

SAF CD self steering axles models covered:

- ZIL9-19W
- BIL9-19W
- ZL9-3020
- ZL8-3718
- SL8-4218

Steer Axle Maintenance & Servicing Training Module - CD Axle

Disclaimer

- These instructions are an over view of key servicing steps taken from the SAF-Holland Maintenance and Parts Manuals.
- These reference instructions do not override instructions listed in the applicable service manual.
- Before beginning a service you must ensure the full service procedure has been read and understood.
- SAF-HOLLAND axles and suspension systems require continuous care, servicing and maintenance in order to be maintained to a safe operational standard.
- Frequent servicing and inspection will help recognise normal wear and tear and identify defects in time.
- The daily inspection of the vehicle for road safety before starting the journey is one of the driver's obligations.
- SAF-HOLLAND recommends that as a minimum the following inspection and maintenance operations should be carried out.
- Equipment operating in extreme conditions should have their service interval reduced where required.

Warranty claims will only be accepted as long as the operating and maintenance instructions have been completed and SAF spare parts have been fitted.

Warnings

- SAF HOLLAND axle components by nature are heavy. Correct lifting techniques and equipment must be used to avoid personal injury. Always ensure items being lifted fall within the SWL for equipment.
- Do not dismantle or work on any part of an axle if you do not feel appropriately qualified or trained to do so.
- Ensure all components are appropriately secured on a stable platform before commencing any work.
- Ensure all tooling is rated for the task at hand and in a safe working condition.

Wheel Alignment

Settings axle, suspension



Axle alignment

General

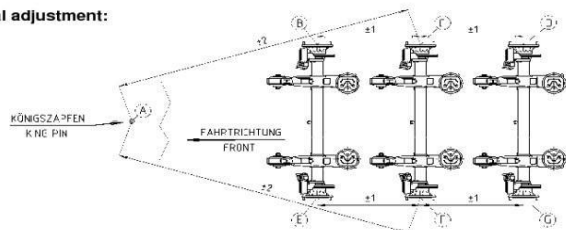
In order to compensate the production tolerances, an axle alignment and, if necessary, an adjustment should be carried out. The maximum permissible deviations (tolerances) of the alignment values are specified by the tyre manufacturer.

The maximum possible wheelbase correction per axle is ± 6 mm, [see page 29](#)

Basic condition

The axle alignment must be done in unladen situation. With air suspension the trailer has to be adjusted in the right ride height.

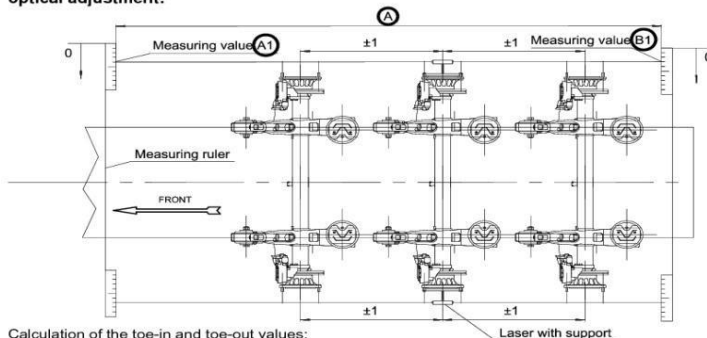
Conventional adjustment:



Procedure:

Determine the lengths of the diagonals **A - C** and **A - F** for the middle axle (reference axle) by comparison measurements, observing the tolerances ($\pm 2,0$ mm).
Check the wheelbases **B - C** and **E - F** for the front axle and **C - D** and **F - G** for the rear axle and correct, if necessary, observing the tolerances ($\pm 1,0$ mm).

optical adjustment:



Calculation of the toe-in and toe-out values:

$$\frac{A1(\text{mm}) - B1(\text{mm})}{A(\text{m})} = C$$

C (positive value) = toe-in
C (negative value) = toe-out

Observe the operating and setting instructions of the measuring system manufacturer.

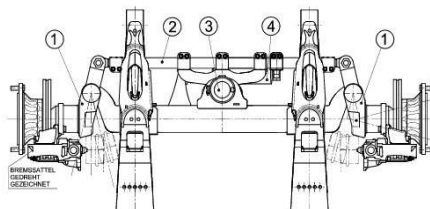
- Disconnect the steering damper and disengage the reverse lock
- Ensure the axle group is aligned to follow the 5th wheel king pin or centre of the ball race.
- Align steering axle straight ahead, with the required toe in.
- Adjust the axle lock to centre with the plunger.
- Refit the steering damper to centre so the bolts are freely going through, do not apply a force to align the bolt holes.
- Tyre pressures play a crucial role with regard to the forces affecting the steering axle and need to be maintained regularly.

Self-steering axle with stabilising damper

Steering mechanism

In the case of self-steering axle with stabilising damper, the steering mechanism comprises:

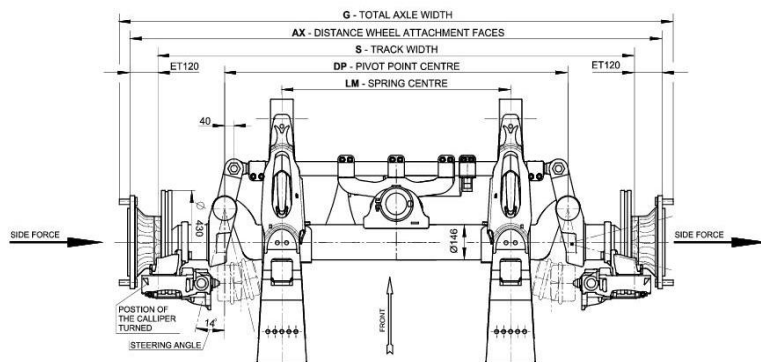
- two pivot-mounted steering knuckles (1)
- a steering tie rod (2)
- a reversing lock (3)
- a stabilising damper (4)



Functional description

Side forces occur in the tyre contact areas when vehicles drive round bends or overtake other vehicles. On account of the offset between the steering knuckle bearings to the axle centre of 140 mm, these side forces (left and right) produce a steering torque that acts on the steering knuckles and forces them into an angled position. This angled position is the so-called axle steering angle. The steering tie rod is responsible for the synchronous turning movement between the left and right steering knuckles.

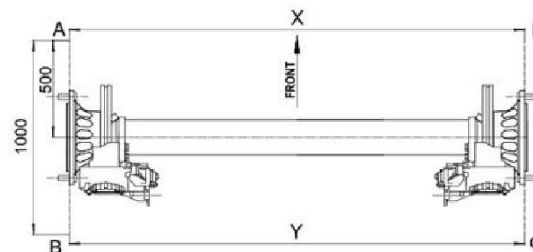
The stabilisation damper is suspended on the axle body on one side and on the steering tie rod on the other. This is either pressed (shortened) or pulled (lengthened) depending on the angle of rotation of the steering knuckles. The special design of this SAF stabilisation dampers means that its internal spiral spring is always compressed during both movements.



As the side forces decrease, the spring force increases in comparison with the side forces, and forces the tyres and/or steering knuckles back into the straight position. The spiral spring, supported by the damper properties, is also the reason for a sturdy and flutter-free straight drive.

To make reversing possible with a self-steering axle, it has to be set rigid. This is done electro-pneumatically through the reversing lock, the task of which is to prevent the steering tie rod moving and to block it in the central position (driving straight on) by the spring-type cylinder.

Positive toe-in/ toe-out:



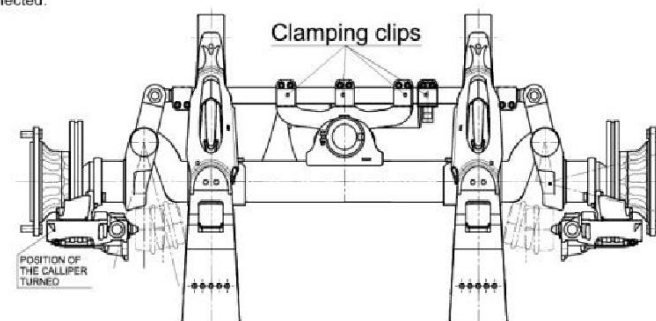
Rigid axle:

Toe-in: +0 to +12' = max. +3,5 mm/m (Example: $Y - X = 0 + 3,5$ mm)

Self-steering axle:

Toe-in: +14 to +24' = min. +4 mm/m to max. +7 mm/m (Example: $Y - X = 4$ mm to 7 mm)

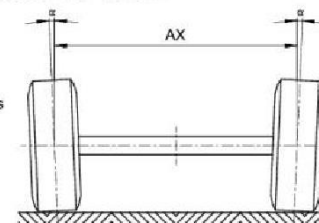
The setting is carried out by lengthening or shortening the steering tie rod. After all the clamping clips have been loosened, the required dimension is set by turning steering tie rod. The tie-rod ends are not affected.



Measuring the axle geometry: Deviations in the distances $AC - BD = 0 \pm 3$ mm

Camber:

The wheel camber (α) has been designed fixed and cannot be adjusted. For the unloaded axle, the value is $\pm 12'$ positive camber (corresponds to 3,5 mm/m)



In order to avoid tyre wear, we recommend that an axle alignment is performed at regular intervals.

We recommend the use of an optical measuring system for carrying out the axle alignment. For alignment, only the centres of the middle of the wheel cap or the middle of the axle stub end are of interest as reference points. Possible causes of deviations in the axle alignment are:

- ✓ Wear of the pivot bush
- ✓ Deformation of the axle assembly components due to improper use.

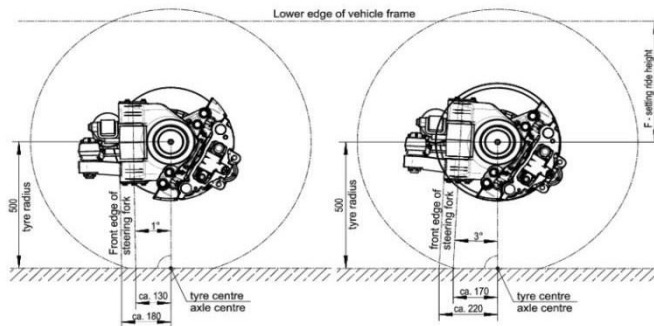
Ride Height

Self-steering axle



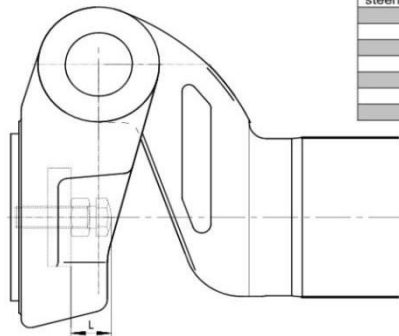
Caster

Installed in a suspension system, the caster (distance steering bolt centre lengthened to the ground to the centre of the tyre contact area) may vary in vehicle setting between 130 mm (steering pin tilted forwards) and 170 mm (steering pin tilted backwards). In contrast to leaf spring suspension, the caster can be influenced in the case of air suspension by the ride height setting.



Steering angle

With SAF self-steering axles, the steering angle is limited to 20° on account of the design. This can be reduced if required, depending on the track width and spring centre ratio. For this purpose, the adjusting screw on the steering knuckle should be screwed out according to the values in the following table and then countered by a locknut.



steering angle	bolt overhang „L“
20°	35 mm
18°	40 mm
16°	45 mm
14°	49 mm
12°	54 mm
10°	59 mm
8°	64 mm

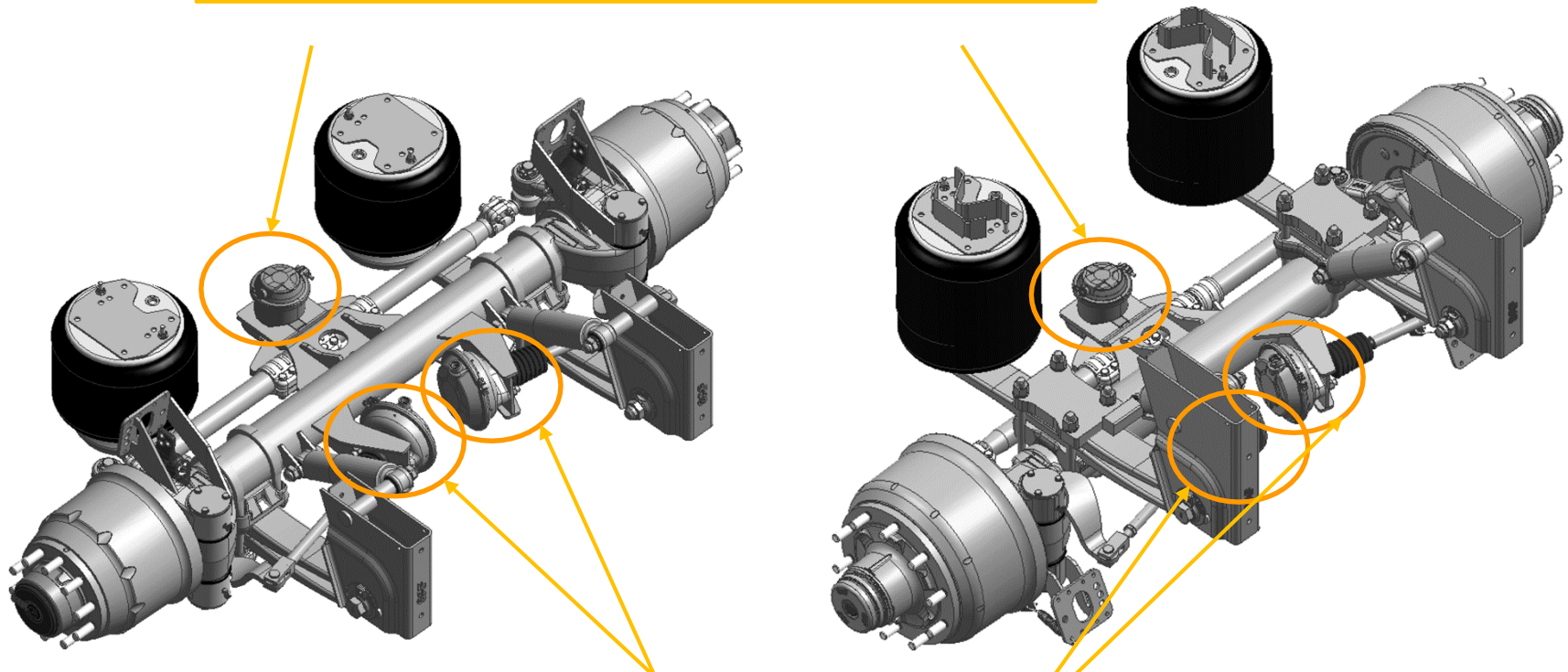
Items to note

- When adjusting the ride height stay with 10mm down and 20mm up of the design ride height.
- When you lower the ride height it reduces the castor angle, similarly increasing it will increase the castor angle.

Steering axles

Self-steering axle with stabilization cylinders

Locking mechanism for reversing. Locks the tie rod and steering knuckles in the middle position.



Stabilization cylinders ensure self-aligning torque (steering response) when curve exceeds load factor (dependent on air suspension bag pressure)

Pneumatic Steering Stabilising

Self-steering axle

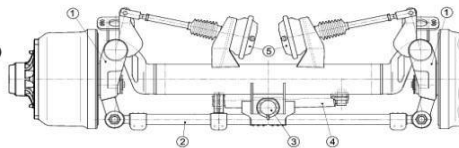


Self-steering axle with pneumatic steering stabilising

Steering mechanism

In the case of self-steering axle with pneumatic steering stabilising, the steering mechanism comprises:

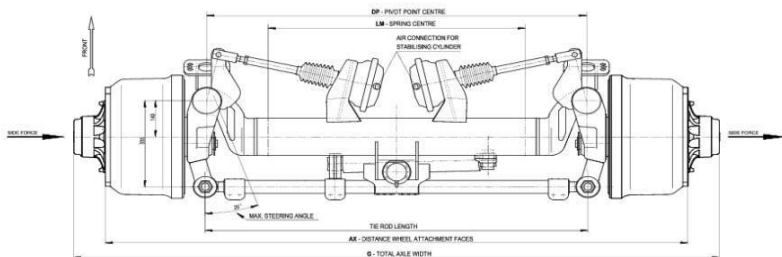
- two pivot mounted steering knuckles (1)
- a steering tie rod (2)
- a reverse lock (3)
- a steering damper (4)
- two stabilising pneumatic cylinders with push rods (5)



Functional description

Side forces occur in the tyre contact areas when vehicles drive round bends or overtake other vehicles. On account of the offset between the steering knuckle bearings to the axle centre of 140 mm, these side forces (left and right) produce a steering torque that acts on the steering knuckles and forces them into an angled position. This angled position is the so-called axle steering angle. The steering tie rod is responsible for the synchronous turning movement between the left and right steering knuckles.

The stabilising cylinders are connected on one side with the axle beam and on the other side over a steering arm with the steering knuckle. The stabilising cylinders are under normal straight drive fully extended and are under load depending pressure (by the connection with the air bag) without force on the steering arms. When cornering (side force) the push rod of the stabilising chamber nearest to the inside tyre is pressed to the inside against the cylinder force. The telescopic push rod of the other stabilising cylinder is pulled out pressure less.



As the side forces decrease, the force in the stabilising cylinder increases in comparison with the side forces and forces the tyres and/or steering knuckles back into the straight position. The steering damper supports a sturdy and flutter-free drive.

When adjusting, the stabilising pressure needs to be minimum 2,0 bar.

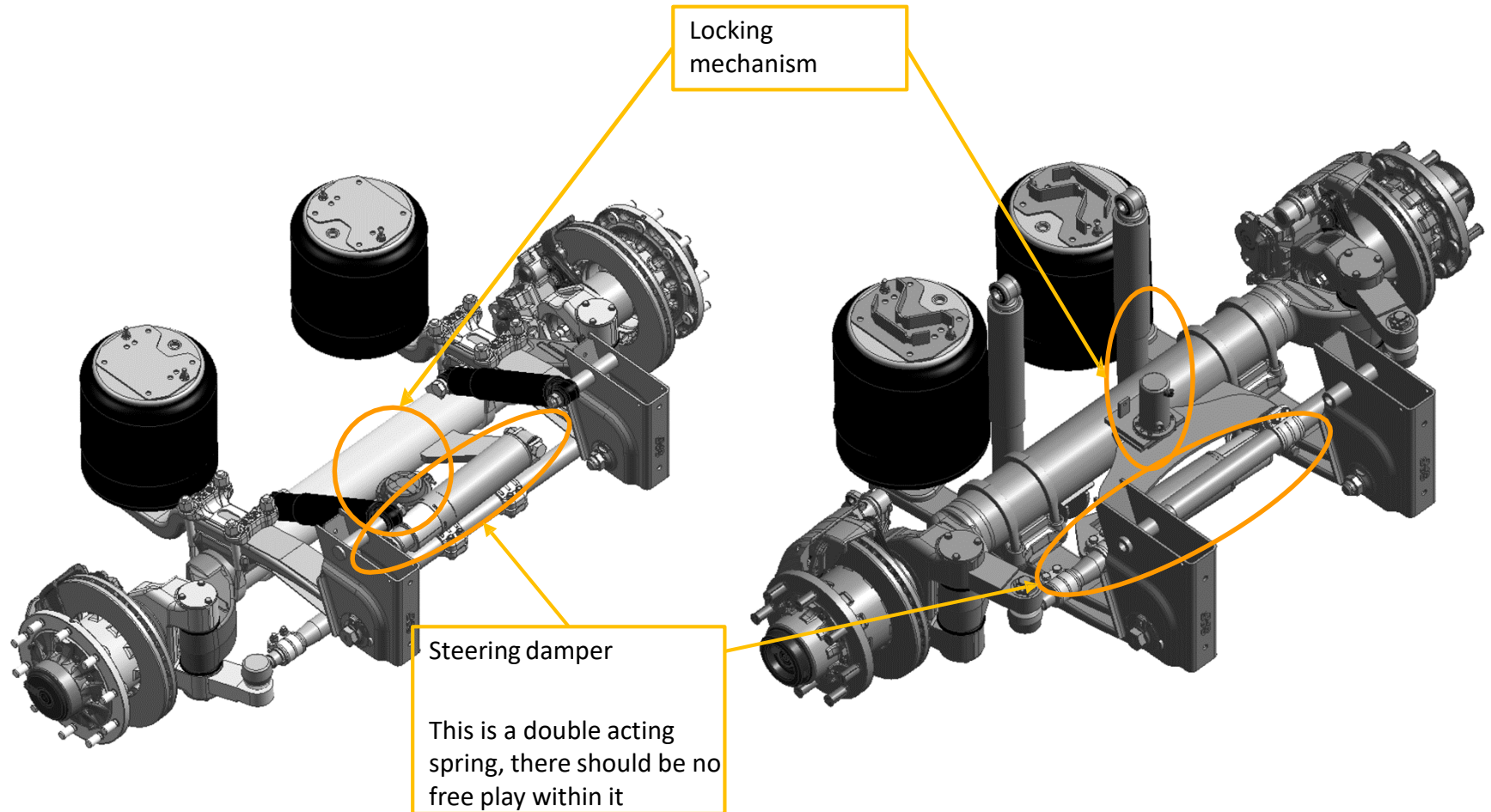
To make reversing possible with a self-steering axle, it has to be set rigid. This is done electro-pneumatically through the reversing lock, the task of which is to prevent the steering tie rod moving and to block it in the central position (driving straight on) by the spring-type cylinder.

Items To Note

- A minimum pressure must be set at 2 bar.
- If plumbed directly to the air springs, unladen the spring pressure is around 0.5 bar, which is too low.
- Some form of pressure retention needs to be used typically from Transpecs the 4A/SLK

Steering axles

Self-steering axle with steering damper



SAF self-steering axle with stabilising damper



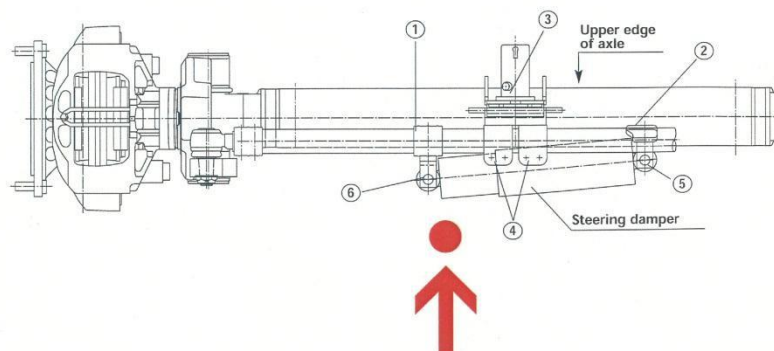
Installation Instructions

Important:

The length of the stabilising damper is preset in the "straight ahead" position for the wheels. It is not permitted to change the length set.

Installation Procedure

- Set the air suspension to the correct ride height
- Set the wheels of the axle in the exact "straight ahead" position, if necessary measure the alignment and adjust, the reverse lock must be able to engage (3), if necessary adjust the check plate using the clamps (4).
- Install stabilising damper on the axle side (2), put on bolt (5), do not tighten.
- Install stabilising damper on clamp (1), the M24 (6) bolt should slide on easily, if necessary, adjust the clamp (1) on the tie rod.
- Tighten the bolts with a torque wrench:
 - a) Bolts M12 (WAF 19) on the clamp (1 + 4) Torque setting 90 Nm
 - b) Pos. 5 + 6, M 24 (WAF 36) of the stabilising damper Torque setting 660 Nm
- Test drive and check function
After negotiating curves the wheels of the self-steering axle must return to the "straight ahead" position without delay, if necessary check ride height.



The red dot must be facing to the ground after installation!

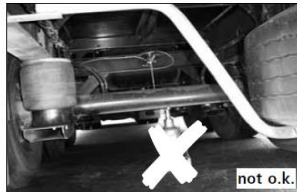
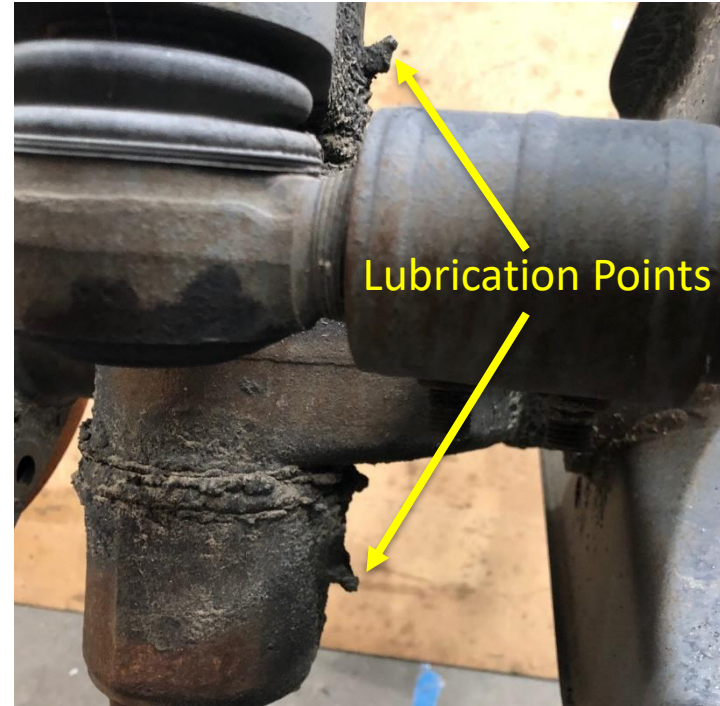
Lubrication

Regular lubrication is critical to ensure the steering axle king pin and bushes are in good working order, avoiding unnecessary costs and down time.

- The vehicle should be unladen before lifting an axle.
- Relieve the weight off the axle by jacking the wheels off the ground.
- Clean the lubrication points before attaching grease coupling.
- Pump grease in each point until the existing grease has been replaced. Refer figure 3.
- Wipe off any excess grease.

Service Intervals:

- Lubricate the steering axle king pins before the vehicle enters service and then after one month in service.
- It is recommended that the pins are lubricated during every trailer service, this will be dependent upon the operating conditions to maximise wear life. Though a maximum interval of 20,000kms or 3 months whichever is the sooner should be maintained.
- A good quality lubricant that suits the operating conditions should be used. The minimum recommendation is a lithium based EP2 grease.
- On major services or when down time allows it is recommended to remove the top and bottom covers and clean out to remove any contamination that may be present. Disconnect the steering damper and cycle the axle from lock to lock whilst re-greasing.



Wear limits - Tolerances

King Pin Lift:

Max 2mm vertical movement measured at the stub knuckle points

King Pin Rock:

Max 2mm horizontal movement measured at the stub knuckle points

Steering Damper

There should be no free play within the damper and bushes

The above are maximum values and repairs must be carried out at this point, these are safety critical components

Steering Knuckle Measurement

King Pin Lift:

Place the dial gauge to axle to measure from the top cover.

Using a jack on the bottom cover jack the axle and record the distance it moves.

If over 2mm replacement is critical.



King Pin Rock:

Place the dial gauge to measure the knuckle bearings.

Have an assistant rock the wheel top to bottom and measure the distance.

If over 2mm replacement is critical.



Tie Rod End Wear Limits - Tolerances

Inspect the rubber bellows on the Tie Rod End joints for splits, damage and for correct seating. For checking press the bellows by hand and ensure no water or grease escape. If there is any leakage the joint needs to be replaced.

Check for ball joint clearance:

- Radial Clearance - Shake the wheels, there should be no more than 0.25mm clearance. Any visible movement, change the ball joint.
- Axial Clearance – Maximum tolerance is 2mm with a checking force of 1050N. If clearance is tactile with hand force, change the ball joint.

When checking have the wheels on the ground in the straight ahead position

The above are maximum values and repairs must be carried out at this point, these are safety critical components

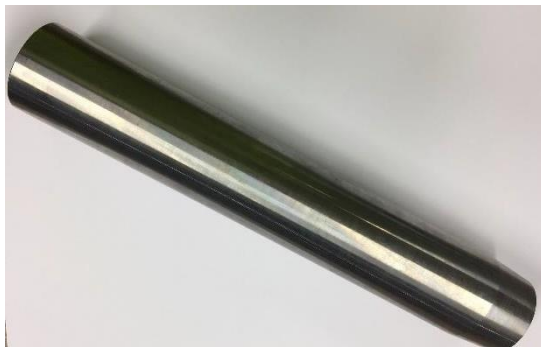
Specialist tooling required for overhauls and repairs

GENERIC TOOLS

- King pin press
- Two gas warming torches
- Tie rod end puller
- Fridge freezer or liquid nitrogen cooling capability

SAFHOLLAND specific tooling

- 4434106800 stub axle guide / thread protector
- 4230017000 King pin bush remover
- 4230017000 King pin bush installer
- 3434365700 King pin alignment tool



RLB King Pin Type

Items to note

- Wear limits –

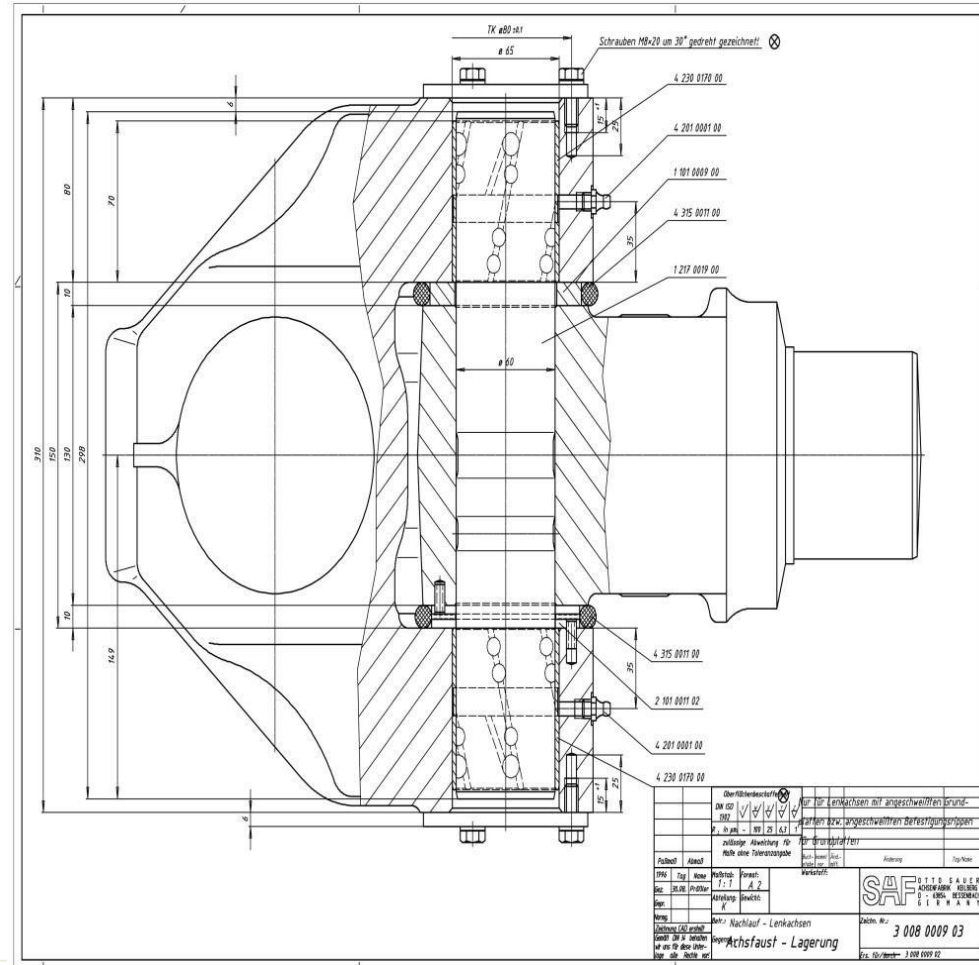
Maximum values, always remember steering is safety critical.

- Tie rod end 2mm
- Bushes 2mm
- Maximum lift of 2 mm

- Pins are heated to remove and frozen to install.

- Contact Transpecs for full replacement procedure and video guide.

- Lock stop at 15 degrees is 47mm long



Basic guide to replacing the king pins

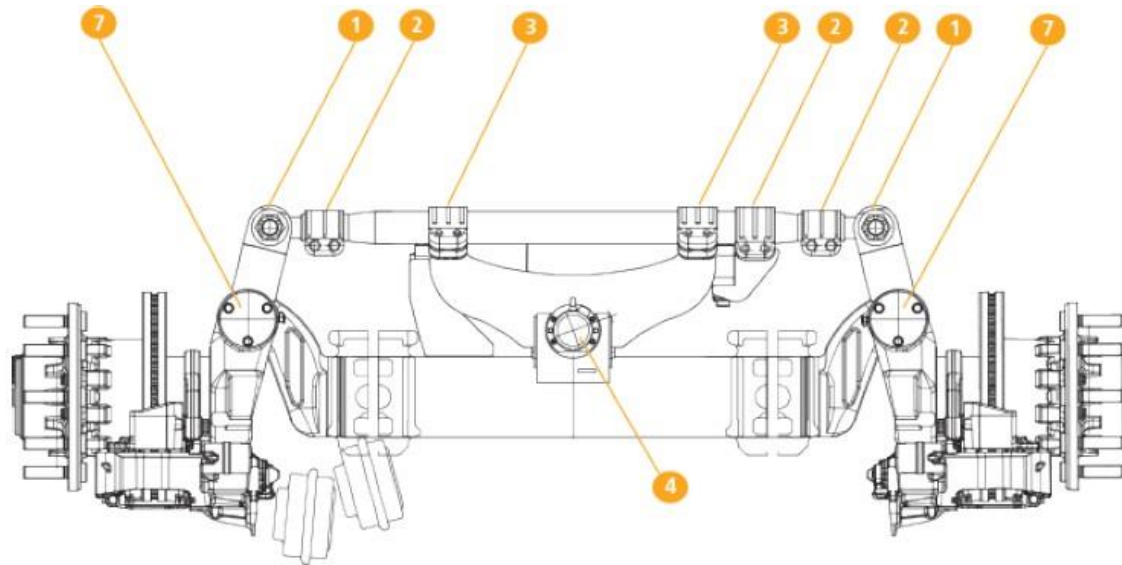
Before beginning the repair process:

- If you do not have access to liquid nitrogen then, you can try placing the new king pin into a freezer for 24hrs before it is required to be fitted.
- If you don't have access to a king pin press it is possible to remove the axle from the vehicle to carry out the repairs. Ensure you have the correct manual handling equipment as the axle weight is around 550kg.
- Remove ancillary items from the axle such as wheels, calipers, hub disc/drums and steering linkages etc to give easy access.

The key rebuild steps are:

- Remove top and bottom king pin plates.
- Quickly heat the pin eye with two oxy-acetylene gas torches to 600°C to avoid heat transfer into the pin.
- Push out the king pin.
- Push out brass bushes and replace.
- Deburr and clean axle & stub thrust faces as required.
- Test fit stub and measure thrust "Vertical clearance".
- Select required thrust plate.
- Fit up stub and install king pin guide with thrust bearings & washers in place
- Remove king pin from freezer and push through stub pushing out guide as it goes
- It may be required to push the king pin home the last few centimetres.
- Lubricate the king pin thoroughly whilst moving stub back and forth.
- Rebuild ancillary items and check all tolerances.

Tightening Torques



TIGHTENING TORQUES

No.	Designation	Number per axle	Tightening torque
1	Ball joint screw	2	M30 (240 Nm)
2	Retaining clamp screw	10	M12 (80-90Nm)
3	Steering damper screw	2	M24 (600 - 660Nm)
4	Lock cylinder screw	4	M6 (8 - 10 Nm)
5	Stabalising cylinder screw (not shown)	4	M16 (180 +/- 30Nm)
6	Lock nut	2	M20 (is locked against the thrust rod)
7	Cover plate screw	6	M8 (25 - 30Nm)

Summary

- Lubricate regularly – minimum every 20,000kms
 - Self steering axles are castor steer, both with trail and angle, so anything that affects these affects the centring forces of the axle e.g. ride and 5th wheel heights.
 - Correct wheel alignment crucial.
 - Ensure stabilisation devices are aligned and fitted correctly.
 - Never forget how important correct tyre pressures are.
-

Thank you for your attention

Service and Technical details :

Transpecs 09-980-7300

www.transpecs.co.nz

www.safholland.com

