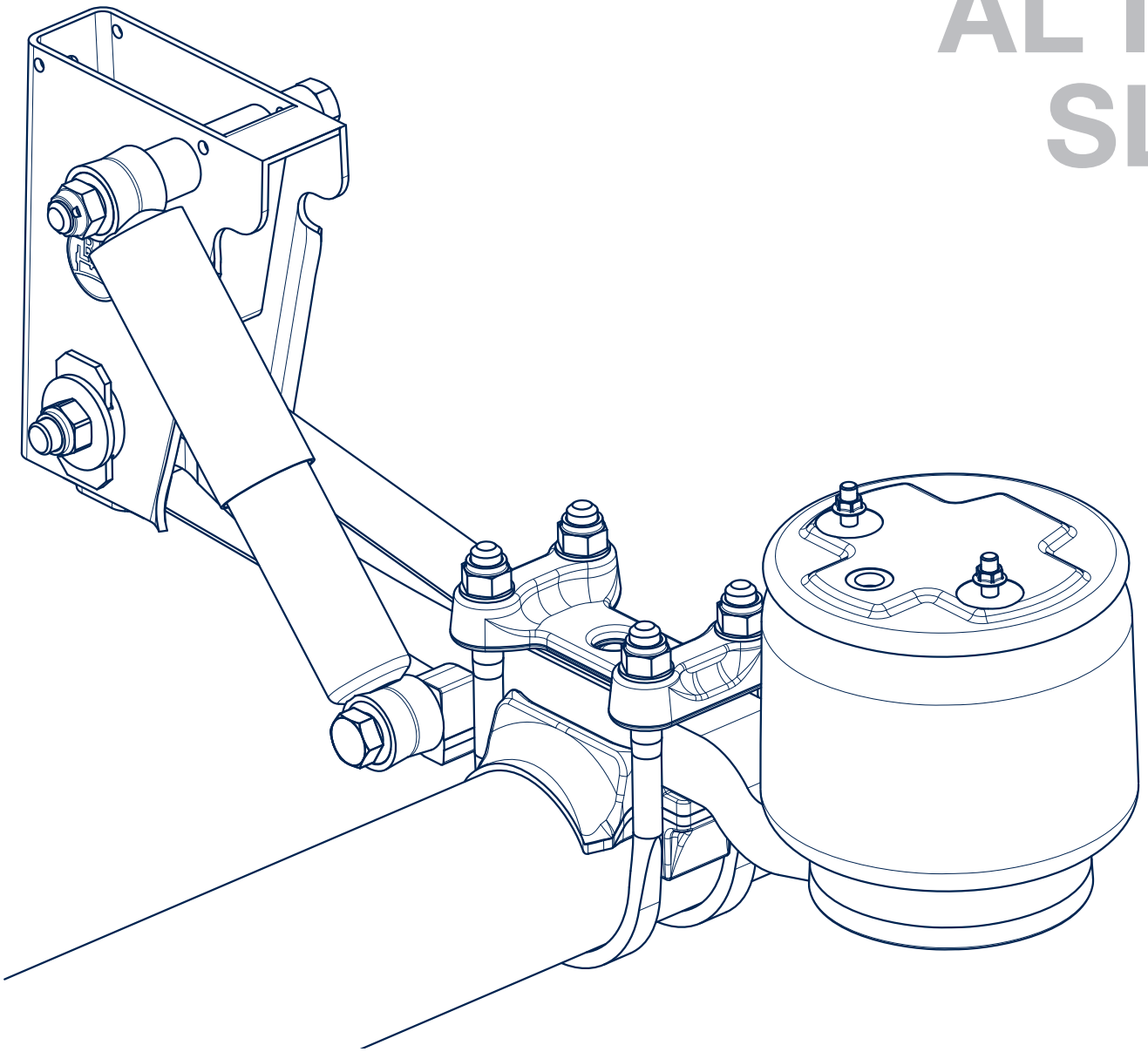


AL II
SL



Installation instruction

BPW axles with air suspension
series Airlight II / SL



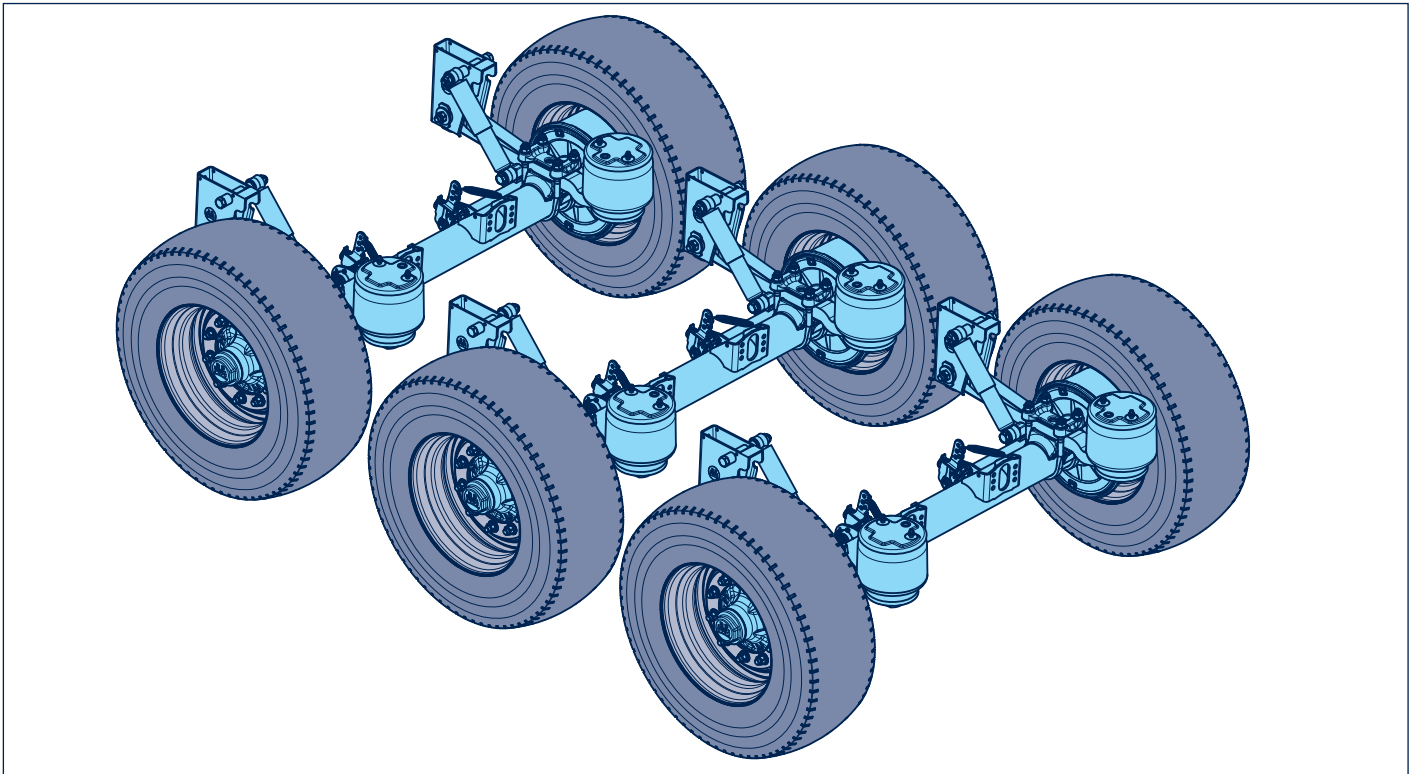
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Introduction, references, general characteristics 1

Airlight II and SL air suspensions



In these installation instructions for BPW Airlight II (AL II) and SL running gear systems, we would like to outline the technical design guidelines and provide suggestions for installation.

Please note that the drawings in the guidelines are examples only and dimensions depend exclusively on the vehicle type and its operating conditions. This data is only known to the vehicle manufacturer who must incorporate it in their design.

Chapters 3.1 to 3.4 contain equations and calculation examples from BPW to assist in determining the various stresses. The safety factors for the constructional design of the vehicle frame and substructure must be defined by the vehicle manufacturer.

Detailed design data for and characteristics of BPW air suspensions such as dimensions, permitted centre of gravity, etc. can be found in the technical documents (air suspension data sheets and offer drawings).

The warranty shall lapse if installation of the BPW running gear system does not correspond to technical guidelines as per current BPW installation instructions. The BPW Guarantee is only valid for the complete ECO Plus air-suspended running gear systems, which have been selected appropriately for their respective use.

For further information, please refer to the current valid service and maintenance instructions or the ECO Plus guarantee brochure (www.bpw.de).

Characteristics of the BPW air suspension systems:

Airlight II (AL II)

- ⊙ Axle load range 9 t – 12 t
- ⊙ 70 mm wide trailing arms
- ⊙ Trailing arms made of spring steel, clamped or welded
- ⊙ Track setting through standard adjustable air suspension hanger brackets
- ⊙ Spring bolt M 24

SL

- ⊙ Axle load area 12 t – 14 t
- ⊙ 100 mm wide trailing arm
- ⊙ Trailing arms made of spring steel, welded
- ⊙ Air suspension hanger brackets, rigid or adjustable
- ⊙ Spring bolt M 30

Version: 01/11/2021
Subject to change

2 Design description

General

The combination of axle and air suspension (running gear system) can be used as single and multiple axle and suspension unit in the vehicle. The modular BPW concept of the multi-component assembly axle - trailing arm provides a maximum of adaptation options. The integrated vertical stop (bump stop in the air bag) ensures that the connection of the running gear to the vehicle frame only has to be created through the air suspension hanger brackets and air bags.

For suspensions with more than three axles, long-stroke air bags are required to ensure that all axles maintain ground contact even on uneven ground. Hydraulic suspensions with special BPW components should be used for suspensions with more than 6 axles.

Trailing arm and stabilizer function

The trailing arms (between axle and air suspension hanger bracket) transfer the wheel forces to the air suspension hanger bracket and are positioned in it through a steel / rubber / steel bush. Whilst air suspension is always used for the pure vertical movement, the body rolling of the vehicle and one-sided driving through dips or obstacles are compensated by the trailing arms (body rolling suspension). The U-shape configuration of axle beam and two trailing arms acts as a stabilizer to counteract the side tilt of the vehicle during lateral acceleration. The body roll stability can be supported with an additional stabilizer in special conditions.

Axle and brake load equalisation

All air bags are connected with one another through air pipes. Uneven driving surfaces or vehicle tilts therefore do not create different axle loads within the multiple axle and suspension unit. The brake forces are also evenly distributed across all axles. BPW air suspension running gear systems therefore provide maximum driving safety and minimal tyre wear.

Suspension and shock absorbers

To achieve the optimal combination of safe and comfortable driving and minimal wear, the air bags and shock absorbers are perfectly matched up with their characteristic curves and installation diagrams. The oscillating movement (vertically and body roll) is absorbed effectively and the wheels retain optimal road contact.

Vertical, longitudinal and lateral forces

The vertical forces are distributed across air suspension hanger brackets and air bags. Longitudinal forces (from uneven road surfaces and due to braking) as well as lateral forces, on the other hand, are exclusively applied to the vehicle frame through the air suspension hanger bracket. Without an adjusted brace, which must be professionally made by the vehicle manufacturer, the lateral forces cannot be transferred from the hanger bracket to the frame.

Raising and lowering; axle lift device

The air suspension facilitates the quick adjustment of the ride height through a switch or rotary disc valve for various loading and unloading processes. This typically involves adjustment to loading ramps or lowering for safe tipping. The also optional axle lift device (axle lift) for one or several axles makes it possible to influence the axle load distribution in an articulated truck and also the turning circle required. Tyre wear and fuel consumption are also reduced on trips with partial loads and manoeuvrability is improved.

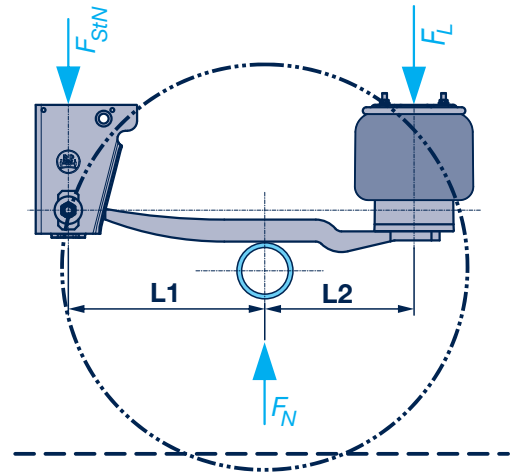
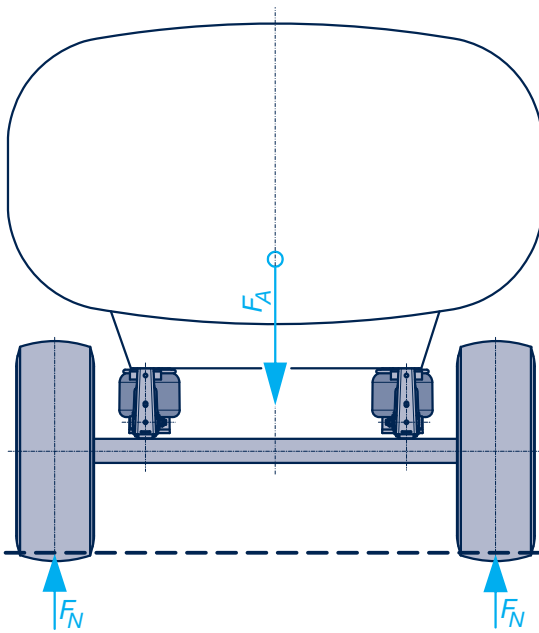
Installation and tracking

BPW vehicle components are designed for the simplest possible installation and maintenance. A tracking device integrated in the air suspension hanger bracket and spring seat arrangement make it possible to adjust the tyre tracking more quickly when required. BPW provides a clamping device for initial installation, see Chapter 12.5, for optimally positioning air suspension hanger brackets and air bag brackets.

Your BPW contact will be happy to answer any further questions you may have.

Force calculations 3

Driving in a straight line 3.1



- G_A = Axle load (kg)
- g = Gravitational acceleration (9.81 m/s²)
- F_A = Axle load (N)
- F_N = Wheel force on ground (N)
- L_1 = Front trailing arm length (mm)
- L_2 = Rear trailing arm length (mm)
- F_{StN} = Hanger bracket force from wheel force on ground (N)
- F_L = Force from the air bag (N)

Driving in a straight line:
(without consideration of unsprung masses)

$$F_A = G_A \times g$$

$$F_N = \frac{F_A}{2}$$

$$F_{StN} = F_N \times \frac{L_2}{L_1 + L_2}$$

$$F_L = F_N \times \frac{L_1}{L_1 + L_2}$$

Example: SHSFALM 9010 30 ECO Plus 3

$$L_1 = 500 \text{ mm}$$

$$L_2 = 380 \text{ mm}$$

$$F_A = 9,000 \text{ kg} \times 9.81 \text{ m/s}^2 = 88,290 \text{ N}$$

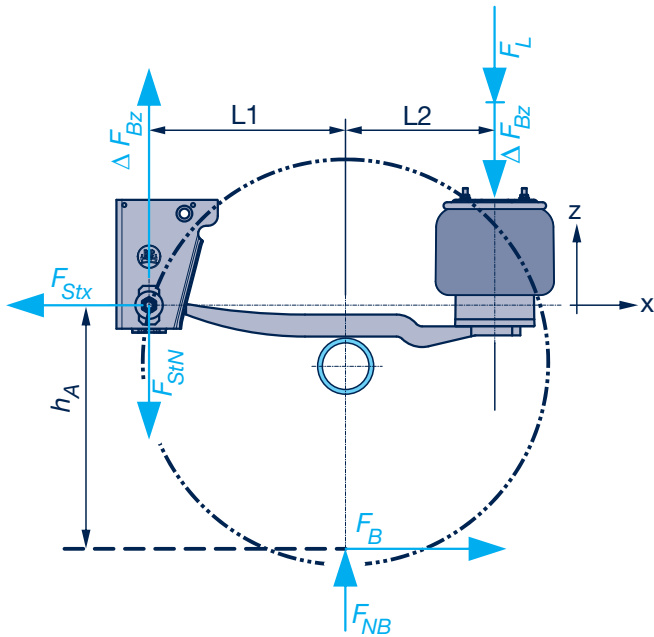
$$F_N = \frac{88,290 \text{ N}}{2} = 44,145 \text{ N}$$

$$F_{StN} = 44,145 \text{ N} \times \frac{380}{500 + 380} = 19,063 \text{ N}$$

$$F_L = 44,145 \text{ N} \times \frac{500}{500 + 380} = 25,082 \text{ N}$$

3 Force calculations

3.2 Forces when braking



- F_{NB} = Wheel force on ground during braking (N)
 ΔF_A = Axle load shift during braking (N)
 (depends on vehicle design, particularly important for trailer front axles)
 F_{StN} = Hanger bracket force from wheel force on ground (N)
 F_L = Force from air bag (N)
 F_B = Braking force (N)
 z = Braking (%)
 ΔF_{Bz} = Reaction force from braking torque (N)
 h_A = Height of spring bolt over road surface
 F_{Stx} = Total force on the air suspension hanger bracket in direction x (N)
 F_{Stz} = Total force on air suspension hanger bracket in direction z (N)
 $F_{Lges.}$ = Total force on the air bag (N)

Normal forces from axle load:

$$F_{NB} = \frac{F_A \pm \Delta F_A}{2}$$

$$F_{StN} = F_{NB} \times \frac{L2}{L1 + L2}$$

$$F_L = F_{NB} \times \frac{L1}{L1 + L2}$$

Brake force:

$$F_B = \frac{z}{100} \times F_{NB}$$

Forces from braking torque support:

$$\Delta F_{Bz} = \frac{F_B \times h_A}{L1 + L2}$$

Total force on the air suspension hanger bracket in direction x:

$$F_{Stx} = F_B$$

Total force on the air suspension bracket in direction z:

$$F_{Stz} = F_{StN} - \Delta F_{Bz}$$

Total force on the air bag:

$$F_{Lges.} = F_L + \Delta F_{Bz}$$

Example: SHSFALM 9010 30 ECO Plus 3

- $F_A = 88,290 \text{ N}$
 $\Delta F_A = \text{Assumed in Example 0}$
 $F_{NB} = \frac{88,290 \text{ N}}{2} = 44,145 \text{ N}$
 $F_{StN} = 44,145 \text{ N} \times \frac{380}{500 + 380} = 19,063 \text{ N}$
 $F_L = 44,145 \text{ N} \times \frac{500}{500 + 380} = 25,082 \text{ N}$
 $z = 80 \%$
 $F_B = 0.8 \times 44,145 \text{ N} = 35,316 \text{ N}$
 $h_A = 600 \text{ mm}$
 $\Delta F_{Bz} = \frac{35,316 \text{ N} \times 600}{880} = 24,079 \text{ N}$
 $F_{Stx} = 35,316 \text{ N}$
 $F_{Stz} = 19,063 \text{ N} - 24,079 \text{ N} = -5,016 \text{ N}$
 $F_L = 25,082 \text{ N} + 24,079 \text{ N} = 49,161 \text{ N}$

Force calculations 3

Cornering 3.3

Driving at the over-balance limit:

(without considering the suspension and weight of unsprung masses, approximate calculation)

$$F_Q = \frac{F_A \times SP}{h_S \times 2} = \frac{F_A}{g} \times a_{quer}^*$$

Hager bracket forces:

$$F_{Stza} = \left(\frac{F_A}{2} \times \frac{L2}{L1 + L2} \right) + \frac{F_Q \times h_e}{FM}$$

$$F_{Stzi} = \left(\frac{F_A}{2} \times \frac{L2}{L1 + L2} \right) - \frac{F_Q \times h_e}{FM}$$

$$F_{Sty} = \frac{F_Q}{2} \quad (\text{assumption})$$

$$F_{Stx} = \pm \frac{F_Q \times L1}{FM}$$

F_A = Axle load (N)

F_Q = Centrifugal force at the over-balance limit (N)

F_{Stza} = Hanger bracket force at curve outer side (N)

F_{Stzi} = Hanger bracket force at curve inner side (N)

h_S = Centre of gravity height above road surface

h_e = Centre of gravity height above trailing arm bolt

F_{Sty} = Lateral force at the air suspension hanger bracket

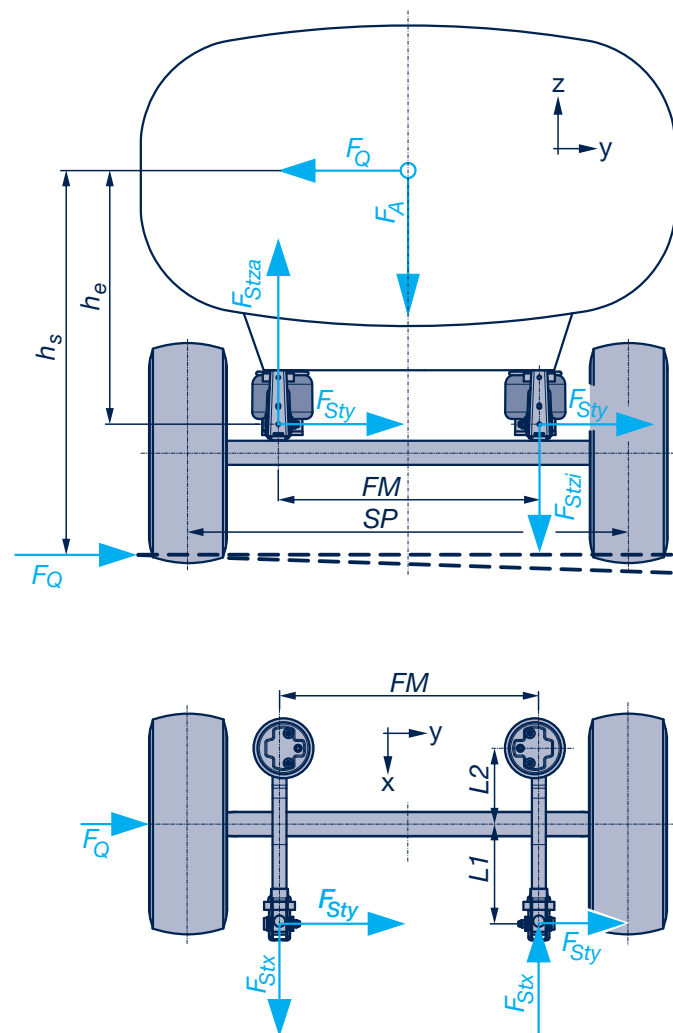
F_{Stx} = Longitudinal force at the air suspension hanger bracket

FM = Spring centre

SP = Track width

g = Gravitational acceleration (9.81 m/s²)

a_{quer} = Lateral acceleration at the over-balance limit (m/s²)



* BPW can provide a calculation of the lateral acceleration in accordance with ECE R 111 on request (side tilt stability calculation).

The track width and centre of gravity height have the main influence on the tilt angle. The calculation also accounts for the geometrical running gear design (steering, roll centre) as well as the rigidity of steering, axle beams, air bags and tyres. The lateral acceleration at the over-balance limit and vehicle body tilt angle are the result of the calculation.

Example: SHSFALM 9010 30 ECO Plus 3

$$SP = 2,040 \text{ mm}$$

$$FM = 1,300 \text{ mm}$$

$$h_S = 2,000 \text{ mm}$$

$$h_e = 1,400 \text{ mm}$$

$$F_A = 88,299 \text{ N}$$

$$L1 = 500 \text{ mm}$$

$$L2 = 380 \text{ mm}$$

$$F_Q = \frac{88,290 \text{ N} \times 2.040}{2,000 \times 2} = 45,028 \text{ N}$$

$$F_{Stza} = \left(\frac{88,290 \text{ N}}{2} \times \frac{380}{880} \right) + \frac{45,028 \text{ N} \times 1,400}{1,300} = 67,554 \text{ N}$$

$$F_{Stzi} = \left(\frac{88,290 \text{ N}}{2} \times \frac{380}{880} \right) - \frac{45,028 \text{ N} \times 1,400}{1,300} = -29,429 \text{ N}$$

$$F_{Sty} = \frac{45,028 \text{ N}}{2} = 22,514 \text{ N (assumption)}$$

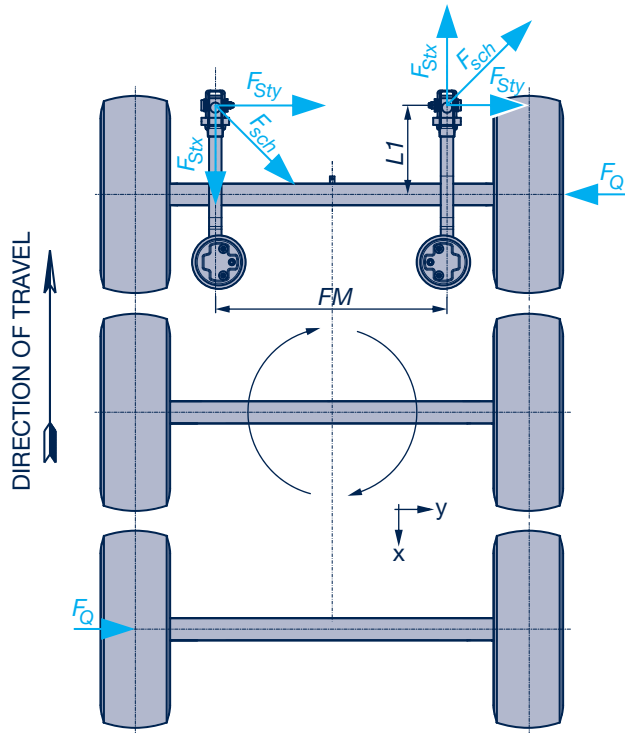
$$F_{Stx} = \pm \frac{45,028 \text{ N} \times 500}{1,300} = \pm 17,318 \text{ N}$$

3 Force calculations

3.4 Turning when stationary

1st or 3rd axle in a rigid tri-axle suspension

The lateral forces are transferred through the two outer axles. The central axle turns on its own axis and does not transmit lateral forces.



$$F_Q = F_A \times \mu_Q$$

$$F_{Stx} = \pm \frac{F_Q \times L1}{FM}$$

$$F_{Sty} = \frac{F_Q}{2} \text{ (assumption)}$$

$$F_{sch} = \text{Resulting thrust (N)}$$

$$F_Q = \text{Lateral force on axles (N)}$$

$$\mu_Q = \text{Driving traction coefficient when turning (from tests: } \mu_Q = 1.6)$$

Example: SHSFALM 9010 30 ECO Plus 3

$$FM = 1,300 \text{ mm}$$

$$L1 = 500 \text{ mm}$$

$$F_A = 9,000 \text{ N} \times 9.81 = 88,290 \text{ N}$$

$$\mu_Q = 1.6$$

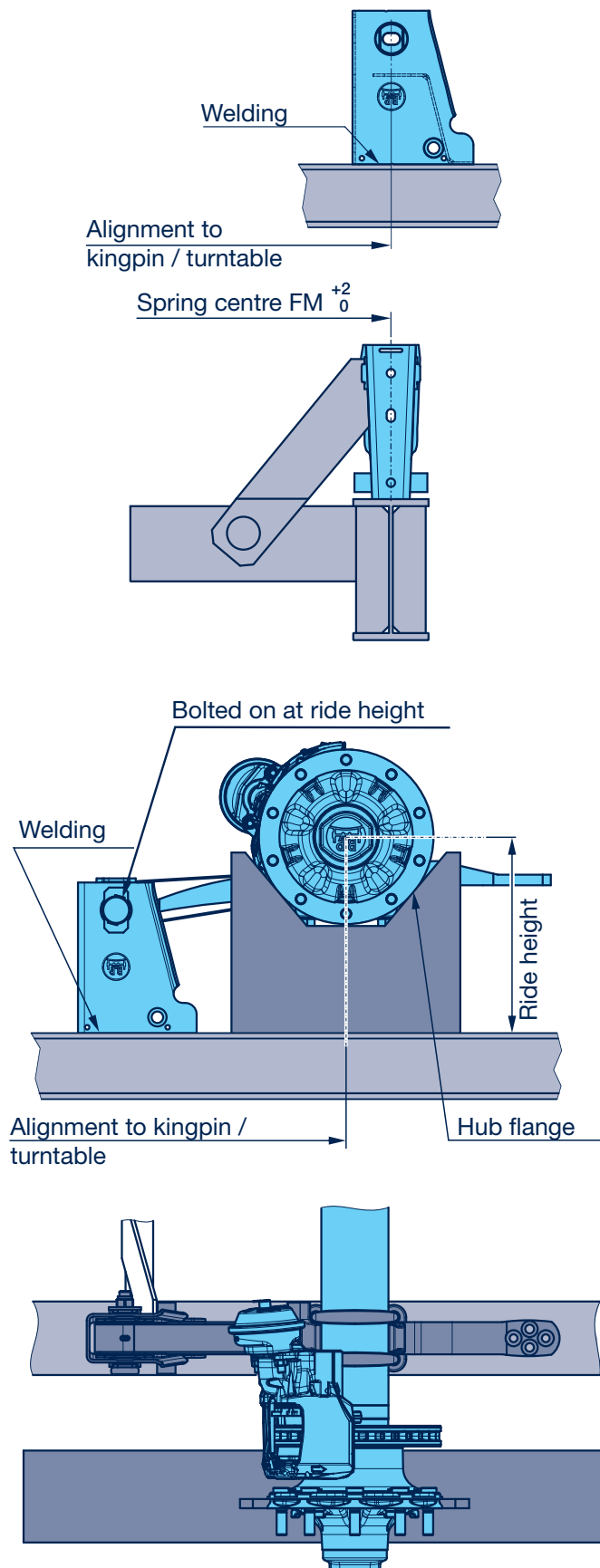
$$F_Q = 88,290 \text{ N} \times 1.6 = 141,260 \text{ N}$$

$$F_{Stx} = \frac{141,260 \text{ N} \times 500}{1,300} = 54,331 \text{ N}$$

$$F_{Sty} = \frac{141,260 \text{ N}}{2} = 70,630 \text{ N}$$

Notes

4 Installation guidelines



As a rule, air suspension axles are installed with the vehicle frame on its back.

Welding of loose air suspension hanger brackets

For BPW Airlight II / SL air suspensions with loose air suspension hanger brackets, the hanger brackets are first welded to the vehicle frame.

The spring bolt bearing points of the hanger brackets are positioned precisely to the longitudinal centre line of the vehicle using the centre of kingpin or turntable. In this installation position, the tolerances of the spring centres and guide links lengths must be taken into consideration.

The hanger bracket position in the sideways direction must be kept within the tolerance range FM (0, +2) to avoid stresses in the axle unit. The braces can then be welded on. Check the track and correct if necessary after welding on the hanger brackets or mounting the axles (see alignment, Chapter 12).

Installation of pre-assembled air spring modules

BPW Airlight II / SL air suspensions with assembled trailing arms and air suspension hanger brackets are generally mounted at the hub flange, arranged according to the vehicle design and aligned precisely to the longitudinal centre line of the vehicle using the centre of kingpin or turntable.

The air suspension hanger brackets are welded on to the bottom flange of the vehicle frame.



For all welding operations, the trailing arms, spring U-bolts, air bags, plastic pipes and shock absorbers must be protected against flying sparks and weld spatter.

The earth terminal should under no circumstances be attached to the trailing arm, spring U-bolt or hub.

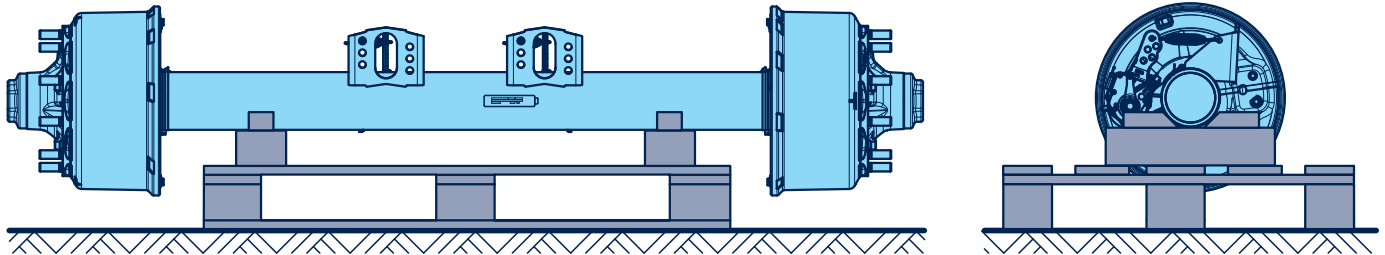
It is not permitted to weld the trailing arms!

It is not permitted for the air suspension hanger brackets to be heated for straightening work!

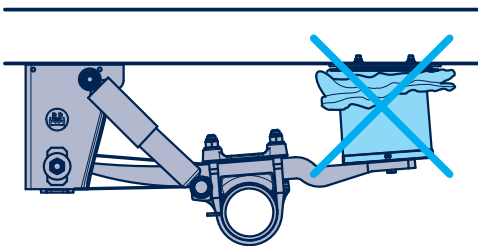
Use new spring bolts and lock nuts when replacing air suspension hanger brackets.

Guidelines for transport / storage 5

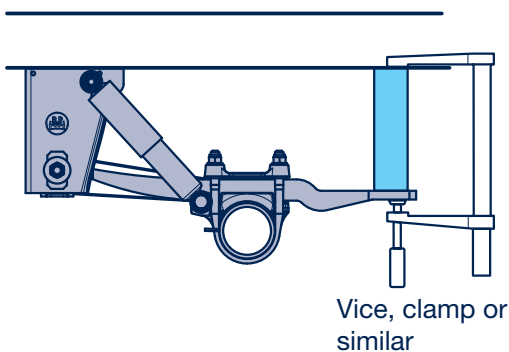
During storage axles should be supported on a suitable stillage or support to prevent single point impacts on the drum/disc circumference. If there should be any single point impact on the brake edge circumference (such as through mishandling) hairline cracks could be caused, and therefore the drum or disc should be immediately replaced.



- Brake drums and brake camshafts should be clear of any pressure from above or below when trailers are stacked for storage and transportation. Until wheels have been fitted the trailer chassis should be suitably supported at all times, allowing the brake edge to be free from any contact surface.
- Landing legs should be wound into the closed position.
- It is recommended that if slave wheels are fitted that at least four wheel nuts are fitted and tightened to the correct torque setting.



The air bag should always be installed with the rubber rolled up. The rubber must not crease as the folds leave a permanent mark and will influence the unrolling behaviour and life expectancy at a later date. If the semi-finished vehicle or chassis is moved on its own axis for purposes such as paint application, for instance, it is recommended to install a strut as an air bag replacement. By doing so, the air bag also does not have to be covered to protect it against the paint and is only installed during the final assembly stage.

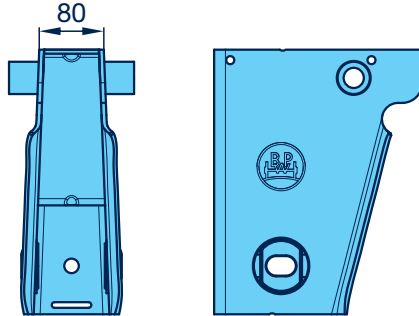


The levelling valve should be disconnected and airbags deflated allowing the trailer to be transported on the airbag bump stops. Airbags should be properly deflated, not crushed.

6 Air suspension hanger brackets

6.1 Airlight II and SL steel air suspension hanger brackets (type V / EV)

Airlight II for single-leaf trailing arms (type V)



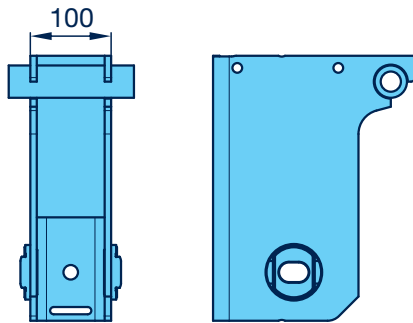
It is easy to connect the smooth surfaces with the vehicle frame and weld on transverse braces.

Together with the low hanger bracket height, the modular design provides extremely high torsional rigidity. Braces can therefore be easily connected (see Chapter 6). The dimensions are given in the technical documents for each version and ride height.

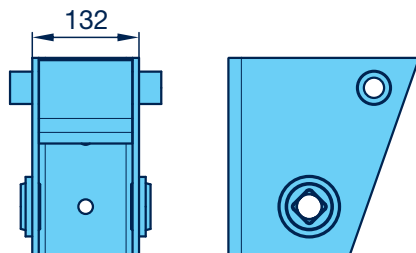
Airlight II steel air suspension hanger brackets characteristics

- ⊙ for 70 mm wide trailing arms
- ⊙ Spring bolts with M 24 thread
- ⊙ Integrated tracking comes as standard
- ⊙ Axle load up to 12 t
- ⊙ Top shock absorber attachment with screw and lock nut

Airlight II for two-leaf trailing arms (type EV)



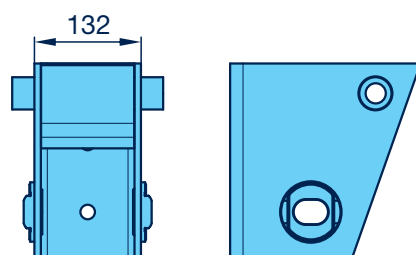
SL rigid design (type E)



SL steel air suspension hanger brackets characteristics

- ⊙ for 100 mm wide trailing arms
- ⊙ Spring bolts with M 30 thread
- ⊙ With and without tracking
- ⊙ Axle load up to 14 t (rigid air suspension hanger brackets)
- ⊙ Axle load 12 t (rigid and adjustable air suspension hanger bracket)
- ⊙ Top shock absorber attachment with screw and lock nut

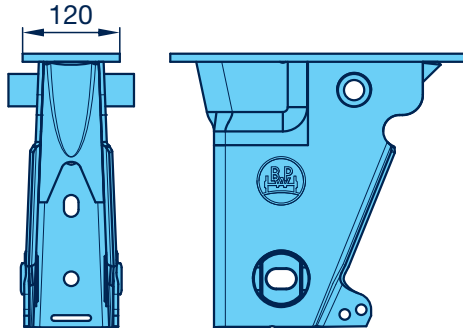
SL adjustable version (type EV)



Air suspension hanger brackets 6

Bolt-on Airlight II steel air suspension hanger brackets (type K) 6.2

Bolt-on Airlight II steel air suspension hanger brackets (type K)

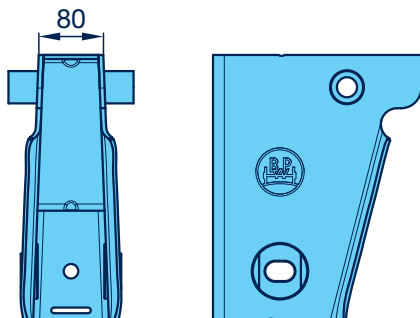


The bolted-on air suspension hanger bracket has a cover plate with 6 holes. The hanger bracket can be bolted on to the bottom boom of a vehicle frame (minimum width 120 mm) with a special knurled screw.

Together with the low hanger bracket height, the modular design provides extremely high torsional rigidity. Braces can therefore be easily connected (see Chapter 7).

Airlight II stainless steel (type X) and aluminium air suspension hanger brackets (type AV) 6.3

Airlight II stainless steel air suspension hanger brackets (type X)

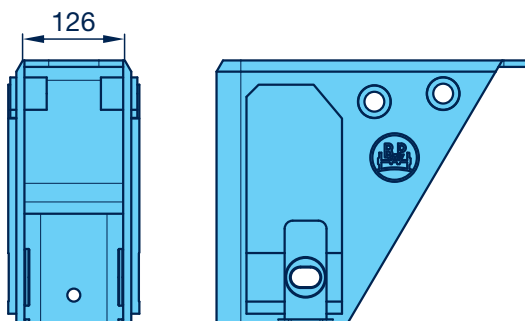


The stainless steel air suspension hanger bracket is intended for use in vehicles with stainless steel frames.

The stainless steel hanger bracket is designed so that it is possible to simply weld it to the stainless steel vehicle frame.

Together with the low hanger bracket height, the modular design provides extremely high torsional rigidity. Braces can therefore be easily connected (see Chapter 7).

Airlight II aluminium air suspension hanger brackets (type AV)



The aluminium air suspension hanger bracket is intended for use in vehicles with aluminium frame.

The aluminium air suspension hanger bracket is designed so that it is possible to simply weld it to the aluminium vehicle frame.

The existing weld seam preparation and internal z sheet facilitate optimal installation.

The brace connection is described in Chapter 7.

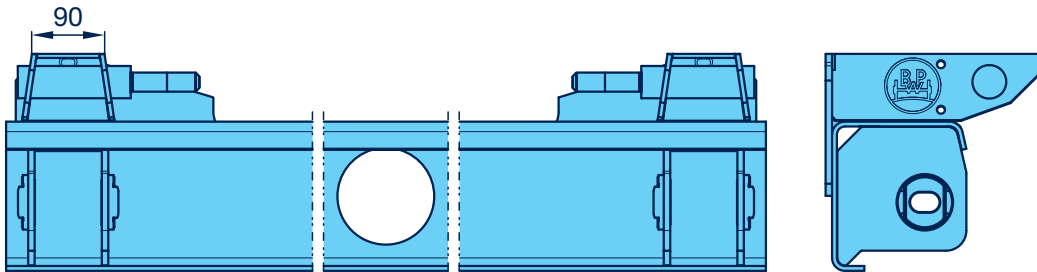
Characteristics of Airlight II bolt-on steel / stainless steel / aluminium air suspension hanger brackets

- ⊙ for 70 mm wide single-leaf trailing arms
- ⊙ Spring bolts with M 24 thread
- ⊙ Integrated tracking comes as standard
- ⊙ Axle load up to 9 t
- ⊙ Top shock absorber attachment with screw and lock nut
- ⊙ The dimensions are given in the technical documents for each version and ride height.

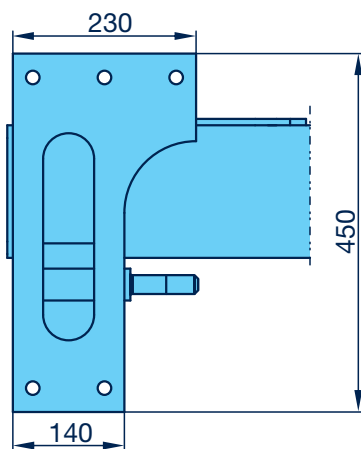
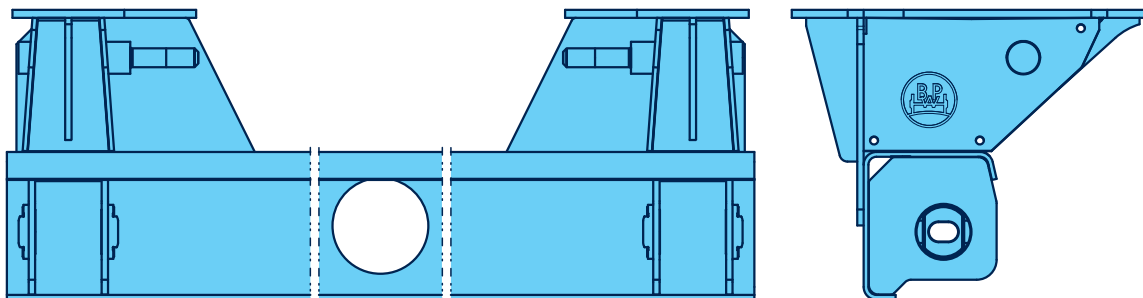
6 Air suspension hanger brackets

6.4 Airlight II steel channel cross-member (type CV)

Weld-on steel channel cross-member (type CV)



Bolt-on steel channel cross-member (type CV)



The open, narrow hanger brackets on the channel cross-member are 90 mm wide and can also be welded on to very narrow frame bottom flanges.

There are also bolt-on channel cross-members with a welded-on cover plate.

When using self-steering axles with trailing arms cranked on the side, shock absorbers can be attached to the channel cross-member.

The forces transferred from the wheels through the axles to the channel cross-member are absorbed by the items included in the BPW scope of delivery and guided into the top of the frame.

Depending on the frame design, additional braces are not necessary in the axle and suspension unit area (see Chapter 7).

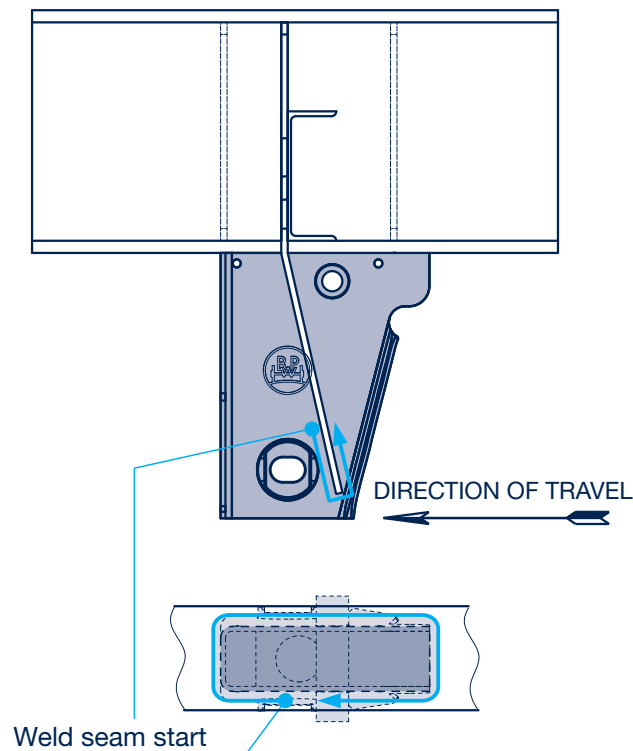
However, the bracing of the frame is not replaced as such by the channel cross-member.

Airlight II channel cross-member characteristics

- ⦿ for 70 mm wide single-leaf trailing arms
- ⦿ Spring bolts with M 24 thread
- ⦿ Integrated tracking comes as standard
- ⦿ Axle load up to 10 t
- ⦿ Top shock absorber attachment on the threaded bolt or with screw and lock nut
- ⦿ The dimensions are given in the technical documents for each version and ride height.

Air suspension hanger brackets 6

Welding instructions 6.5



Airlight II - and SL steel hanger brackets / Airlight II channel cross-members

- ⊙ Gas shielded arc welding
Weld wire quality G 4 Si 1 – EN ISO 14341-A
- ⊙ Manual arc welding
Stick electrodes E 46 5 B 32 H 5 – EN ISO 2560-A
- ⊙ Mechanical quality values must correspond to the basic material S 420 or S 355 J 2
- ⊙ Seam thickness acc. to DIN EN ISO 5817
 - Hanger bracket sheet thickness 6 mm -> a4 Δ
 - Hanger bracket sheet thickness 8 mm -> a6 Δ

Airlight II - stainless steel hanger brackets

- ⊙ Gas shielded arc welding
Weld wire quality G 19 9 L Si (EN ISO 14343)
- ⊙ Manual arc welding
Stick electrodes E 19 9 L R 32 (DIN EN ISO 3581)
- ⊙ Mechanical quality values must meet the basic material X5CrNi18-10 or X6CrNiTi18-10 Seam thickness a4 Δ (DIN EN ISO 5817)
- ⊙ Tempering colours must be removed for the purpose of verification on the resistance to corrosion

Airlight II - aluminium hanger brackets

- ⊙ MIG or WIG welding
Identical additional material Al Mg 4.5 Mn
- ⊙ Clean thoroughly before welding
- ⊙ Recommendation: Preheat to approx. ca. 60 – 80°C
- ⊙ Seam thickness a8 Δ (DIN EN ISO 10042)



The general state-of-the-art regulations must be complied with when welding.

Avoid end craters and undercuts.

Functional surfaces have to be free from weld spatter.

For all welding operations, the trailing arms, spring U-bolts, air bags, plastic pipes and shock absorbers must be protected against flying sparks and weld spatter.

The earth terminal should under no circumstances be attached to the trailing arm, spring U-bolt or hub.

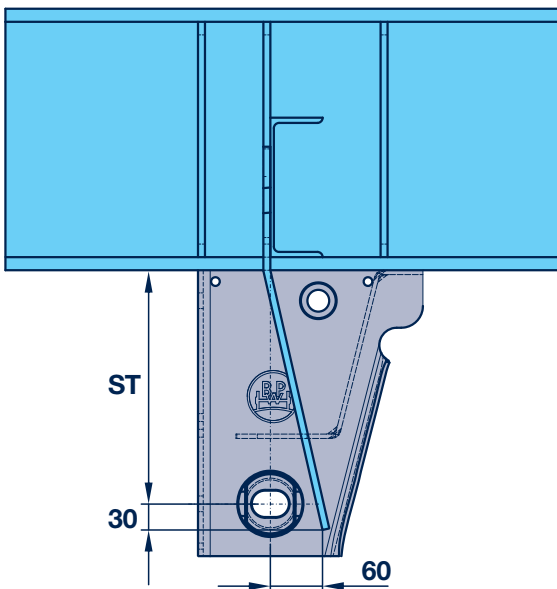
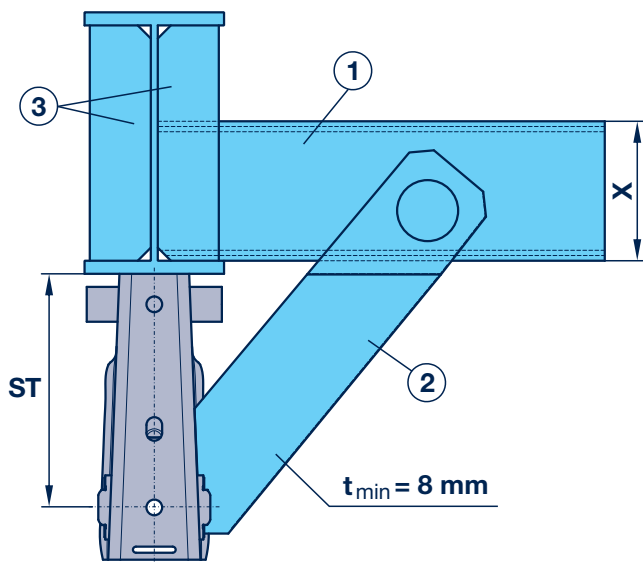
Use new spring bolts and lock nuts when replacing air suspension hanger brackets.

It is not permitted to weld the trailing arms!

It is not permitted for the air suspension hanger brackets to be heated for straightening work!

7 Braces

7.1 Welded-on Airlight II and SL air suspension hanger brackets



Example of a proposed general brace connection with welded-on air suspension hanger brackets respectively gusset plates

General

With vehicle frames that are subject to torsion, a corresponding elastic and torsional brace on the air suspension hanger brackets is particularly necessary.

① Cross-members

The forces created when travelling around bends are transmitted via the air suspension hanger brackets and gusset plates into the cross-member. This must be dimensioned accordingly. It has to be ensured that the correct connection to the longitudinal beam is used. The connection of rigid-torsional, closed cross-member profiles to the soft-torsional dual-T longitudinal beam must be designed with extra care as there is a risk of cracking at stiffness discontinuity.

② Gusset plates

The lateral forces are transmitted via the gusset plates as tensile / compressive loads to the cross-member.

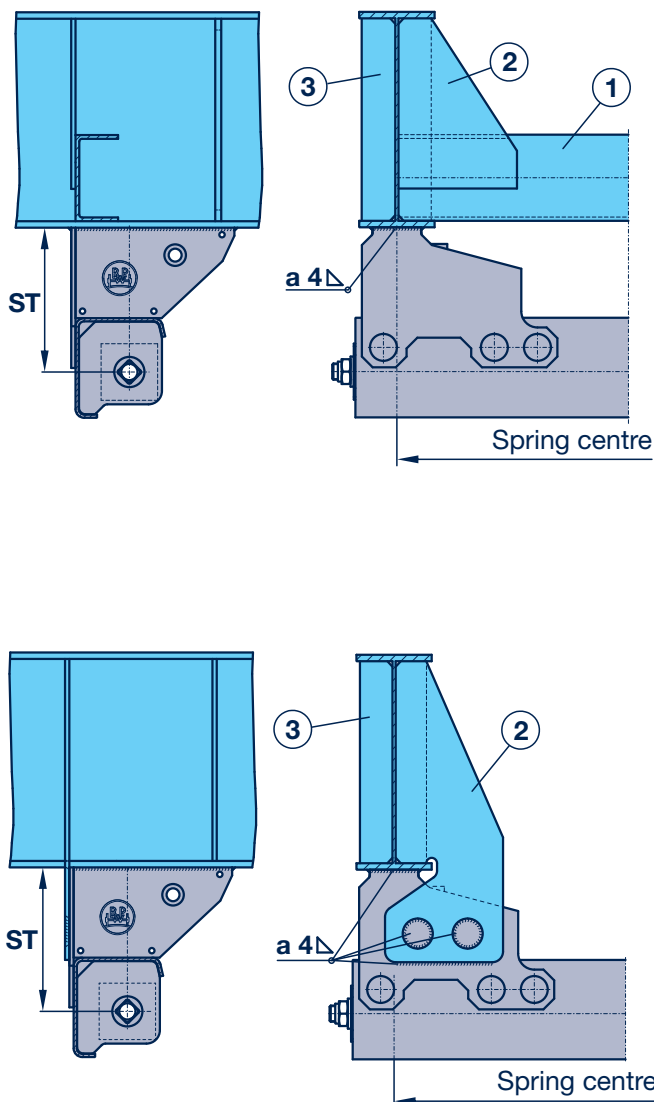
The gusset plate has to be connected at the inner side of the hanger bracket, behind the spring bolt to optimally stiffen the hanger bracket which is open at the rear. The gusset plate should reach 30 mm lower than the centre of the spring bolt. It is recommended to attach the gusset plate to the frame in the centre to the spring bolt.

③ Vertical profiles

Suitable vertical profiles and ribs must be planned to stiffen the vehicle frame.

Braces 7

Welded-on Airlight II channel cross members 7.2



Example of a proposed general brace connection to vehicle frames with channel cross members

General

With vehicle frames that are subject to torsion, a corresponding elastic and torsional brace on the channel cross members is necessary. A cross-member does not have to be used when using the proposed bracing.

① Cross-members

The forces created when driving through bends, for example, are absorbed within the channel cross member group. The cross-member must have adequate dimensions. It has to be ensured that the correct connection to the longitudinal beam is used. The connection of rigid-torsion, closed cross-member profiles to the soft-torsion dual-T longitudinal beam must be designed with extra care as there is a risk of cracking at stiffness discontinuity.

② Gusset plates

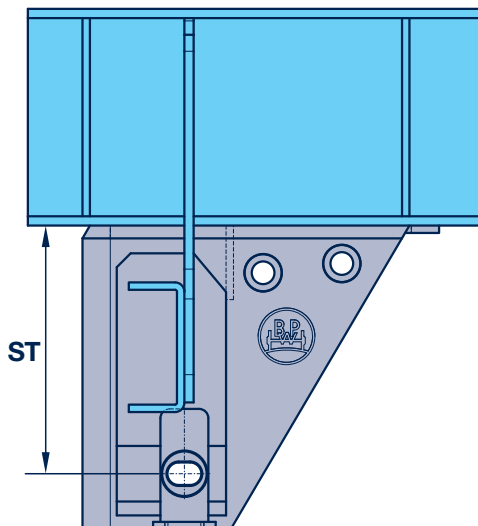
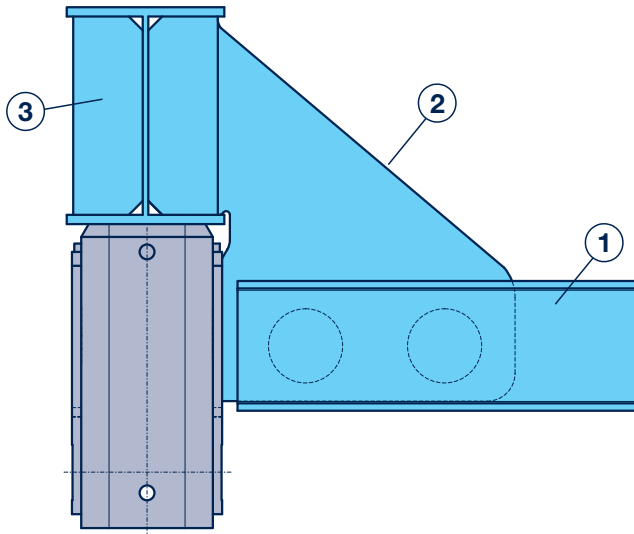
The lateral forces and frame deformation created when travelling around bends are transmitted through the gusset plates into the channel cross member group. To ensure a good connection to the frame, the gusset plate must be placed up to the top flange of the frame where it should ideally be welded on to the bottom flange of the frame as well. It should ideally be connected to the front of the channel cross member with a plug welding seam.

③ Vertical profiles

Suitable vertical profiles and ribs must be planned to stiffen the vehicle frame.

7 Braces

7.3 Welded-on Airlight II - aluminium air suspension hanger brackets



Example of a proposed general brace for tankers with aluminium hanger brackets

General

With vehicle frames that are subject to torsion, a corresponding elastic and torsional brace of the aluminium hanger bracket is particularly necessary.

① Cross-members

The forces created when travelling around bends are transmitted via the air suspension hanger brackets and gusset plates in to the cross-member. This must be dimensioned accordingly. It has to be ensured that the correct connection to the longitudinal beam is used. The connection of rigid-torsion, closed cross-member profiles to the soft-torsion dual-T longitudinal beam must be designed with extra care as there is a risk of cracking at stiffness discontinuity.

② Gusset plates

The lateral forces and frame deformation created when travelling around bends are transmitted through the gusset plates into the member assemblage.

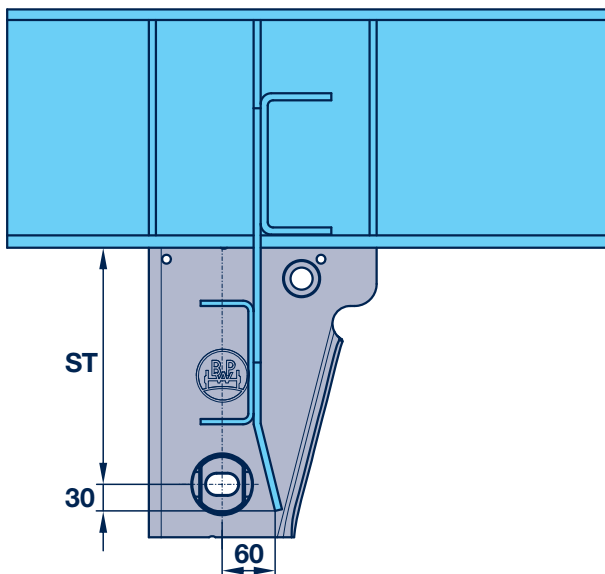
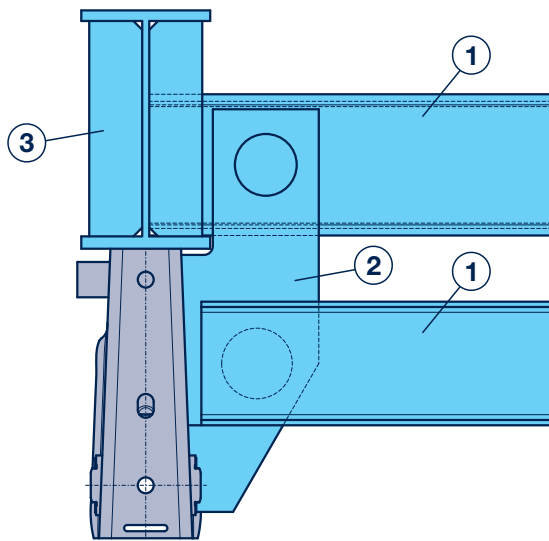
The cross-members should ideally be attached on the front with a plug welding seam.

③ Vertical profiles

Suitable vertical profiles and ribs must be planned to stiffen the vehicle frame.

Braces 7

Welded-on, stiff connection Airlight II and SL air suspension hanger brackets 7.4



Example of bracing a vehicle frame that is torsionally stiff in longitudinal direction (tankers, silos, box vehicles) respectively for especially tough applications.

General

With vehicle frames that are not subject to torsion, a corresponding rigid brace can be used for the air suspension hanger brackets via 2 cross-members.

① Cross-members

The forces created when travelling around bends are transmitted through the air suspension hanger brackets and gusset plates into the cross-members. They must be dimensioned accordingly. It has to be ensured that the correct connection to the longitudinal beam is used.

② Gusset plates

The gusset plates transfer the lateral forces as tensile or compressive loads to the cross-member.

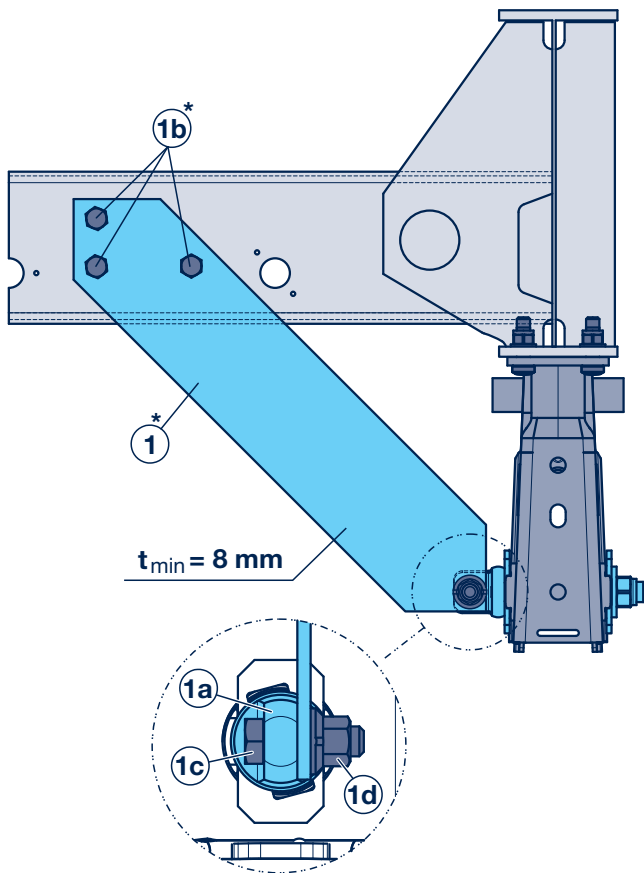
The gusset plate has to be connected at the inner side of the hanger bracket, behind the spring bolt to optimally stiffen the hanger bracket which is open at the rear. The gusset plate should reach 30 mm lower than the centre of the spring bolt.

③ Vertical profiles

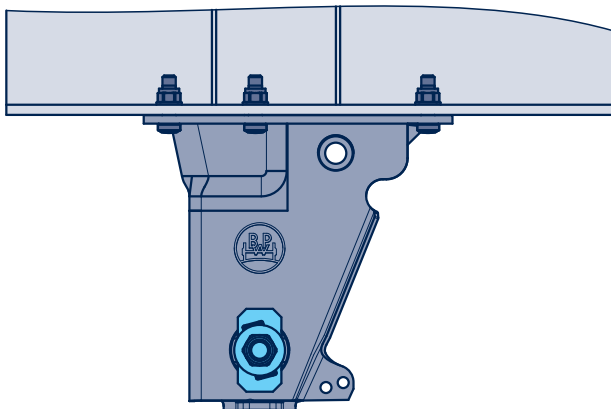
Suitable vertical profiles and ribs must be planned to stiffen the vehicle frame.

7 Braces

7.5 Bolt-on Airlight II air suspension hanger brackets and gusset plates



5 screws per hanger bracket,
take note of the direction of installation!



Example of a proposed general brace connection with bolt-on hanger brackets or gusset plates (see also Chapter 6.1).

General

With the bolted-on Airlight II air suspension hanger bracket, BPW is offering the opportunity of prefabricating compact vehicle frames without air suspension hanger brackets, coating them but not attaching the running gear until the final assembly stage. The final design is only determined during the installation of the running gear. The bolt-on system therefore provides vehicle manufacturers with logistics advantages and increases production flexibility.

① Gusset plate screw connections

The bottom end of the gusset plate (1) is bolted onto the spring bolt (1a) directly using an M 18 connection bolt with nut (1c, 1d), which therefore permits direct force input. The spring bolt itself is a special bolt with flange. The flange simultaneously serves as a rotation protection.

The top end of the gusset plate is bolted onto the cross-member of the frame using at least three M 16 10.9 bolts (1b). The bore holes in the components must have the following diameters:

Bore hole in the cross-member: \varnothing 16 mm

Bore hole in the gusset plate: \varnothing 18 mm

② Air suspension hanger bracket screw connections

The air suspension hanger brackets are attached to the vehicle frame with 5 knurled screws each (take note of the direction of installation!).

The knurling of the screws serves as rotation protection. The special screw also has a flat head so that it can be installed directly next to the hanger bracket. The maximum unevenness of the longitudinal member is permitted to be 1mm in the hanger bracket area.



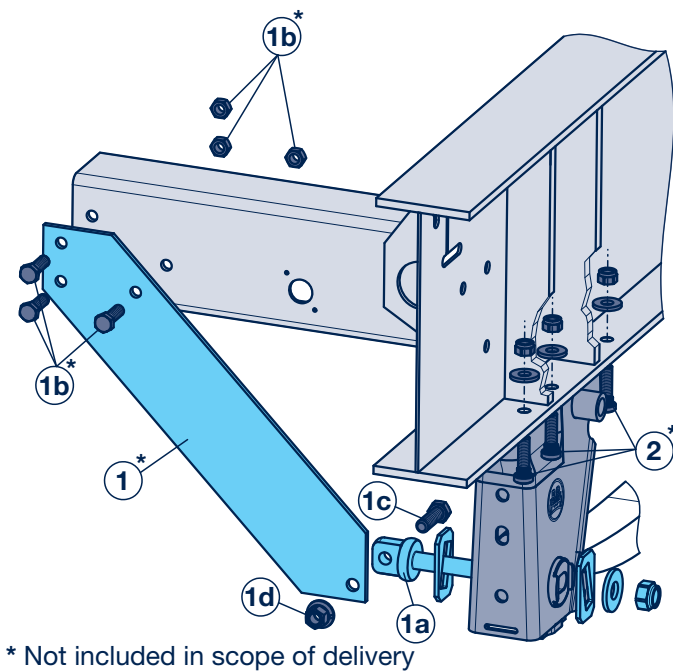
As the rotation protection of the screwed joint is created by the spring bolt flange, the bolt must always be attached to the vehicle frame through a gusset plate.

A bolt-on cross-member between the spring bolts without a connection to the frame is impermissible!

With vehicle frames that are subject to torsion, a corresponding elastic and torsional brace on the air suspension hanger brackets is particularly necessary.

Braces 7

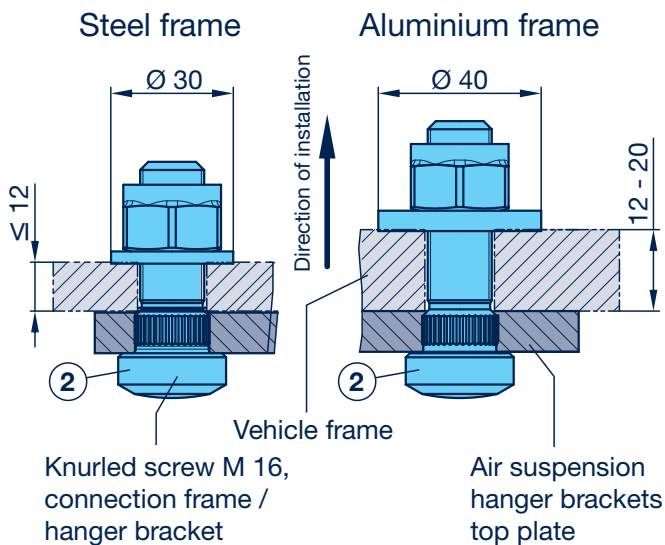
Bolted-on Airlight II air suspension hanger brackets and gusset plates 7.5



Installation process for bolt-on air suspension hanger brackets

1. Bolt hanger bracket M 16 (2) on to vehicle frame.
Tightening torque: 260 Nm (240 - 285 Nm).
2. Loosely pre-mount spring bolt (1a).
3. Pre-mount gusset plates (1) with min. three screws (1b) M 16, 10.9 (top) and screw M 18 (1c) (bottom).
Pre-mount the corresponding nuts (1d).
4. Tighten the M 18 (1c) connecting bolt to approx. 50 Nm.
5. Tighten the M 24 spring bolt (1a) loosely until all components have been brought into contact.
6. Adjust the track, see tracking, Chapter 12).
7. Tighten M 24 (1a) spring bolt.
Tightening torque: 650 Nm (605 - 715 Nm).
Do not use an impact driver!
8. Tighten the M 18 connecting bolt (1c) (gusset plate-spring bolt).
Tightening torque: 420 Nm (390 - 460 Nm)
9. Tighten the top connecting bolts M 16, 10.9 (1b) (gusset plate / cross-member) to the max. permitted tightening torque (not supplied by BPW).

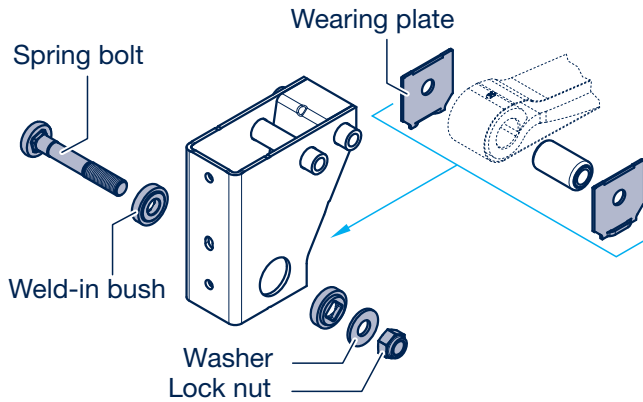
See Chapter 12 for tightening torque.



8 Spring bolt bearing

8.1 AL II- (M 24) and SL air suspension (M 30) hanger brackets and channel cross members

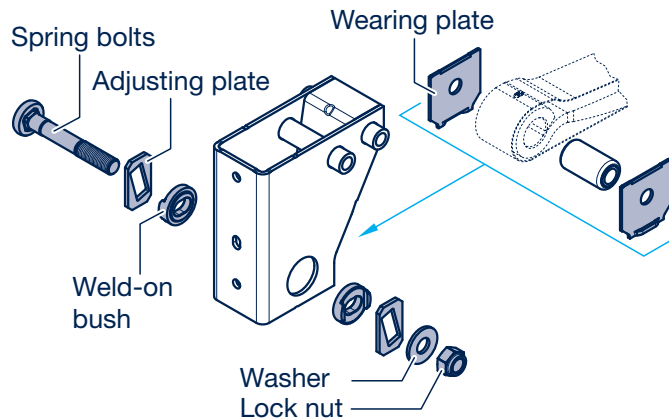
Spring bolt bearing, rigid



With BPW air suspension hanger brackets, the head of the spring bolt is secured from rotating by means of a profiled lot.

The spring bolts should be mounted from the outside (wheel side) towards the inside (from the inside to the outside for bolted-on gusset plates).

Spring bolt bearing, adjustable

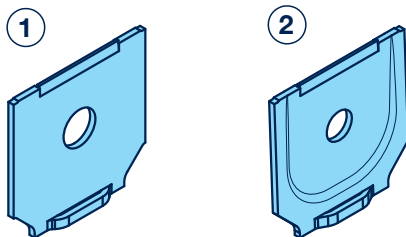


Make sure the inner and outer adjusting plates of the hanger bracket are adjusted symmetrically.

Ensure that the correct wearing plates are used (see below).

Before tightening the lock nut, the axle position must be set to ride height to prevent impermissible distortion of the rubber bush.

See Chapter 17 for tightening torque.



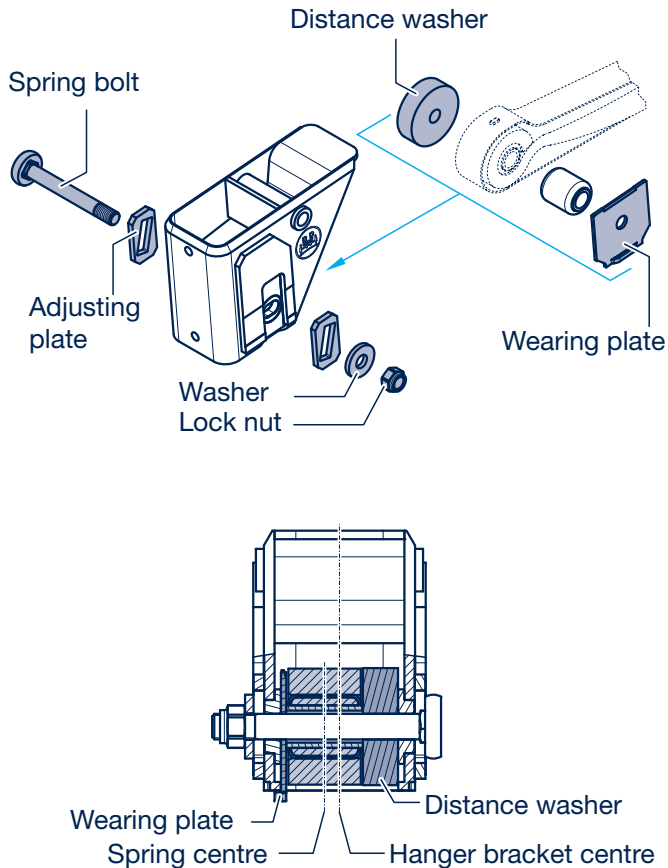
BPW uses two different versions of wearing plates.

1. A straight shaped plate for straight air suspension hanger brackets and channel cross members
2. An offset shaped plate for angled air suspension hanger brackets (narrow at top).

Spring bolt bearing 8

Airlight II (M 24) adjustable aluminium air suspension hanger brackets 8.2

Aluminium hanger bracket, side shock absorber attachment



With BPW air suspension axles with adjustable aluminium hanger brackets, the head of the spring bolt is secured from rotating by means of a profiled lot in the adjusting plate.

The spring bolt should be mounted from the outside (wheel side) towards the inside.

A distance washer is placed between the rubber bush and steel bush of the alloy hanger bracket on the wheel side instead of a wearing plate when installing shock absorbers from the side.

A straight wearing plate must be used on the inside.

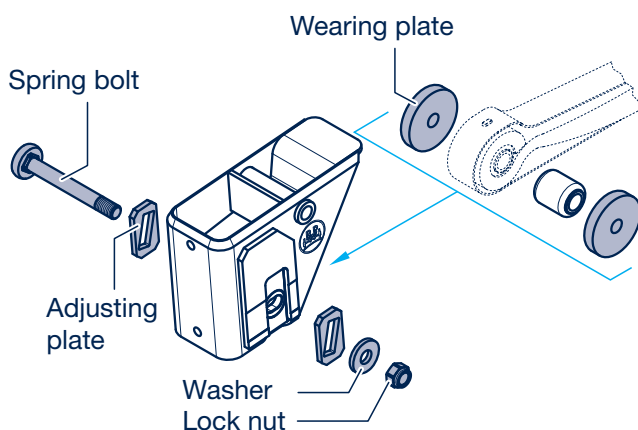
Make sure the inner and outer adjusting plates on each hanger bracket are adjusted symmetrically.

Before tightening the lock nut, the axle position must be set to ride height to prevent impermissible distortion of the rubber bush.

See Chapter 17 for tightening torque.

In asymmetrical designs, the centre of the hanger bracket is 30 mm bigger than the spring centre.

Aluminium hanger bracket, central shock absorber attachment



If the shock absorber is positioned in the centre on the spring or if there is no shock absorber fastening in the hanger bracket, two round wearing plates are used.

Make sure the inner and outer adjusting plates on each hanger bracket are adjusted symmetrically.

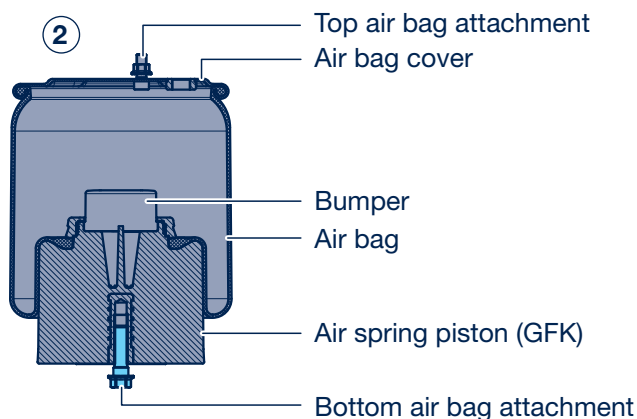
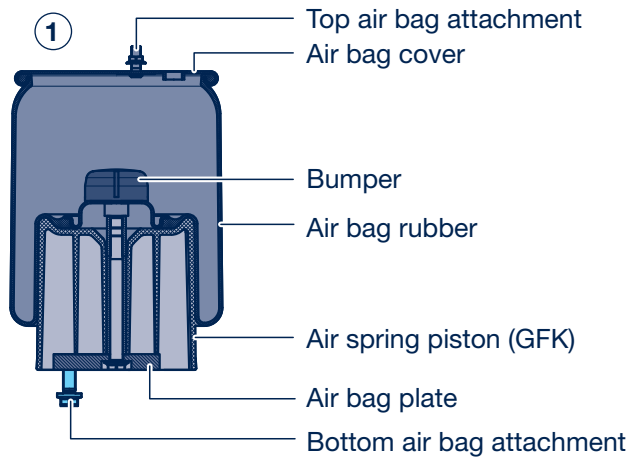
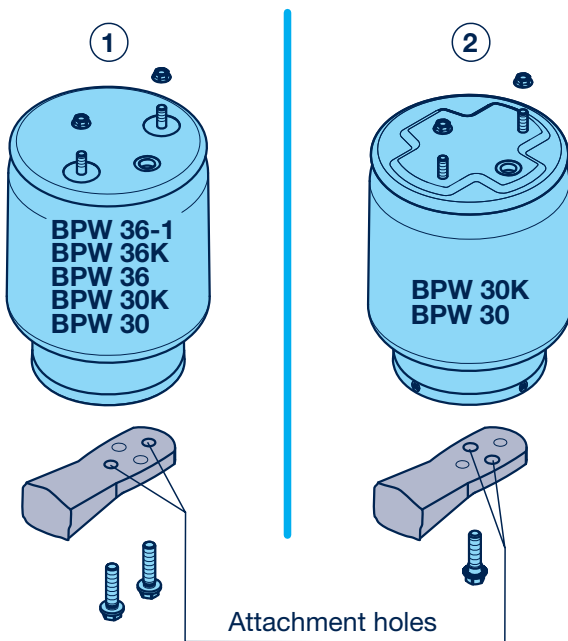
Before tightening the lock nut, the axle position must be set to ride height to prevent impermissible distortion of the rubber bush.

See Chapter 17 for tightening torque.

The hanger bracket centre is identical to the spring centre in case of the symmetrical design.

9 Air bags

9.1 Air bags, general



See Chapter 17 for tightening torque.

2 variants of air bags are used for BPW Airlight II and SL air suspension kits.

1. Air bag with bolt-on bag plate or washer (BPW 36-1) in the air spring piston

The bag is connected with the trailing arm with two fixing screws.

The following offsets are achieved with the bag plate:

- 0 / 20 / 60 mm with bag Ø 300
- 45 / 80 mm with bag Ø 360
- special offset with bag Ø 360 = 0, 32, 55, 90

2. Air bag with central bolt (Ø 300)

The air bag is connected with the trailing arm by a fixing screw.

A 20 mm offset is achieved with the bore hole in the trailing arm.



Technical information on the behaviour of air spring system 30 + 30K at maximum „raised position“ on the vehicle

The air spring system consists of the air bag and the air spring piston. These two components are inextricably linked via a prestressed barrel gasket seat. Highly reinforced polyamide materials are used in the air spring system.

At the maximum „raised position“ at the vehicle, untightness can occur at the barrel gasket seat. Such untightness is non-critical, reversible and does not constitute a malfunction/material defect. The complete sealing of the air spring system is permanently restored after just slight lowering.

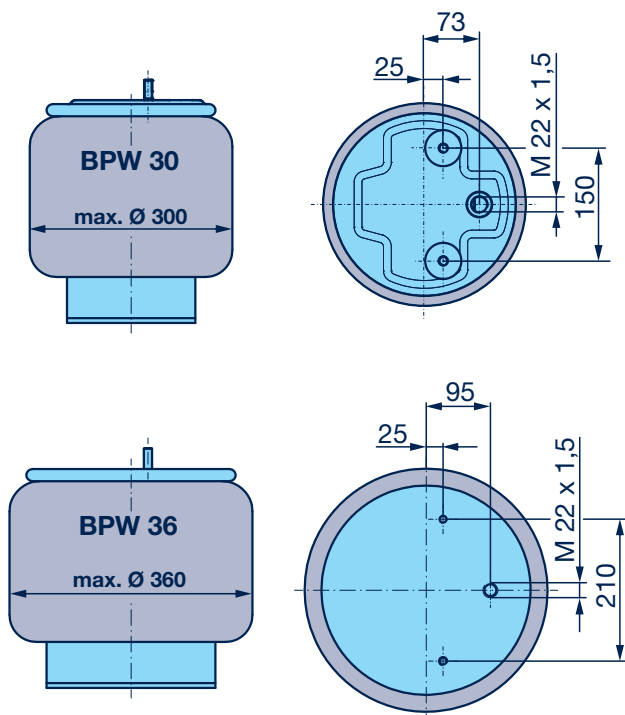
3. General

The top air bag plate is attached to the vehicle frame through the screwed joint of the 2 stud bolts (M 12).

Type 30 bags are operated at a higher pressure than type 36 bags. The quicker power build-up is achieved thanks to the lower pressure in the type 36 bags. They are therefore particularly suitable for applications where it is important to lift or lower the vehicle quickly. Type 36 bags also have a bigger power reserve for greater lifting heights.

Air bags 9

Versions 9.2



The various bag lengths (standard, K, -1) result in various spring deflections and lifting heights (e.g. 190 mm, 220 mm, 260 mm at axle centre). Greater spring deflections are generally more suitable for off-road use to ensure the required axle load equalization.

Versions

- a: BPW 30 for 220 mm spring deflection at axle centre
 BPW 30 K for 190 mm spring deflection at axle centre
 (both spring deflections based on trailing arm
 $L1 = 500$ mm, $L2 = 380$ mm)

Diameter max. 300 mm at approx. 5 bar

specific air bag pressure 0,00023 bar/N (at ride height)

Air bag offset $V = 0, 20, 60$ mm with air bag with
 air bag plate ($t = 20$ mm)

Air bag offset $V = 20$ mm with air bag with central bolt

- b: BPW 36 for 220 mm spring deflection at axle centre
 BPW 36 K for 190 mm spring deflection at axle centre
 BPW 36-1 (Long-stroke version)
 for 260 mm spring deflection at axle centre

(all spring deflections based on trailing arm
 $L1 = 500$ mm, $L2 = 380$ mm)

Diameter max. 360 mm at approx. 3,5 bar

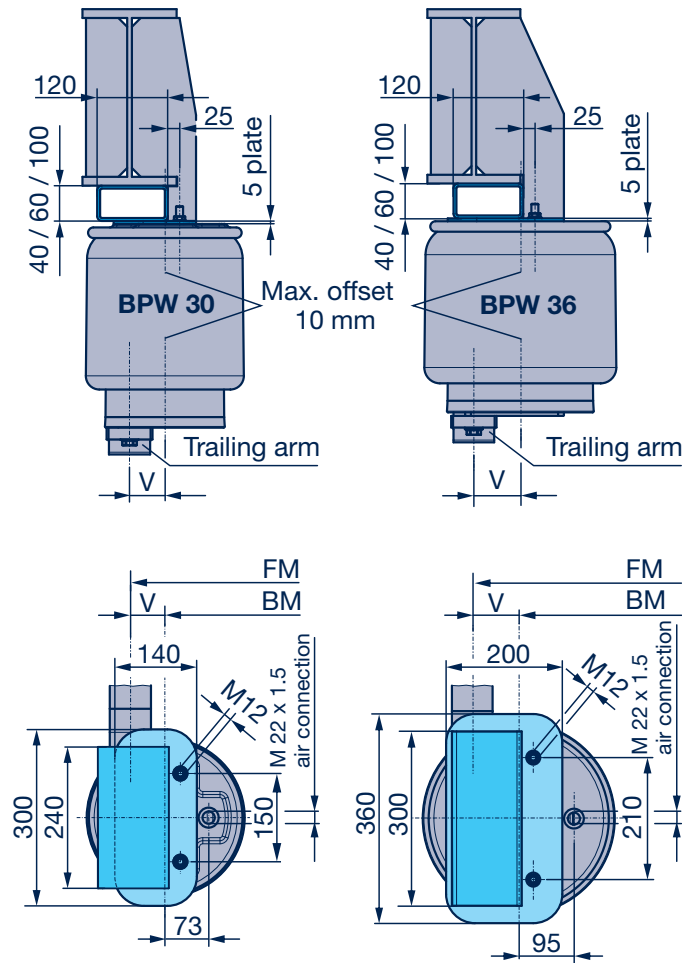
specific air bag pressure 0.000156 bar/N (at ride height)

Air bag offset $V = 80$, bottom air bag plate with
 $t = 14$ mm

Air bag offset $V = 45 / 80$ (0, 32, 55, 90), reinforced
 bottom air bag plate with $t = 20$ mm

9 Air bags

9.3 Air bag with offset



General

The transmission of force between the air bag and vehicle frame must be ensured with a suitable design. Particularly when installing components with an offset to the side, the bending moment which occurs must be absorbed with ribs and gusset plates or even cross-members. The air bag force calculation is described in Chapter 3.

The “loaded without air” load case must also be taken into consideration, if necessary. In special situations (e.g. loading a semi-trailer onto a ferry or unloading a rear dump truck), the axle load portion which then must be supported through the air bag bumper can significantly exceed the static value.

During installation, the air bag centre at the top (on the vehicle frame) must not deviate by more than 10 mm from the air bag centre at the bottom (on the axle side). The air bag must not be installed with a twist between the top and bottom air bag attachment.

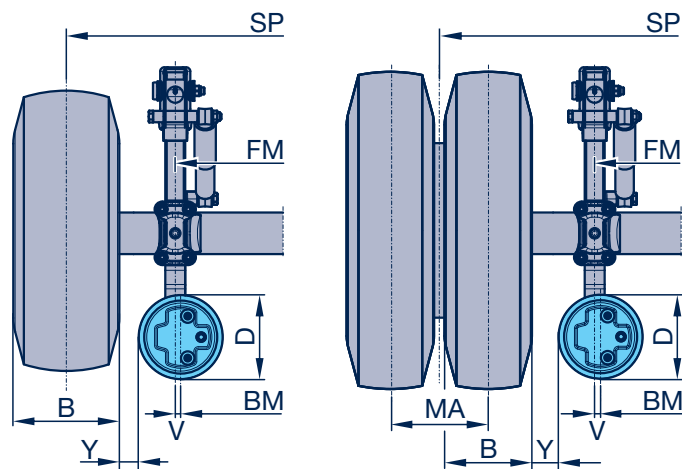
Example of installation and reinforcement with packer

In this case, an air bag plate with the following minimum dimensions must be planned in addition to the square tube and rib:

Air bag BPW 30:	300 mm x 140 mm
Air bag BPW 36:	360 mm x 200 mm

Example of installation and reinforcement without packer

In this case, the air bag plates also have to be planned with the minimum dimensions stated above.



Clearance between air bag and tyre

The min. clearance between the air bag and tyre should be 30 mm and can be calculated as follows:

$$Y = 0.5 \times (SP - FM - B - D - MA) + V$$

- SP = Track
- FM = Spring centre
- D = Air bag diameter
- V = Air bag offset
- B = Tyre width
- MA = Tyre centre distance (for single wheels = 0)

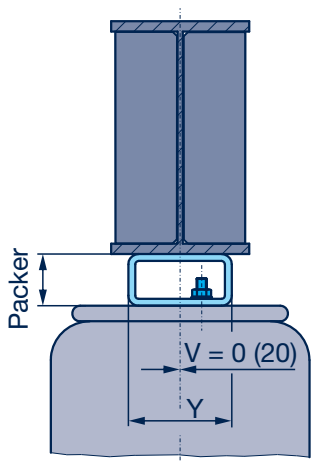
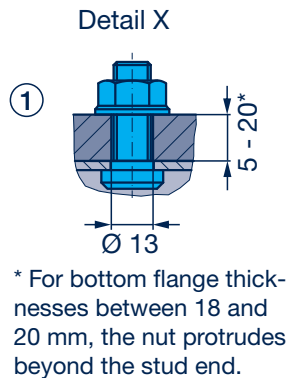
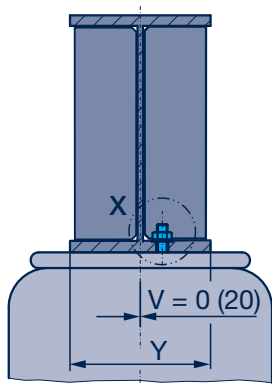
Clearance between air bag and brake cylinder (for drum brakes)

The min. clearance between the air bag and brake cylinder must be 30 mm.

See Chapter 17 for tightening torques

Air bags 9

Air bag in centre of frame 9.4



Y min. 140 for BPW 30 air bag
Y min. 200 for BPW 36 air bag

General

The transmission of force between the air bag and vehicle frame must be ensured with a suitable design. The calculation of the air bag force is described in Chapters 3.1 and 3.2. The "loaded without air" load case may also have to be taken into consideration.

In special situations (e.g. loading a semi-trailer onto a ferry or unloading a rear dump truck), the axle load portion which then must be supported through the air bag bumper can significantly exceed the static value.

During installation, the air bag centre at the top (on the vehicle frame) must not deviate by more than 10 mm from the air bag centre at the bottom (on the axle side). The air bag must not be installed with a twist between the top and bottom air bag attachment.

Example of installation and reinforcement with packer

When installing the air bag in the centre of the frame with little or no offset ($V = 0$ or 20 mm), holes may be drilled into the bottom flange of the vehicle frame for inserting the upright bolt M 12. For bottom flanges with a thickness of 20 mm, shaft nuts with spring washers must be used and bore holes with 21 mm diameter.

Example of installation and reinforcement without packer

The minimum dimensions of the air bag support (plate or wide bottom flange) for the BPW 30 air bag must also be 140 mm x 300 mm in this case.

Clearance between air bag and tyre

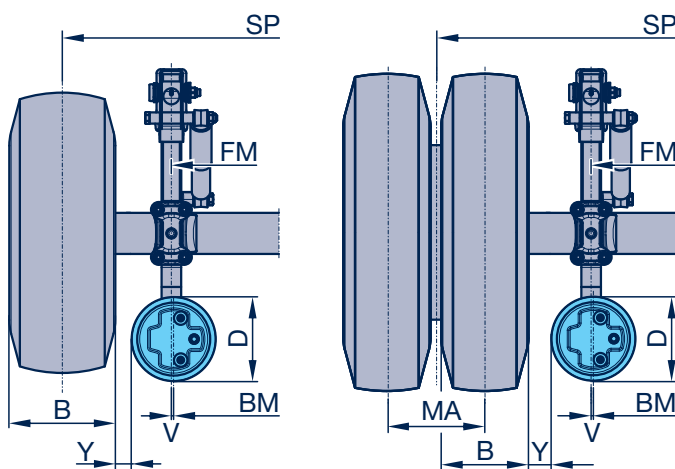
The min. clearance between the air bag and tyre should be 30 mm and can be calculated as follows:

$$Y = 0.5 \times (SP - FM - B - D - MA) + V$$

- SP = Track
- FM = Spring centre
- D = Air bag diameter
- V = Air bag offset
- B = Tyre width
- MA = Tyre centre distance (for single wheels = 0)

Clearance between air bag and brake cylinder (for drum brakes)

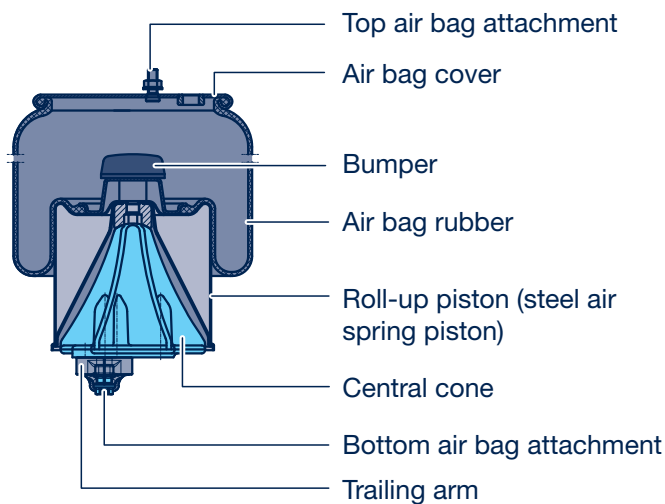
The min. clearance between the air bag and brake cylinder must be 30 mm.



See Chapter 17 for tightening torques

9 Air bags

9.5 Air bag with split piston (Combi air bag)



Split air bag piston

This design provides unrestricted usability of vehicles with air suspension for combination traffic.

The air bag is split in two halves and consists of the central cone which is installed on the trailing arm and the roll-up bag with the piston.

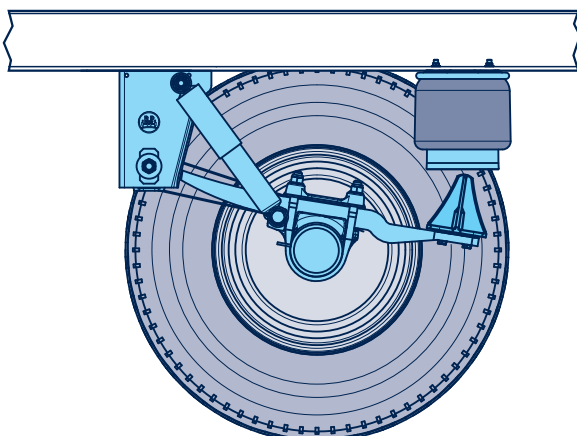
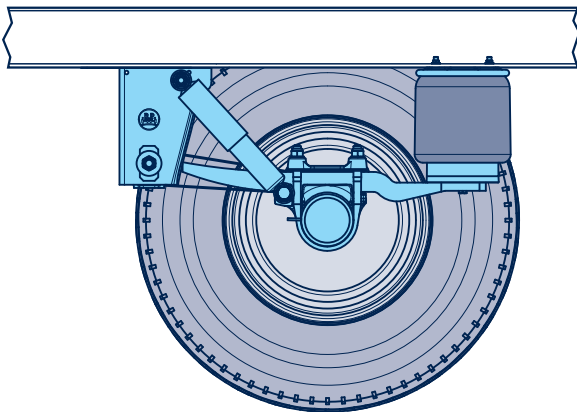
If the vehicle is raised after the air is exhausted from the suspension, the axles move downwards through their own weight. The roll-up bag with the piston remains in its resting position and the trailing arm with the central cone drops down.

The air suspension unit securely reconnects once the vehicle is lowered again. The air bags can neither fold nor crease.

This guarantees a long life expectancy.

When driving on road, there is no difference between the Combi air bag and a conventional BPW air suspension.

Split air bags are available as BPW 30 or BPW 30K.

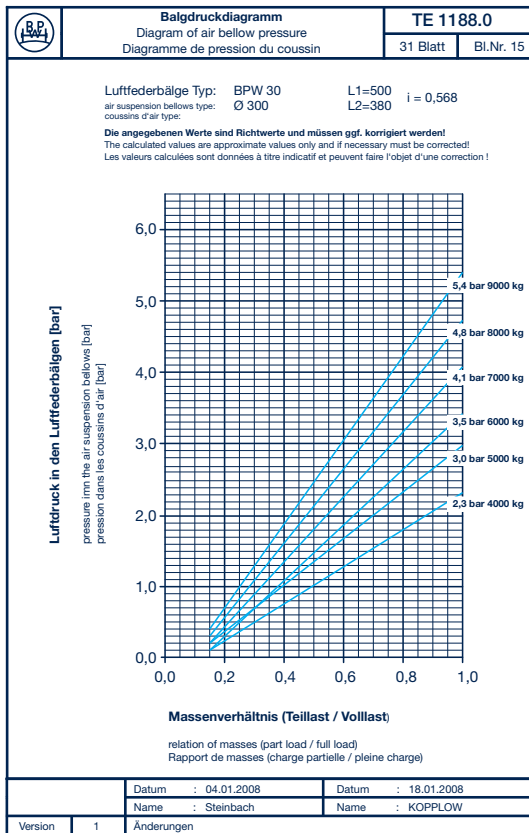


As the shock absorbers act as end stops in this design, it must be ensured that they are installed with a corresponding length.

Please refer to the instructions on the air spring installation / raising and lowering (Chapter 12.5).

Air bags 9

Air bag pressure diagrams / characteristics curves 9.6

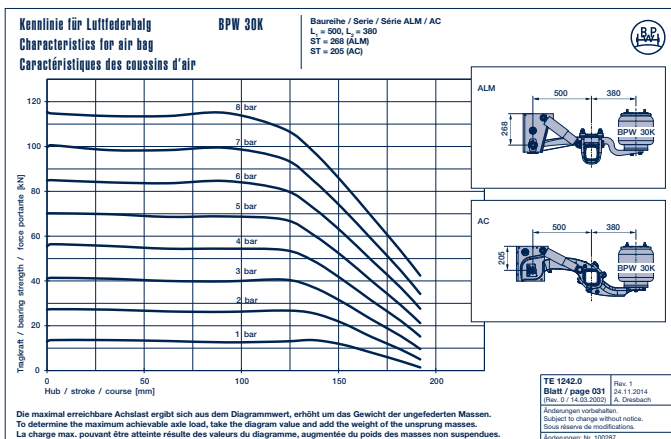


BPW provides the following characteristics curves on its website (My BPW*):

TE-1188.0 Air bag pressure diagrams

The characteristics curves serve to determine the air bag pressures based on the load status of the axles. There is one diagram sheet for each air bag type and the trailing arm transmission ratio (L1, L2). The straight lines are allocated to the maximum axle loads and describe the relation between the air pressure in the air bags and weight ratio (part load : full load of the axle loads on the ground GA).

* My BPW is the customer portal of BPW.



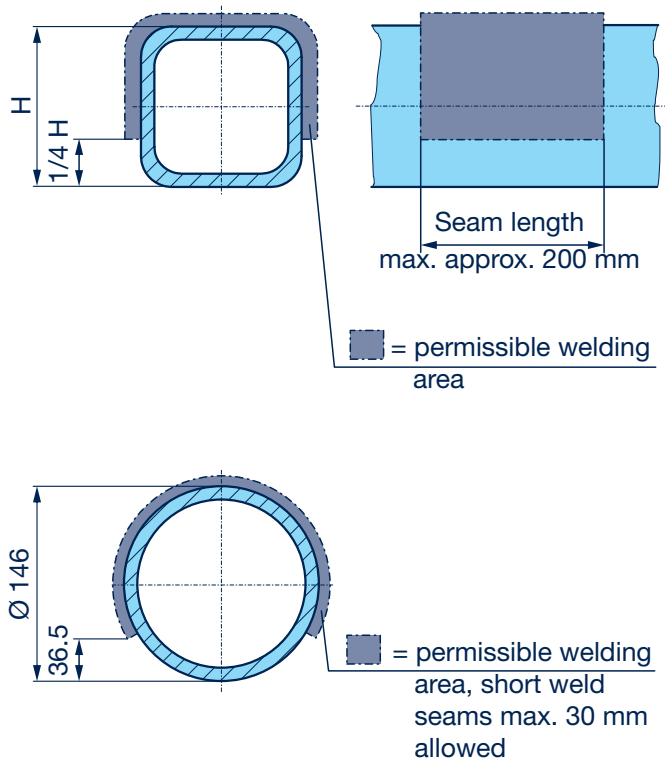
TE-1242.0 characteristics curves for air bags

The characteristics curves serve to estimate the load index of the air bags which declines over the stroke, e.g. for the raising and lowering function. A diagram sheet is available for each air bag type and trailing arm transmission ratio (L1, L2). The isobars (from 1 bar to 8 bar air bag pressure, from TE-1188.0) describe the relation between the lifting capacity (of the sprung mass per axle) and stroke in the sense of the axle spring deflection between minimum ride height (empty, without air) and maximum ride height (fully extended air bag). $FA_{gef} = FA \times 0,92$ (single wheels) applies approximately for the sprung masses respectively axle load (axle load on the ground less the weight force of axle, wheels and part of the suspension).

10 Axle beam

10.1 Axle beam welding guidelines

Material: S 420 bzw. S 355 J 2



General

When installing trailer axles, it may be necessary to subsequently weld components on to the axle beam (e.g. support for central axle lift).

BPW axles are made of materials that can be welded. The axle beams do not have to be pre-heated before welding.

The carrying capacity and faultless operation of BPW axles are not impaired by welding, if the following points are complied with.

Welding process

- ⊙ Gas shielded arc welding
Weld wire quality G 4 Si 1 – EN ISO 14341-A
- ⊙ Manual arc welding
Stick electrodes E 46 5 B 32 H 5 – EN ISO 2560-A
- ⊙ Mechanical quality values must correspond to the basic material S 420 or S 355 J 2
- ⊙ Weld thickness a 5 ∇ (DIN EN ISO 5817)
- ⊙ Avoid end craters and undercuts!
- ⊙ Functional areas free from weld spatter



Weld seams must not create impermissible changes in the camber and side directions of the axle. The welding areas and seam lengths (see drawing) must therefore be complied with at all times.

Do not weld in the tensile stress area of the axle beam (bottom)!

For all welding operations, the trailing arms, spring U-bolts, air bags, plastic pipes and shock absorbers must be protected against flying sparks and weld spatter.

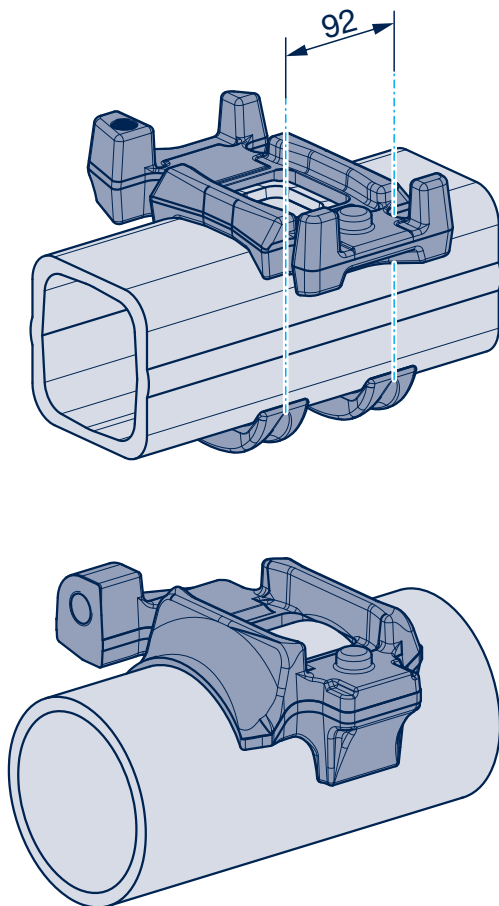
The earth terminal should under no circumstances be attached to the trailing arm, spring U-bolt or hub.

It is not permitted to weld the trailing arms!

Axle connection 10

Airlight II and SL air suspension 10.2

Clamped axle connections



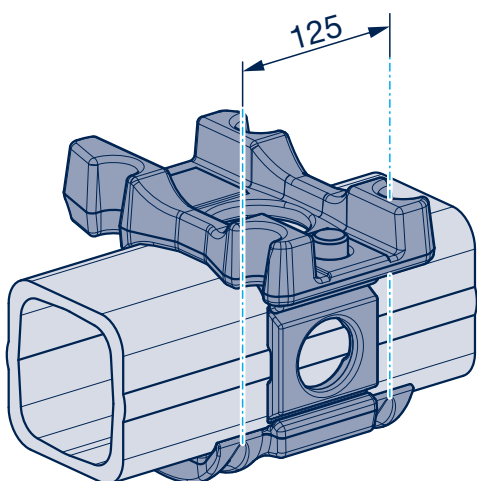
Clamped axle connections (Airlight II)

This Airlight II axle connection with spring U-bolt diameter M 22 (wrench size 32 mm) is tightened with a torque / angle process controlled by the tensile yield strength. This has the advantage that the Airlight II air suspension is maintenance-free in on-road applications.

The axle connection therefore must not be uninstalled so as not to invalidate the guarantee!

In Airlight II air suspension systems with clamped axle connection, the screwed joints have to be checked regularly and retightened if necessary because of the high loads when used off-road for 9 t vehicles. The specified tightening torques (see Chapter 16) must be complied with at all times to prevent damage to the components.

Welded axle connections



Welded axle connection (Airlight II and SL air suspension)

The welded Airlight II axle connection contain the spring U-bolt M 24 (SW 36).

In case of welded axle connection, the screwed joints have to be regularly checked and tightened, if necessary.

Please note:

The tight seat of the spring U-bolt screw joints for the clamped and welded axle connection must be checked at the specified intervals.

For more information about the maintenance intervals, please refer to the applicable maintenance regulations or workshop manuals.

The specified tightening torques (see Chapter 16) must be complied with at all times to prevent damage to the components.

11 Shock absorber

11.1 General

The purpose of shock absorbers is to rapidly reduce the vibrations occurring between the axle and body during driving.

This prevents any further yawing of the body and running gear components, and ensures that the tyres maintain optimum roadholding. The purpose of this roadholding is to ensure that the vehicle tracking remains accurate and that the vehicle brakes correctly.

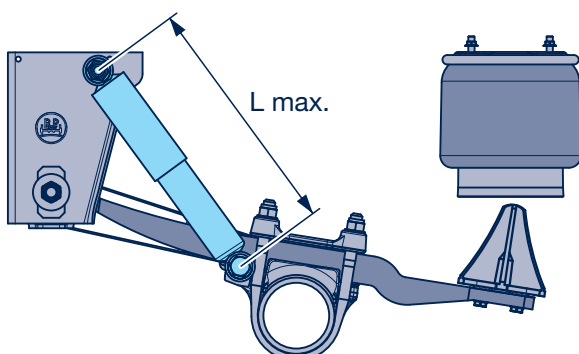
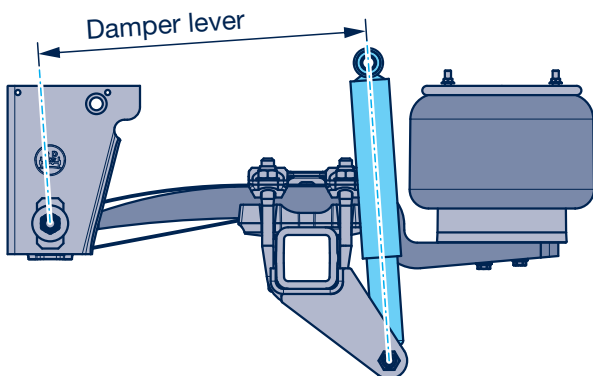
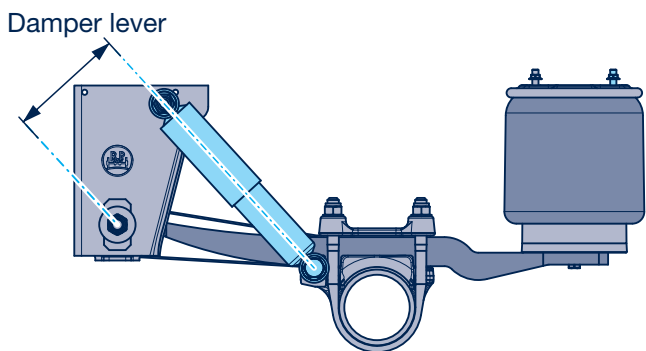
BPW shock absorbers operate according to the twin tube principle. In the compression stage (corresponding to upward travel), the oil is pressed into the working space at the top, which then flows back into the working space at the bottom during the rebound travel (corresponding to downwards travel). The built-in valves produce the required damping characteristics (characteristics curve).

BPW recommends using HD dampers for use on rough road surfaces and for high off-road speeds.

The effect depends on this characteristics curve as well as the lever around the spring bolt. The damping moment crucial for the dampening process results from the damping force and this lever.

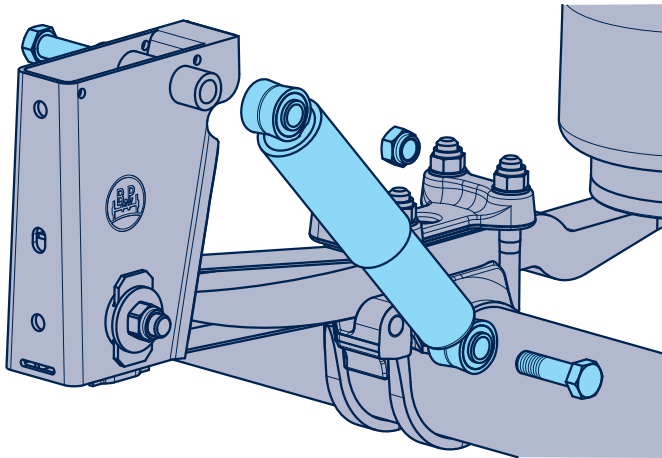
Dampers located at the rear with large stroke therefore have a bigger lever but flatter characteristics curve. The increase in damping torque with rising lever is non-linear as the damper speed, and therefore forces, increase as well. Overall, the damping effect of dampers located at the rear is higher.

BPW shock absorbers are matched to the vehicle, overall height, installation position and applications. For air suspensions with split bags (combination air bag), the shock absorbers also act as an end stop to prevent further lowering of the axles.



Shock absorber 11

Attachments 11.2



Shock absorbers may be arranged in different ways depending on the version:

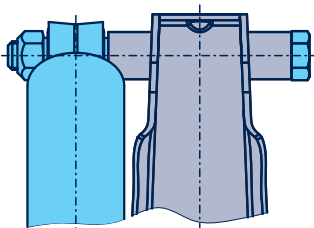
- ⦿ On the side next to the air suspension hanger bracket (towards the centre of the axle next to the trailing arms)
- ⦿ Centrally in relation to the air suspension hanger brackets above the trailing arms

The shock absorbers are attached using M 24 screws or welded on threaded bolts with lock nuts.

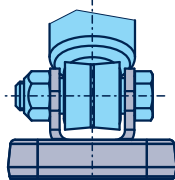
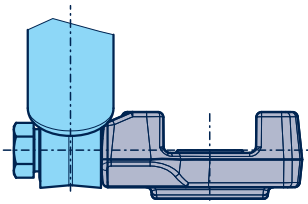
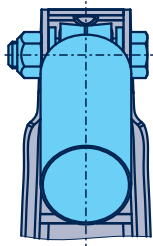
Depending on the version, it may be necessary to use additional rings, washers and sleeves for installation.

See Chapter 17 for tightening torques

**Location
at side**

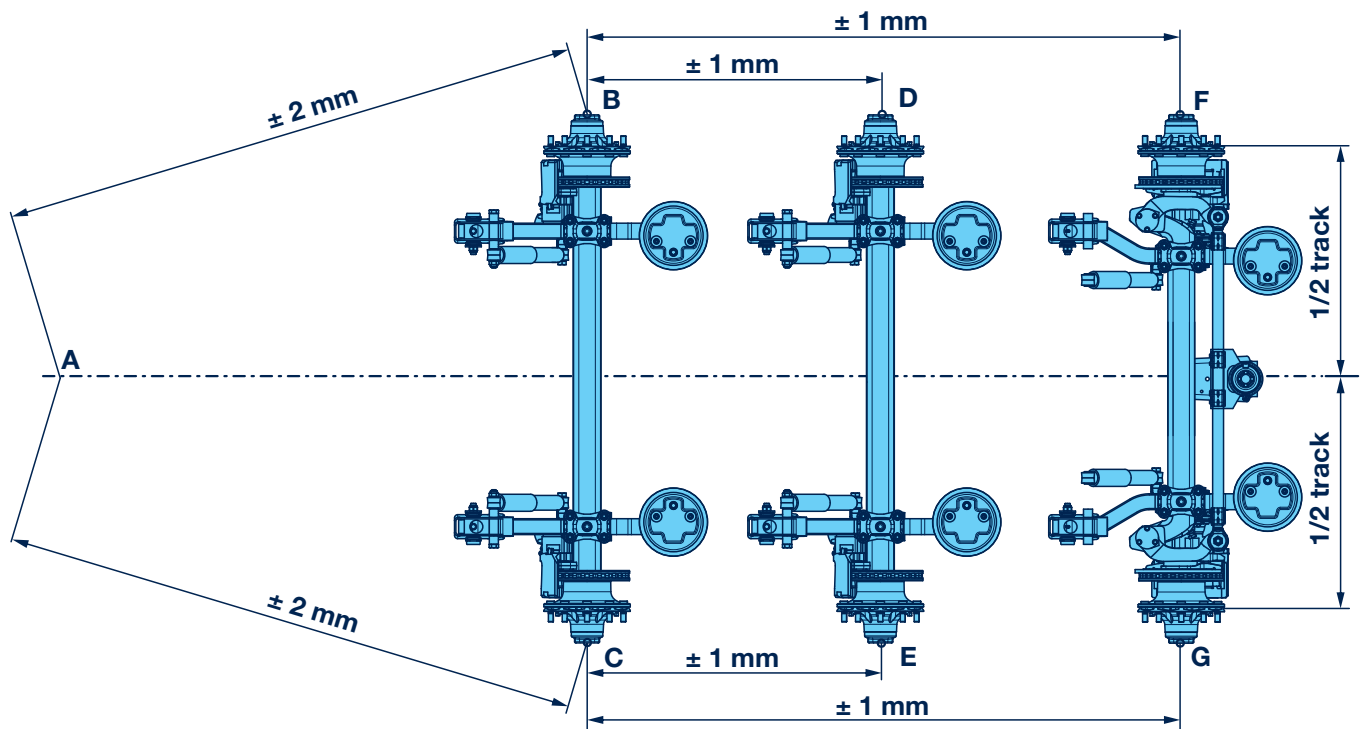


**Central
location**



12 Axle alignment

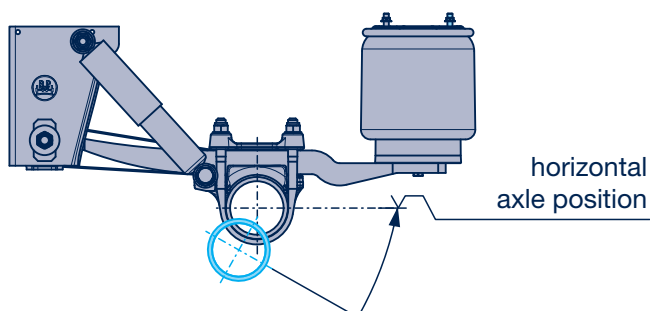
12.1 Axle alignment, conventional



To compensate for manufacturing tolerances, an axle alignment check must be conducted and any corrections made as necessary.

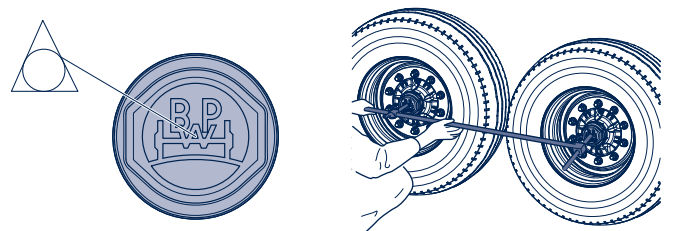
Determine the diagonal dimensions **A - B** and **A - C** for the front axle (reference axle) by means of comparative measurements (± 2 mm tolerance). Check and if necessary correct the wheelbase dimensions **B - D** and **C - E** for the centre axle, and **B - F** and **C - G** for the rear axle (max. tolerance 1 mm). Measurement is generally carried out above the hub cap centre point (illustration on the right). It can also be carried out using suitable distancing devices or screwed-on calibration tubes.

Care must be taken to ensure that the axle is aligned **horizontally** (at ride height) with the base in order to obtain a correct measurement.



The triangle in the BPW logo is in the centre and can be used for holding a measuring tool:

The maximum possible wheel base correction per axle is ± 10 mm for tracking plates (see Chapter 12.4) and ± 5 mm for adjustable hanger brackets (see Chapter 12.3).

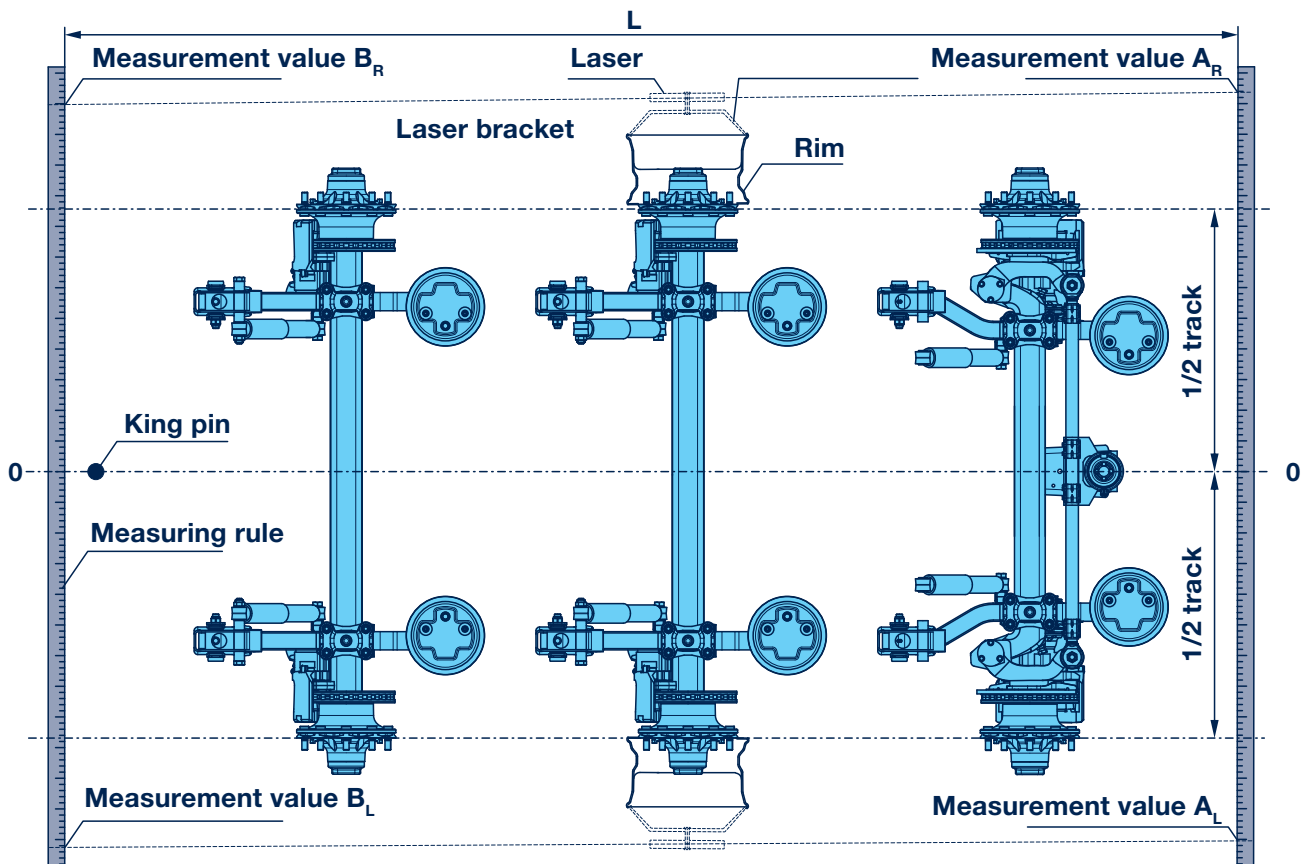


This method only takes into consideration the distances of the axles, but not the individual tracking values on the axle sides. This is sufficient for axles with optimal tracking values. This conventional method has a higher probability of incorrect measurements than the laser method (Chapter 12.2).

The measurement of smaller differences across greater lengths can be impacted by factors such as the elasticity in the measuring tool (manual force).

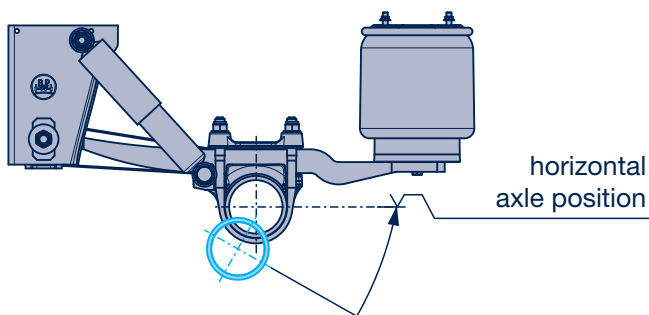
Axle alignment 12

Axle alignment with laser measuring system 12.2



To compensate for manufacturing tolerances, an axle alignment check must be conducted and any corrections made as necessary.

Care must be taken to ensure that the axle is aligned **horizontally** (at ride height) with the base in order to obtain a correct measurement. It is assumed that the vehicle does not carry any loads.



During the tracking process, the tracking values of the right and left wheel side must be averaged for each axle.

Instead of measuring all three axles using the laser method, it is also possible to only track the mid-axle using the laser method. The front and rear axle are positioned relative to the mid-axle using suitable axle centre distance devices (like during conventional tracking).

$$\frac{(AR - BR) + (AL - BL)}{L} = \text{Axle track (mm/m)}$$

Positive value = toe-in

Negative value = toe-out

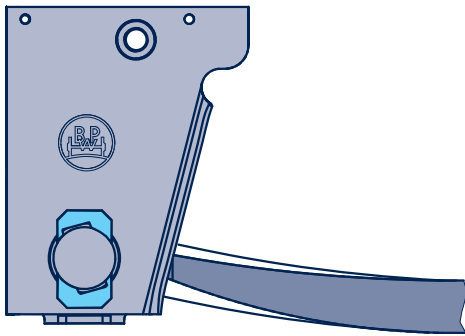
Target values (total axle track):

- ⊙ Rigid axle
 - => -1 ... + 5 mm/m (Axle beam □ 120, □ 150)
 - => -2 ... + 5 mm/m (Axle beam ○ 146)
- ⊙ Self-steering axle
 - => 0 ... + 4 mm/m (drum brake)
 - => -5 ... - 1 mm/m (disc brake)

The operating and setting instructions of the laser measuring system manufacturer must be adhered to! The maximum possible wheel base correction per axle is ± 10 mm for tracking plates (see Chapter 12.4) and ± 5 mm for adjustable hanger brackets (see Chapter 12.3).

12 Axle alignment

12.3 Axle alignment correction with adjustable hanger bracket

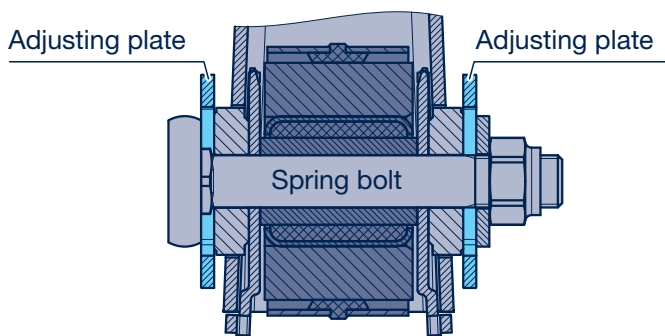


General

It is necessary to check the tracking accuracy during installation as well as after repairs on axles, hanger brackets or guide links. The diagonal measurements and the wheel bases must be checked as described in Chapters 12.1 / 11.2. If a track correction is necessary, it can be carried out as follows:

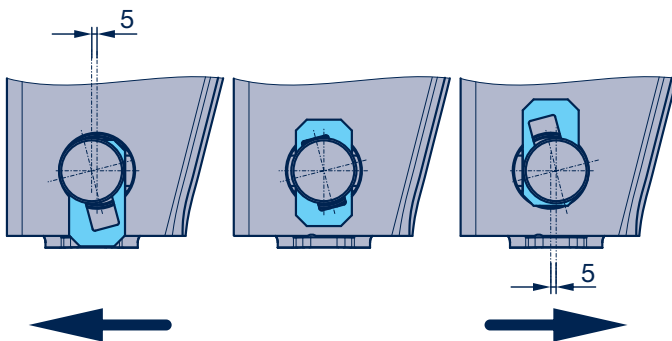
Please note:

The spring U-bolts must not be loosened on adjustable air suspension hanger brackets.



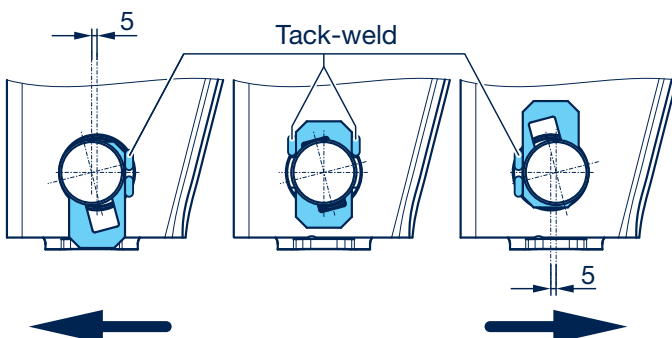
Axle alignment correction:

1. Raise and support the vehicle frame at ride height
2. Deflate air bags
3. Slacken the lock nuts on the spring bolt
4. Align the mid-axle (reference axle). To do so, slide the adjusting plates upwards or downwards with light hammer blows (see fig.)
5. Make sure the inner and outer adjusting plates on each hanger bracket are adjusted symmetrically!
6. Tighten lock nut on the spring bolt to the specified tightening torque.
7. Check the correct track settings of the front and rear axles and re-align if necessary
8. Inflate the air bags and remove supports from underneath the vehicle.



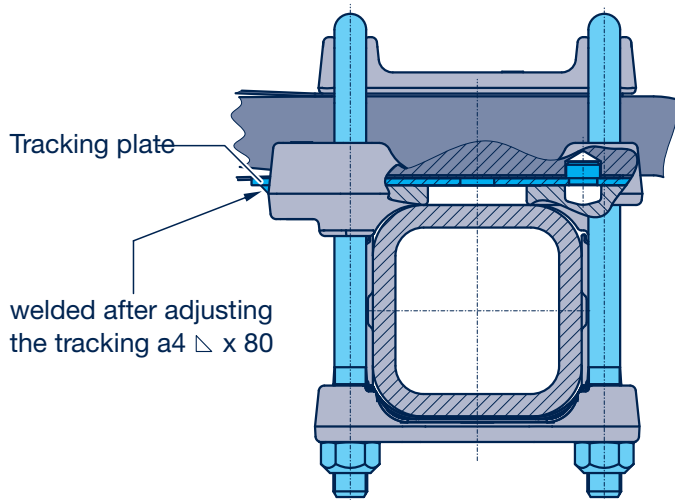
See Chapter 17 for tightening torques

For off-road use the adjusting plates can be tack-welded after track adjustment.



Axle alignment 12

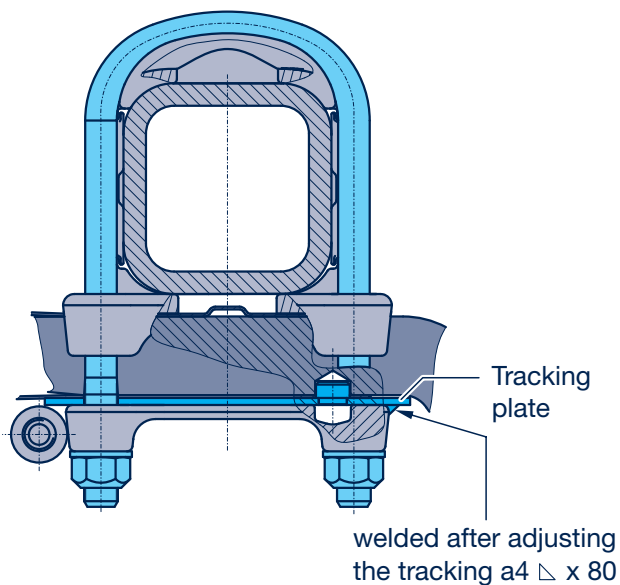
Axle alignment with rigid SL air suspension hanger brackets with tracking plates 12.4



General

It is necessary to check the tracking accuracy during installation as well as after repairs on axles, hanger brackets or guide links. The diagonal measurements and the wheel bases must be checked as described in Chapters 12.1 / 12.2.

If a track correction is necessary, it can be carried out as follows:



Axle alignment correction:

1. Raise and support the vehicle frame at ride height
2. Deflate air bags
3. Loosen the spring U-bolts
4. If necessary, grind off the welding seam on the tracking plate and axle plate / spring plate.
5. Align the centre axle (reference axle)
6. Tighten the spring U-bolts evenly
7. Check the correct track settings of the front and rear axles and re-align if necessary
8. Tighten the spring U-bolts evenly and weld all tracking plates to the front of the axle plates / spring plates
9. Inflate the air bags and remove supports from underneath the vehicle

See Chapter 17 for tightening torques



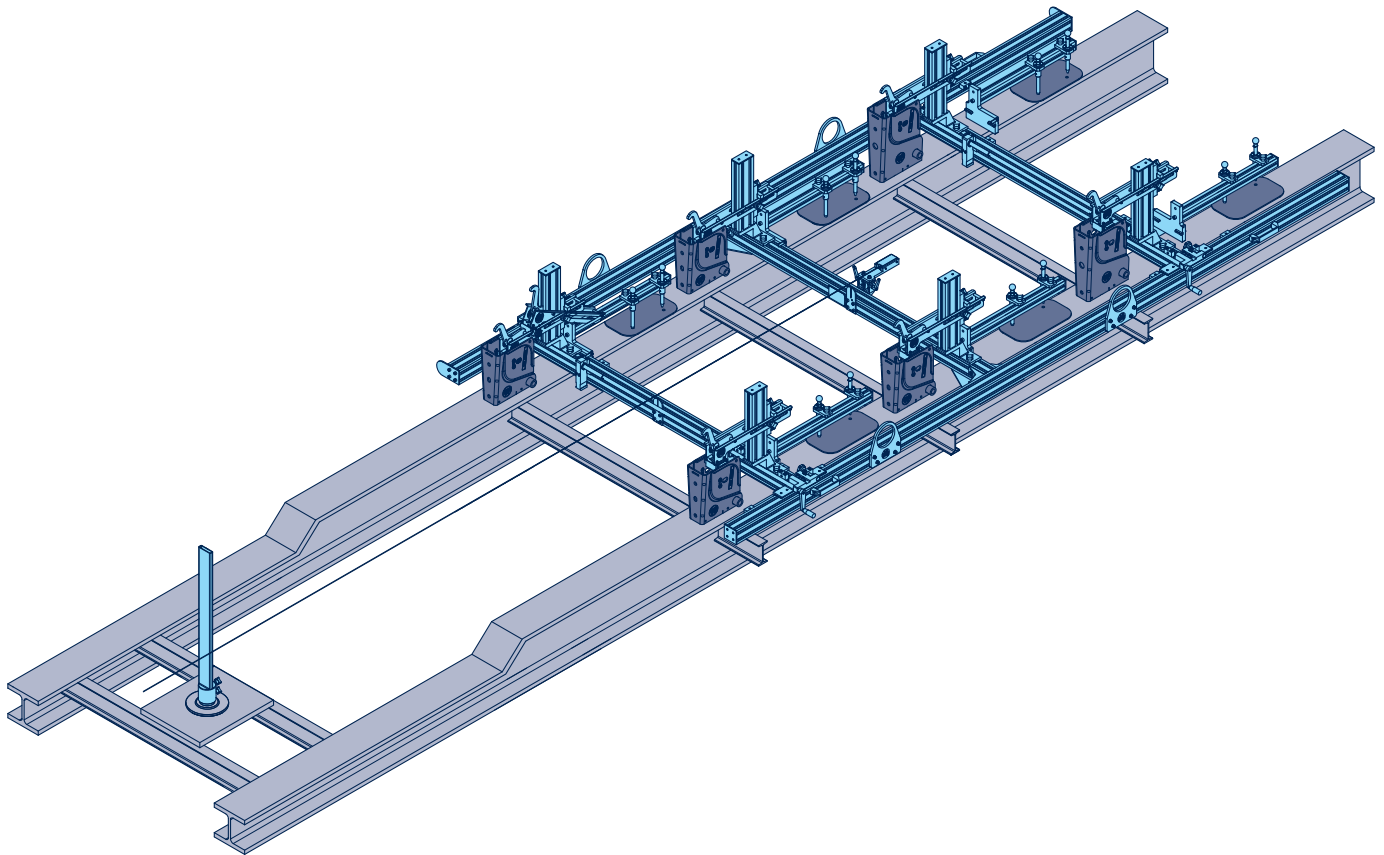
For all welding operations, the trailing arms, spring U-bolts, air bags, plastic pipes and shock absorbers must be protected against flying sparks and weld spatter

The earth terminal should under no circumstances be attached to the trailing arm, spring U-bolt or hub

It is not permitted to weld the trailing arms!

12 Axle alignment

12.5 BPW tack welding device



To quickly and accurately position hanger brackets and air bag plates, BPW provides a special device that can be used for fixing components in the exact position on the frame.

To do so, the vehicle frame of the semi-trailer is first positioned whilst upside down. The fixing device consists of a multi-setting, stable aluminium frame with clamping and positioning devices for various air suspension hanger brackets as well as air bag plates. It is placed on top of the vehicle frame.

After adjusting it in relation to the kingpin using a laser, the device is clamped between the longitudinal beams. Six air suspension hanger brackets and air bag plates are placed on top of the frame simultaneously for fixing using corresponding fitting sockets.

After removing the device, the hanger brackets and air bag plates can be finished and welded on.

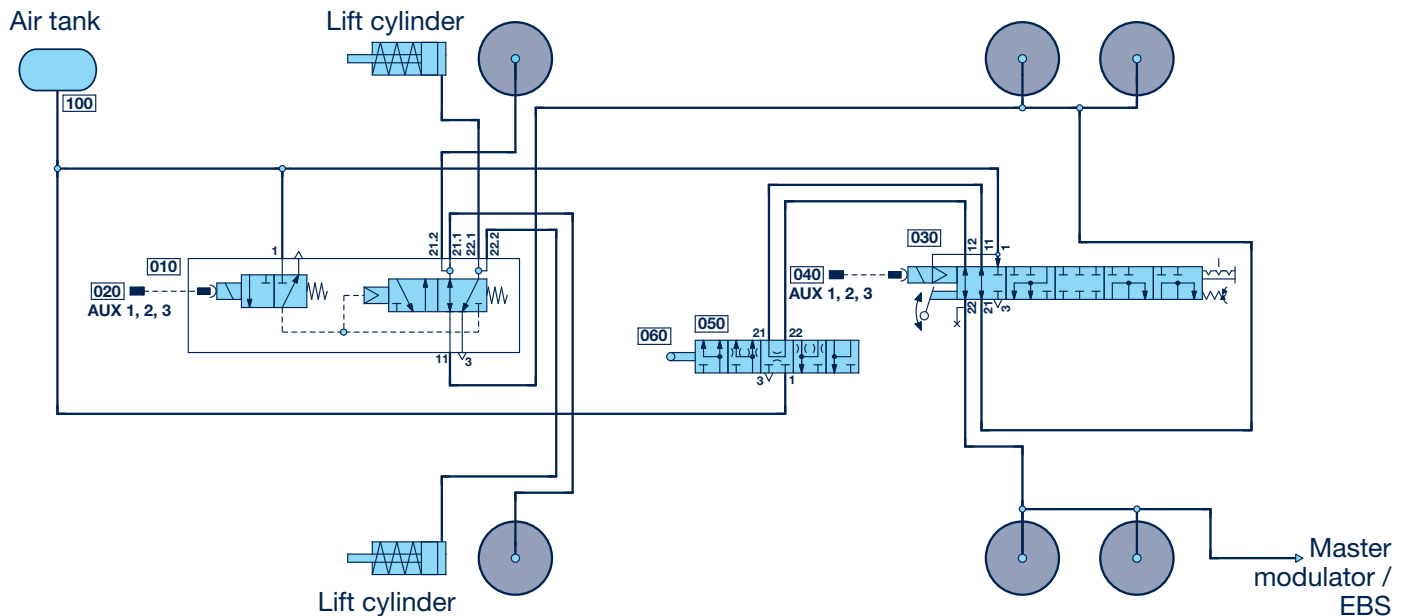
The following assembly of the air suspension unit should ideally make it possible to leave out the additional tracking process as the axles are aligned through the defined position of the hanger brackets to the kingpin and toward one another.

Air installation 13

Air installation, general 13.1

Example of an air suspension installation:

Tri-axle suspension, raising and lowering, with two-sided axle lift



Item	Designation
010	Lift axle valve
020	Connection cable EBS
030	Raise and lower valve
040	Connection cable EBS
050	Air suspension valve
060	Connection to the axle beam (see Chapter 12.3)
100	Air tank

On request, BPW also supplies installation parts and plans for common air suspension installations. The installation plans identify the valves using the ISO illustration method.

The BPW air suspension kit is only as good as its installation. If installed incorrectly, the BPW warranty becomes null and void.

The air suspension is supplied with compressed air from the brake system via a pressure limit valve.

The air tank pressure is approx. 6.5 bar. An air supply of 20 litres is recommended for each axle, lifting and lowering demands correspondingly more.

Without an appropriate air supply there is a risk for safety as no air will remain for the air suspension if the wheel brake has a high air consumption.



To achieve good axle load equalization, the air piping connecting the air bags should not have an inner diameter of less than \varnothing 8 mm (e.g. \varnothing 10 x 1).

Single and dual-circuit air suspension installation 13.2

BPW air suspension kits possess a high roll stability for low side tilt when cornering, leading to excellent road safety. This high roll stability is achieved by supporting the superstructure especially with the axle beam - trailing arm unit when cornering.

The support from the air bags also has an impact, albeit a much smaller one.

For dual-circuit air installation kits, the air bags on the right and left sides of the vehicle are pneumatically separated and are only connected together by a transverse

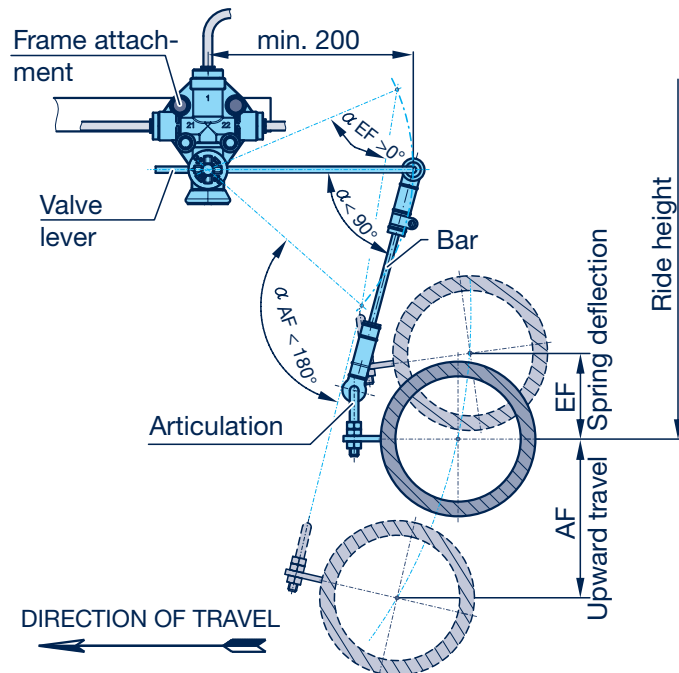
throttle in the air suspension valve. This ensures that the air pressure can compensate slowly when cornering. This creates an additional stabilizing effect when cornering quickly in different directions.

Single-circuit air installation kits (e.g. through a distributor block) do not have this stabilising effect.

Due to the long-standing experience of using single-circuit air installations gathered as well by now, these single-circuit systems can also be approved without reservations for standard applications.

13 Air installation

13.3 Air suspension valve / height sensor



General

BPW air suspension axles are prepared for use with a support and air suspension valve as standard.

This regulates the air bag pressure according to the respective vehicle load, thereby holding the vehicle at a constant ride height. The air suspension valve is screwed to the vehicle frame and connected to the axle via the lever and bar. The pivot link is located in the middle of the axle, on three-axle units at the centre axle, on two-axle units on the rear axle. In special cases (e.g. axle lift device, large vehicle slope) the air suspension valve may also be connected to the front or rear axle.

The valve lever, which is at least 200 mm long, is positioned horizontally in the direction of travel. For testing purposes, the lever is pressed slightly downwards. The air must be released into the atmosphere via the pressure relieve valve.

If the air is directed into the air bag, the valve shaft must be rotated by 180°.

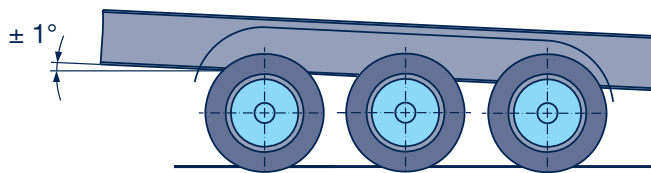
The valve lever must be switched over for this purpose. The ride height is set by adjusting the link rod in the rubber joints and then fixing this position with the lock nuts.

The vehicle must be standing on a level ground when this setting is made. The setting can be performed when the vehicle is laden or unladen. Electronic ride height measuring devices can also be installed.

Stroke limitation of air suspension axles for vehicles with a raising and lowering feature to adjust to the height of ramps can also be achieved with an air suspension valve with integrated lock, see Chapter 13.5.

Ride height

The ride height of the air suspension axles should be set to the permitted range indicated according to the corresponding documents (data sheets). With single axles a minimum upward travel of 60 mm is necessary. With multi-axle bogies a minimum upward travel of 70 mm is necessary.



The max. superstructure inclination of the semi-trailer must not exceed $\pm 1^\circ$.



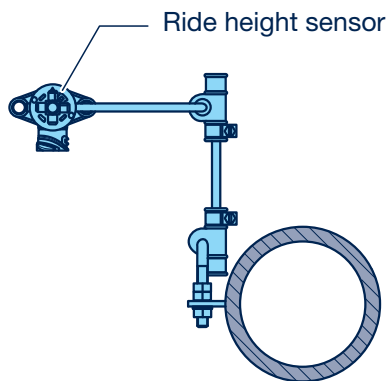
The air suspension can be checked by activating the compression stroke to the air bag bump stop, and then the extension stroke to its limits (shock absorber, air bag length).

The angles stated must be maintained to avoid the valve linkage going over centre.

Due to the strong stabilizing effect, the use of two air suspension valves for regulating the sides is not recommended.

Air installation 13

Electronic air suspension 13.4



In addition to the conventionally operated air suspension valves, electronic air suspension modules are also often used in vehicles. The conventional air suspension valve is replaced with a robust ride height sensor and a multi-functional air suspension block is added.

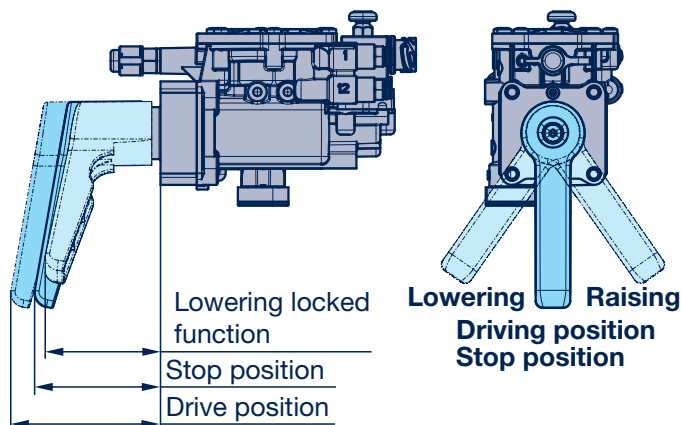
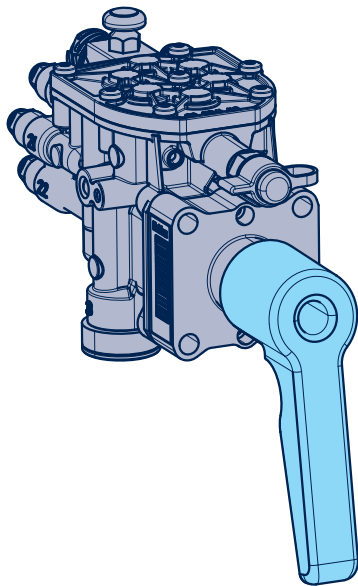
The sensor is usually connected to the brake system, which also controls the valve functions.

The ride height is regulated in a closed regulation circuit, which has advantages compared with a conventional air suspension system when regulating ride heights in terms of parameters and diagnostics options for the vehicle manufacturer and driver. The mechatronic ride height adjuster also provides further advantages compared with conventional valve technology:

- ⊙ Low air consumption as the level regulation is not linked to the dynamic upward / downward movements
- ⊙ Easy option for realising several ride heights
- ⊙ Reset-to-ride function without additional valve technology
- ⊙ Rapid lifting and lowering due to large valve cross-sections
- ⊙ Lift axle control with residual pressure tank, often integrated in the valve block for pulling-off and maneuvering aids
- ⊙ Operability of the trailer suspension from the truck or via mobile devices
- ⊙ Installation advantages due to reduced wiring and tubing

13 Air installation

13.5 Raising and Lowering



Raising and lowering

Today, lift and sink valves, often also called rotary disc valves, provide further functionalities and switchings for influencing the ride height in addition to the original function of raising or lowering the ride height of a vehicle. Depending on the air suspension valve installed, raising and lowering valve can be designed as single or dual circuits. The raising and lowering valve is switched after the air suspension valve and connects the supporting air bags of the axle with the air suspension valve.

Ride height function

The ride height is usually secured through the air suspension valve, which inflates and deflates the supporting air bags, depending on the ride height, thus keeping it constant. The connection of the supporting air bags of the axles with the air suspension valve is also maintained.

Stop function

In this switching position, the link between the air suspension valve and supporting air bags is interrupted and the last ride height set with the raising and lowering valve remains intact. Changes to the ride height caused by loading or unloading are not compensated.

Raising function

To raise the ride height, the connection of the supporting air bags with the air suspension valve is interrupted with the raising and lowering valve and the supporting air bags are inflated with supply pressure for raising the vehicle.

Lowering function

To lower the ride height, the connection of the supporting air bags with the air suspension valve is interrupted with the raising and lowering valve and the supporting air bags are deflated for lowering.

Dead man's switch

The so-called dead man's switch ensures that the vehicle is only raised or lowered if the operator holds the operating lever in the corresponding raising or lowering position. Once the lever is released, it automatically returns to the stop position. This prevents the uncontrolled raising and lowering of the vehicle superstructure.

Lowering locked function

To load or fix vehicles in combination traffic, it may be necessary to lower the vehicle right down to the air bag stop and to maintain this condition for the duration of the vehicle transport. This function is often also called ro-ro function (roll on / roll off).

Resetting the vehicle to ride height

The vehicle is primarily reset to ride height, often also called reset-to-ride function, through a switching impulse of the brake system. The ABS/EBS switching impulse is triggered once a certain speed is exceeded (e.g. 15 km/h) and operates a magnetic valve integrated in the raising and lowering valve. This magnetic valve returns the operating lever to the driving position and therefore ensures that the supporting air bags are reconnected to the air suspension valve for the journey.

Air installation 13

Raising and lowering 13.5

Stroke limitation during compression

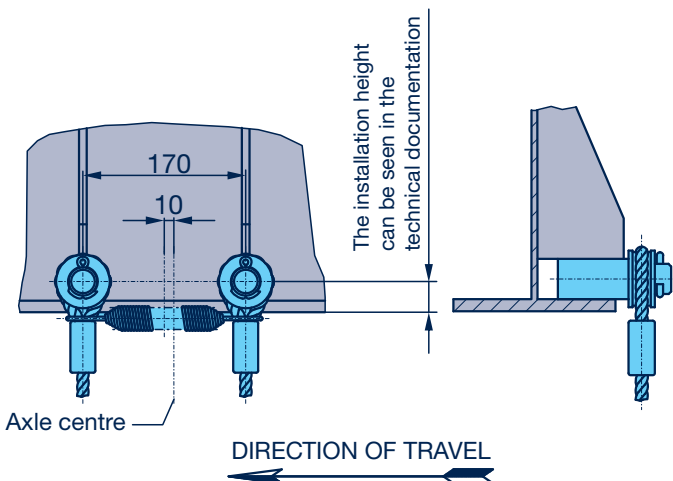
The upward travel is limited by a rubber bump stop inside the air bag. The downward travel must be restricted under certain operating conditions.

Versions of stroke limitation during rebound

The stroke limitation can be carried out via an air suspension valve with integrated shut-off (see Chapter 13.3) or a separate shut-off valve. The shut-off valve is bolted to the vehicle frame and connected to the axle with a return spring attached to the tension pin. After the maximum lift height is reached, the air supply to the air bag is shut off and the stroke thus limited.

The stroke limitation may be in the form of a catch-strap. When assembling the catch straps, their exact length must be ensured as well as that they rub as little as possible on the axle beam, do not collide with other components (e.g. disc brake cylinders, brake camshaft or pipes) and have sufficient ground clearance.

The limitation of raising and lowering devices without stroke limitation in the form of shut-off valves depends on the shock absorbers or air bag, depending on design. The shock absorbers are equipped with a travel limiter; however they are not designed to operate with airbag pressures above approx. 8.5 bar.



Long-stroke air bags

As a rule, no stroke limitation is required for type 30, 30K, 36 or 36K air bags when a rotary disc valve with dead man's lever is installed.

Air bag type 36-1

Stroke limitation is required in vehicles with a raising and lowering device and type 36-1 / 36-2 / 36-5 air bags.

Rapid unloading

With vehicles where the usable load is unloaded quickly, e.g. tippers, container vehicles, coil vehicles etc., stroke limitation is required by means of rapid venting of the air bags.

Crane, railway or ship loading

With vehicles for crane, railway or ship loading, BPW recommends split air bag pistons, Combi Air bag system. If not expressly demanded in the technical documentation (see Chapter 9.5), no stroke limitation is needed when the Combi Air bag is used. In this case, the shock absorber is the lower stop.

Vehicles, especially those with split air bags (combi-airbag) must not be moved in an unventilated state when manoeuvring in ferry traffic.

Traction assist

Even if the vehicle is fully loaded, the semi-trailer front axle can be raised to increase the traction of the driven axle, e.g. in wintery conditions. In accordance with 97/27/EC, Section 3.5 of Annex IV, the deflation of the front axle of the suspension unit of the tri-axle semi-trailer correspondingly increases the load of the axles remaining on the ground. The load on these two axles may then be increased by 30%, corresponding to the following value:

18,000 kg plus 30% = 23,400 kg (11,700 kg per axle).

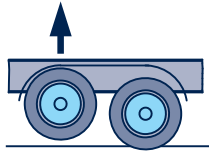
The air bag pressure of the axles on the ground also increases significantly, e.g. when using the 30 air bag (L1 = 500 mm and L2 = 380 mm), from 4.7 bar to 6.65 bar. It must be ensured that the reserve pressure in the tank is approx. 1.5 bar higher. This can prevent the temporary drop down to the bumper of the air bag and therefore an additional, impermissible load increase.

The above axle load increase is only acceptable under the conditions stated in the above guideline. After pulling off, the load must automatically rest back on the axle before exceeding 30 km/h.

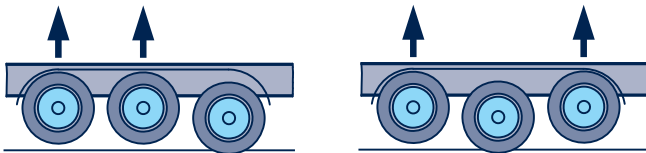
14 Axle lift devices

14.1 General

BPW air suspension axles can be equipped with axle lifts. With tandem suspensions, one axle can be raised,

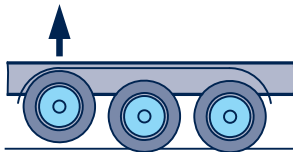


or max. two axles with tri-axle suspensions.



With steering axle

In vehicles with BPW self-steering axles, series LL, a "rigid axle/steering axle ratio" of 1:1 is permitted. With tri-axle suspensions a rigid axle may also be raised.



It is recommended to raise the front axle of a suspension due to the improved ground clearance (gradient of superstructure) and the longer wheel base, thus resulting in more stable driving characteristics.

In the case of vehicles with axle lift devices, ground clearance for the raised axle must be ensured.

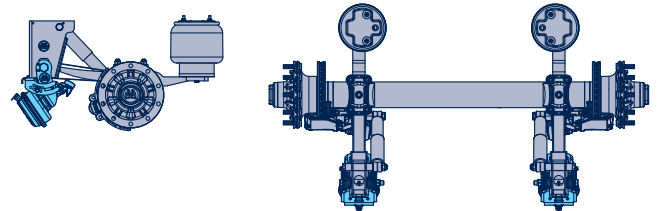
The statutory provisions regarding turning circle requirement must be observed!



BPW air suspension kits and axle lift devices only operate as well as the installation of the air suspension: The reliable functioning of the axle lift and the correct rolling of the air bags should be ensured by means of the air installation and its activation times.

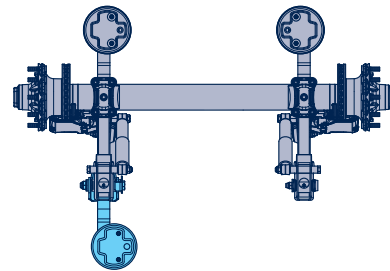
If installed incorrectly, the BPW warranty becomes null and void.

Two-sided lift



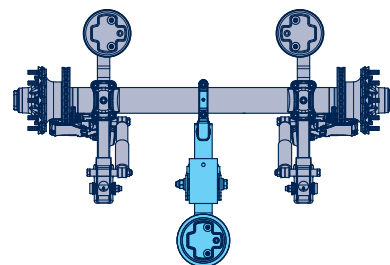
Can be used on all axles, the installation space in front of the air suspension hanger brackets and in the vehicle centre remains free

Side axle lift



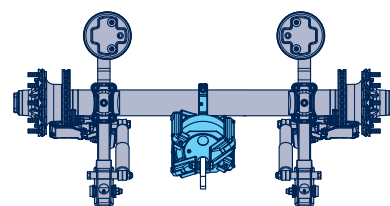
For raising the front axle

Middle axle lift



For raising the front, central or rear axle

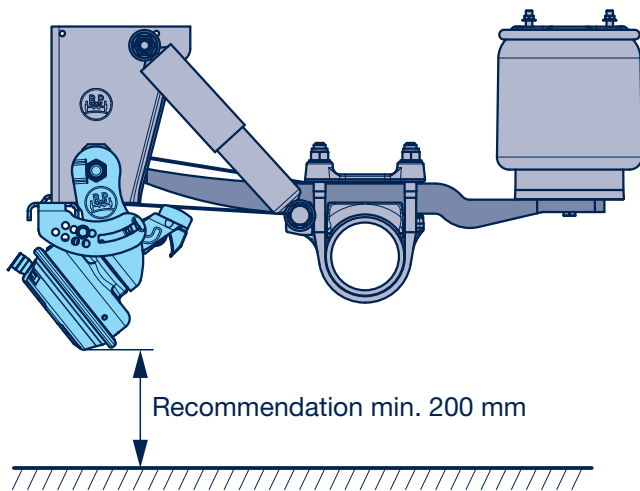
Central axle lift (ALII only)



For raising the front, central or rear axle

Axle lift devices 14

Double-sided axle lift 14.2



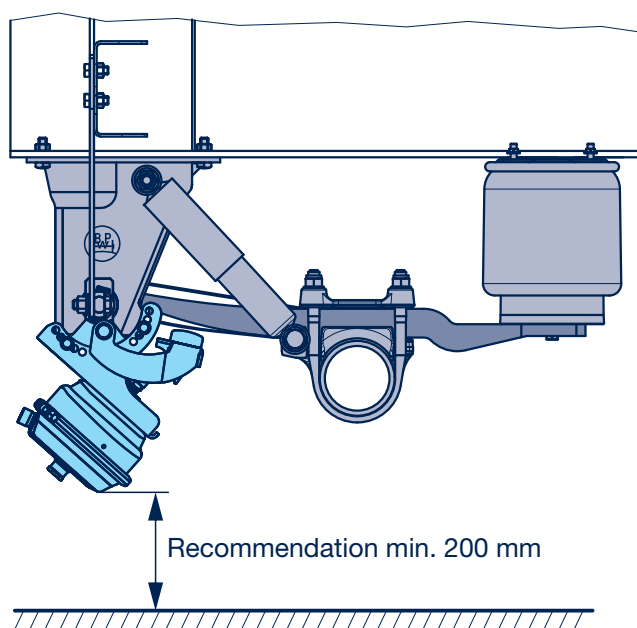
For rigid and adjustable air suspension hanger brackets, channel cross members and aluminium hanger brackets

Function:

In the two-side axle lift, the lifting force is generated by one integrated diaphragm cylinder on each side. The pivot point is the spring bolt, meaning that no other installation preparations have to be planned by the vehicle manufacturer other than the air installation.

Advantages:

- ⊙ Can be used for disc and drum brake axles
- ⊙ Installation space in front of the air suspension hanger bracket (e.g. for pallet boxes) and in the centre of the vehicle remains free
- ⊙ Easy subsequent assembly, if required
- ⊙ Compact design, good ground clearance
- ⊙ Low weight
- ⊙ Installation position can be set for different suspension types
- ⊙ Robust construction
- ⊙ Durable technology thanks to the use of tried and tested brake components



For bolt-on AL II air suspension hanger brackets

Significantly easier assembly thanks to attachment to the hanger bracket with 2 screws.

The spring bolt does not have to be removed.



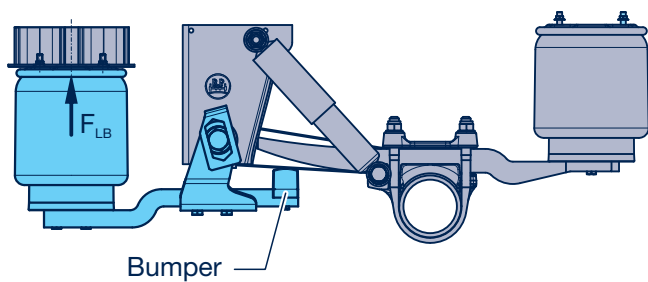
The correct double-sided axle lift and pinning position are shown in the BPW technical documents.

The installation position can be seen in the BPW technical documents.

The pinning position must be correct for the design and ride height to ensure reliable functions.

14 Axle lift devices

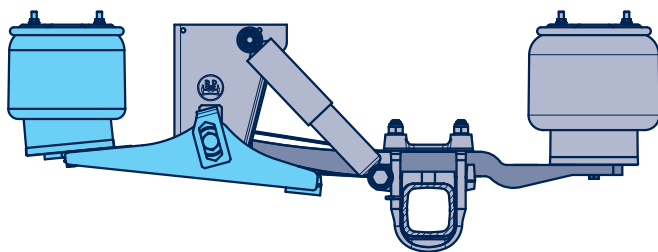
14.3 Sidewise mounted axle lift



Side location is suitable for lifting the front axle of the suspension unit. The lifting arm is assembled on the front air suspension hanger bracket using the spring pivot bolt bearing.

The air bag sits centrally on the lever arm ($V = 0 \text{ mm}$) and is attached under the vehicle chassis trail. Additional cross-members are not required.

The top plate of the lifting bag can be offset to the side by $\pm 20 \text{ mm}$.



BPW provides a sidewise mounted axle lift for improved grounds clearance, especially for air suspension units for low-loaders.

The air pressure for the lifting bag must be limited by a reducing valve, depending on the design!

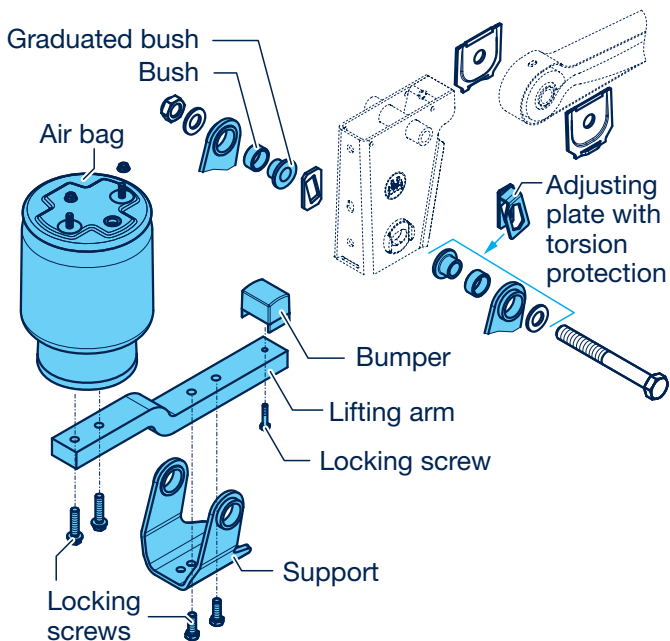
Force on lifting bag BPW 30 ($p = 5.0 \text{ bar}$):

$$F_{LB} = \frac{5.0 \text{ bar}}{0.00023 \text{ bar/N (spec. air bag pressure)}} = 21,750 \text{ N}$$

Force on lifting bag BPW 36 ($p = 3.5 \text{ bar}$):

$$F_{LB} = \frac{3.5 \text{ bar}}{0.000156 \text{ bar/N (spec. air bag pressure)}} = 22,450 \text{ N}$$

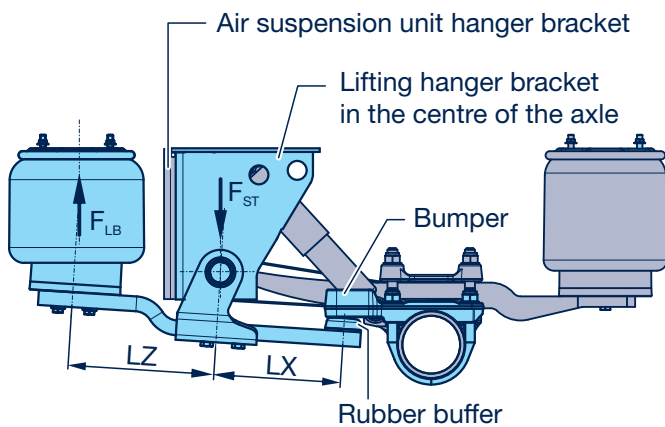
The dynamic axle movements are not transferred to the axle lift device and therefore no consistent initial pressure is required in the lifting bag, even if the axle lift is not being operated.



The installation location and assembly of the axle lift device should be carried out according to BPW technical documents and the installation drawing supplied.

Axle lift devices 14

Middle axle lift device 14.4



The lifting device can be arranged in the centre of the axle for lifting the central (rear) suspension axle or if space is limited.

This axle lift device is attached to a cross-member on the vehicle frame via an additional lifting hanger bracket in the centre of the vehicle.

The installation position of the lifting hanger bracket can be seen in the technical documentation.

The bumper on the axle comes as a weld-on or bolt-on version.

The lifting bag forces are also to be counteracted by a lateral cross-member.

The air pressure for the lifting bag must be limited by a reducing valve, depending on the design!

Example:

- Axle lift device with lifting bag BPW 30
- Pressure reduction valve set at 5 bar.
- Lever lengths LX = 280 mm / LZ = 320 mm (from BPW technical documents)

Force on lifting bag BPW 30 (p = 5.0 bar):

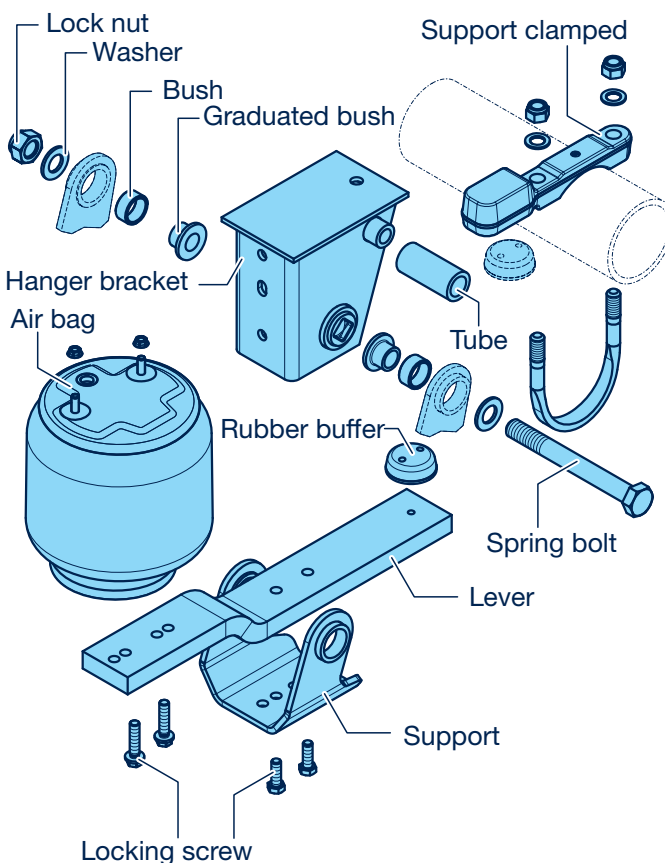
$$F_{LB} = \frac{5.0 \text{ bar}}{0.00023 \text{ bar/N (spec. air bag pressure)}} = 21,750 \text{ N}$$

Force of hanger bracket (p = 5.0 bar):

$$F_{ST} = \frac{21750 \text{ N} \times 600 \text{ mm}}{280 \text{ mm}} = 46,600 \text{ N}$$

If the cross-member over the lifting hanger bracket is not fitted, the torsion moment ($F_{LB} \times LZ$) of the lifting hanger bracket cross-members must be counteracted.

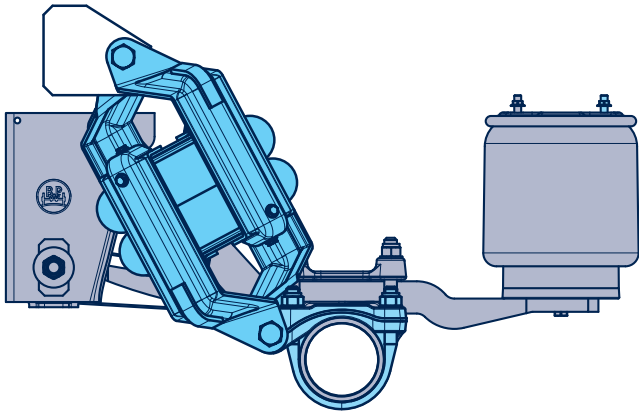
The lateral cross-member and gusset plate must be dimensioned according to standard safety reserves in the commercial vehicle industry.



The installation position and mounting of the axle lift device can be seen in the BPW technical documents and the supplied installation drawing.

14 Axle lift devices

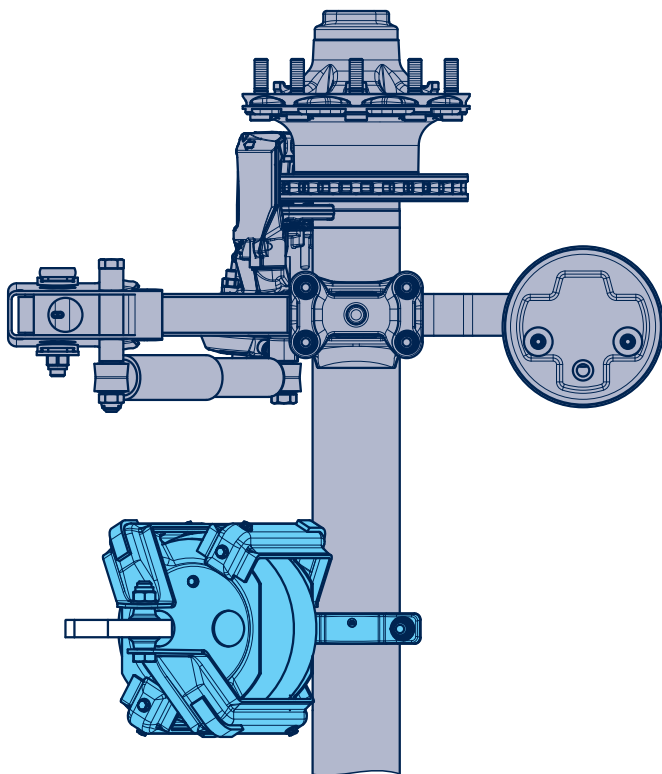
14.5 Central axle lift (ALII only)



The central axle lift is located in the centre of the axle and used for lifting the centre (rear) suspension axle or if space is limited.

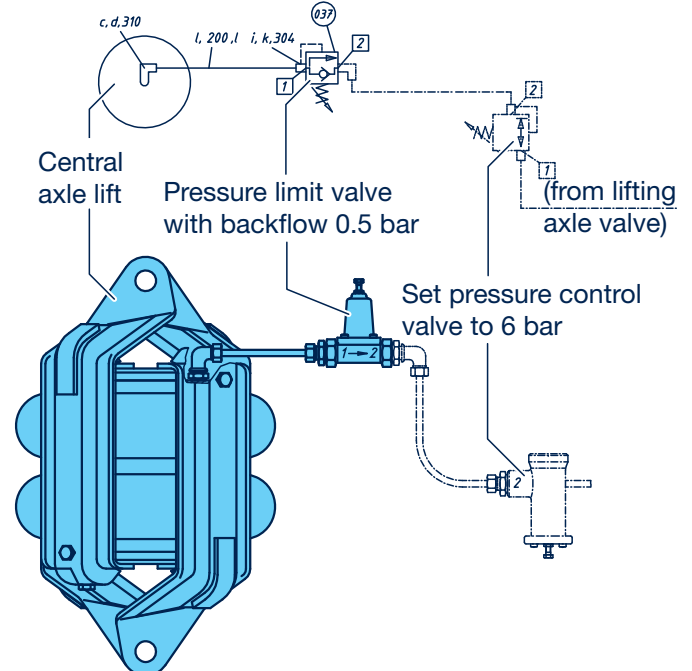
This central axle lift is attached to a cross-member on the vehicle frame in the centre of the vehicle and bolted on to the axle.

The lifting forces must be absorbed with cross-members that are dimensioned as standard in the commercial vehicle industry.



Air installation with pressure retention device

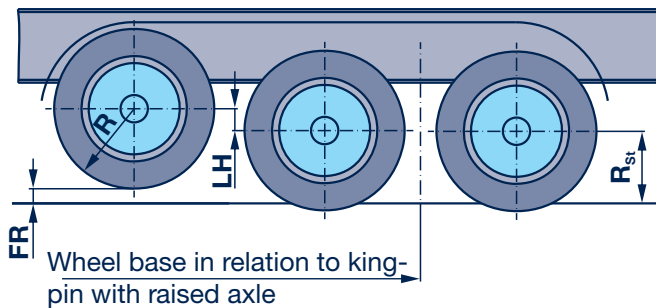
The air pressure in the air bag must be set to 6 bar on the pressure control valve!



The installation location and assembly of the axle lift device must be carried out according to BPW technical documents and the installation drawing supplied.

Axle lift devices 14

Lift stroke 14.6



The ride height of air suspension units equipped with an axle lift device should be set at a minimum of approx. 100 mm upward travel to create sufficient ground clearance beneath the raised axle.

If it is impossible to adjust the ride height to the minimum upward travel, corresponding air suspension valve technology must be used to create sufficient ground clearance with a second ride height.

The axle lift stroke equals the suspension upward travel stroke. The clearance under the tyre is reduced by the upward travel of the tyres.

FR = Clearance

LH = Lift stroke

R_{st} = Tyre radius, statically loaded

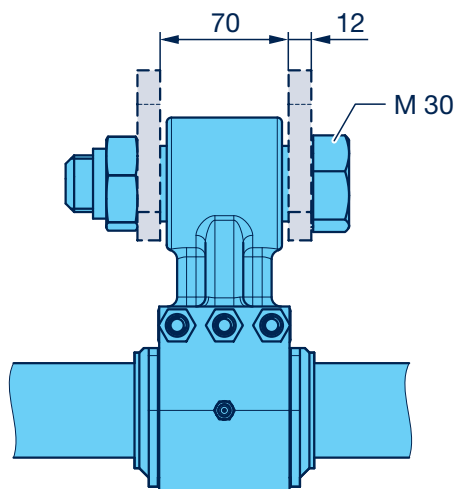
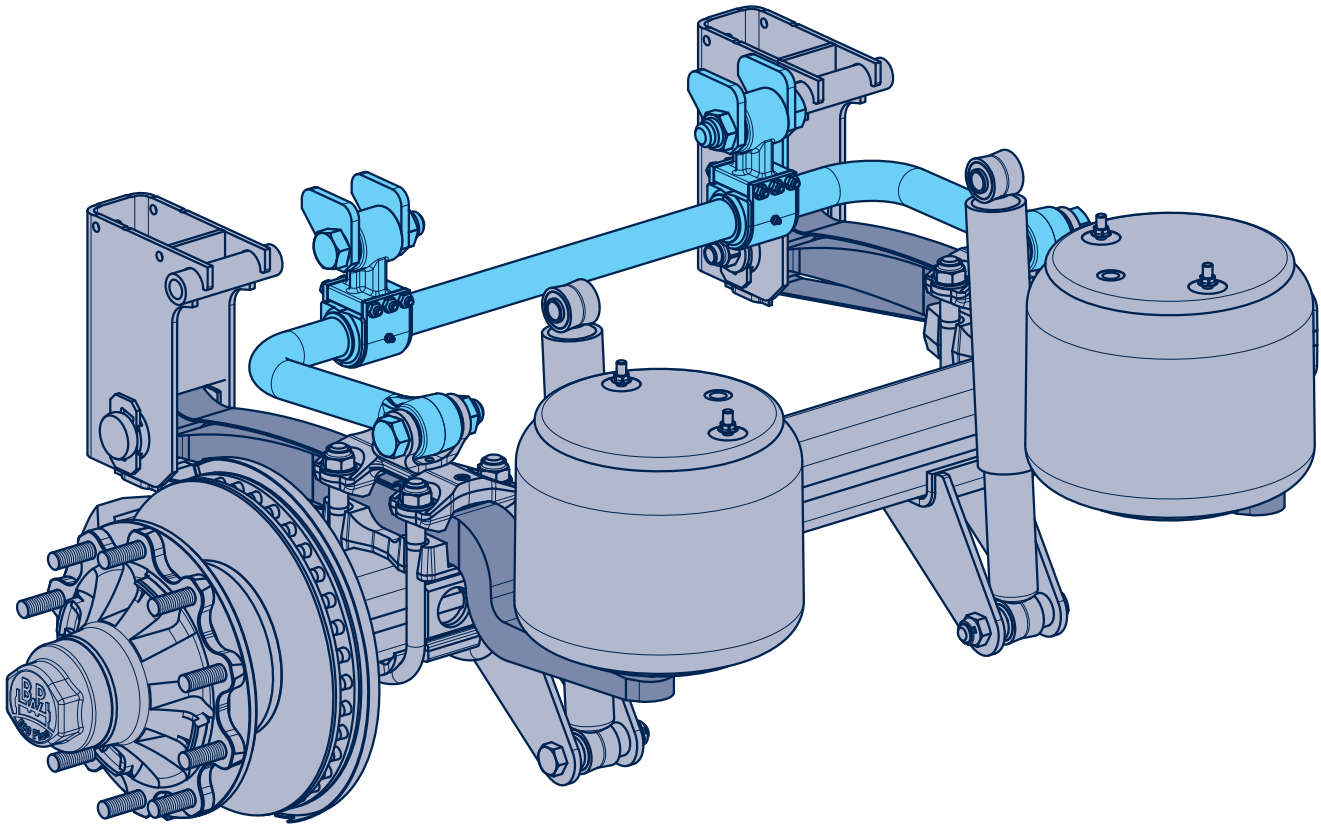
R = Tyre radius, unloaded

Clearance under the tyre

$$FR = LH - (R - R_{st})$$

LH min. 100 mm

15 U-stabilizers



BPW also offers U-stabilizers for air suspension units with increased rolling stability requirements.

The stabilizer is attached to a cross-member in the vehicle frame using two supports and bolted on to the axle in the area of the spring seat arrangement.

The crossmember must be dimensioned according to standard safety reserves in the commercial vehicle industry.

U-stabilizers are available for the standard spring centres, 900, 980, 1100, 1200 and 1300 mm.

The length of the top support is designed by BPW according to the ride height and spring deflection of the air suspension unit.

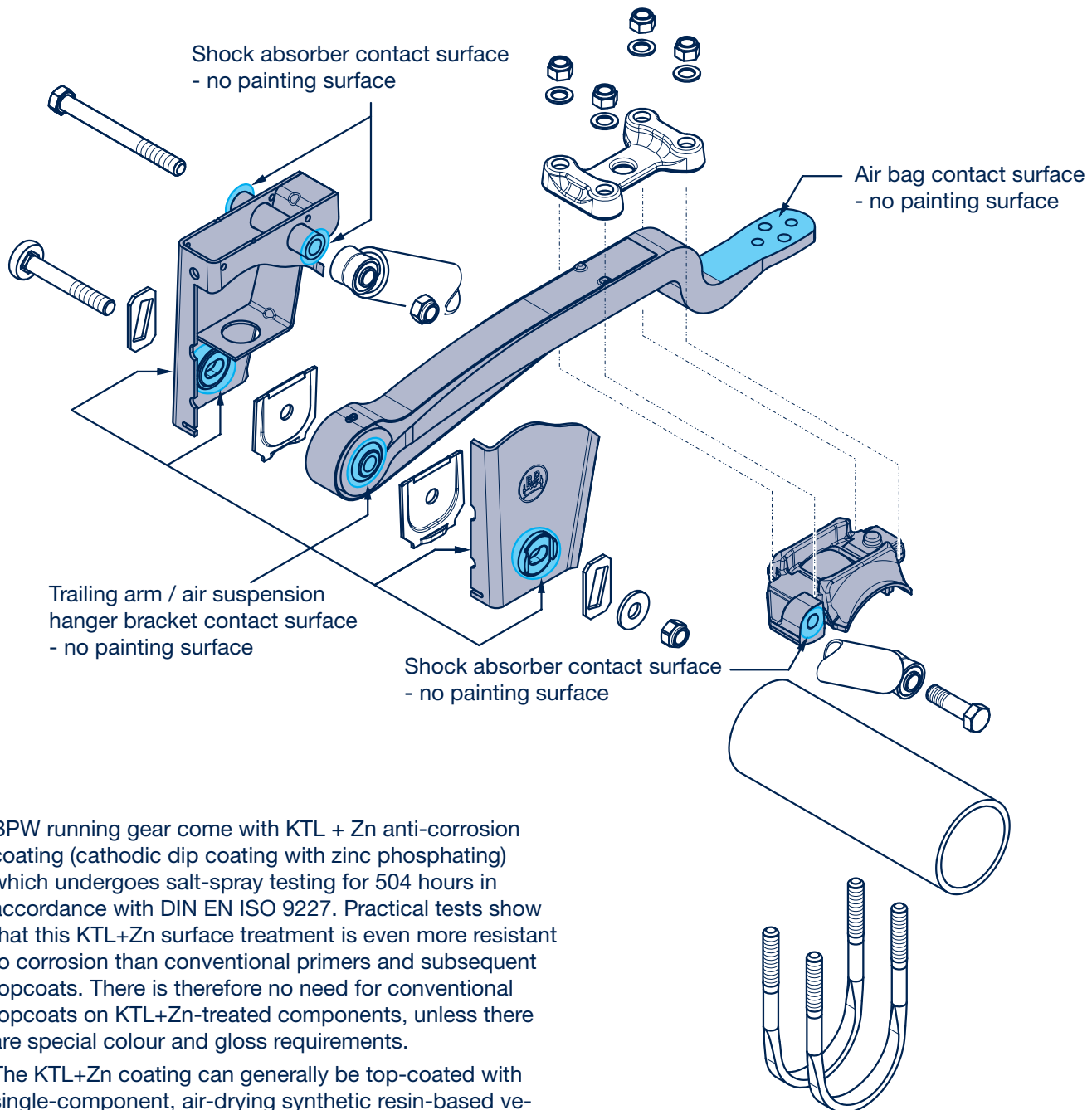
The bearing points between the U-bolt and top supports must be lubricated through the grease nipples in the beginning and also at regular intervals (e.g. with BPW special longlife grease, ECO-L^{iPlus}).

The U-stabilizer increases the stabilization rate by approx. 6 - 8% in combination with the strongest trailing arm.



The installation location and assembly of the U-stabilizer should be carried out according to BPW technical documents.

Surface treatment 16



BPW running gear come with KTL + Zn anti-corrosion coating (cathodic dip coating with zinc phosphating) which undergoes salt-spray testing for 504 hours in accordance with DIN EN ISO 9227. Practical tests show that this KTL+Zn surface treatment is even more resistant to corrosion than conventional primers and subsequent topcoats. There is therefore no need for conventional topcoats on KTL+Zn-treated components, unless there are special colour and gloss requirements.

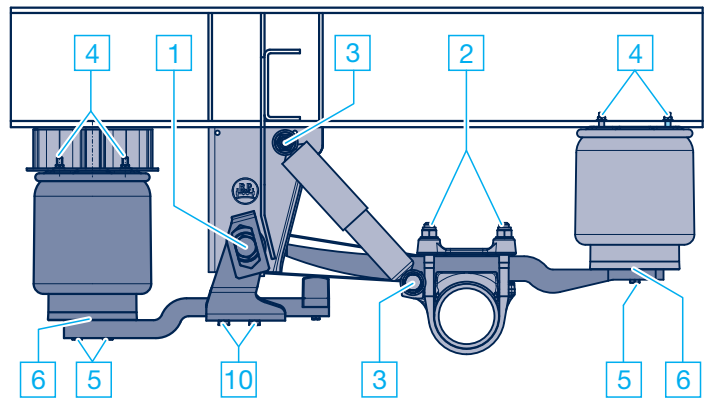
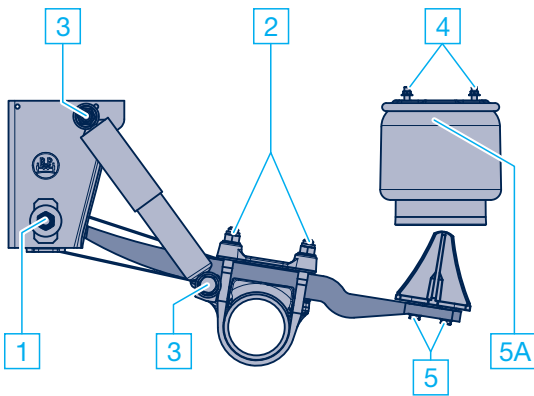
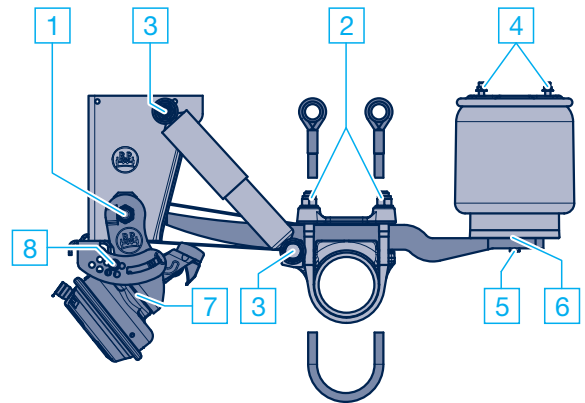
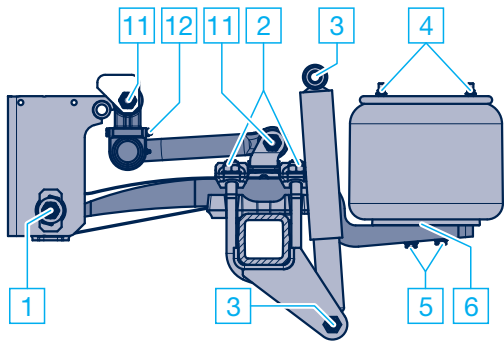
The KTL+Zn coating can generally be top-coated with single-component, air-drying synthetic resin-based vehicle chassis paints as well as two-component, solvent-based or water-based coating systems. However, emulsion paints, architectural paints or nitrocellulose paints must not be used.

When applying the top coat, it must be ensured that the following areas of the running gear have been covered or masked: wheel contact surfaces, booster bracket contact surfaces to the drum brake cylinder and their attachment nuts, brake discs, brake lining shaft, exciter rings, ABS sensors, disc brake cylinder contact surfaces (unless already installed), all air suspension hanger bracket contact surfaces (internal and external) and the bolt-on parts of the spring pivot bolt bearing, bolt-on parts of the dampers and the air bag piston supports on the trailing arm.

The reason is that contact surfaces between dynamically loaded and inter-bolted components are subject to micro-movements which result in the destruction of the coating and gaps forming at a later date. The clamping assembly could detach as a result.

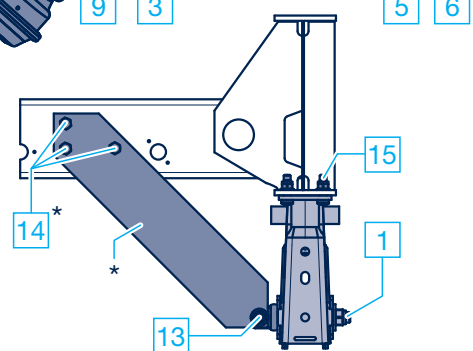
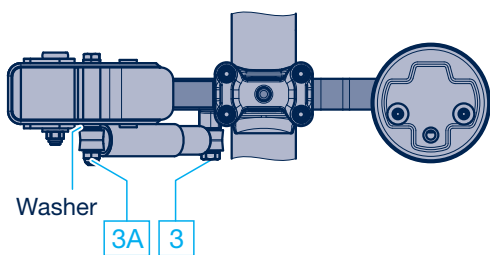
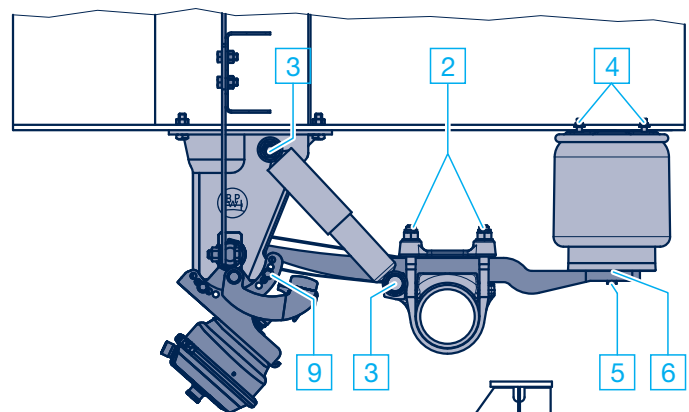
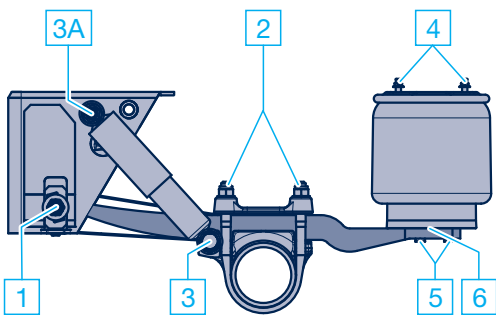
The total thickness of the coating must not exceed 30 µm on the contact surfaces of the bolt-on parts of the air suspension hanger brackets. For hot-dipped hanger brackets, the maximum coat thickness around the bolt-on parts is 100 µm.

17 Tightening torques



Aluminium hanger bracket

Bolted on air suspension hanger bracket



* Not included in the scope of delivery

Tightening torques 17

Area	Item	Attachment	Thread	Tightening torque (thread lightly greased)
Spring bolts				
	1	Spring bolt ¹⁾	M 24	650 Nm (605 - 715 Nm)
		Steel hanger bracket / channel cross member / aluminium hanger bracket	M 30	900 Nm (840 - 990 Nm)
U-bolts				
	2	U-bolts	M 20	340 Nm (315 - 375 Nm)
			M 24 - 10.9	650 Nm (605 - 715 Nm)
		Spring U-bolt AL II (initial installation) ²⁾	M 22 - 10.9	550 Nm + 90° rotation angle
		Spring U-bolt AL II (check)	M 22 - 10.9	550 Nm (510 - 605 Nm)
Shock absorber				
	3	Bottom attachment	M 24	420 Nm (390 - 460 Nm)
		Top attachment, steel hanger bracket / channel cross member	M 20	320 Nm (300 - 350 Nm)
			M 24	420 Nm (390 - 460 Nm)
		Top attachment, stainless steel hanger bracket, welded on bolt	M 24	320 Nm (300 - 350 Nm)
	3A	Top attachment, aluminium hanger bracket	M 24	320 Nm (300 - 350 Nm)
Air bag				
	4	Attachment top cover plate	M 12	66 Nm
	5	Bottom attachment with 2 locking screws	M 16	230 - 300 Nm
		Bottom attachment with 1 central bolt		300 Nm
	5A	Bottom central nut on Combi Air bag		130 Nm
	6	Attachment bottom plate on air bag		230 Nm
Axle lift				
	7	Attachment diaphragm cylinder	M 16	180 - 210 Nm
			M 20	350 - 380 Nm
	8	Two-sided axle lift bumper	M 12	66 Nm
	9	Hexagon screw SW 24	M 12	75 Nm
	10	Attachment lifting arm	M 16	230 Nm
U-stabilizer				
	11	Attachment U-stabilizer	M 30	750 Nm (700 - 825 Nm)
	12	Attachment shaped plate	M 10-10.9	53 Nm
Bolted on air suspension hanger bracket				
	13	Spring bolt / gusset plate	M 18 x 1.5	420 Nm (390 - 460 Nm)
	14	Gusset plates / cross-member (use M 16 at a minimum!) ³⁾	M 16-10.9	Max. permitted Md.
	15	Bottom flange / hanger bracket (knurled screw)	M 16	260 Nm (240 - 285 Nm)
Wheel nuts				
	16	Wheel nut - Stud alignment	M 22 x 1.5	510 Nm (485 - 535 Nm)
		Wheel nut - Spigot alignment	M 22 x 1.5	630 Nm (600 - 660 Nm)
		Wheel nut - Alloy wheels	M 22 x 1.5	630 Nm (600 - 660 Nm)

¹⁾ Spring bolts are coated with Geomet and must not be greased.

²⁾ Apply grease to the threads of the spring U-bolts and nut contact surfaces.

³⁾ BPW does not supply the gusset plate / cross-member bolt connection.

Notes

BPW is a globally leading manufacturer of intelligent running gear systems for trailers and semi-trailers. As an international mobility and system partner, we offer a wide range of solutions for the transport industry from a single source, from axle to suspension and brake to user-friendly telematics applications.

We thereby ensure outstanding transparency in loading and transport processes and facilitate efficient fleet management. Today, the well-established brand represents an international corporation with a wide product and service portfolio for the commercial vehicle industry. Offering running gear systems, telematics, lighting systems, composite solutions and trailer superstructures, BPW is the right system partner for automotive manufacturers.

BPW, the owner-operated company, consistently pursues one target: To always give you exactly the solution which will pay off. To this end, we focus our attention on uncompromising quality for high reliability and service life, weight and time-saving concepts for low operating and maintenance costs as well as personal customer service and a close-knit service network for quick and direct support. You can be sure that with your international mobility partner BPW, you always use the most efficient method.

Your partner on the path to economic viability



BPW Bergische Achsen Kommanditgesellschaft

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