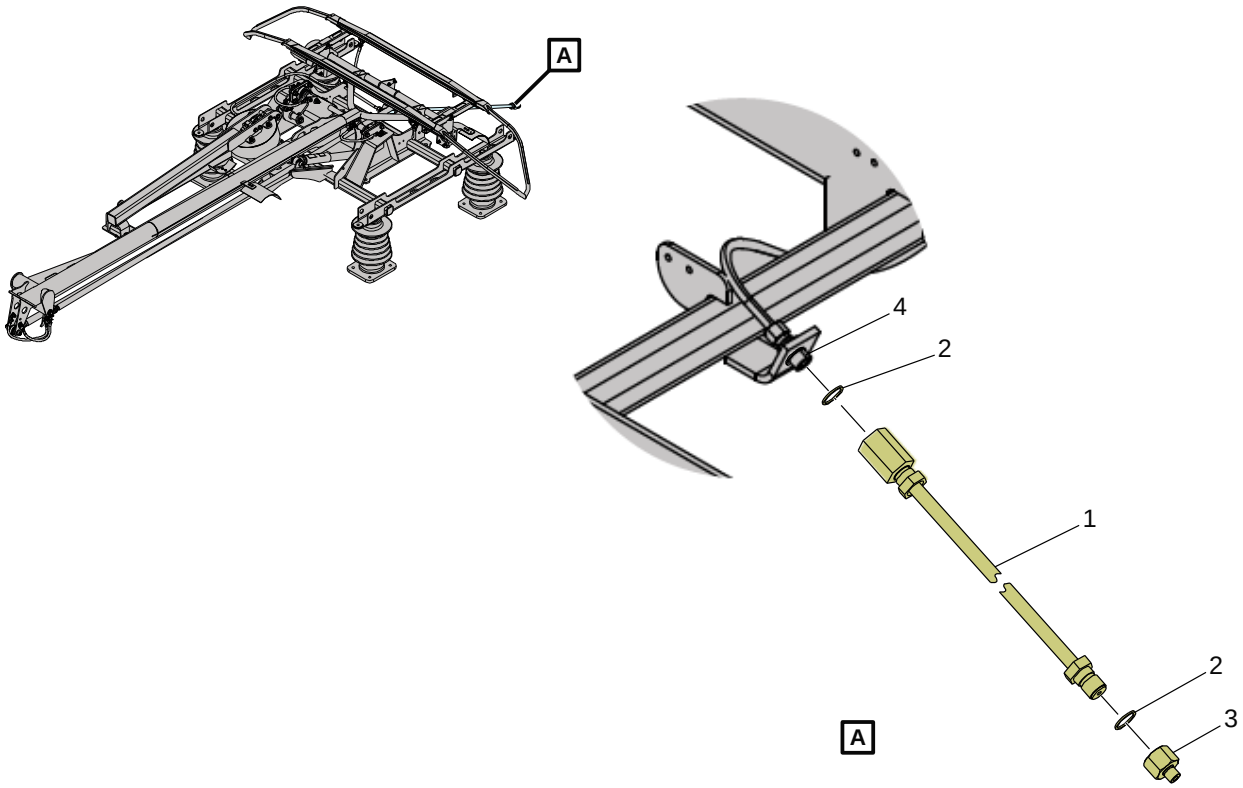
Follow the instructions as mentioned below for installation of the Damper Assembly:

NOTE: Direction of Damper must be according to Figure 56 and sign (Coloured spot or plastic sign) has to be visible from the upper side.

- For installation prepare FT0072490-111 [M33], refer to List of materials Section 7.3.
- Before installation, lubricate both joints of the Damper with Grease [B01].
- Insert and press bague plate (2) into the Damper (5).
- Install the Damper (5) to its right position, in accordance to Figure 56 and attach to Lower Arm and Frame, using two Screws (4) with two Washers (3).
- Install two Washers (3), and two Nuts (1).
- Tighten Nuts (1) to a torque of 40 Nm.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.1.6 REPLACEMENT OF INSULATED HOSE ASSEMBLY



Note: Insulators are shown for illustration purpose.

Figure 57 – Replacement of insulated hose assembly

Location	Item No	Description	Part Number / Set Number	Qty
M06	**Insulated Hose Assembly**		**E043116-SET24**	1
	1	Pipe Assembly	FT0076779-103	1
	2	Teflon Washer	FT0054419-000	2
	3	Fitting	FT0076779-013	1
Not part of set	4	Crossing Bulkhead	5315602-001	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 57.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Insulated Hose Assembly:

- Remove one end of Pipe Assembly (1) which is connected to Crossing Bulkhead (4), using adjustable wrench.
- Remove teflon washer (2) from Pipe Assembly (1).
- Remove Fitting (3) which is connected to Pipe Assembly (1), using adjustable wrench.
- Remove teflon washer (2) from Fitting (3).

Follow the instructions as mentioned below for installation of the Insulated Hose Assembly:

- For installation prepare E043116-SET24 [M06], refer to List of materials Section 7.3.
- Install teflon washer (2) to Fitting (3).
- Install Fitting (3) along with teflon washer (2) to Pipe Assembly (1) using adjustable wrench.
- Tighten the Fitting (3).
- Install teflon washers (2) to Pipe Assembly (1).
- Install one end of Pipe Assembly (1) to Crossing Bulkhead (4), using adjustable wrench.
- Tighten the Pipe Assembly (1).

Follow the instructions as mentioned below for checking the Insulated Hose Assembly:

- Check the tightness of Pneumatic Connections.
    - Secure the Pantograph in lowered position.
    - Pressurize the Pantograph at 3.8bar.
    - Apply the Air-leak Detection Spray [B04] to Pneumatic Connections, which were dismounted during replacement.
- Verify the Raising and Lowering times, according to Section 8.6.6

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.1.7 REPLACEMENT OF PRESSURE REGULATOR

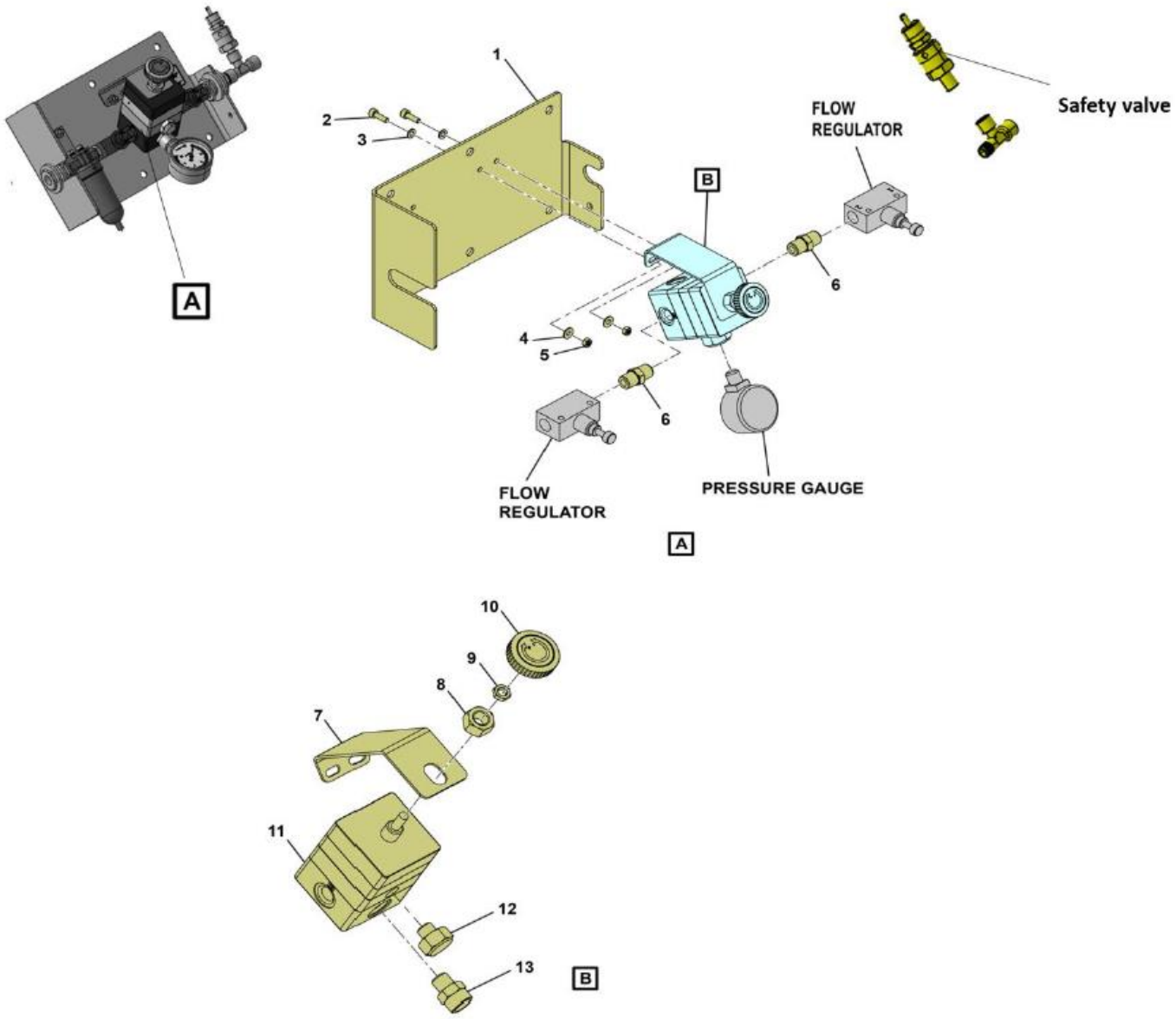


Figure 58 – Replacement of Pressure Regulator

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Location	Item No	Description	Part Number / Set Number	Qty
M38	**Pressure Regulator**		**FT0053911-036**	1
Not part of set	1	BASE PLATE	-	1
	2	BOLT M5 X 16 LONG		2
	3	PLAIN WASHER M5	FT0053911-041	2
	4	CONTACT WASHER	FT0053911-042	2
	5	HEX NUT M5	FT0053911-044	2
	6	NIPPLE R1/4"	-	2
	7	BRACKET REGULATOR	-	1
	8	HEX NUT	-	1
	9	NUT	-	1
	10	KNOB	-	1
M38	11	PRESSURE REGULATOR G1/4"	FT0053911-036	1
	12	Part of PRESSURE REGULATOR	-	-
Not part of set	13	CONNECTOR REDUCER	FT0053911-050	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 58.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Pneumatic Control Unit Pressure Regulator:

- Remove the Pneumatic Control Unit (PCU) from vehicle, according to Section 8.8.2.
- Unplug Connectors, if necessary.
- Unscrew nuts (5) and remove screws (2) with washers (4 and 3) that fix the pneumatic components to the Base Plate (1).
- Release the Nuts on crossing Bulkheads and remove the assembly of Pneumatic components from the Base Plate (1).
- Release the Nipple (6) and unscrew from Pressure Regulator (11).
- Remove the Pressure Gauge accordingly.
- Unscrew the Pipe Plug (12 and 13).
- Remove the Turn Knob (10) from Pressure Regulator Body (11).
- Unscrew both Nuts (8 and 9) from Pressure Regulator (11).
- Remove the Regulator Support (7).

Follow the instructions as mentioned below for installation of the Pneumatic Control Unit Pressure Regulator:

- For installation prepare FT0053911-036 [M38], refer to List of materials Section 7.3.
- Tighten the Pipe Plug (12 and 13) to a torque of 10 Nm.
- Install the Regulator Support (7) on Pressure Regulator (11).
- Assemble the Regulator Components (8), (9) and (10) according to Figure 58.
- Install the Pressure Gauge accordingly
- Tighten the Nipple (6) between the Pneumatic Components to torque of 20 Nm.
- Install the assembly of Pneumatic Components to Base Plate (1).
- Tighten the Nuts on crossing Bulkheads to a torque of 30 Nm.
- Install screws (2) with washers (3).
- Fix the assembly to Base Plate by tightening nuts (5) with washers (4).
- Tighten the nuts (9) to a torque of 5 Nm.
- Install the PCU back to vehicle, according to Section 8.8.2.

Follow the instructions as mentioned below for checking the Pneumatic Control Unit Pressure Regulator:

- Check the tightness of Pneumatic Connections.
  - Secure the Pantograph in lowered position.
  - Pressurize the Pantograph at 3.8bar.
  - Apply the Air-leak Detection Spray [B04] on the Pneumatic Connections, which were mounted.
- Using soap solution or any other form of solution on the bleed port, breather/exhaust port, quick exhaust pilot vent, and safety valve in the PCU is not permitted. This method could cause a malfunction of the pressure regulator. However, it is applicable for checking leakages only on the PCU joints.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.1.8 REPLACEMENT OF FLOW REGULATOR

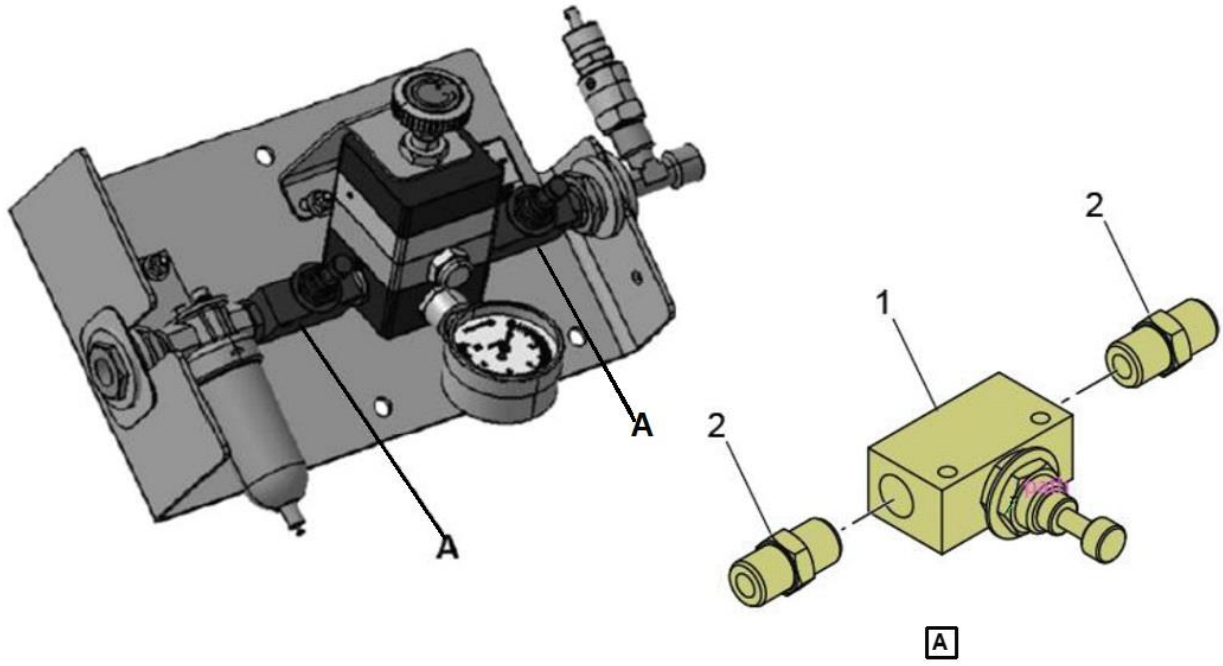


Figure 59 – Replacement of Flow Regulator

Location	Item No	Description	Part Number / Set Number	Qty
M40	**Flow Regulator**		**FT0053911-037**	2
	1	Flow Regulator	FT0053911-037	2
Not part of set	2	Nipple R1/4"	FT0053911-039	4

NOTE: For item numbers mentioned below in bracket, refer to Figure 59.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Pneumatic Control Unit Flow Regulator:

- Remove the Pneumatic Control Unit (PCU) from vehicle, according to Section 8.8.2.
- Unplug Connectors, if necessary.
- Remove Pressure Regulator along with Pressure Gauge according to section 8.9.1.7.
- Release the Nipple (2) from both side of flow regulator (1).

Follow the instructions as mentioned below for installation of the Pneumatic Control Unit Flow Regulator:

- For installation prepare FT0053911-037 [M40], refer to List of materials Section 7.3.
- Install one end of flow regulator (1) to Nipple (2).
- Install another Nipple (2) to other end of flow regulator (1).
- Tighten the Nipple (2) between the Pneumatic Components to torque of 20 Nm.
- Install Pressure Regulator along with Pressure Gauge according to section 8.9.1.7.
- Install Connectors, if unplugged.
- Install the PCU back to vehicle, according to Section 8.8.2.

Follow the instructions as mentioned below for checking the Pneumatic Control Unit Flow Regulator:

- Check the tightness of Pneumatic Connections.
  - Secure the Pantograph in lowered position.
  - Pressurize the Pantograph at 3.8bar.
  - Apply the Air-leak Detection Spray [B04] on the Pneumatic Connections, which were mounted.
- Using soap solution or any other form of solution on the bleed port, breather/exhaust port, quick exhaust pilot vent, and safety valve in the PCU is not permitted. This method could cause a malfunction of the pressure regulator. However, it is applicable for checking leakages only on the PCU joints.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.1.9 REPLACEMENT OF AIR FILTER

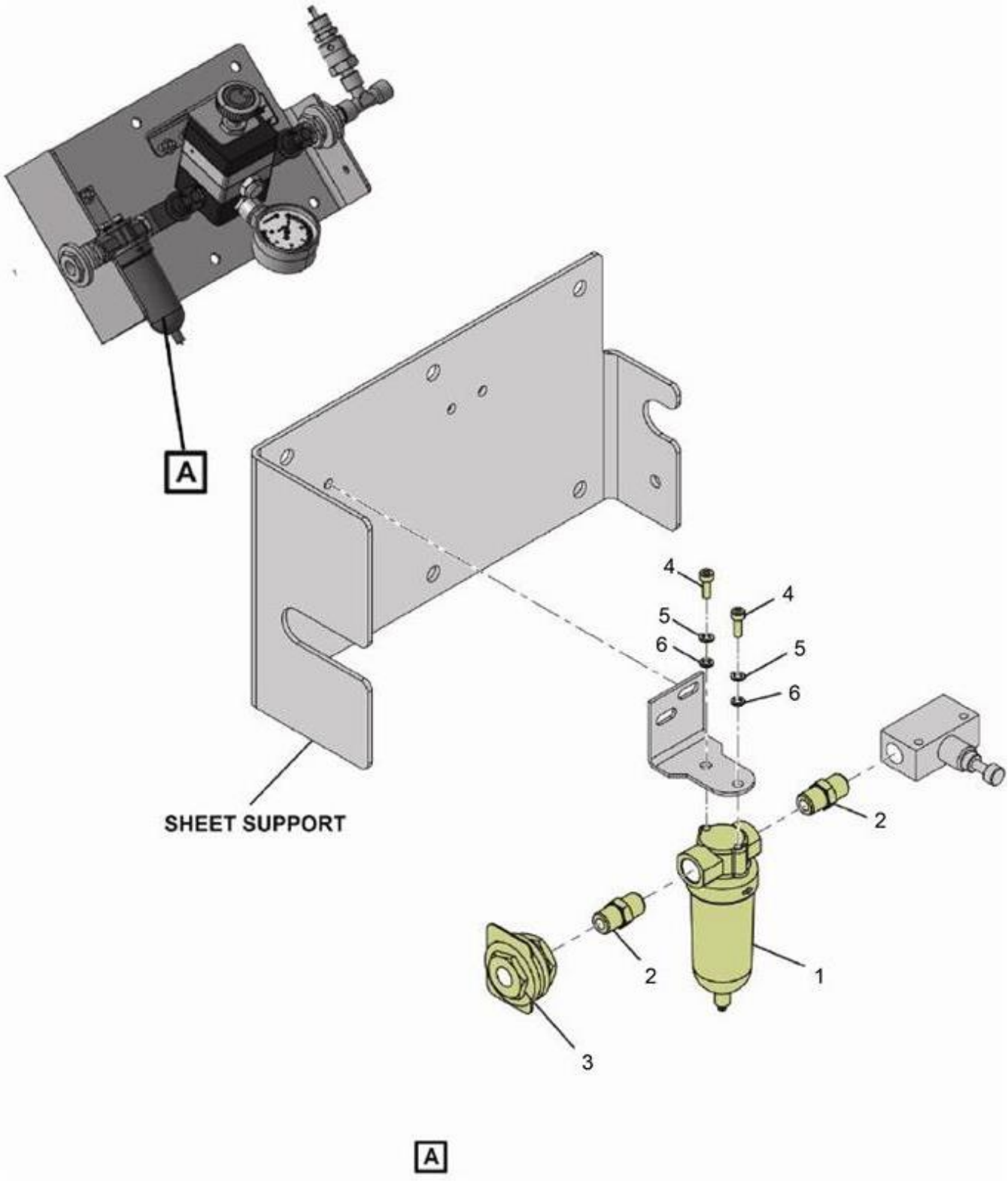


Figure 60 – Replacement of Air Filter

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Location	Item No	Description	Part Number / Set Number	Qty
M36	**1**	**Air filter**	**FT0053911-035**	1
Not part of set	2	NIPPLE	FT0053911-039	1
	3	BULKHEAD G1/4"	FT0053911-038	2
	4	BOLT M4 X 16 LONG	FT0053911-047	2
	5	SPRING WASHER M4	FT0053911-046	2
	6	PLAIN WASHER M4	FT0053911-045	2

NOTE: For item numbers mentioned below in bracket, refer to Figure 60.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

Follow the instructions as mentioned below for removal of the PCU Air Filter:

- Remove the Pneumatic Control Unit (PCU) from Vehicle, according to Section 8.8.2.
- Unplug the connectors, if necessary.
- Unscrew the two plain bolts (4) along with two plain washer (6) and spring washer (5).
- Release the Nuts on crossing Bulkheads (3) and remove the assembly of pneumatic components from the sheet support.
- Release and unscrew the nipple (2) and Unscrew from Air Filter (1).
- Release and unscrew the nipple (2) from Air Filter (1).

Follow the instructions as mentioned below for installing the PCU Air Filter:

- For installation prepare FT0053911-035 [M36], refer to List of materials Section 7.3.
- Tighten the nipple (2) between Air Filter (1) and assembled components to a torque of 25 Nm.
- Tighten the previously dismounted assembly of nipple (2) with Tube and crossing Bulkhead (3) to a torque of 20 Nm.
- Tighten the two plain bolts (4) along with two plain washer (6) and spring washer (5).
- Plug in the previously disconnected Connectors.
- Install the Pneumatic Control Unit (PCU) back to vehicle, according to Section 8.8.2.

Follow the instructions as mentioned below for checking the PCU Air filter:

- Check the tightness of Pneumatic Connections.
  - Secure the Pantograph in lowered position.
  - Pressurize the Pantograph at 3.8bar.
  - Apply the Air-leak Detection Spray [B04] on the Pneumatic Connections which were mounted.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

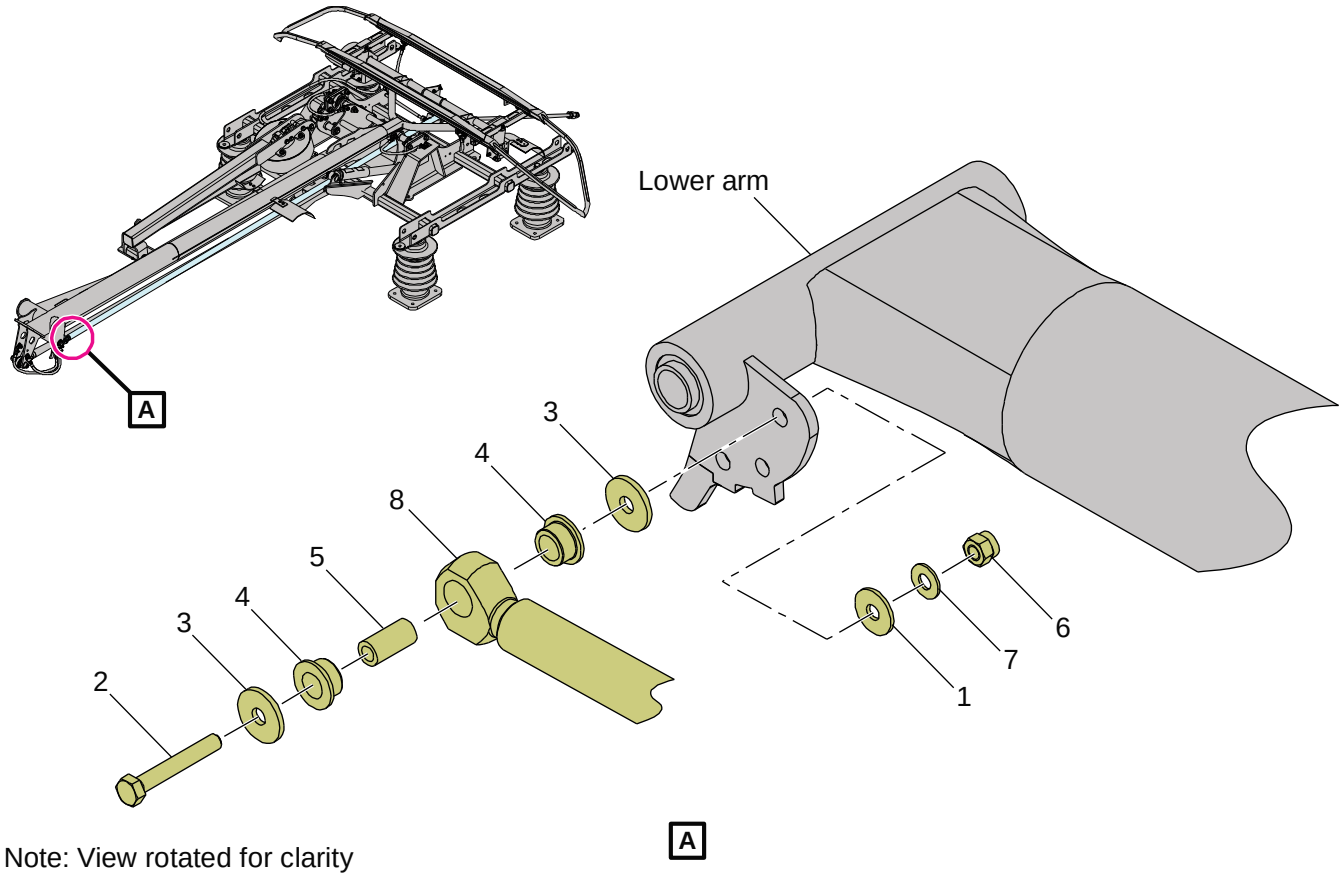
8.9.2 PERIODIC OVERHAUL (POH)

WARNING!

- The Pantograph should be removed from the Locomotive to perform Periodic Overhaul (POH) Maintenance, as per Section 8.9.2.
- During Periodic Overhaul (POH) Maintenance, all the Must Change components also must be replaced, as per Section 8.4.
- The Periodic Overhaul (POH) Maintenance should be carried out along with TI, IA, IB and IC Maintenances.
- Inspect the other components as per section 8.6, if required remove and replace.
- Perform necessary adjustments and tests for better functioning of the system as per Section 8.6.
- The Periodic Overhaul (POH) Maintenance Must change components must be procured from the Faiveley Transport / Wabtec.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.2.1 REPLACEMENT OF UPPER ROD / LOWER ARM JOINT



Note: View rotated for clarity

Note: Insulators are shown for illustration purpose.

Figure 61 – Replacement of Upper Rod / Lower Arm Joint

Location	Item No	Description	Part Number / Set Number	Qty
M17	**Upper Rod /Lower Arm Joint**		**E043642-SET12**	1
	1	Plain Washer	FT0030004-013	1
	2	Hex Screw	FT0030006-030	1
	3	Plain Washer	FT0030004-053	2
	4	Ring	YE040217-0001	2
	5	Spacer	YE040218-0001	1
	6	Hex Nut	2930803-082	1
	7	CS Washer	FT0030004-017	1
Not part of set	8	Upper Rod	XE043656-0101	-

NOTE: For item numbers mentioned below in bracket, refer to Figure 61.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Upper Rod / Lower Arm joint:

- Remove the Nut (6), Washers (1) and (7) from Upper Rod / Lower Arm Joint.
- Remove the Screw (2) with two Washers (3).
- Remove the Spacer (5).
- Push out the two Rings (4) from either side of upper rod (8).

Follow the instructions as mentioned below for installation of the Upper Rod / Lower Arm joint:

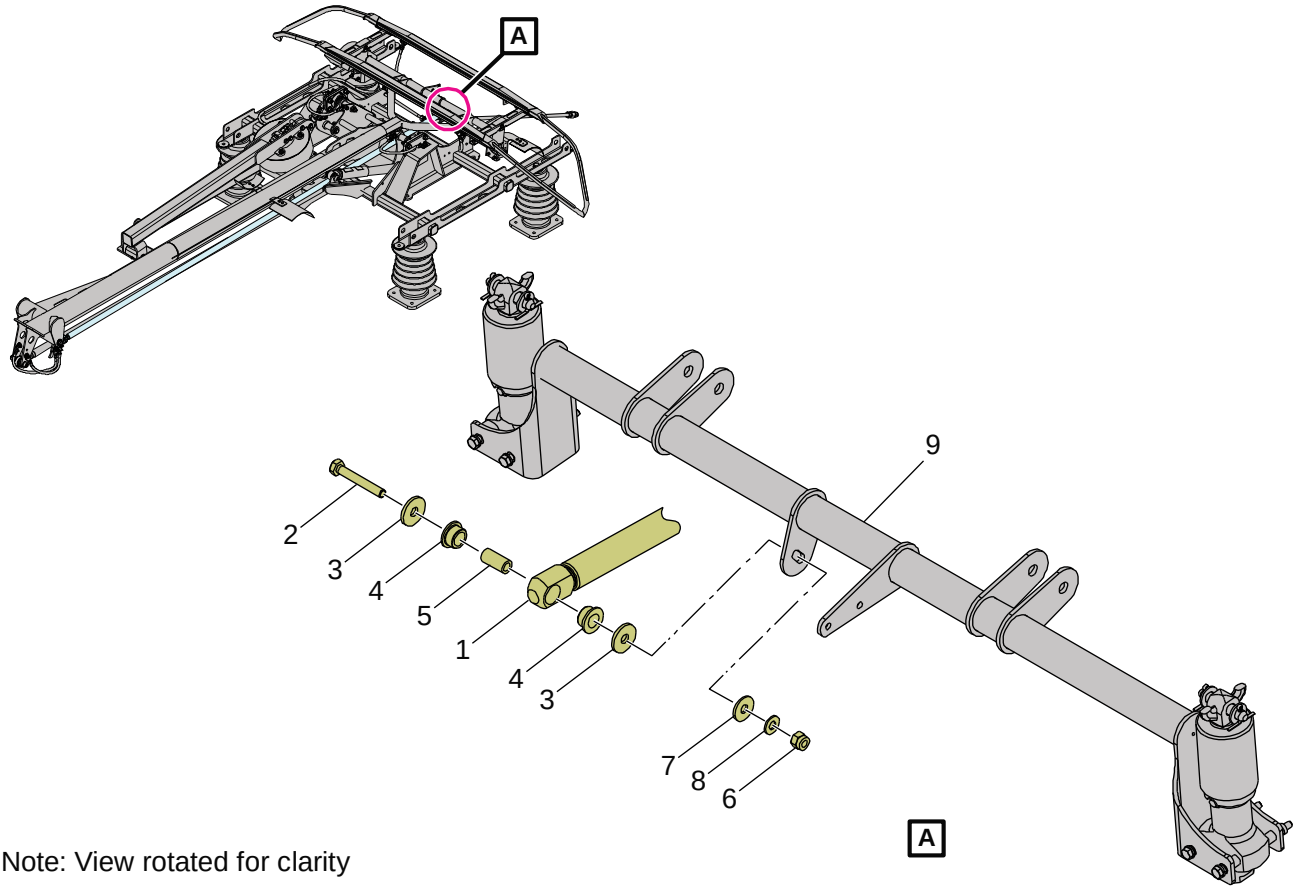
- For installation prepare E043642-SET12 [M17], refer to List of materials Section 7.3.
- Insert and press the two new Rings (4) to Upper Rod (8).
- Lubricate the Joints with Grease [B01].
- Insert the Spacer (5).
- Insert the Screw (2) and two washers (3) through Upper Rod and Lower Arm joint.
- Install the Washers (1) and (7) and tighten the Nut (6) to a torque of 24 Nm.

Follow the instructions as mentioned below for checking of Upper Rod / Lower Arm Joint:

- Check that Collector Head is in horizontal position, refer to Section 8.6.8.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.2.2 REPLACEMENT OF UPPER ROD / SWAYING SHAFT JOINT



Note: View rotated for clarity

Note: Insulators are shown for illustration purpose.

Figure 62 – Replacement of Upper Rod / Swaying Shaft Joint

Location	Item No	Description	Part Number / Set Number	Qty
M16	**Upper Rod Swaying Shaft Joint**		**E043642-SET11**	1
Not part of set	1	Upper Rod	XE043656-0101	-
M16	2	Hex Screw	FT0030006-030	1
	3	Plain Washer	FT0030004-053	2
	4	Ring	YE040217-0001	2
	5	Spacer	YE040218-0001	1
	6	Prevailing Torque Hex. Nut	2930803-082	1
	7	Plain Washer	FT0030004-013	1
	8	CS Washer	FT0030004-017	1
Not part of set	9	Swaying Shaft	E043125-0102	-

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: For item numbers mentioned below in bracket, refer to Figure 62.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Upper Rod / Swaying Shaft Joint:

- Remove the Nut (6), Washers (7) and (8) from Upper Rod / Swaying Shaft Joint.
- Remove the Screw (2) with two Washers (3).
- Remove the Spacer (5).
- Push out the two Rings (4) from upper rod (1).

Follow the instructions as mentioned below for installation of the Upper Rod / Swaying Shaft Joint:

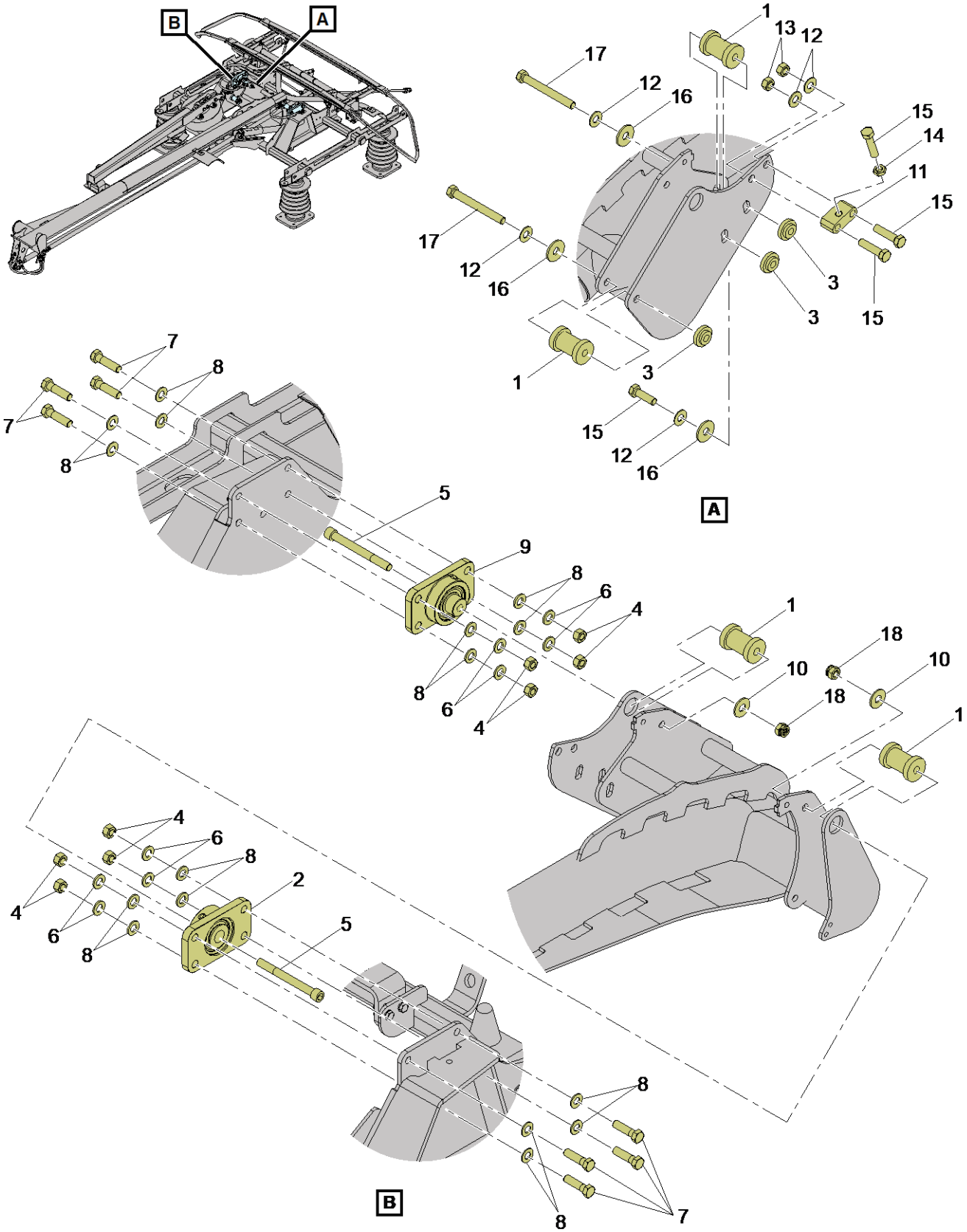
- For installation prepare E043642-SET11 [M16], refer to List of materials Section 7.3.
- Insert and press the new two Rings (4) to Upper Rod (1).
- Lubricate the joint with Grease [B01].
- Insert the Spacer (5) to Upper Rod (1).
- Insert the Screw (2) and two Washers (3) through joint and Swaying Shaft (9).
- Install the Washers (7) and (8) and Nut (6).
- Tighten the Nut (6) to a torque of 24 Nm.

Follow the instructions as mentioned below for checking of Upper Rod / Swaying Shaft Joint:

- Check that Collector Head is in horizontal position, refer to Section 8.6.8.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.2.3 REPLACEMENT OF LOWER ARM / FRAME JOINT



Note: Insulators are shown for illustration purpose.

Figure 63 – Replacement of Lower Arm / Frame Joint

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Location	Item No	Description	Part Number / Set Number	Qty
M08	**Lower Arm / Frame Joint**		**E043642-SET6**	1
	1	Spacer	YE040137-0001	4
	2	Bearing Housing assembly	E043628-0101	1
	3	Spacer	XE044077-0001	3
	4	Hex Nut M12	N2601200-082	8
	5	HSHC Screw	FT0030030-023	2
	6	CS Washer	3362200-082	8
	7	Hex Screw	S1001245-082	8
	8	Plain Washer	FT0030004-005	16
	9	Bearing Housing Assembly	E043628-0201	1
	10	Washer	FT0030031-014	2
	11	End Stop Support	YE043690-0001	1
	12	CS Washer, 12-27-1.8	FT0030004-065	5
	13	Hex. Nut	FT0030001-030	2
	14	Hex. Nut	FT0030001-021	1
	15	Hex. Hd Screw	FT0030005-066	4
	16	Plain Washer	FT0030004-058	3
	17	Hex Screw	FT0030005-067	2
	18	Hex Stop Nut	FT0042411-004	2

.

NOTE: For item numbers mentioned below in bracket, refer to Figure 63.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Lower Arm / Frame Joint:

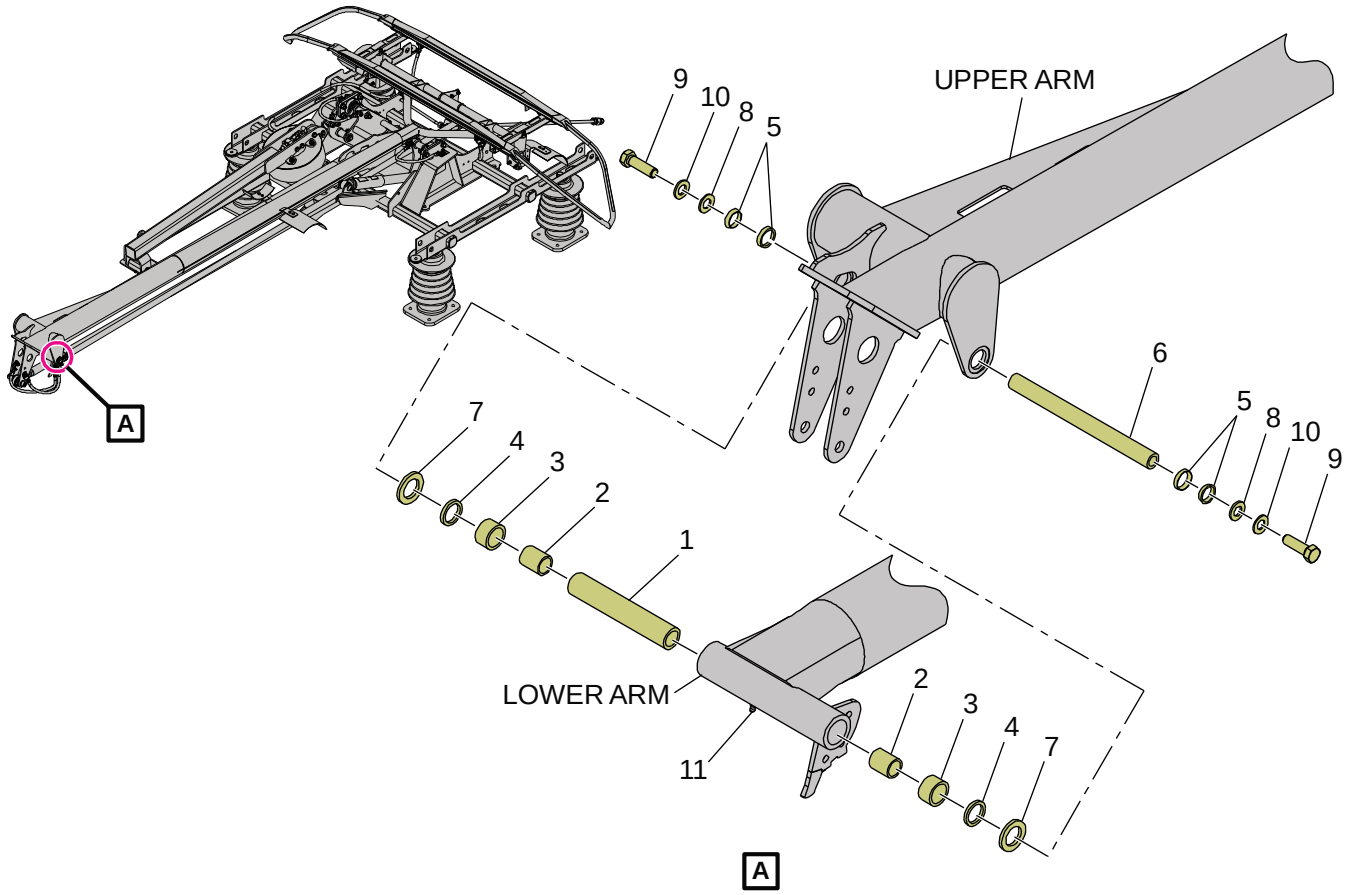
- Remove the Nuts (4) with Washers (6) and (8) from the Frame.
- Remove the Screw (7) with Washers (8) and pull out the Lower Arm from Frame.
- Remove the Nut (18) and Washers (10) from the Screw (5) of Bearing Housing Assembly (2) and (9).
- Remove the Screws (5), Spacer (1) and Bearing Housing Assembly (2) and (9) from Lower Arm / Frame Joint.
- Remove the Spacers (3) with Spacers (1), Screws (17), Washers (12) and (16) on both sides.
- Remove Spacer (3) with Screw (15), Washers (12) and (16) from Lower Arm.
- Remove Nuts (13) with Washers (12), End Stop Support (11) and Screws (15) from Lower Arm.
- Remove Screw (15) and nut (14) from End Stop Support (11) from Lower Arm.

Follow the instructions as mentioned below for installation of the Lower Arm / Frame Joint:

- For installation prepare E043642-SET6 [M08], refer to list of materials Section 7.3.
- Install Screw (15) and nut (14) to End Stop Support (11) to Lower Arm.
- Tighten the Screw (15) to a torque of 50 Nm.
- Install End Stop Support (11) to Lower Arm and secure with Screws (15), Washers (12) and Nuts (13).
- Tighten the Nuts (13) to a torque of 50 Nm.
- Install Screw (15), Washers (12), (16) to Lower Arm and secure with Spacer (3).
- Install the Spacers (1) to both sides of Lower Arm and secure with Screws (17), Washers (12), (16) and Spacers (3).
- Tighten the Screws (17) and (15) to a torque of 50 Nm.
- Lubricate the Frame Joint with Grease [B01].
- Install the Spacers (1), bearing assembly (2) to Lower Arm.
- Install the Screw (5) then secure with Nut (18) and Washer (10) on one side.
- Install another Spacers (1) and Bearing Housing Assembly (9) to Lower Arm other side.
- Install the Screw (5) then secure with Nut (18) and Washer (10) on other side.
- Tighten the Nut (18) to a torque of 90 Nm on both the Bearing Housing Assemblies (2) and (9).
- Install the Lower Arm to Frame with the Screws (7) with Washers (8).
- Secure it with the Nut (4) with Washers (8) and (6) on both sides.
- Tighten the Nuts (4) to a torque of 70 Nm.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.2.4 REPLACEMENT OF LOWER ARM / UPPER ARM JOINT



Note: Insulators are shown for illustration purpose.

Figure 64 – Replacement of Lower Arm / Upper Arm Joint

Location	Item No	Description	Part Number / Set Number	Qty
M09	**Lower Arm / Upper arm Joint**		**E043642-SET7**	1
	1	Spacer	YE040132-0001	1
	2	Inner Ring	4960443-000	2
	3	Needle Socket	4960413-000	2
	4	Seal Ring	4900124-000	2
	5	Washer	ED449525_1	2
	6	Axle	YE040131-0001	1
	7	Washer	YE040133-0001	2
	8	Plain Washer	FT0030004-005	2
	9	Hex Screw	FT0030006-025	2
	10	CS Washer	FT0030004-023	2
	11	Grease Lubricator	M01268	1

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: For item numbers mentioned below in bracket, refer to Figure 64.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed

Follow the instructions as mentioned below for removal of the Lower Arm / Upper Arm Joint:

- Unscrew the two Screws (9) and remove the two Washers (8) and (10) on each side.
- Remove the two washers (5) (lock ring consist of two conical elements) and pull out the Axle (6).
- Lift the Upper Arm and remove the two Washers (7) and two Sealing Rings (4).
- Press out the Spacer (1), two Inner Rings (2) and two Needle Sockets (3).
- Remove grease lubricator (11) from lower arm.

Follow the instructions as mentioned below for installation of the Lower Arm / Upper Arm Joint:

- For installation prepare E043642-SET7 [M09], refer to List of materials Section 7.3.
- Install grease lubricator (11) to lower arm.
- Grease the lower arm with Grease [B01] through the grease lubricator (11) until the grease will came out using grease gun.
- Lubricate the Joint with Grease [B01].
- Insert the Spacer (1) and two Inner rings (2) into the Lower arm.
- Install the two Needle Sockets (3) and two Seal Rings (4) into the Lower Arm.
- Install the two Washers (7).
- Position Upper Arm to Lower Arm.
- Install Axle (6) to Upper Arm.
- Install the two washers (5) (lock ring consist of two conical elements) to either side of Axle (6).
- Secure Lower Arm and Upper Arm joint with two Washers (8), two CS Washer (10) and two Screws (9).
- Tighten two Screws (9) to a Torque of 68 Nm.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.2.5 REPLACEMENT OF SAFETY VALVE

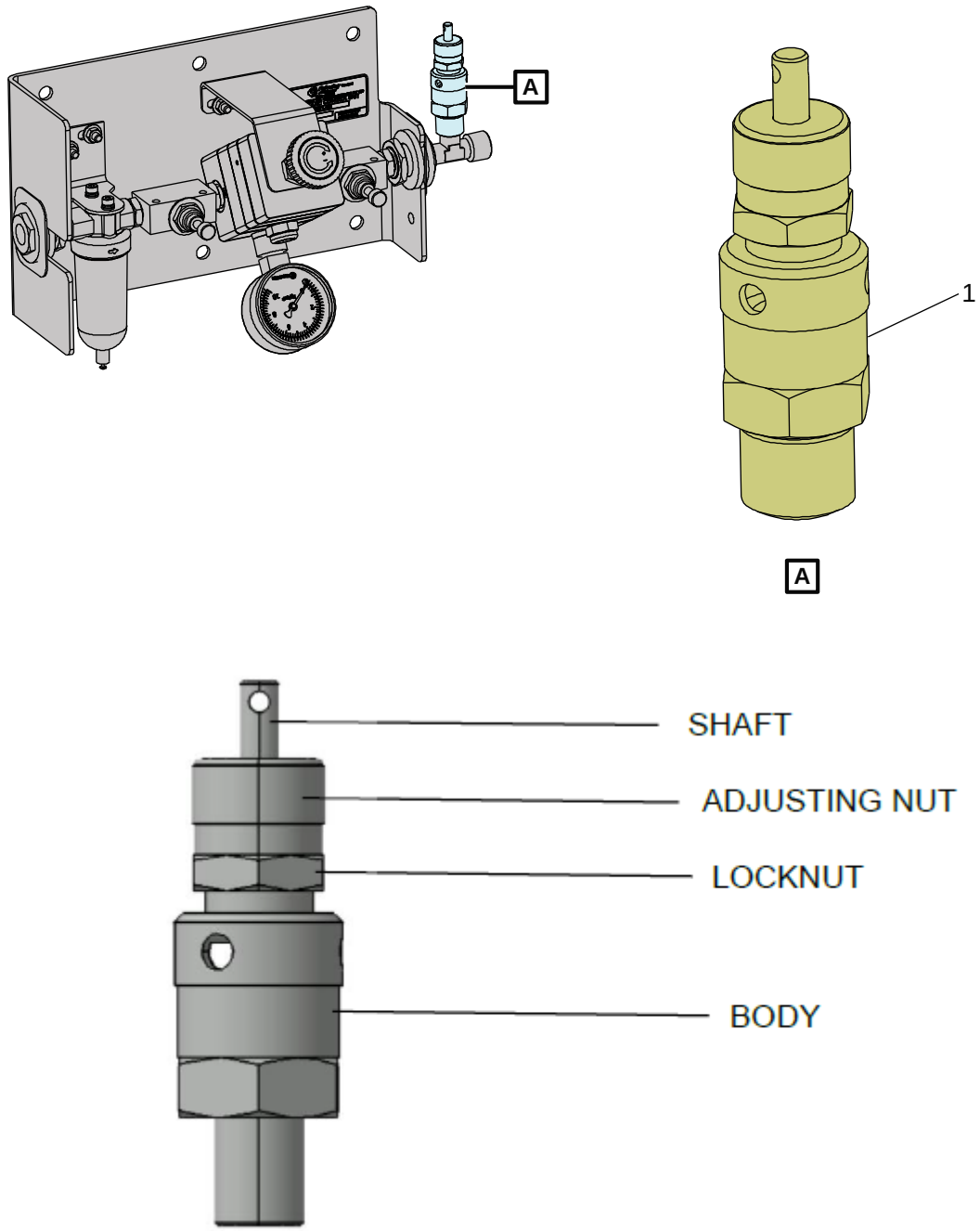


Figure 65 – Replacement of Safety Valve

Location	Item No	Description	Part Number / Set Number	Qty
M39		**Safety Valve**	FT0053911-054	1

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

Pressure safety valves are spring loaded devices. Normally, the valve is forced shut by the spring, but when the pressure rises, the force of the spring is overcome, forcing the valve open.

These valves are designed to regulate the level of pressure within a system, preventing it from building higher than a pre-defined amount.

Example: When pressure safety valve is set for 5 to 5.2 Bar, if any malfunction in the pressure regulator, the outlet pressure may vary it may be high or low, if its higher the outlet pressure ≥5 to 5.2bar or above, the safety valve will get activated and exhausts the excess air without allowing supply of higher-pressure air into Bellow.

Pressure Safety valve is spring loaded type, having metal to metal seating.

Pressure safety valve is set to 5 to 5.2 Bar and will have constant seepage of 0.05 SLPM @ 5.2 bar.

The replacement of a safety valve is only necessary if there is any malfunction, such as the valve not operating at the set pressure or failing to pop up even after disassembling, cleaning the spring, stem, and ball, and reassembling for testing. If it doesn't function properly after these steps, replacement may be required. For replacement prepare FT0053911-054** [M39], refer to List of materials Section 7.3.

If safety valve is not popping once pressure reached 5.2bar and above, follow the below details to set to popup 5.2Bar pressure.

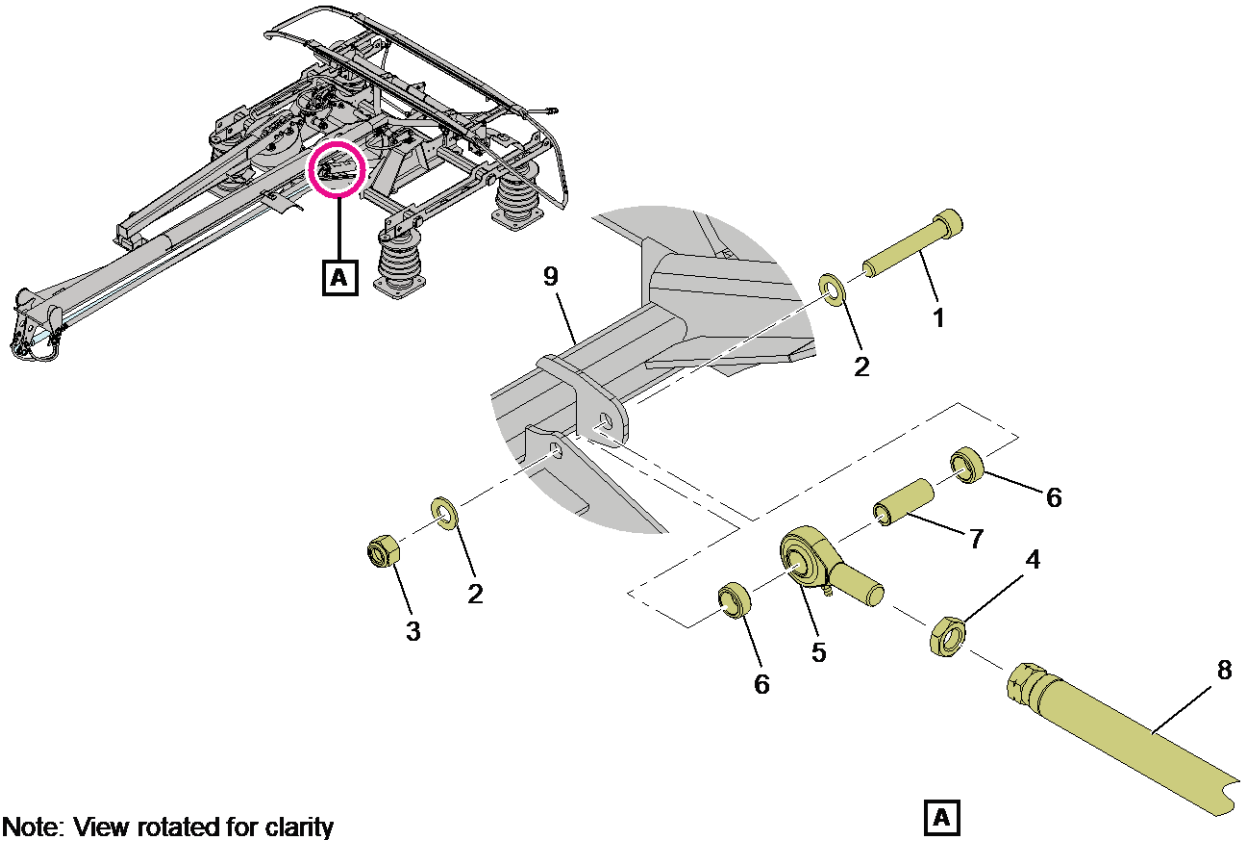
To set the safety valve to 5-5.2 bar, loose the LOCKNUT and tight the ADJUSTING NUT to increase the popup pressure and to reduce the popup pressure loosen the ADJUSTING NUT once popup pressure is set tighten the LOCKNUT.

PRESSURE SAFETY VALVE SET CRACKING PRESSURE: 5 – 5.2 BAR (CRACK OFF PRESSURE WILL BE ~1.6 BAR LOWER THAN CRACKING PRESSURE).

Soap solution or any form of solution are not permitted to be used on safety valve in the PCU, this will cause malfunction of pressure regulator, this method is however applicable for checking leakages only on the PCU joints.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.2.6 REPLACEMENT OF LOWER ROD / FRAME JOINT



Note: View rotated for clarity

Note: Insulators are shown for illustration purpose.

Figure 66 – Replacement of Lower Rod / Frame Joint

Location	Item No	Description	Part Number / Set Number	Qty
M13	**Lower Rod / Frame Joint**		**E043642-SET9**	1
	1	Screw M14x90	M14x90/1	1
	2	Washer	15/4	2
	3	Hex Nut M14	M14/5	1
	4	Hex Nut L	M20x1,5/4	1
	5	Bearing Eye right	OKO LOZISKOVE/8	1
	6	Bushing	YL100738-0001	2
	7	Bushing	YL100737-0001	1
Not part of set	8	Lower Rod	XE043676-0101	-
	9	Frame	VE043667-0101	-

NOTE: For item numbers mentioned below in bracket, refer to Figure 66.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Lower Rod / Frame Joint:

- Release the Nut (3) on the Frame joint, then remove the Washer (2) and remove the Screw (1) with Washer (2).
- Pull out the Lower Rod (8) from the Frame (9).
- Remove the two Bushings (6) and Inner Bushing (7) from Bearing Eye Right (5).
- Release the Nut (4) and Unscrew the Bearing Eye Right (5) from Lower Rod (8).

Follow the instructions as mentioned below for installation of the Lower Rod / Frame Joint:

- For installation prepare E043642-SET9 [M13], refer to List of materials Section 7.3.

NOTE: Joints must be lubricated with Grease [B01].

- Install the Lower Rod Bearing Eye Right (5) with the Nut (4) to the end of Lower Rod (8), which is mounted to the Frame (9).
- Screw-in or out the Lower Rod Bearing Eye Right (5) to achieve centre to centre length of 2080 mm (Distance between Bearing Eye Right and Bearing Eye Left other end of Lower Rod).

NOTE: At this moment, do not tighten the Nut (4).

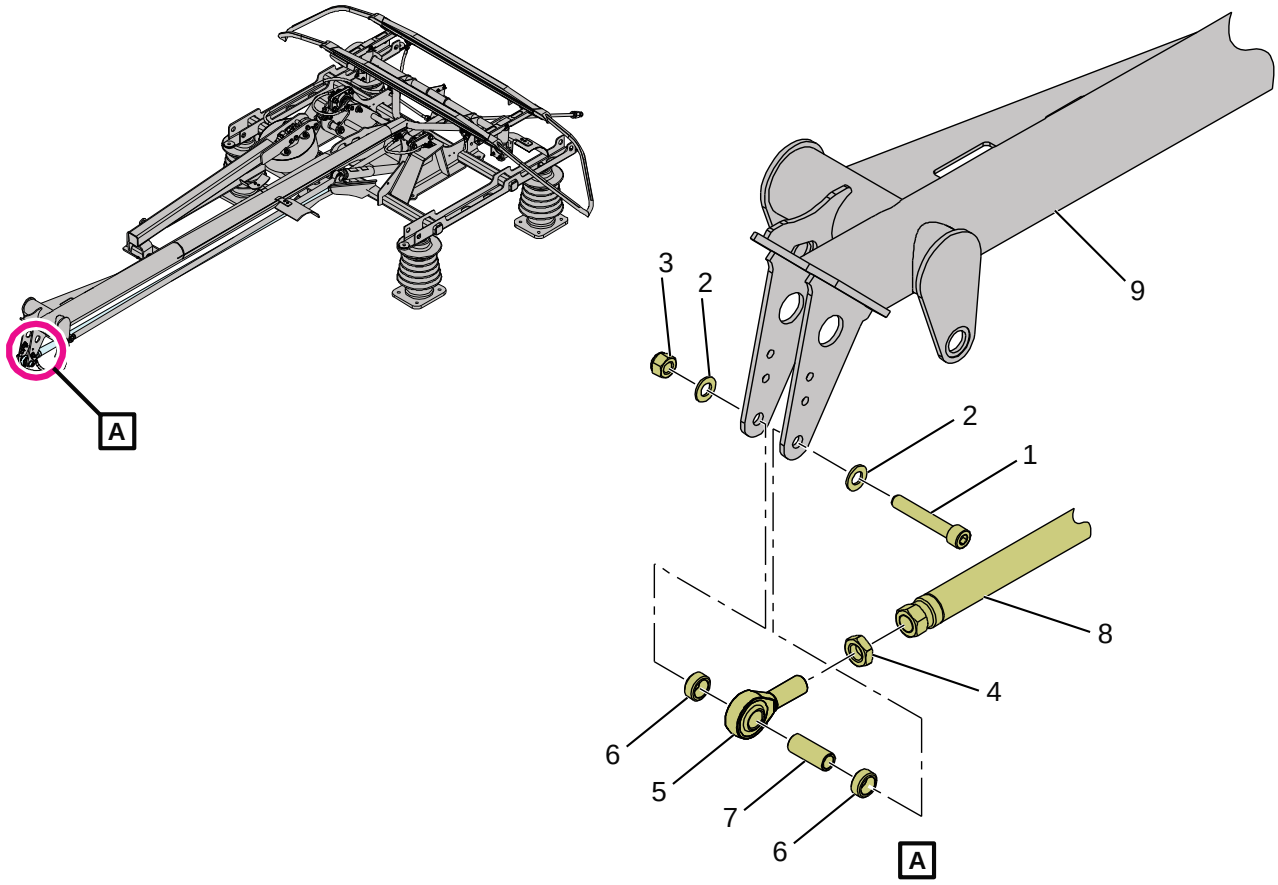
- Install the Bushings (6) and (7) to the Lower Rod (8) and insert the Lower Rod Joints Assembly to the Frame (9).
- Insert the Screw (1) with Washers (2).
- Insert the Washer (2) and tighten Nut (3) to a torque of 87 Nm.

Follow the instructions as mentioned below for checking of Lower Rod / Frame Joint:

- Check the Static characteristic of Contact Force, refer to Section 8.6.5.
- Check, if the Pantograph satisfies the criteria given in Section 8.6.5.3. If not, refer to instructions in Section 8.6.5.4 for adjustment and check it again.
- Tighten the Nut (4) to a torque of 50 Nm.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.2.7 REPLACEMENT OF LOWER ROD / UPPER ARM JOINT



Note: Insulators are shown for illustration purpose.

Figure 67 – Replacement of Lower Rod / Upper Arm Joint

Location	Item No	Description	Part Number / Set Number	Qty
M14	**Lower Rod / Upper Arm Joint**		**E043642-SET10**	1
	1	Hex. Hd bolt	M14x90/1	1
	2	Washer	15/4	2
	3	Hex Nut	M14/5	1
	4	Hex Nut	M20x1,5/3	1
	5	Bearing Eye Left	OKO LOZISKOVE/7	1
	6	Bushing	YL100738-0001	2
	7	Bushing	YL100737-0001	1
Not part of set	8	Lower Rod	XE043676-0101	-
	9	Upper Arm	VE043662-0101	-

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: For item numbers mentioned below in bracket, refer to Figure 67.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Lower Rod / Upper Arm Joints:

- Release the Nut (3) from Upper Arm Joint, then remove the Washer (2) and remove the Screw (1) with Washer (2).
- Pull out the Lower Rod (8) from Upper Arm (9).
- Remove two Bushings (6) and Inner Bushing (7) from Bearing Eye Left (5).
- Release the Nut (4) and Unscrew the Bearing Eye Left (5) from Lower Rod (8).

Follow the instructions as mentioned below for installing the Lower Rod / Upper Arm Joints:

- For installation prepare E043642-SET10 [M14], refer to List of materials Section 7.3.

NOTE: Joints must be lubricated with Grease [B01].

- Install the Lower Rod Bearing Eye Left (5) with Nut (4) to the end of Lower Rod (8), which is mounted on Upper Arm (9).
- Screw-in or out the Lower Rod Bearing Eye Left (5) to achieve centre to centre length of 2080 mm (Distance between Bearing Eye Right and Bearing Eye Left other end of Lower Rod).

NOTE: At this moment, do not tighten the Nut (4).

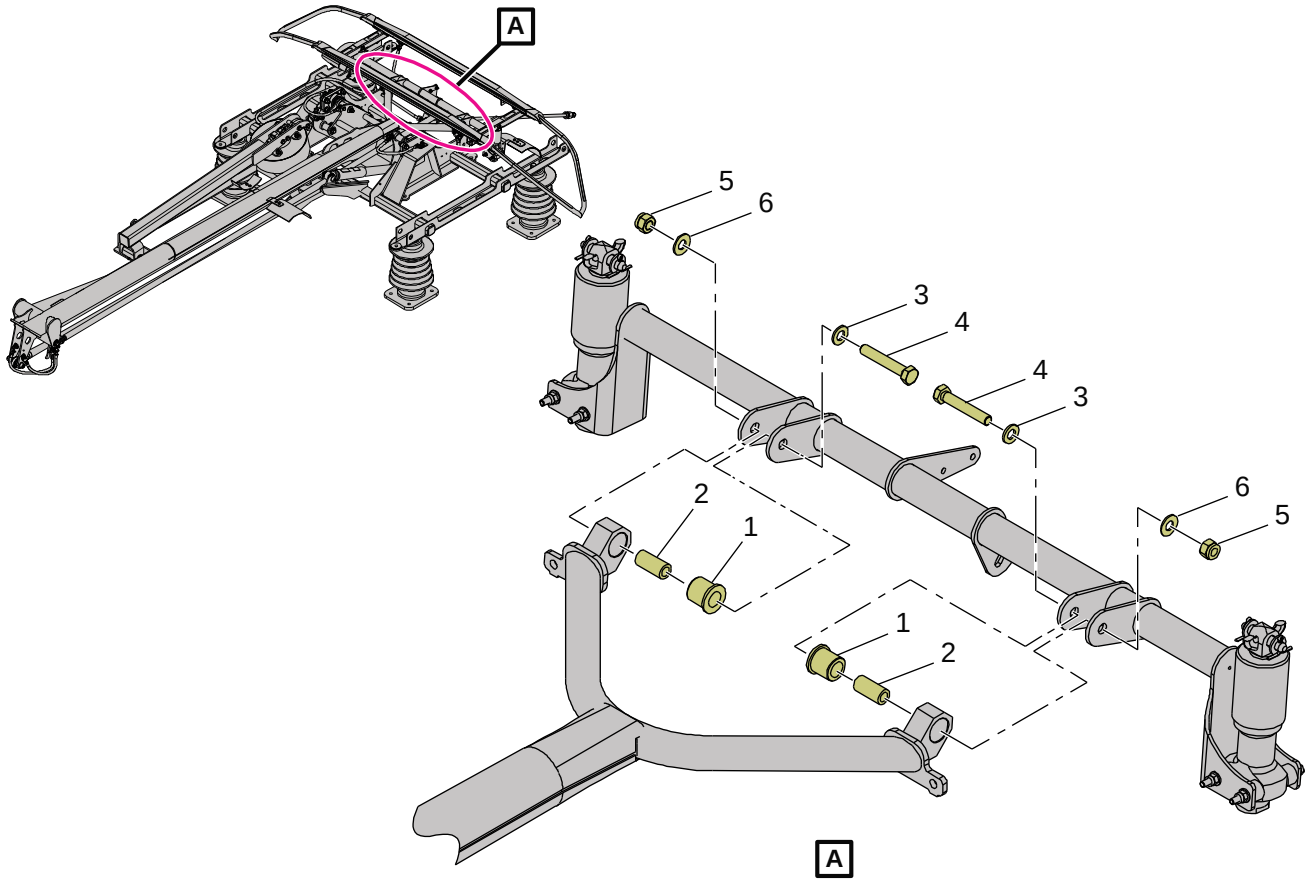
- Install the Bushings (6) and (7) to Lower Rod (8) and insert the Lower Rod Joints Assembly to the Upper Arm (9).
- Insert the Screw (1) with Washers (2).
- Insert the Washer (2) and tighten Nut (3) to a torque of 87 Nm.

Follow the instructions as mentioned below for checking of Lower Rod / Upper Arm Joints:

- Check the Static characteristic of Contact Force, refer to Section 8.6.5.
- Check, if the Pantograph satisfies the criteria given in Section 8.6.5.3. If not, refer to instructions in Section 8.6.5.4 for adjustment and check it again.
- Tighten the Nut (4) to a torque of 50 Nm.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.9.2.8 REPLACEMENT OF UPPER ARM / SHAFT JOINT



Note: Insulators are shown for illustration purpose.

Figure 68 – Replacement of upper arm / shaft joint

Location	Item No	Description	Part Number / Set Number	Qty
M11	**Upper Arm / Shaft Joint**		**E043642-SET8**	1
	1	Bush	YE038872-001	2
	2	Spacer Bush	YE039982-0001	2
	3	Plain Washer	FT0030003-035	2
	4	Hex Screw	FT0030005-069	2
	5	Hex Nut	FT0030001-025	2
	6	CS Washer	FT0030003-032	2

NOTE: For item numbers mentioned below in bracket, refer to Figure 68.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

Follow the instructions as mentioned below for removal of the Upper Arm / Shaft Joint:

- Disconnect the Flexible Connections of Collector Head-Upper Arm according to Section 8.10.16.
- Disconnect the one end of Upper Rod from Swaying Shaft according to Section 8.9.2.2.
- Unscrew the Nut (5) and remove the Screw (4) with Washers (3) and (6).
- Remove the Collector Head with Swaying Shaft from the Upper Arm.
- Press out the Spacer Bush (2) and Bush (1) from both end of Upper Arm.

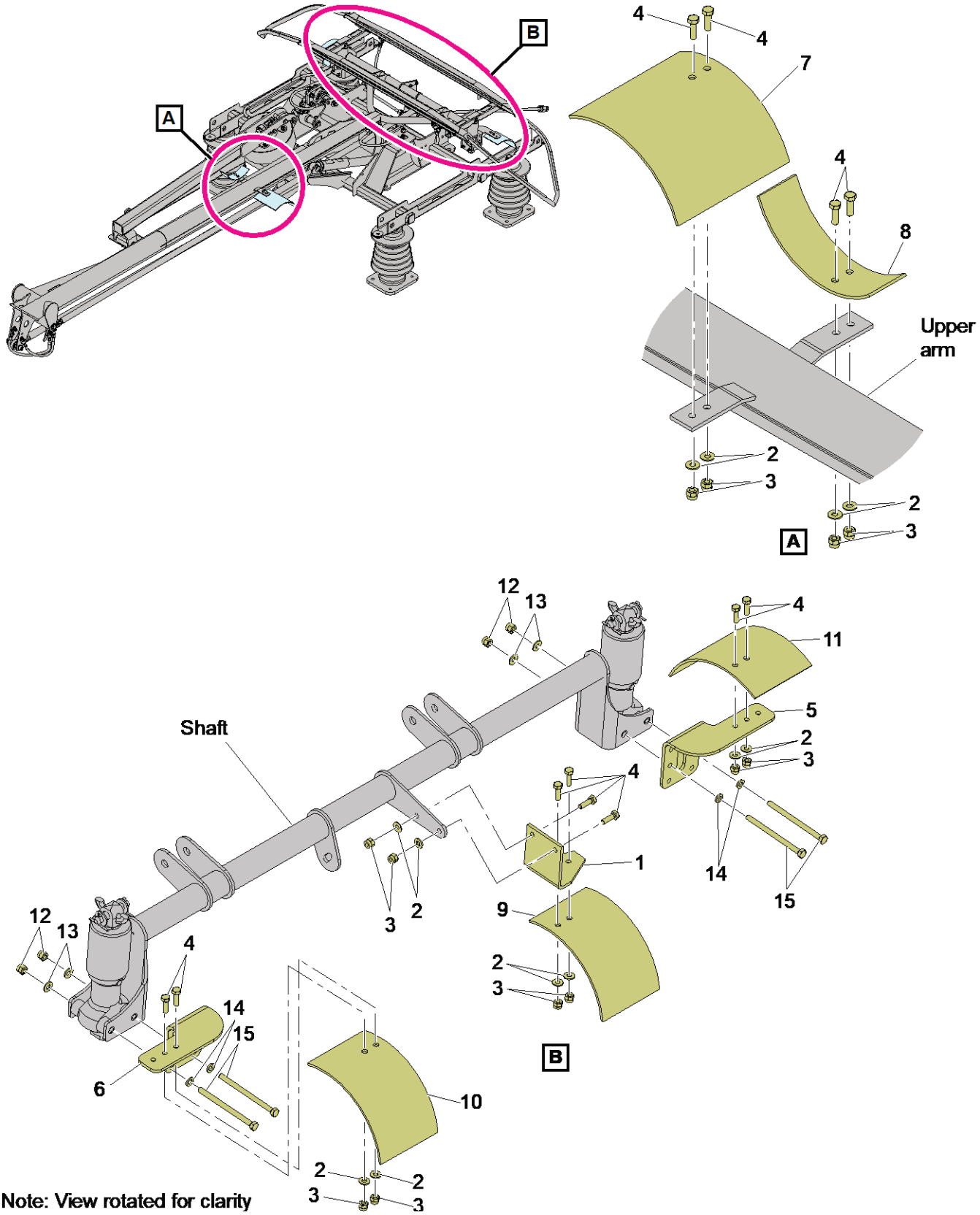
Follow the instructions as mentioned below for installation of the Upper Arm / Shaft Joint:

- For installation prepare E043642-SET8 [M11], refer to List of materials Section 7.3.
- Lubricate both Joints with Grease [B01].
- Install the Spacer Bush (2) and Bush (1) into both end of Upper Arm.
- Install the Collector Head with Swaying Shaft to Upper Arm.
- Install the Screws (4) with Washers (3) and (6) to both joints and secure with Nut (5).
- Tighten the Nuts (5) to a torque of 44 Nm.
- Reconnect the Upper Rod to the Swaying Shaft, according to Section 8.9.2.2.
- Connect the Flexible Connections of Collector Head-Upper Arm, according to Section 8.10.16.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10 CORRECTIVE MAINTENANCE

8.10.1 REPLACEMENT OF AEROFOIL



Note: Insulators are shown for illustration purpose.

Figure 69 – Replacement of Aerofoil

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Location	Item No	Description	Part Number / Set Number	Qty
M27	**Aerofoils**		**E043642-SET19**	1
	1	Bracket	XE043306-0001	1
	2	CS Washer	FT0030003-022	12
	3	Prevailing Torque Hex. Nut	FT0030001-023	12
	4	Hex Screw	FT0030005-039	12
	5	Bracket	E043308-0001	1
	6	Bracket	E043308-0002	1
	7	Aerofoil	VE043470-0016	1
	8	Aerofoil	VE043470-0017	1
	9	Aerofoil	VE043470-0014	1
	10	Aerofoil	VE043470-0015	1
	11	Aerofoil	VE043470-0012	1
	12	Prevailing Torque Hexagon Nut	FT0030002-023	4
Not part of set	13	CS Washer	FT0030004-016	4
	14	Plain Washer	FT0030004-001	4
	15	Hex. Screw M6x20	FT0030006-063	4

NOTE: For item numbers mentioned below in bracket, refer to Figure 69.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Aerofoil:

- Lower the Pantograph and secure it.
- Unscrew and remove four Nuts (3) with four Washers (2) from Upper Arm.
- Remove Aerofoil (7) and (8) with four Screws (4) from Upper Arm.
- Unscrew and remove two Nuts (3) with two Washers (2) which secures Bracket (1) from Shaft.
- Remove Bracket (1) with Aerofoil (9) and two screws (4) from Shaft.
- Unscrew and remove two Nuts (3) with two Washers (2) from Bracket (1).
- Remove Aerofoil (9) and two Screws (4) from Bracket (1).
- Remove four Nuts (12), four CS Washers (13), four Screws (15) and four Washers (14).

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

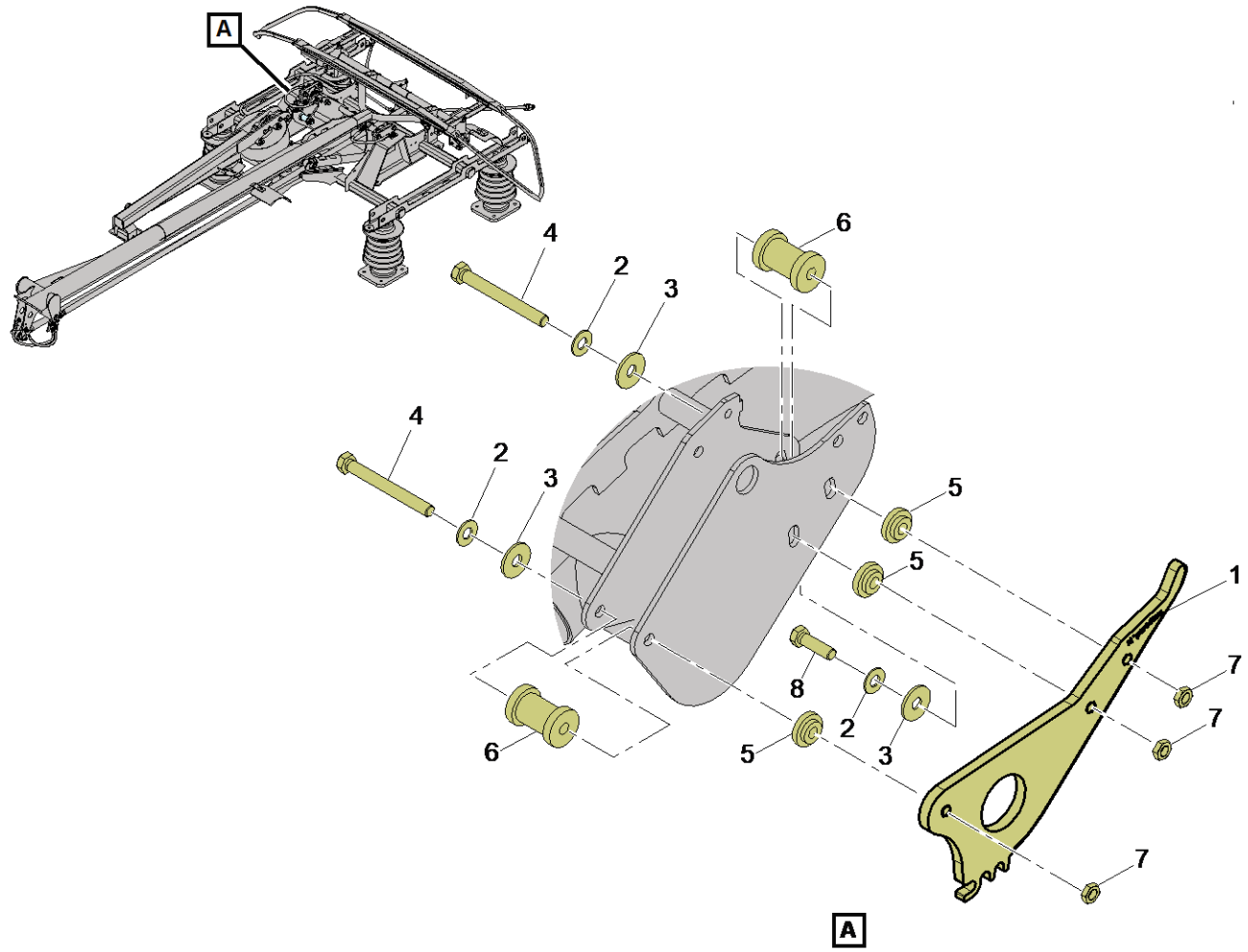
- Remove Brackets (5) and (6) with Aerofoil (11) and (10) from Shaft.
- Unscrew and remove four Nuts (3) with four Washers (2) from Brackets (5) and (6).
- Remove Aerofoil (11) and (10) with four Screws (4) from Brackets (5) and (6).

Follow the instructions as mentioned below for installation of the Aerofoil:

- For installation prepare E043642-SET19 [M27], refer to List of materials Section 7.3.
- Install Aerofoil (11) and (10) with four Screws (4) to Brackets (5) and (6).
- Secure Aerofoil (11) and (10) to Brackets (5) and (6) using four Nuts (3) and four Washers (2).
- Position Brackets (5) and (6) with Aerofoil (11) and (10) to Shaft.
- Secure Brackets (5) and (6) with four Screws (15) with four Washers (14), four CS Washers (13) and four Nuts (12).
- Tighten the Nuts (12) to a torque of 10.4 Nm.
- For Securing Brackets (5) and (6), Install fasteners which secure Brackets (5) and (6) to shaft according to section 8.9.1.4.
- Install Aerofoil (9) and two Screws (4) to Bracket (1).
- Secure Aerofoil (9) to Bracket (1) with two Nuts (3) and two Washers (2).
- Position Bracket (1) with Aerofoil (9) and two screws (4) to Shaft.
- Secure Bracket (1) with Aerofoil (9) to Shaft using two Nuts (3) and two Washers (2).
- Install Aerofoil (7) and (8) with four Screws (4) to Upper Arm as relevant positions according to Figure 69.
- Secure Aerofoil (7) and (8) to Upper Arm using four Nuts (3) and four Washers (2).
- Tightens Nut (4) to a torque of 7 Nm.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.2 REPLACEMENT OF CAM



Note: Insulators are shown for illustration purpose.

Figure 70 – Replacement of Cam

Location	Item No	Description	Part Number / Set Number	Qty
M31	**Cam**		**E043642-SET23**	1
	1	Cam	VE044073-0001	1
	2	CS washer	FT0030004-065	3
	3	Plain Washer	FT0030004-058	3
	4	H Screw	FT0030004-067	2
	5	Spacer	XE044077-0001	3
	6	Spacer	YE040137-0001	2
	7	Thin Nut	FT0042411-007	3
	8	H Screw	FT0030005-066	1

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: For item numbers mentioned below in bracket, refer to Figure 70

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Cam:

- Remove Chain from Cam (1) according to section 8.10.9.
- Unscrew and remove three thin nuts (7) which secure Cam (1) to Lower Arm Assembly.
- Remove the Spacers (5) with Spacers (6), Screws (4), Washers (3) and (2) on both sides.
- Remove Spacer (5) with Screw (8), Washers (3) and (2) from Lower Arm.
- Separate the Cam (1) from Lower Arm Assembly.

Follow the instructions as mentioned below for installation of the Cam:

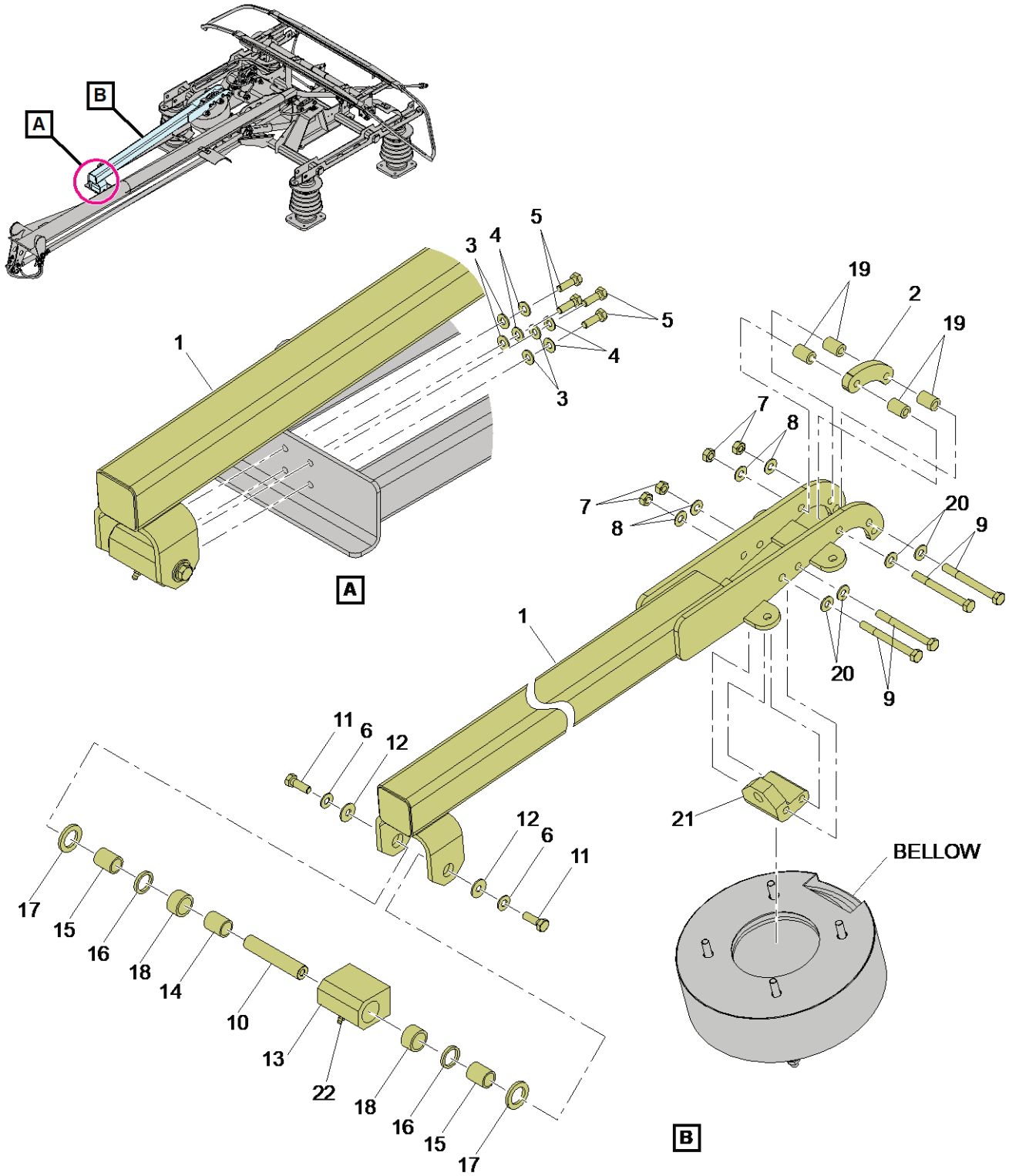
- For installation prepare E043642-SET23 [M31], refer to List of materials Section 7.3.
- Install Screw (8), Washers (3), (2) to Lower Arm and secure with Spacer (5).
- Install the Spacers (6) to both sides of Lower Arm and secure with Screws (4), Washers (2), (3) and Spacers (5).
- Install Cam (1) to the relevant position of Lower Arm Assembly.
- Secure Cam (1) to Lower Arm Assembly with three thin nuts (7),
- Tightens Screws (4) and (8) to a Torque of 50 Nm.
- Install the Chain to Cam (1) according to section 8.10.9.

Follow the instructions as mentioned below for checking the Cam:

- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.3 REPLACEMENT OF BELLOWS ARM



Note: Insulators are shown for illustration purpose.

Figure 71 – Replacement of Bellows Arm

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Location	Item No	Description	Part Number / Set Number	Qty
M29	**Bellows Arm**		**E043642-SET22**	1
	1	Shoulder of Bellows	VE043671-0101	1
	2	Nose	YE044076-0001	1
Not part of set	3	Washer	3220508-000	4
	4	CS Washer	3360801-000	4
	5	Hex Screw	1300825-000	4
M29	6	Washer	3361001-000	2
	7	Hex Nut	2501000-082	4
	8	Washer	3361000-082	4
	9	Hex Hd Bolt	YE069670-0060	4
	10	Axle	YE040942-0001	1
	11	Hex Screw	1301030-000	2
	12	Washer	3241001-000	2
	13	Base	XE043707-0001	1
	14	Spacer	YE040944-0001	1
	15	Inner Bearing	4960443-000	2
	16	Seal Ring	4900124-000	2
	17	Washer	YE040133-0001	2
	18	Needle Socket	4960413-000	2
	19	Spacer	XE044074-0001	4
	20	Washer	3221000-082	4
	21	Support	XE044075-0001	1
	22	Grease Lubricator	M01268	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 71

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Bellows Arm:

- Remove the Chain, according to Section 8.10.9.
- Dismount the Bellows with Cover from Bellows Arm, according to Section 8.9.1.3.
- Unscrew the four Nuts (7) and remove with Washers (8).
- Pull out the four Bolts (9) with Washers (20).
- Remove the Nose (2) with four Spacers (19) from bellows arm (1).
- Remove the Support (21) from bellow.
- Release the two Screws (11) and remove with Washers (6) and (12).
- Release the four Screws (5) and remove with Washers (4) and (3) and remove the Base Revolving Joint (13) from the Frame.
- Disassemble the Bellows Arm (1) and Base Revolving Joint (13) along with item number (10), (14) to (18), (22) as described in the Figure 71.
- Press out the Axle (10) from Base (13).
- Remove two Washers (17), two Inner Bearings (15), two Seal Rings (16), two Needle Sockets (18) and spacer (14) from Base (13).

Follow the instructions as mentioned below for installation of the Bellows Arm:

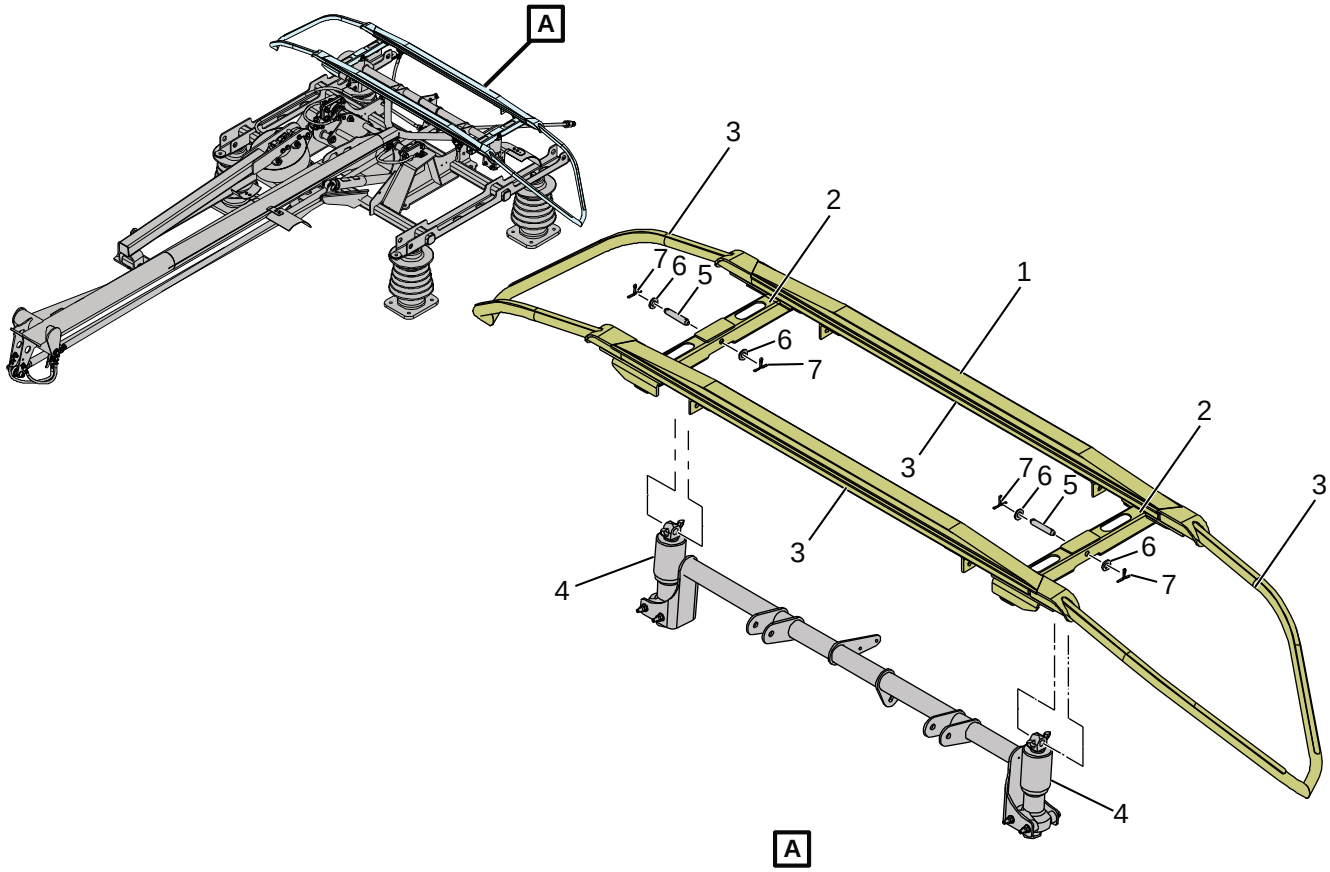
- For installation prepare E043642-SET22 [M29], refer to List of materials Section 7.3.
- Install the Support (21) to the relevant position of bellows.
- Lubricate the Nose (2) with Grease [B01].
- Install the Nose (2) with four Spacers (19) to bellows arm (1).
- Insert the four Bolts (9) with Washers (20).
- Install the four Nuts (7) with Washers (8) and tighten to a torque of 44 Nm.
- Lubricate the Needle Socket (18) with Grease [B01].
- Install spacer (14), two Needle Sockets (18), two Seal Rings (16), two Inner Bearings (15) and two Washers (17) to Base revolving joint (13) as described sequence in the Figure 71
- Lubricate the Axle (10) with Grease [B01].
- Install the Axle (10) to Base revolving joint (13).
- Assemble the Bellows Arm (1) and Base revolving joint (13) along with item number (14) to (18), (22) and Axle (10) as described in the Figure 71.
- Secure Bellows Arm (1) and Base revolving joint (13) with Washers (6) and (12) and Screws (11) in its position.
- Secure Base revolving joint (13) to Frame using four Screws (5), Washers (4) and (3)
- Tighten the Screws (11) and (5) to a torque of 20 Nm.
- Mount back the Bellows with Cover onto Bellows Arm, according to Section 8.9.1.3.
- Install the Chain, according to Section 8.10.9.
- Grease the base joint (13) with Grease [B01] through the grease lubricator (22) until the grease will came out using grease gun.

Follow the instructions as mentioned below for checking the Bellows Arm:

- Check the tightness of the Pneumatic Connections.
  - Secure the Pantograph in lowered position.
  - Pressurize the Pantograph at 3.8bar.
  - Apply the Air-leak Detection Spray [B04] to Pneumatic Connections, which were dismounted during replacement.
- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.4 REPLACEMENT OF COLLECTOR HEAD



Note: Insulators are shown for illustration purpose.

Figure 72 – Replacement of Collector Head

Location	Item No	Description	Part Number / Set Number	Qty
M21	**Collector Head**		E043642-SET20	1
	1	Carbon strip	E043642-SET18	2
	2	Strip Support	FT0053911-113	2
	3	Horn and Carbon strip support	E043642-SET17	2
Not part of set	4	Suspension	E043642-SET16	2
	5	Axle	E042357-0001	2
	6	Plain Washer	FT0030004-004	4
	7	Split Pin 3.2-22	3113222-000	4

NOTE: For item numbers mentioned below in bracket, refer to Figure 72

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Collector Head:

- Move the Pantograph to lowered position.
- Remove flexible connection from collector head according to section 8.10.16.
- Straighten the legs of Split Pin (7) and remove Axle (5) with Washers (6).
- Lift the Collector Head along with Carbon Strips (1), Strip support (2) and Horn (3) from Spring Box Mounted Units (4).

Follow the instructions as mentioned below for installation of the Collector Head:

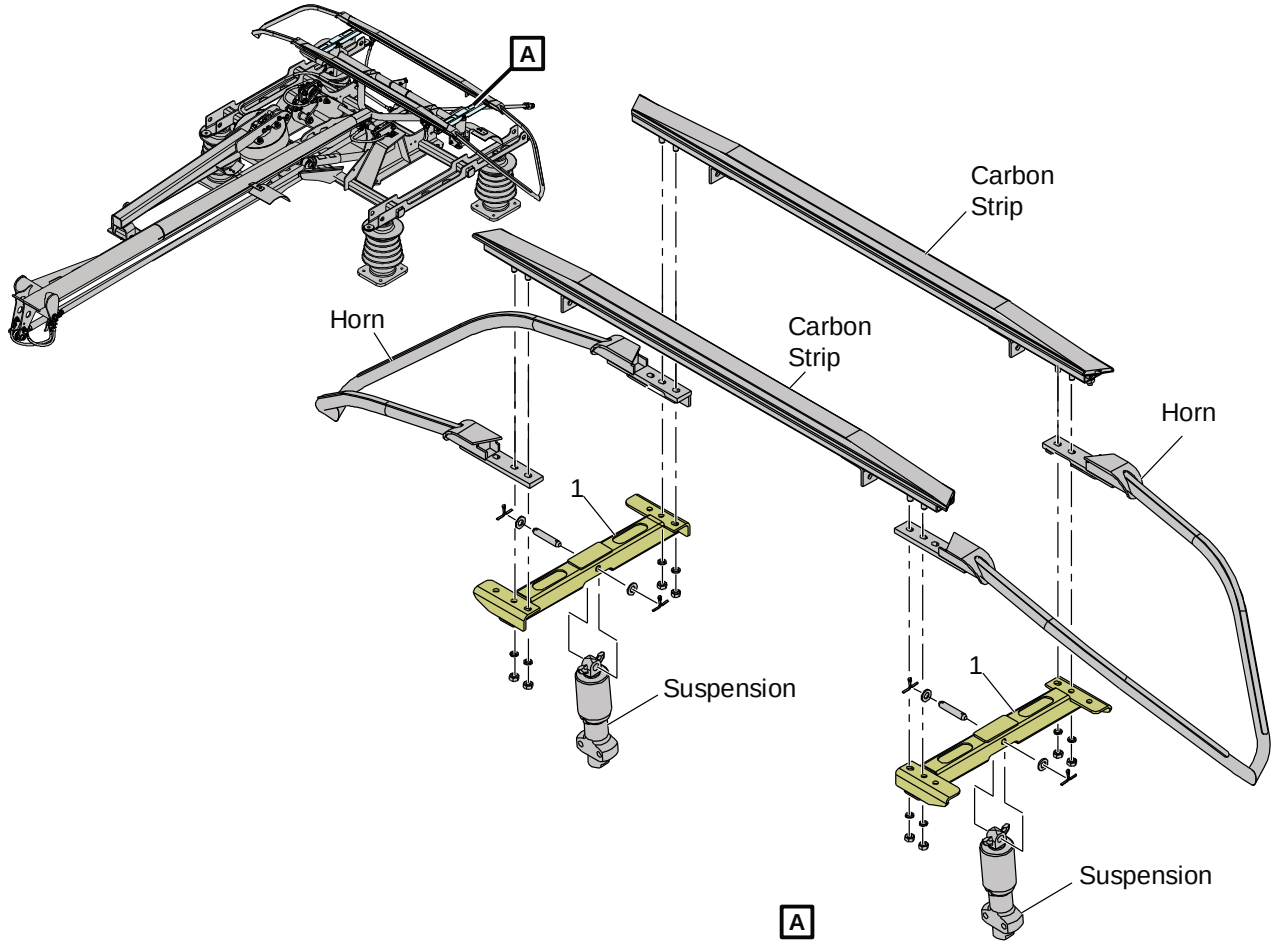
- For installation prepare E043642-SET20 [M21], refer to List of materials Section 7.3.
- Install the Collector Head along with Carbon Strips (1), Strip support (2) and Horn (3) to Spring Box Mounted Units (4).
- Lubricate the Axle (5) with Grease [B01].
- Insert the Axle (5) with Washers (6) through support of Collector Head and Spring Box Mounted Units (4).
- Install the Split Pin (7) into the Axle (5) and spread to legs and secure it.
- Install the Flexible Connections on the Collector Head, refer to Section 8.10.16.

Follow the instructions as mentioned below for checking the Collector Head:

- Check the Collector Head horizontal position, according to Section 8.6.8.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.5 REPLACEMENT OF STRIP SUPPORT



Note: Insulators are shown for illustration purpose.

Figure 73 – Replacement of Strip Support

Location	Item No	Description	Part Number /	Qty
M23	**Strip Support**		**FT0053911-113**	**-**
	1	Strip Support	FT0053911-113	2

NOTE: For item numbers mentioned below in bracket, refer to Figure 73

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Strip Support:

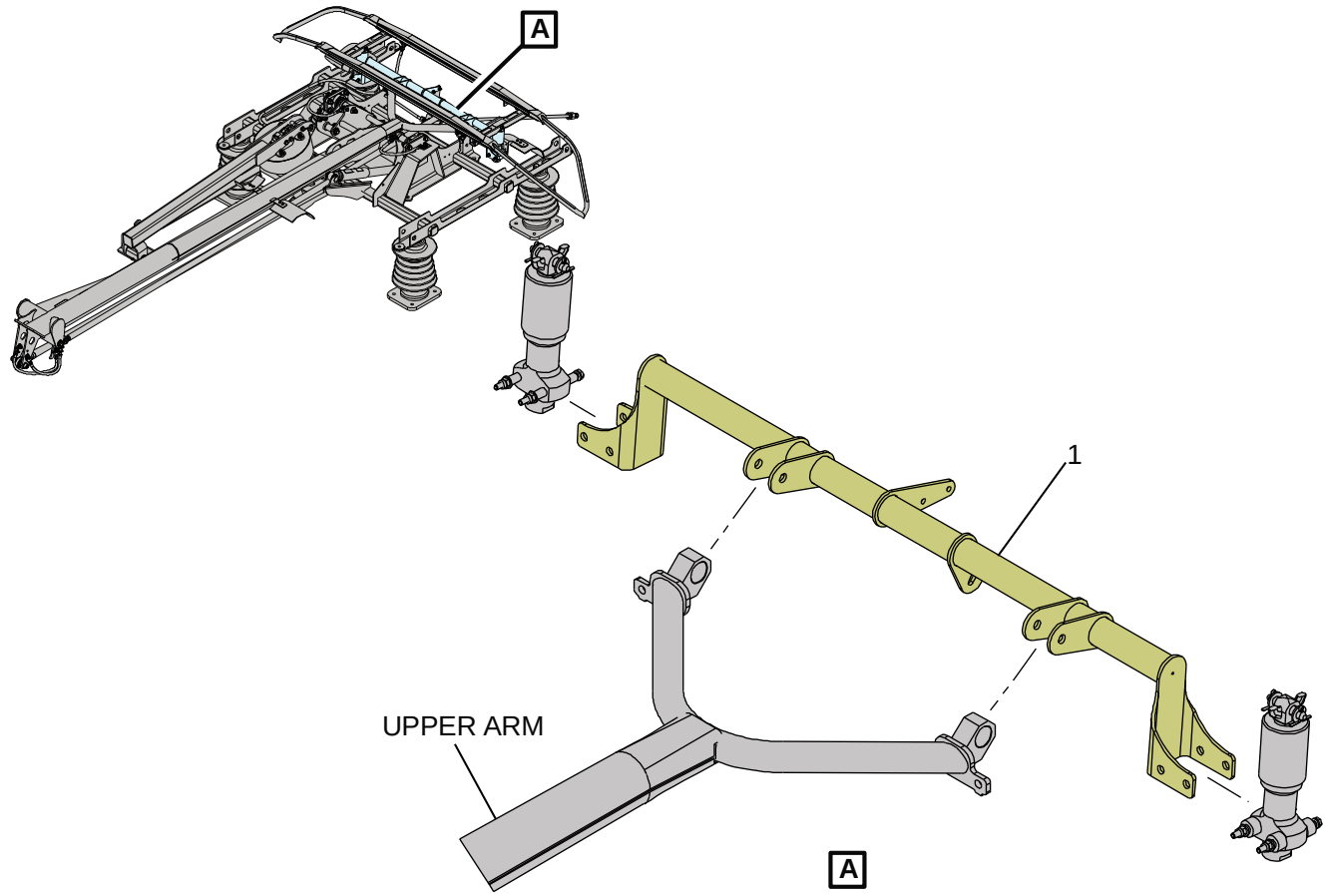
- Move the Pantograph to lowered position.
- Dismount the Collector Head from Pantograph, according to Section 8.10.4
- Dismount the Carbon Strips Support with Carbon Strip, according to Section 8.10.8
- Dismount the Horns, according to Section 8.10.8 and separate Strips Support (1).

Follow the instructions as mentioned below for installation of the Strip Support:

- For installation prepare FT0053911-113 [M23], refer to List of materials Section 7.3.
- Install the Strips Support (1).
- Install the Horns, according to Section 8.10.8
- Install the Carbon Strips Support with Carbon Strip, according to Section 8.10.8.
- Install the Collector Head to Pantograph, according to Section 8.10.4.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.6 REPLACEMENT OF SWAYING SHAFT



Note: Insulators are shown for illustration purpose.

Figure 74 – Replacement of Swaying Shaft

Location	Item No	Description	Part Number / Set Number	Qty
M22	**Swaying Shaft**		E043125-0102	-
	1	Swaying Shaft	E043125-0102	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 74

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Swaying Shaft:

- Move the Pantograph to lowered position.
- Dismount the Collector Head from Pantograph, according to Section 8.10.4
- Dismount the Upper Arm / Shaft Joint, according to Section 8.9.2.8.
- Separate Shaft (1) along with Suspension and Aerofoils from Upper Arm.
- Remove Suspension from Shaft, according to Section 8.9.1.4.
- Remove Aerofoils from Shaft, according to Section 8.10.1.

Follow the instructions as mentioned below for installation of the Swaying Shaft:

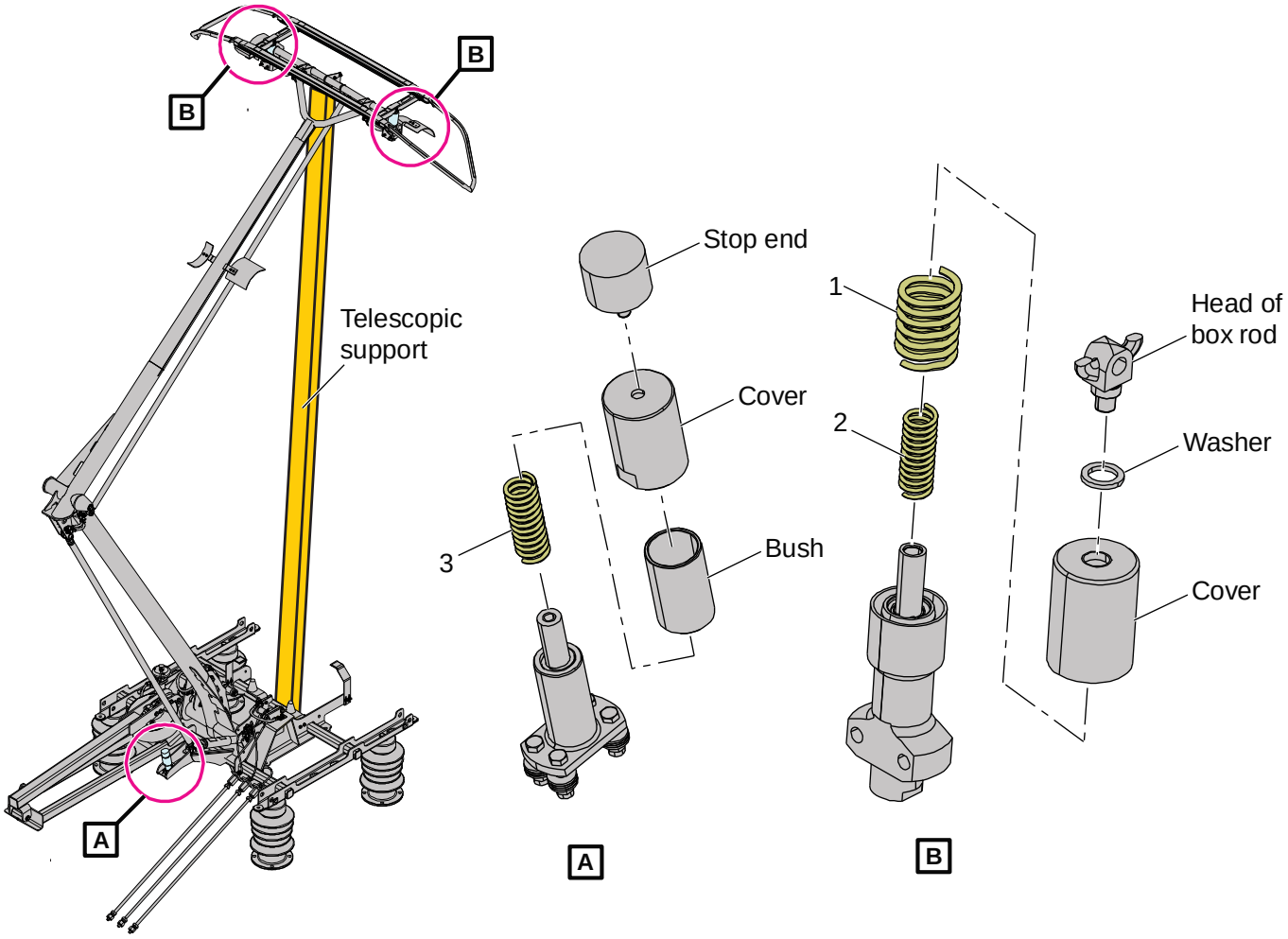
- For installation prepare E043125-0102 [M22], refer to List of materials Section 7.3.
- Install Aerofoils to Shaft, according to Section 8.10.1.
- Install Suspension to Shaft, according to Section 8.9.1.4.
- Position Shaft (1) along with Suspension and Aerofoils to Upper Arm.
- Install the Upper Arm / Shaft Joint, according to Section 8.9.2.8.
- Install the Collector Head to Pantograph, according to Section 8.10.4

Follow the instructions as mentioned below for checking the Swaying Shaft:

- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Collector Head horizontal position, according to Section 8.6.8.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.7 REPLACEMENT OF SUSPENSION SPRING



Note: Insulators are shown for illustration purpose.

Figure 75 – Replacement of Suspension Spring

Location	Item No	Description	Part Number / Set Number	Qty
M25	**Suspension spring**		**E043642-SET26**	1
	1	Compression Spring	FT0078368-001	2
	2	Compression Spring	FT0078367-001	2
	3	Compression Spring	YE044115-0001	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 75

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Suspension Spring:

- Remove Suspension from Collector Head according to section 8.9.1.4
- Remove End of Box Rod and Washer from Box Bottom.
- Remove Cover from Box Bottom.
- Remove Compression Spring (1) and (2) from Box Bottom.
- Remove Endstop on Spring from Frame according to section 8.7.3.1
- Unscrew and Remove Stop End from Basement.
- Remove Cover and Bush from Basement.
- Remove Compression Spring (3) from Basement.

Follow the instructions as mentioned below for installing the Suspension Spring:

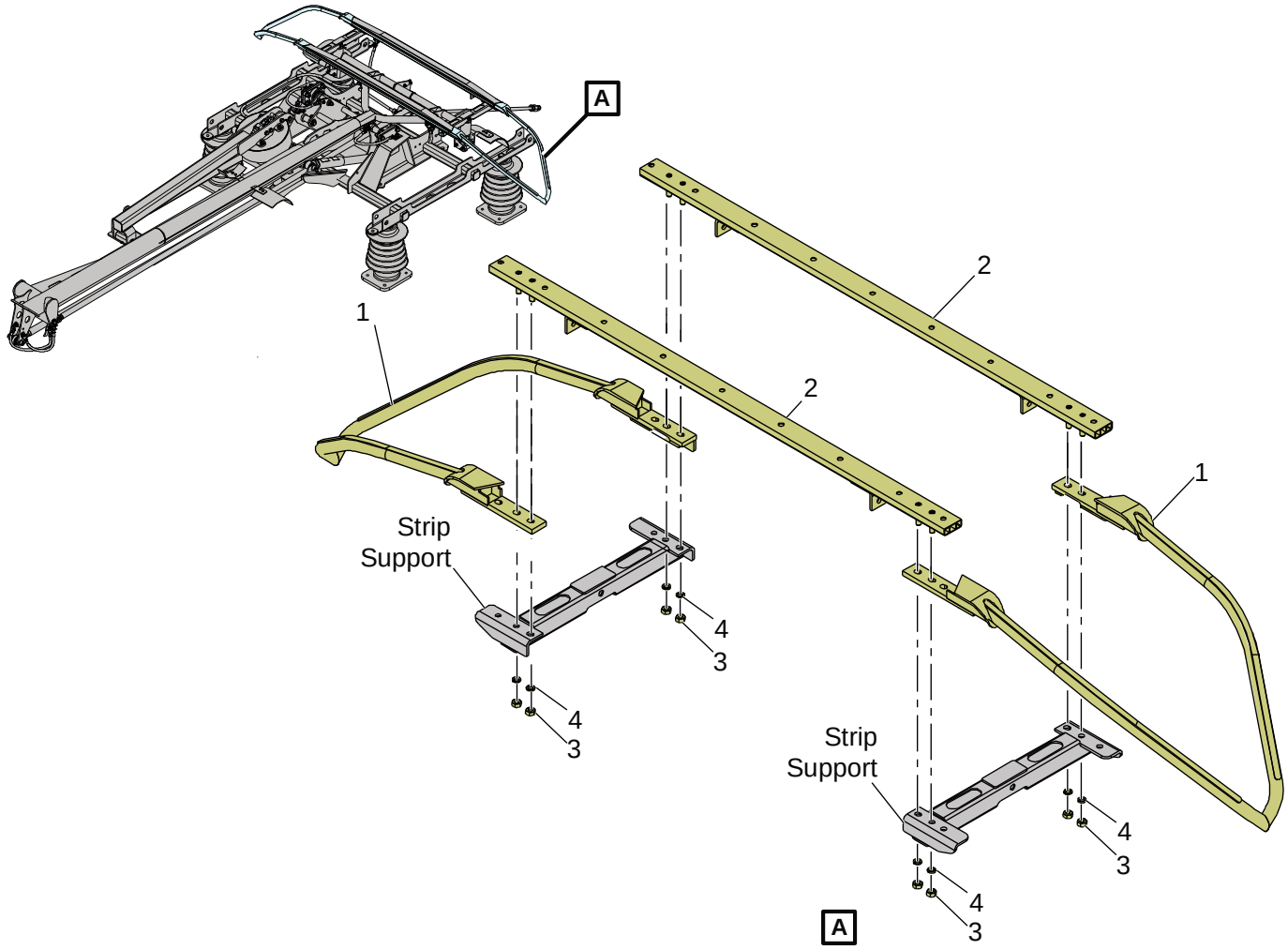
- For installation prepare E043642-SET26 [M42], refer to List of materials Section 7.3.
- Install Compression Spring (3) to Basement.
- Install Cover and Bush to Basement.
- Install and secure Stop End to Basement.
- Install Endstop on Spring to Frame according to section 8.7.3.1.
- Install Compression Spring (1) and (2) to Box Bottom.
- Install Cover to Box Bottom.
- Install and Secure End of Box Rod and Washer to Box Bottom.
- Install Suspension to Collector Head according to section 8.9.1.4

Follow the instructions as mentioned below for checking the Suspension Spring:

- Check the tightness of Pneumatic Connections.
- Secure the Pantograph in lowered position.
- Pressurize the Pantograph at 3.8bar.
- Verify the Raising and Lowering times, according to Section 8.6.6.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.8 REPLACEMENT OF HORN AND CARBON STRIP SUPPORT



Note: Insulators are shown for illustration purpose.

Figure 76 – Replacement of Horn and Carbon Strip Support

Location	Item No	Description	Part Number / Set Number	Qty
M25	**Horn and Carbon strip support**		**E043642-SET17**	2
	1	Bearing	FT0053911-112	1
	2	Carbon strip Support	FT0074365-101	1
Not part of set	3	Nut	FT0030001-024	8
	4	Washer	FT0030003-030	8

NOTE: For item numbers mentioned below in bracket, refer to Figure 76

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Horn and Carbon Strip Support:

- Move the Pantograph to lowered position.
- Unscrew and Remove nine Nuts, nine Washers and Carbon Strips according to section 8.7.1.
- Unscrew and remove four Nuts (3), four Washers (4) and separate Carbon Strips support (2) from horn (1).
- Remove the Horn (1) from Strips Support.

Follow the instructions as mentioned below for installation of the Horn and Carbon Strip Support:

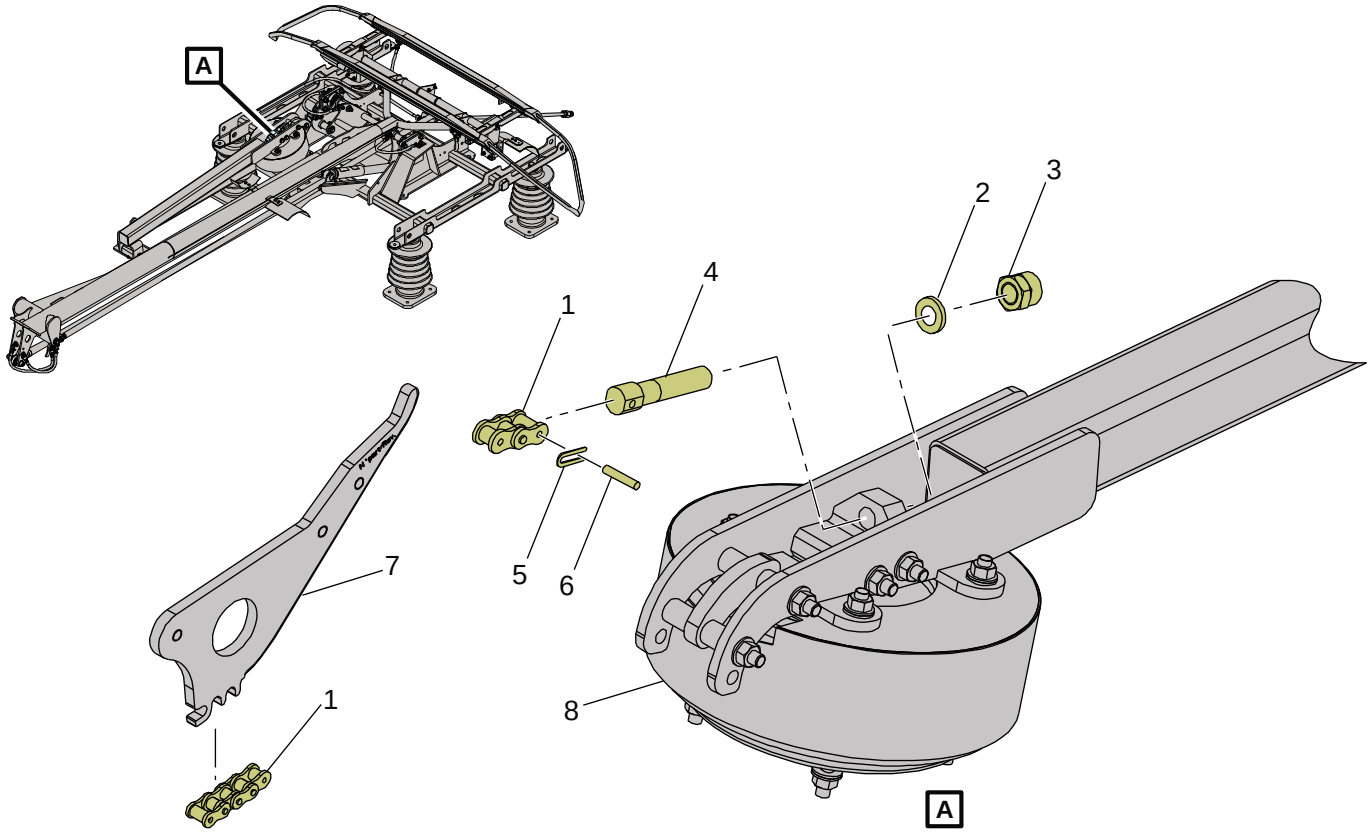
- For installation prepare E043642-SET17 [M25], refer to List of materials Section 7.3.
- Install the Horn (1) to its location.
- Install and secure Carbon Strips support (2) to horn (1) using four Nuts (3), four Washers (4).
- Torque tighten the Nuts (3) to a torque of 18 Nm
- Install the nine Nuts, nine Washers and Carbon Strips according to section 8.7.1.

Follow the instructions as mentioned below for checking the Horn and Carbon Strip Support:

- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Collector Head horizontal position, according to Section 8.6.8.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.9 REPLACEMENT OF CHAIN



Note: Insulators are shown for illustration purpose.

Figure 77 – Replacement of Chain

Location	Item No	Description	Part Number / Set Number	Qty
M32	**Chain**		**E043642-SET24**	1
	1	Chain	YL100099-0102	1
	2	Plain Washer	3221600-082	1
	3	Stop Nut	2931603-080	1
	4	Screw	YE040950-0001	1
	5	Splint	Child part of Item 1	-
	6	Connecting link		-
Not part set	7	Cam	VE044073-0001	-
	8	Bellows	YE039985-0001	-

NOTE: For item numbers mentioned below in bracket, refer to Figure 77

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Chain:

- Unscrew the Nut (3) and remove the Washer (4).
- Remove one end of Chain (1) and Screw (2) from Bellow Assembly (8).
- Disconnect the other end of Chain (1) from hook on Cam (7).
- Remove splint (5) and connecting link (6) to separate Chain (1) from screw (2).

Follow the instructions as mentioned below for installing the Chain:

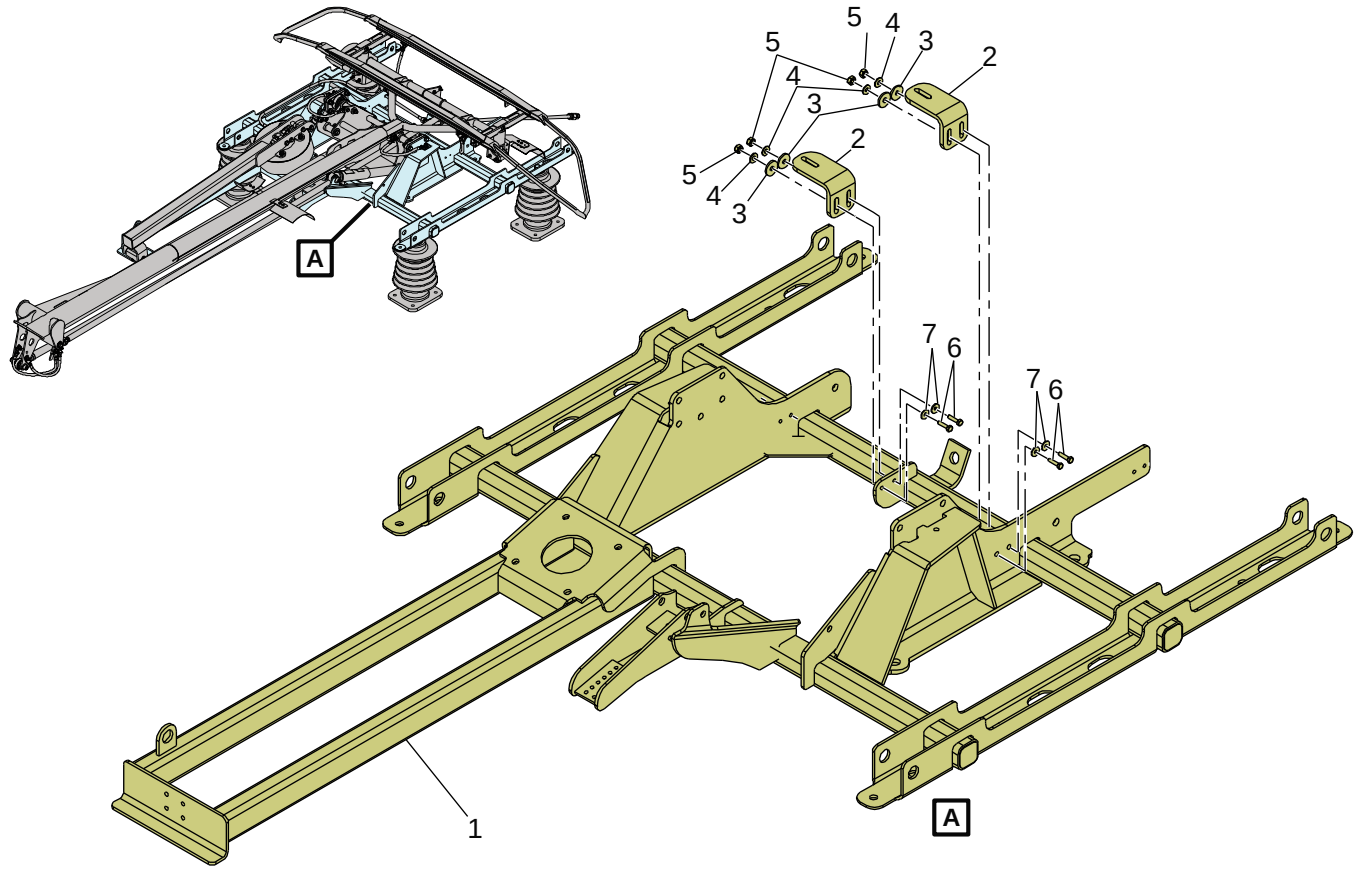
- For installation prepare E043642-SET24 [M32], refer to List of materials 7.3.
- Chain must be lubricated before installation of "Chain and Rope Lube Spray" [B03].
- Install one end of Chain (1) to screw (2) using splint (5) and connecting link (6).
- Install Screw (2) to bellow assembly (8) using new Nut (3) and Washer (4). Do not fully tighten the Nut (3).
- Guide the Chain (1) along the Cam (7) to its position.
- Install other end of Chain (1) onto the hook of Cam (7).
- Tighten Nut (3) until the slack in chain links are removed.

Follow the instructions as mentioned below for checking the Chain:

- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.10 REPLACEMENT OF FRAME



Note: Insulators are shown for illustration purpose.

Figure 78 – Replacement of Frame

Location	Item No	Description	Part Number / Set Number	Qty
M02	1	Frame	VE043667-0101	1
Not part of set	2	Support	E043704-0001	2
	3	Plain washer	FT0030004-053	4
	4	CS Washer	FT0030004-017	4
	5	H Nut	FT0030002-003	4
	6	H Screw M8x30	FT0030006-013	4
	7	Plain washer	FT0030004-003	4

NOTE: For item numbers mentioned below in bracket, refer to Figure 78.

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

Follow the instructions as mentioned below for removal of the Frame:

- Move the Pantograph to lowered position.
- Remove the Stops, according to Section 8.7.3.
- Remove the Upper Rod, according to Section 8.10.12.
- Remove the Lower Arm, according to Section 8.10.13
- Remove the Bellows, according to Section 8.9.1.3.
- Remove the Bellows Arm, according to section 8.10.3.
- Remove the Lower Rod, according to Section 8.10.11.
- Remove the Insulated hose assembly, according to Section 8.9.1.6.
- Unscrew and remove four Hex. Nuts (5) with four Plain Washers (3) and four CS Washers (4) from Frame (1).
- Remove two supports (2) with four Hex. Screws (6) and four Plain Washers (7) from Frame (1).

Follow the instructions as mentioned below for installation of the Frame:

- For installation prepare VE043667-0101 [M02], refer to List of materials Section 7.3.
- Install two supports (2) with four Hex. Screws (6) and four Plain Washers (7) to Frame (1).
- Secure two supports (2) to Frame (1) using four Hex. Nuts (5), four Plain Washers (3) and four CS Washers (4).
- Tighten the four Nuts (5) to torque of 20 Nm.
- Remove the Insulated hose assembly, according to Section 8.9.1.6.
- Remove the Lower Rod, according to Section 8.10.11.
- Remove the Bellows Arm, according to section 8.10.3.
- Remove the Bellows, according to Section 8.9.1.3.
- Remove the Lower Arm, according to Section 8.10.13
- Remove the Upper Rod, according to Section 8.10.12.
- Remove the Stops, according to Section 8.7.3.

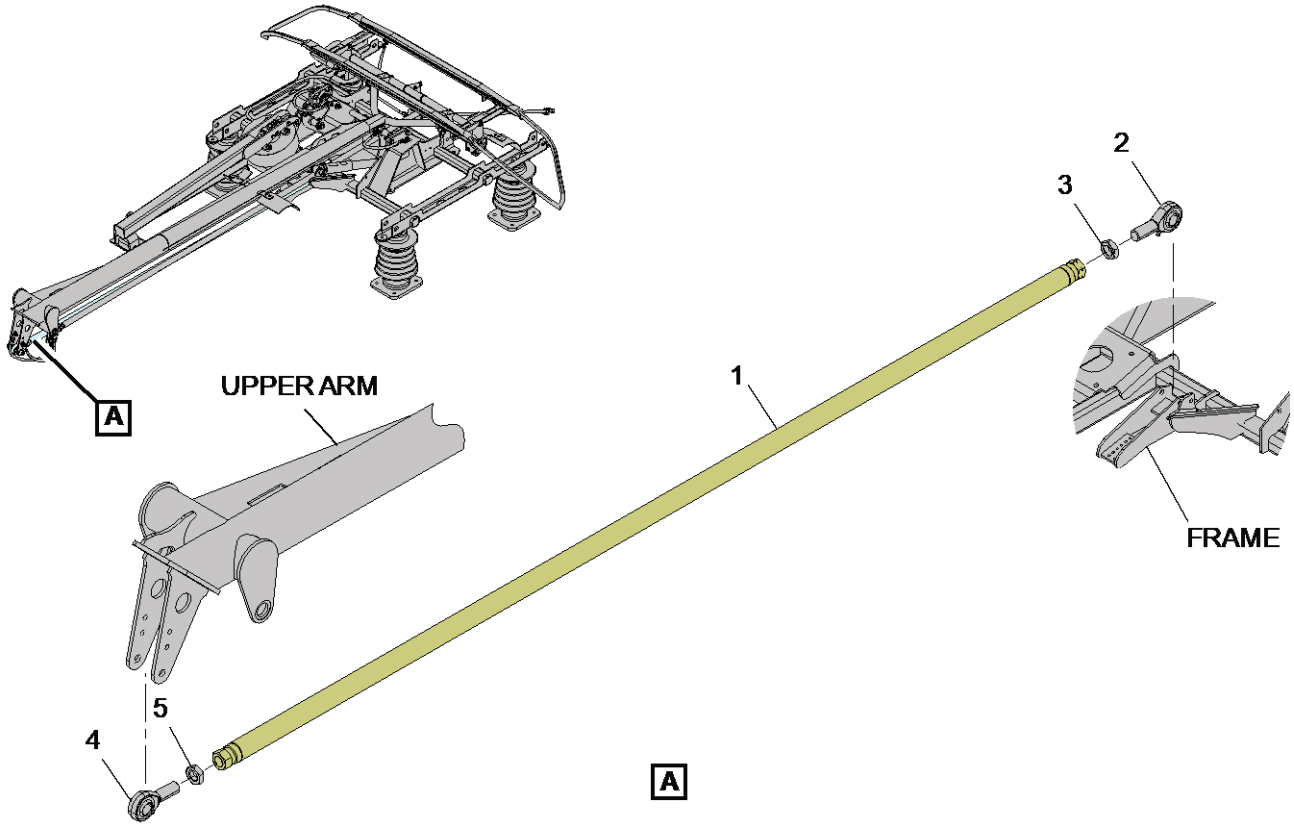
Follow the instructions as mentioned below for checking the Frame:

- Check of lifting and lowering times. Refer to Section 8.6.6.
- Check of Collector Head Horizontal Position. Refer to Section 8.6.8.
- Check the Static Contact Force curve, according to Section 8.6.5.

NOTE: Wabtec Does not recommend to replace the Frame Assembly, this details are given only for information, Changing the frame assembly is only possible at Wabtec Plant level.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.11 REPLACEMENT OF LOWER ROD



Note: Insulators are shown for illustration purpose.

Figure 79 – Replacement of Lower Rod

Location	Item No	Description	Part Number / Set Number	Qty
M12	**Lower Rod**		**XE043676-0101**	-
	1	Lower Rod	XE043676-0101	1
Not part of set	2	Bearing Eye Right	OKO LOZISKOVE/8	1
	3	Hex Nut	M20x1.5/4	1
	4	Bearing Eye Left	OKO LOZISKOVE/7	1
	5	Hex Nut	M20x1.5/3	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 79

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Lower Rod:

- Expand the Pantograph manually to around 500 mm.
- Remove Lower Rod / Upper Arm joint according to section 8.9.2.7.
- Remove Lower Rod / Frame joint according to section 8.9.2.6.
- Separate Lower Rod (1).

Follow the instructions as mentioned below for installation of the Lower Rod:

- For installation prepare XE043676-0101 [M12], refer to List of materials Section 7.3.

NOTE: Both joints must be lubricated with Grease [B01].

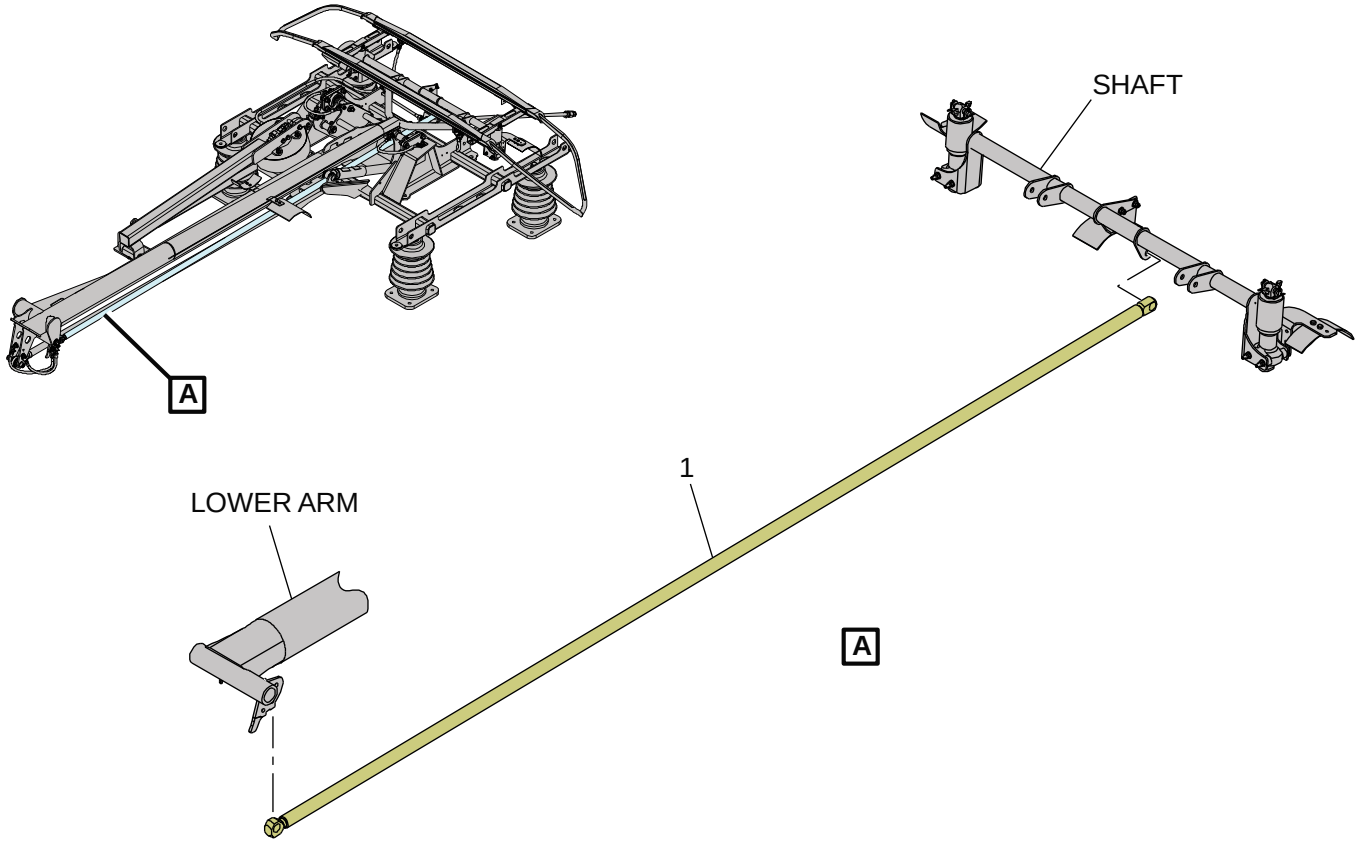
- Install the Rod End Bearing (2) with Nut (3) to the end of Lower Rod (1) which is mounted to Frame.
- Install the Rod End Bearing (4) with Nut (5) to the end of Lower Rod (1) which is mounted to Upper Arm.
- Screw-in or out the Rod End Bearings (2) and (4), to achieve centre to centre length of 2080 mm.
- At this moment, do not tighten the nuts (3) and (5).
- Secure one end of Lower Rod to Frame using relevant fasteners, according to section 8.9.2.6.
- Install Lower Rod / Upper Arm joint according to section 8.9.2.7.
- Lower the Pantograph.

Follow the instructions as mentioned below for checking the Lower Rod:

- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Static Contact Force curve, according to Section 8.6.5.
- Check if Pantograph satisfies the criteria given in Section 8.6.5.3. If not, then adjust it, refer to instructions in Section 8.6.5.4 and then check again.
- Tighten the Counter Nuts (3) and (5) to a torque of 50 Nm.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.12 REPLACEMENT OF UPPER ROD



Note: Insulators are shown for illustration purpose.

Figure 80 – Replacement of Upper Rod

Location	Item No	Description	Part Number / Set Number	Qty
M15	**Upper Rod**		**XE043656-0101**	-
	1	Upper Rod	XE043656-0101	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 80

Follow the instructions as mentioned below for removal of the Upper Rod:

- Move the Pantograph to lowered position.
- Remove Upper Rod / Swaying Shaft joint, according to section 8.9.2.2.
- Remove Upper Rod / Lower Arm joint, according to section 8.9.2.1.
- Separate Upper Rod (1).

Follow the instructions as mentioned below for installation of the Upper Rod:

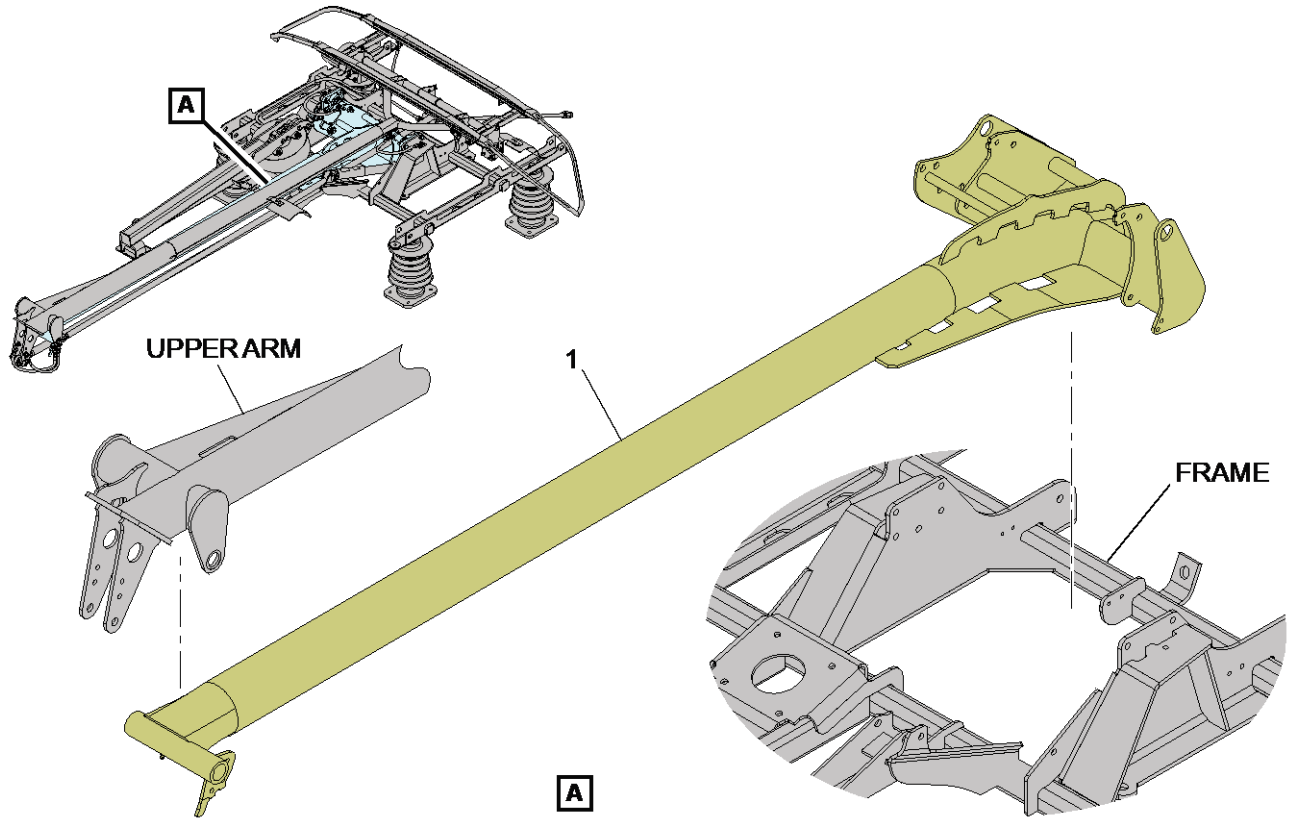
- For installation prepare XE043656-0101 [M15], refer to List of materials Section 7.3.
- Install Upper Rod / Lower Arm joint, according to section 8.9.2.1.
- Install Upper Rod / Swaying Shaft joint, according to section 8.9.2.2.

Follow the instructions as mentioned below for checking the Upper Rod:

- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.13 REPLACEMENT OF LOWER ARM



Note: Insulators are shown for illustration purpose.

Figure 81 – Replacement of Lower Arm

Location	Item No	Description	Part Number / Set Number	Qty
M07	**Lower Arm**		VE043659-0101	-
	1	Lower Arm	VE043659-0101	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 81

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Lower Arm:

- Move the Pantograph to lowered position.
- Remove the Flexible Connections, according to below sections:
  - Flexible Connections Long 1, according to 8.10.16
  - Flexible Connections Long 2, according to 8.10.17.
  - Flexible Connections Short, according to 8.10.15.
- Remove the Damper, according to Section 8.9.1.5.
- Remove the Collector Head, according to Section 8.10.4
- Remove the Swaying Shaft, according to Section 8.10.6.
- Remove the Upper Arm, according to Section 8.10.14.
- Remove the Cam, according to Section 8.10.2.
- Remove Lower arm Frame joint, according to section 8.9.2.3
- Remove and Separate Lower Arm (1) from Frame.

Follow the instructions as mentioned below for installation of the Lower Arm:

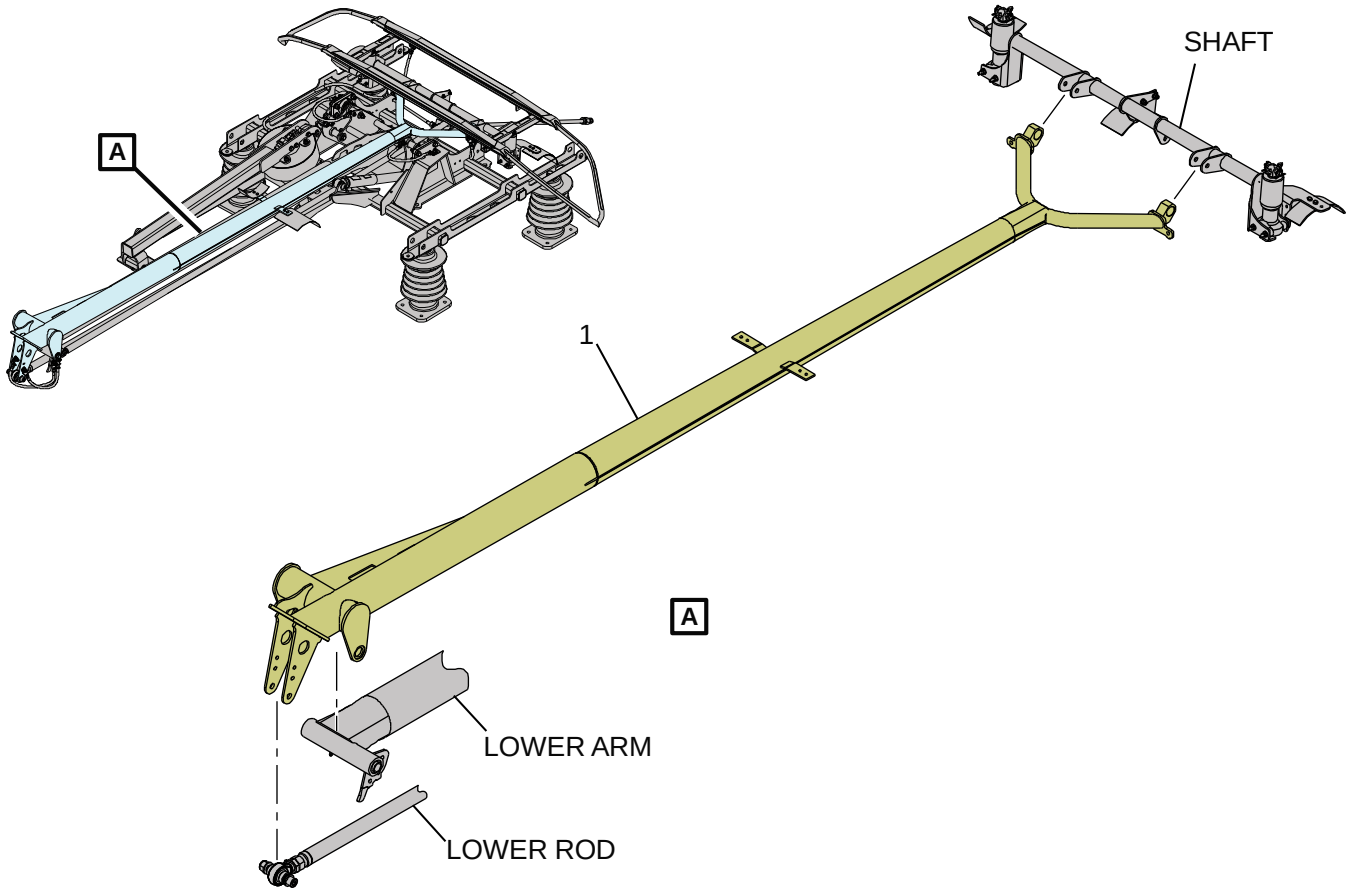
- For installation prepare VE043659-0101 [M07], refer to List of materials Section 7.3.
- Position Lower arm to Frame.
- Install Lower arm Frame joint, according to section 8.9.2.3.
- Install the Cam, according to Section 8.10.2.
- Install the Upper Arm, according to Section 8.10.14.
- Install the Swaying Shaft, according to Section 8.10.6.
- Install the Collector Head, according to Section 8.10.4
- Install the Damper, according to Section 8.9.1.5.
- Install the Flexible Connections, according to below sections:
  - Flexible Connections Long 1, according to 8.10.16
  - Flexible Connections Long 2, according to 8.10.17.
  - Flexible Connections Short, according to 8.10.15.

Follow the instructions as mentioned below for checking the Lower Arm:

- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Collector Head horizontal position, according to Section 8.6.8.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.14 REPLACEMENT OF UPPER ARM



Note: Insulators are shown for illustration purpose.

Figure 82 – Replacement of Upper Arm

Location	Item No	Description	Part Number /	Qty
M10	**Upper Arm**		**VE043662-0101**	-
	1	Upper arm	VE043662-0101	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 82

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Upper Arm:

- Move the Pantograph to lowered position.
- Remove the Flexible Connections Long 2, according to 8.10.17.
- Remove the Collector Head, according to Section 8.10.4
- Remove the Upper arm / Shaft joint, according to Section 8.9.2.8.
- Remove the Lower Arm / Upper Arm joint, according to Section 8.9.2.4.
- Remove the Lower Rod / Upper Arm joint, according to Section 8.9.2.7.
- Lift and Separate Upper Arm (1) along with Aerofoils from Pantograph.
- Remove Aerofoils from Upper Arm (1) according to Section 8.10.1

Follow the instructions as mentioned below for installing the Upper Arm:

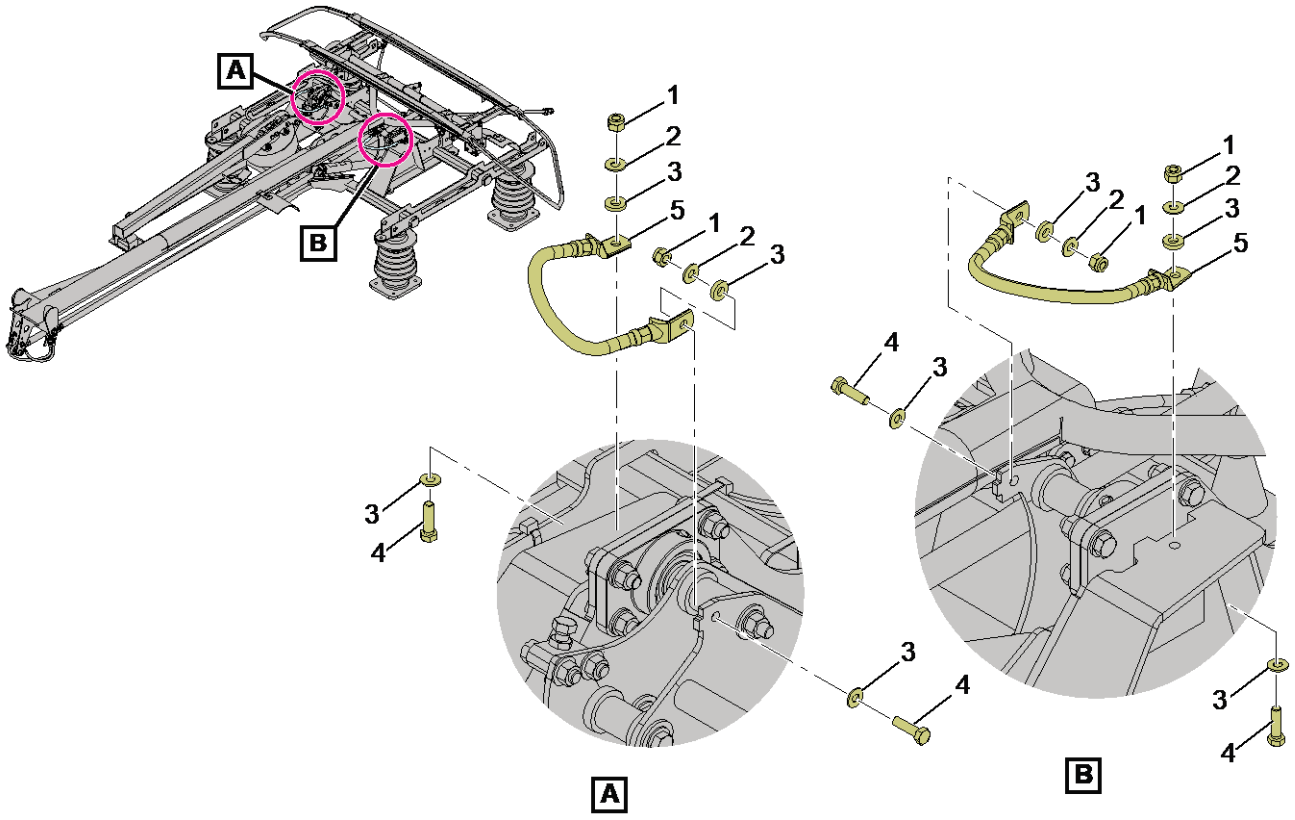
- For installation prepare VE043662-0101 [M10], refer to List of materials Section 7.3.
- Install Aerofoils from Upper Arm (1) according to Section 8.10.1
- Install Upper Arm (1) along with Aerofoils to Pantograph.
- Install the Lower Rod / Upper Arm Joint, according to Section 8.9.2.7.
- Install the Lower Arm / Upper Arm Joint, according to Section 8.9.2.4.
- Install the Upper arm / Shaft joint, according to Section 8.9.2.8.
- Install the Collector Head, according to Section 8.10.4
- Install the Flexible Connections Long 2, according to 8.10.17.

Follow the instructions as mentioned below for checking the Upper Arm:

- Verify the Raising and Lowering times, according to Section 8.6.6.
- Check the Collector Head horizontal position, according to Section 8.6.8.
- Check the Static Contact Force curve, according to Section 8.6.5.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.15 REPLACEMENT OF FLEXIBLE CONNECTIONS SHORT



Note: Insulators are shown for illustration purpose.

Figure 83 – Replacement of Flexible Connections Short

Location	Item No	Description	Part Number / Set Number	Qty
M20	**Flexible Connection Short**		**E043642-SET15**	2
	1	Stop Nut, M8	2930805-000	2
	2	CS Washer	3360801-000	2
	3	Washer M8	3220508-000	4
	4	Hex. Bolt M8 x 30	1300830-000	2
	5	Flexible Connection Short	VE038875-105	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 83

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of the Flexible Connections Short:

- Mark the position of the Flexible Connections (5).
- Remove the Nuts (1), Washers (2) and (3) and Screws (4) on both ends of Flexible Connections (5). One end is connected to Lower Arm and other end is connected to Frame.
- Remove the Flexible Connections (5).

Follow the instructions as mentioned below for installation of the Flexible Connections Short:

NOTE: The flexible connections must not touch any edge of the Pantograph structure or one each other during raising of the Pantograph.

Direction of the Cable Lugs are maintained to not obstruct the movement of the Lower Arm and Frame.

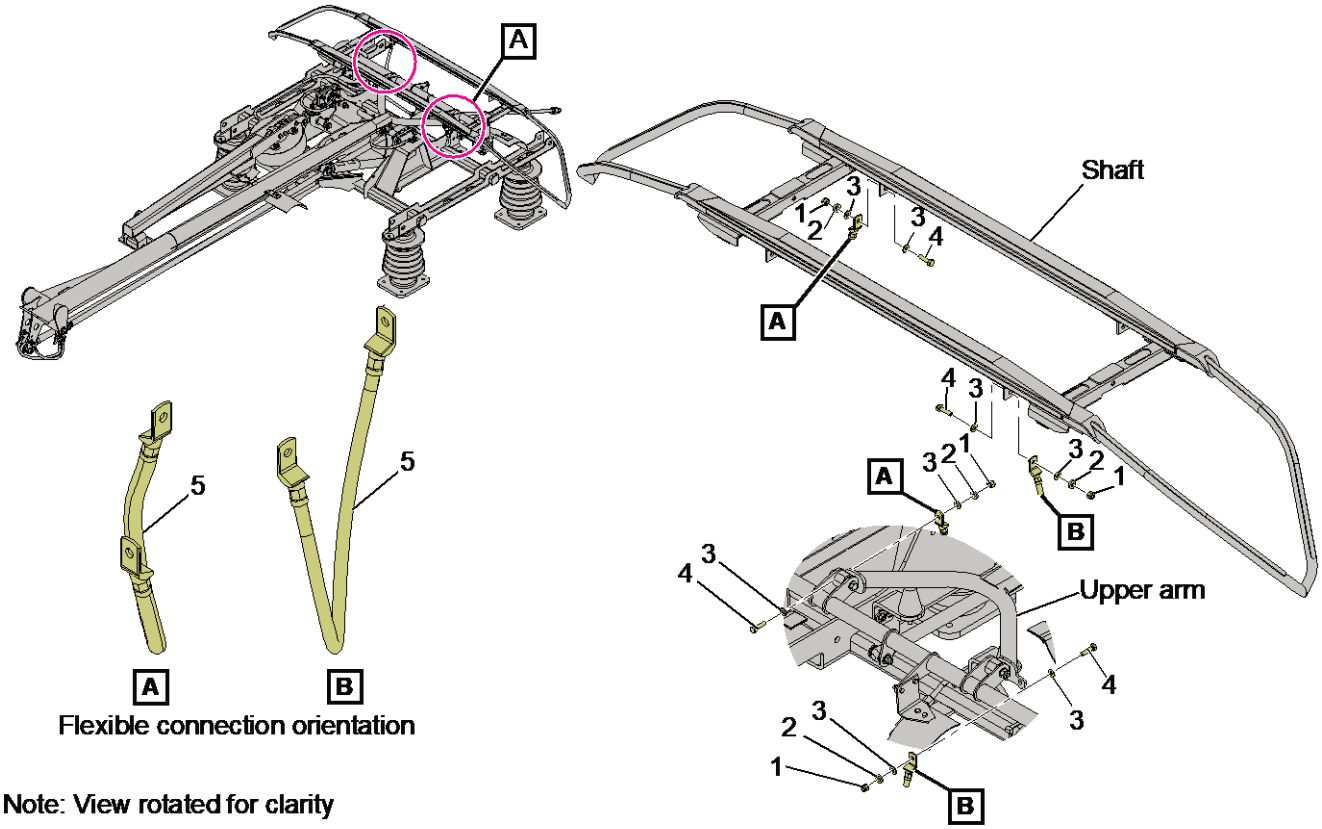
- For installation prepare E043642-SET15 [M20], refer to List of materials Section 7.3.
- Before installing the Flexible Connections, brush the surfaces which come into contact and lubricate with the CONTACTAL HPG Grease [B02].
- Lubricate Screws with Grease [B01] before assembly.
- Install the Flexible Connections (5) and secure with Screws (4) and Washers (3).
- Install the Washers (3), CS Washers (2) and Nuts (1). One end is connected to Lower Arm and other end is connected to Frame.
- Tighten the Nuts (1) to a torque of 20 Nm.

Follow the instructions as mentioned below for checking the Flexible Connections Short:

- Check that there is no interface or snagging with other parts, during raising of the Pantograph.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.16 REPLACEMENT OF FLEXIBLE CONNECTIONS LONG 1



Note: Insulators are shown for illustration purpose.

Figure 84 – Replacement of Flexible Connections Long 1

Location	Item No	Description	Part Number / Set Number	Qty
M18	**Flexible Connection Long - 1**		**E043642-SET13**	2
	1	Stop Nut, M8	2930805-000	2
	2	CS Washer	3360801-000	2
	3	Washer M8	3220508-000	4
	4	Hex. Bolt M8 x 30	1300830-000	2
	5	Flexible Connection Long 1	VE038875-106	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 84

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow the instructions as mentioned below for removal of Flexible Connections Long 1:

- Mark the position of the Flexible Connections (5).
- Remove the Nuts (1), Washers (2) and (3) and Screws (4) on both ends of Flexible Connections (5). One end is connected to Upper Arm and other end is connected to Strip Support.
- Remove the Flexible Connections (5).

Follow instructions as mentioned below for installation of Flexible Connections Long 1:

NOTE: The flexible connections must not touch any edge of the Pantograph structure or one each other during raising of the Pantograph.

Direction of the Cable Lugs are maintained to not obstruct the movement of the Upper Arm.

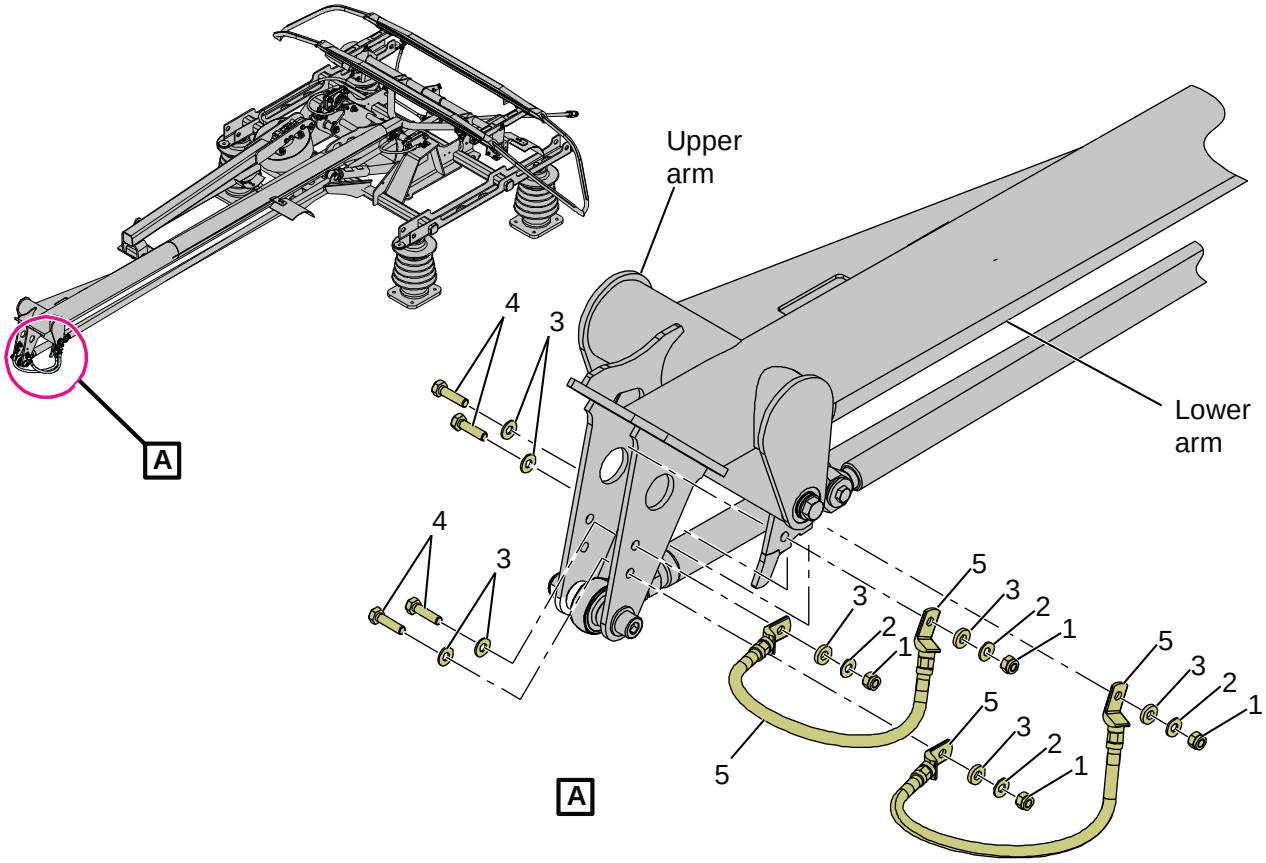
- For installation prepare E043642-SET13 [M18], refer to List of materials Section 7.3.
- Before installing the Flexible Connections, brush the surfaces which come into contact and lubricate with the CONTACTAL HPG Grease [B02].
- Lubricate Screws with Grease [B01] before assembly.
- Install the Flexible Connections (5) and secure with Screws (4) and Washers (3).
- Install the Washers (3), CS Washers (2) and Nuts (1). One end is connected to Upper Arm and other end is connected to Support.
- Tighten the Nuts (1) to a torque of 20 Nm.

Follow the instructions as mentioned below for checking the Long Flexible Connections 1:

- Check that there is no interface or snagging with other parts, during raising of the Pantograph.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

8.10.17 REPLACEMENT OF FLEXIBLE CONNECTIONS LONG 2



Note: Insulators are shown for illustration purpose.

Figure 85 – Replacement of Flexible Connections Long 2

Location	Item No	Description	Part Number / Set Number	Qty
M19	**Flexible Connection Long - 2**		**E043642-SET14**	2
	1	Stop Nut, M8	2930805-000	2
	2	CS Washer	3360801-000	2
	3	Washer M8	3220508-000	4
	4	Hex. Bolt M8 x 30	1300830-000	2
	5	Flexible Connection Long 2	VE038875-108	1

NOTE: For item numbers mentioned below in bracket, refer to Figure 85

NOTE: Refer Spare part catalogue to order specific components. The above part numbers are for illustrative purpose only.

NOTE: Never reuse CS washer and stop nuts/prevailing torque nuts once removed.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Follow instructions as mentioned below for removal of the Flexible Connections Long 2:

- Mark the position of the Flexible Connections (5).
- Remove the Nuts (1), Washers (2) and (3) and Screws (4) on both ends of Flexible Connections (5). One end is connected to Upper Arm and other end is connected to Lower Arm.
- Remove the Flexible Connections (5).

Follow instructions as mentioned below for installation of Flexible Connections Long 2:

NOTE: The flexible connections must not touch any edge of the Pantograph structure or one each other during raising of the Pantograph.

Direction of the Cable Lugs are maintained to not obstruct the movement of the Upper Arm and Lower Arm.

- For installation prepare E043642-SET14 [M19], refer to List of materials Section 7.3.
- Before installing the Flexible Connections, brush the surfaces which come into contact and lubricate with the CONTACTAL HPG Grease [B02].
- Lubricate Screws with Grease [B01] before assembly.
- Install the Flexible Connections (5) and secure with Screws (4) and Washers (3).
- Install the Washers (3), CS Washers (2) and Nuts (1). One end is connected to Upper Arm and other end is connected to Lower Arm.
- Tighten the Nuts (1) to a torque of 20 Nm.

Follow instructions as mentioned below for checking the Flexible Connections Long 2:

- Check that there is no interface or snagging with other parts, during raising of the Pantograph.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

/// 9.TRANSPORTATION, MANIPULATION, STORAGE AND DISPOSAL

9.1 TRANSPORT AND MANIPULATION

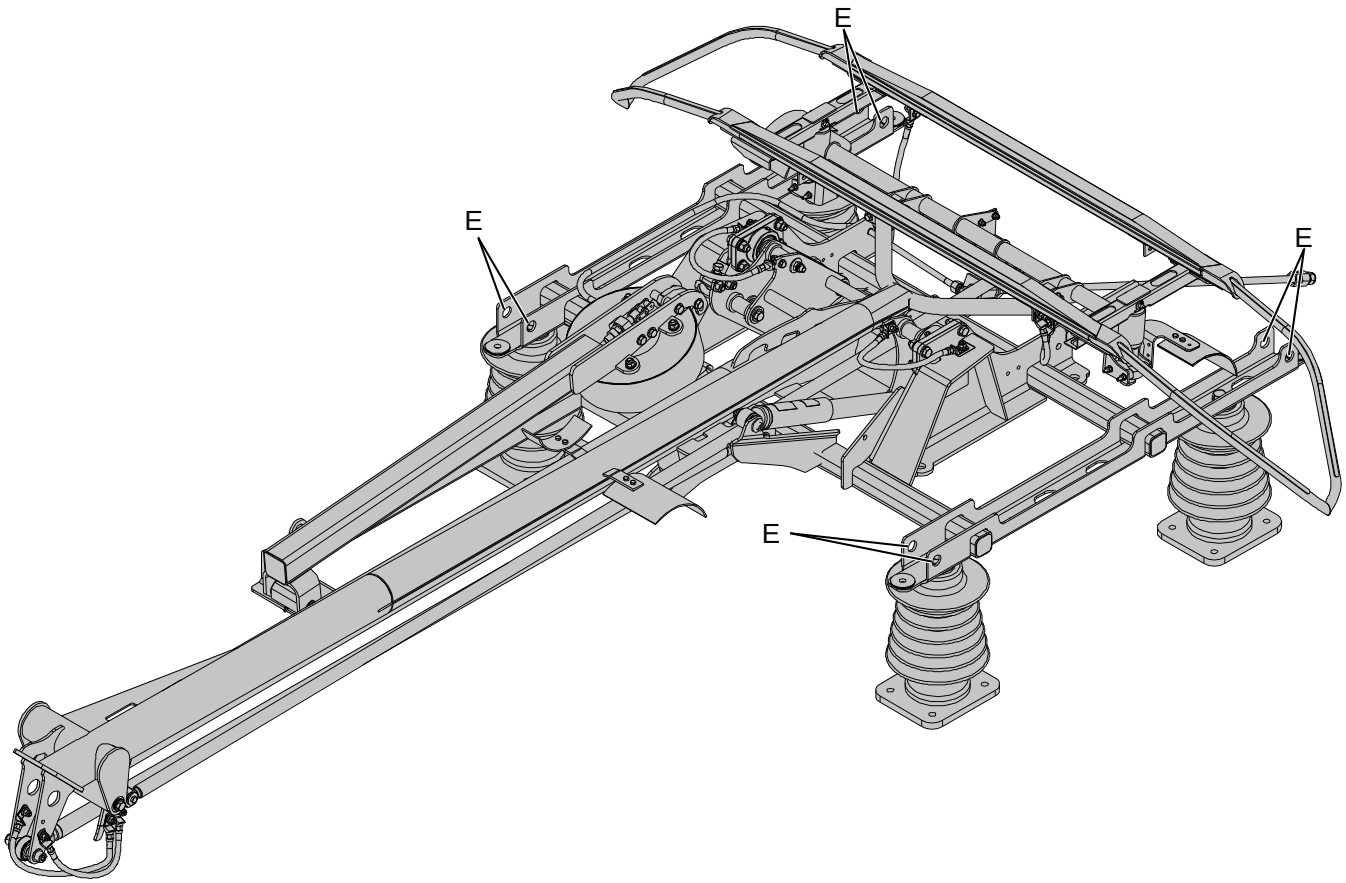
Pantograph is fixed to a completely assembled Pallet.
Pantograph parts delivered separately:

- 4x Insulators - not Wabtec scope of delivery.
- 1x Pipe Assembly and
- 1x Union Double Fitting
- Pneumatic Control Unit (not placed on the Pantograph structure).

NOTE: Numbers corresponding with assembly drawing (E043642-0101).

NOTE: Refer to Section 8.8.1 for Installation of Pantograph.

Pantograph is equipped with four handling points for Manipulation during transport, service or Installation. Mark “E” on Figure 86.



Note: Insulators are shown for illustration purpose.

Figure 86 – Pantograph with Handling Points

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

9.2 STORAGE

9.2.1 TRANSPORT AND MANIPULATION

Pantograph can be stored in outside environment but in case of prolonged storage (more than 3 months), it is necessary to follow the below mentioned points:

- Store in indoor areas and they should not be affected from rain and snow.
- Protect the Pantograph (specially the Rubber End Stops) against direct Sunlight. Rubber parts will have longer life, if protected against UV light.
- Lubricate the Pantograph parts, according to maintenance procedures.
- Apply Grease [B01] to free threaded ends of Screw connections for protection.
- Check the Pantograph according to plan of maintenance Section 8.3.

NOTE: If the Pantograph has been stored in low temperature for a longer period, it is necessary to carry out a functional test before installation, in order to verify whether joints are not seized-up.
Before installation after prolonged storage, it is necessary to follow the below mentioned point:

- Check, if the Pantograph can reach maximum extension.
- Check, if the lowering is smooth and without any shocks.
- Check the tightness of the Pneumatic connections.

9.2.2 PNEUMATIC CONTROL UNIT (PCU)

Pneumatic Control Unit (PCU) must be stored only inside.

- Check the Pneumatic Control Unit (PCU), according to plan of maintenance Section 8.3.

9.2.3 DISPOSAL

Pneumatic Control Unit (PCU) must be stored only inside.
Safe waste disposal is according to the standard: ISO 22628: 2002.
Road vehicles-recyclability and recoverability-calculation method.
The weight of Pantograph is separated into several weights, according to the recyclability.
Example for Pantograph weights are mentioned in below Flowchart, refer to Figure 87.

Distribution of vehicle weights	
MP	Weight of the materials considered during pre-treatment stage.
MD	Weight of the materials considered during dismantling / disposal stage.
Mm	Weight of the metals considered during the stage during which metals are separated.
MTr	Weight of the materials considered during which non-metallic residues considered as recyclable are treated.
MTe	Weight of the materials considered for treatment of non-metallic residues, considered as not recyclable but recoverable for their energy content.
MV	Weight of the Pantograph.
D	Waste: weight of the materials not considered in the previous stages. Paints, glues, inscriptions and logos, etc.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

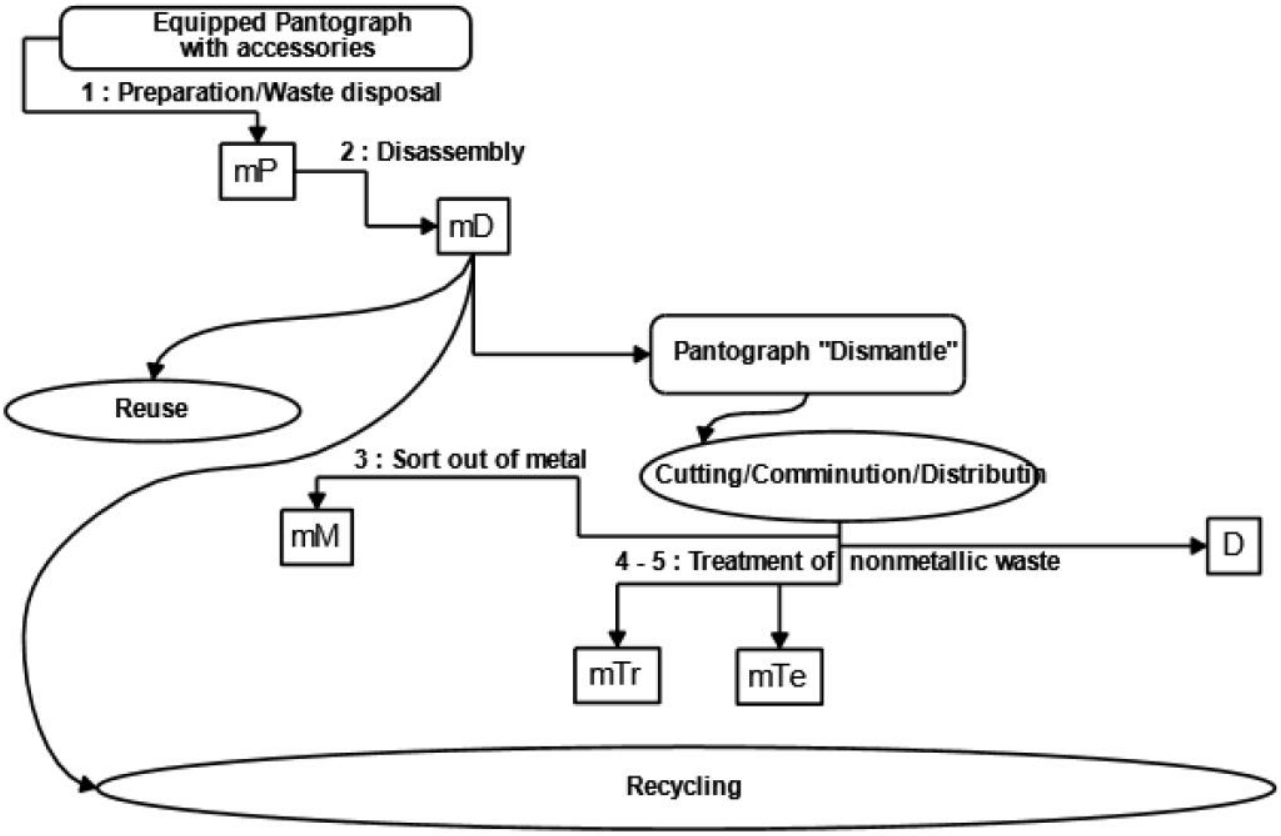


Figure 87 – Pantograph Weights Chart

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

9.3 TELESCOPIC SUPPORT

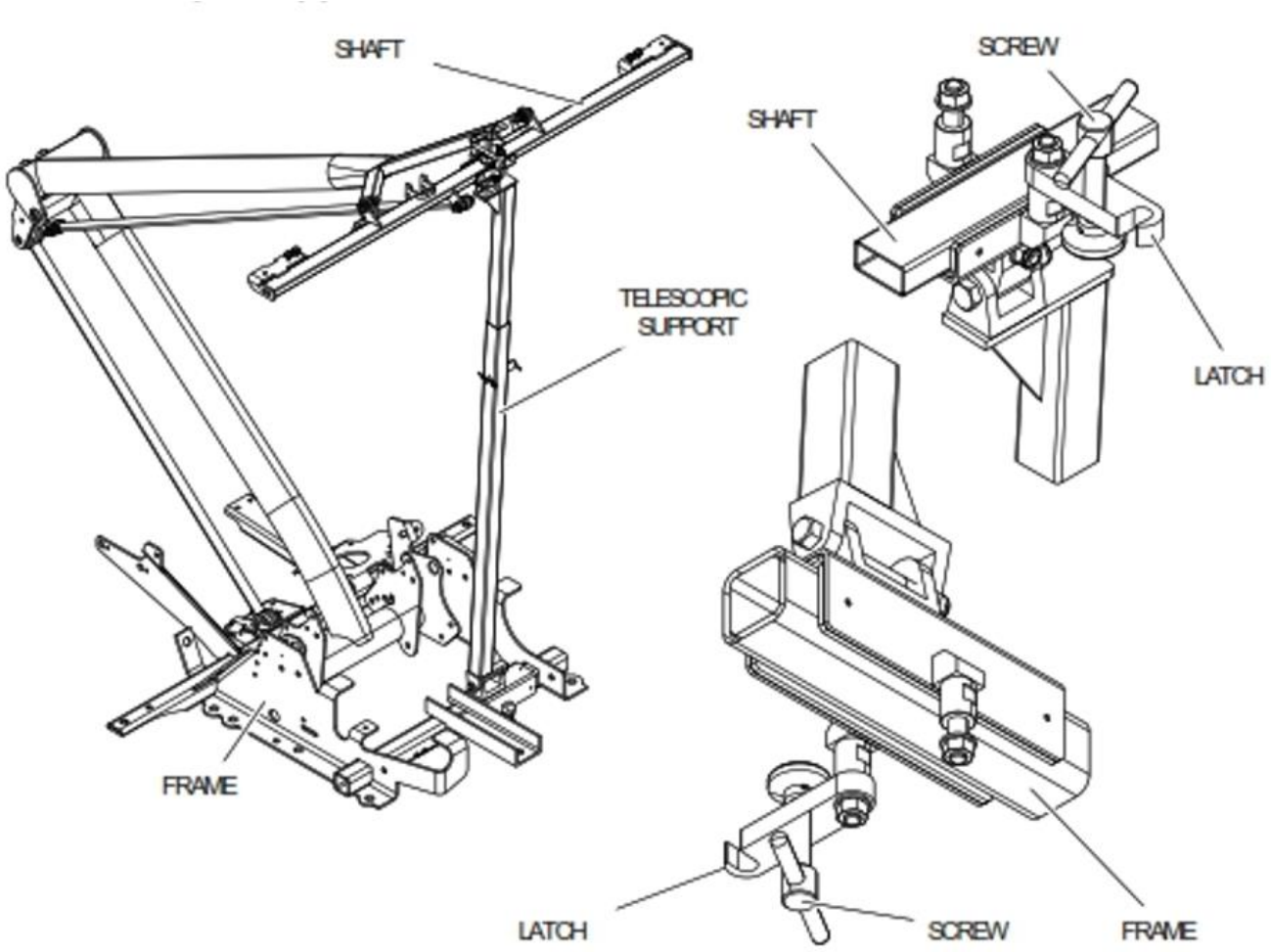


Figure 88 – Telescopic Support

Warning! Do not disconnect Pantograph in joints while it's supported by telescopic support!

Disconnecting Pantograph in joints can lead it to collapse and cause serious injuries.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

9.4 TEST BENCH 151SMC-LITE

Test Bench 151SMC-lite is special tool and optional solution.

Test Bench 151SMC-lite can be used for the measurement of the Static Force curve characteristic of Pantograph.

Test Bench 151SMC-lite is connected to Pantograph and signal to raise / lower the Pantograph are given along with predetermined values.

Test Bench 151SMC-lite records the data and plots the graph and measures after every setting of the Static Force. The curve must be inside the fixed value for correct functioning of Pantograph.

Test Bench 151SMC-lite equipment can report (Static curve) the precise setting of Pantograph.

Refer to Section 8.6.5 for Static Force Adjustment.

Test bench is used for setting in shop floor along with static weights manually.

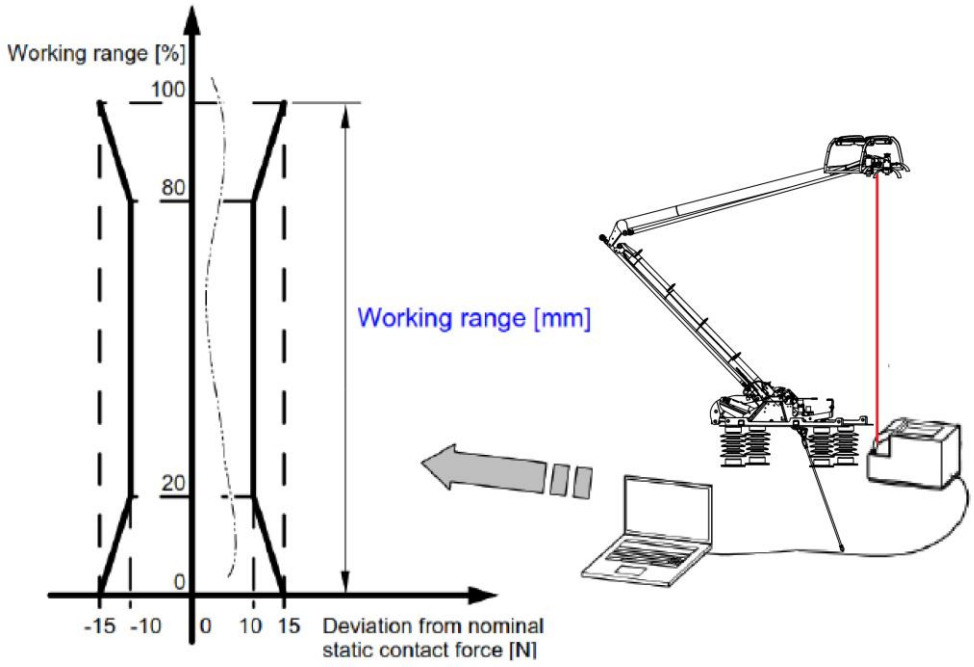


Figure 89 – 151SMC-lite - test bench description

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

Set for static force adjusting which consist of:

- Test desk
- Dynamometer 151SMC-lite (tester)
- Computer + software
- Maintenance manual (EN).

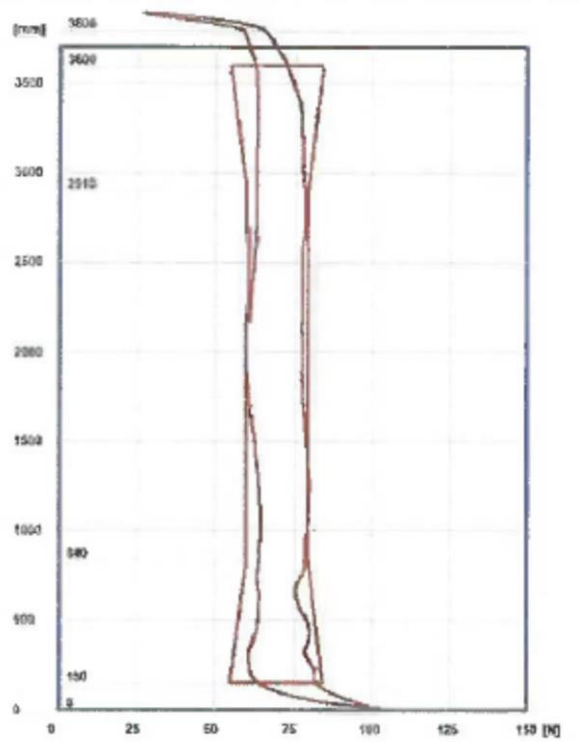


Figure 90 – Dynamometer Recording

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited

9.5 151SMC-LITE USER AND MAINTENANCE MANUAL

Refer to Document SMC system.pdf.

FAIVELEY TRANSPORT RAIL TECHNOLOGIES INDIA LTD.
This document contains legally privileged, confidential, proprietary or otherwise private information. Any unauthorized use, reproduction, dissemination, distribution or other disclosure of the contents is strictly prohibited