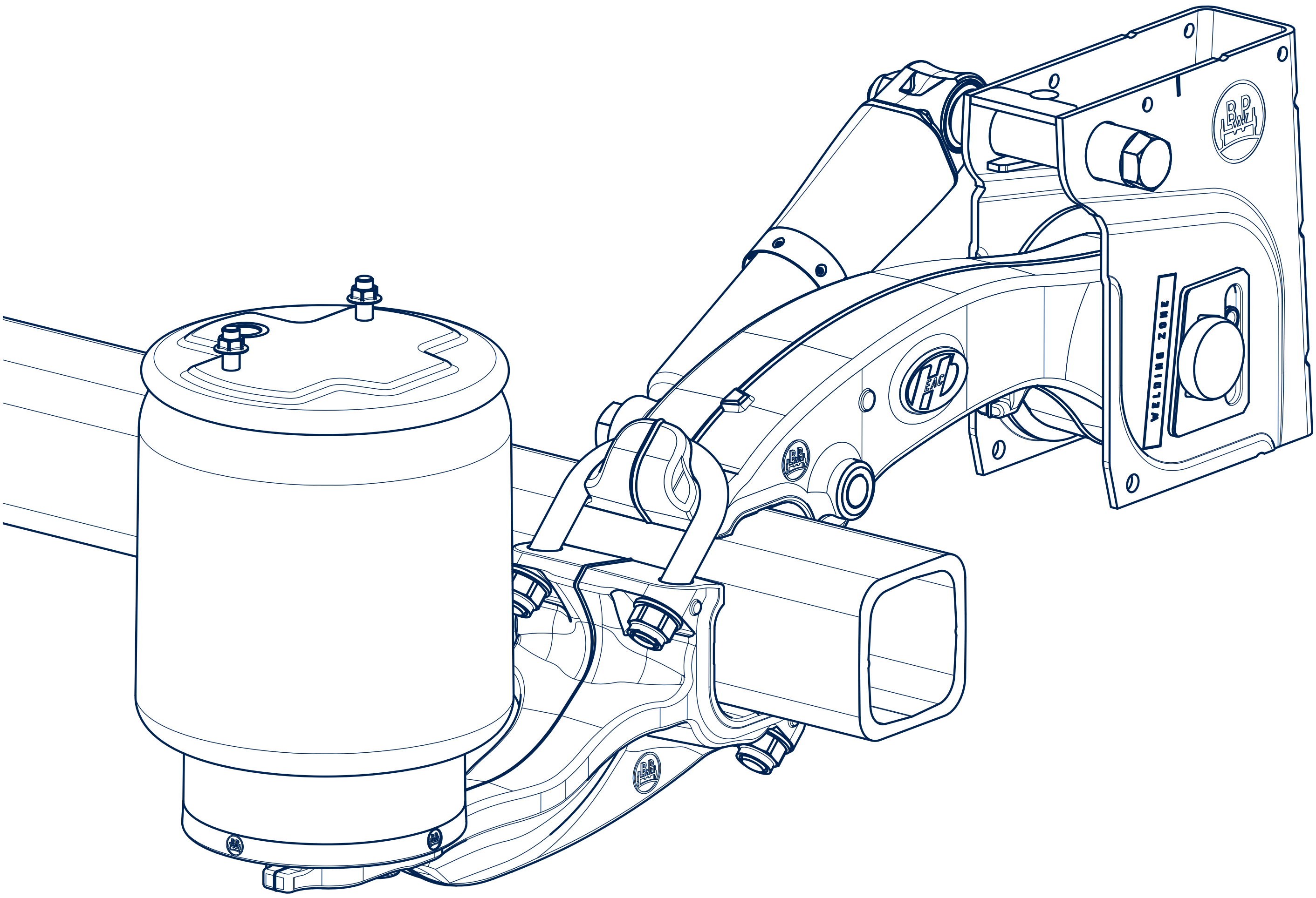
EAC
EAC HD



Installation instructions

for ECO Air COMPACT running gear systems

BPW EA-ECO Air COMPACT 37231902e

we think transport

Contents

Valid: 01.09.2019

Subject to change (without notice)!

Introduction, notes

Content Notes

These installation instructions for BPW running gear system ECO Air COMPACT are designed to illustrate technical design recommendations.

We explicitly state that the drawings and instructions are solely to be understood as examples for installation as cross bracing and component dimensions depend upon the respective vehicle type and its field of application.
This data is intended as a guide to be incorporated into the manufacturer‘s vehicle design.

The chapter 3.1 - 3.4 contains a list of equations and calculation examples from BPW to assist in determining the various stresses.

The safety factors when designing the vehicle framework and chassis are to be determined by the vehicle manufacturer.

Detailed design data for BPW air suspensions such as dimensions, permitted centre of gravity heights, etc. can be found in the appropriate technical documents (standard ranges or offer drawing).

The warranty will be invalidated if the correct technical BPW instructions are not followed.

1 Running gear system ECO Air COMPACT

1.1 Equipment features for BPW air suspension (Europe)

Advice	Conditions	Axle load	Air suspension series	Tyre S = Single tyres Z = Twin tyres	Spring centre	Trailing arm 70 mm	Trailing arm 100 mm
1	On-Road use	9 t	EAC	S	≥ 1200	Guide link	
2			AL II			1 x 56	
3				Z	< 1200	1 x 62	
4		10 t		S / Z	≥ 1100		
5				Z	< 1100	1 x 65	
6		11.8 t (only with SN 4220)		S / Z			
7	Off-Road use	9 t	EAC HD	S	≥ 1200	Guide link	
8			AL II			1 x 62	
9				S / Z		1 x 65	
10		10 t					
11		10 t - 12 t	SL				1 x 57 / 2 x 43

Observations:

1. Deviations from the required features may affect the ECO-Plus warranty. Your BPW contact is at your disposal for further information and personal advice.
2. The data sheets of the BPW air suspension must be observed for the exact specification of the air spring modules according to the application areas and the possible combinatorial function of the components mentioned (incl. TE-3075.0).
3. Disc cover plate for disc brakes

   On-road: Generall, no cover plate is necessary for on-road use.

   Rugged conditions: Cover plates are recommended for use in rugged conditions. Rugged conditions are the off-road use as well as difficult on-road conditions (e.g. high amounts of dirt, ice or snow).

Running gear system ECO Air COMPACT 1

Equipment features for BPW air suspension (Europe) 1.1

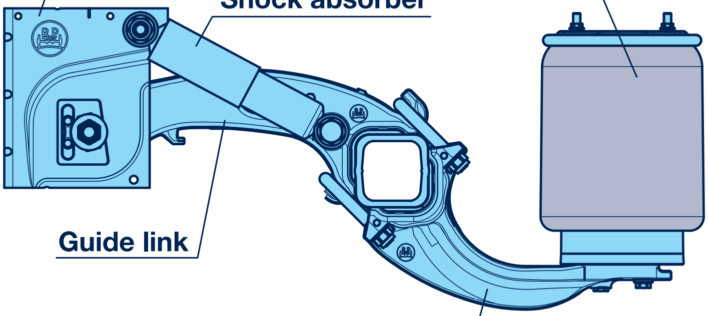
Shock absorber	Air bag	Axle beam	Axle connection	Comments
Standard	Ø 300 / Ø 360	120 x 10	Clamped	For container and coil carrier trailers, the use of air bag stroke limitation is necessary.
	Ø 360	120 x 15		
		120 x 17	Welded	
HD	Ø 300 / Ø 360 with reinforced airbag plate	120 x 10	Clamped	Tipper trailers require the use of a lowering device or stroke limitation.
Standard / HD		120 x 15		
	Ø 360 with reinforced airbag plate	120 x 17	Welded	Heavy off-road use: such as mining or logging operations on unpaved ground, which can only be used with all-wheel drive machines. For higher speed the use of the HD shock absorbers are necessary.
		150 x 16		

1 ECO Air COMPACT running gear systems

1.2 General

Features of the ECO Air COMPACT running gear systems

- **EAC** solely for on-road use
  EAC-HD also for Off-Road use
- Axle load up to 9t with single wheels
- ECO Disc TSB 3709 and TSB 4309 disc brake with ET 120 mm
- ECO Drum SN 4218 drum brake
- 2 air suspension hanger brackets with heights of 205 mm and 290 mm
- Axle alignment correction is standard
- Guide links with steel rubber bush
- M 24 spring pivot bolts
- **EAC HD**
  HP shock absorbers (characteristics optimised for use in poor road conditions);
  lasered, robust integration;
  additional bellows support with L2 = 335 mm;
  clip in the trailing arm and sticker on the hub cap
- See also construction kit on next page



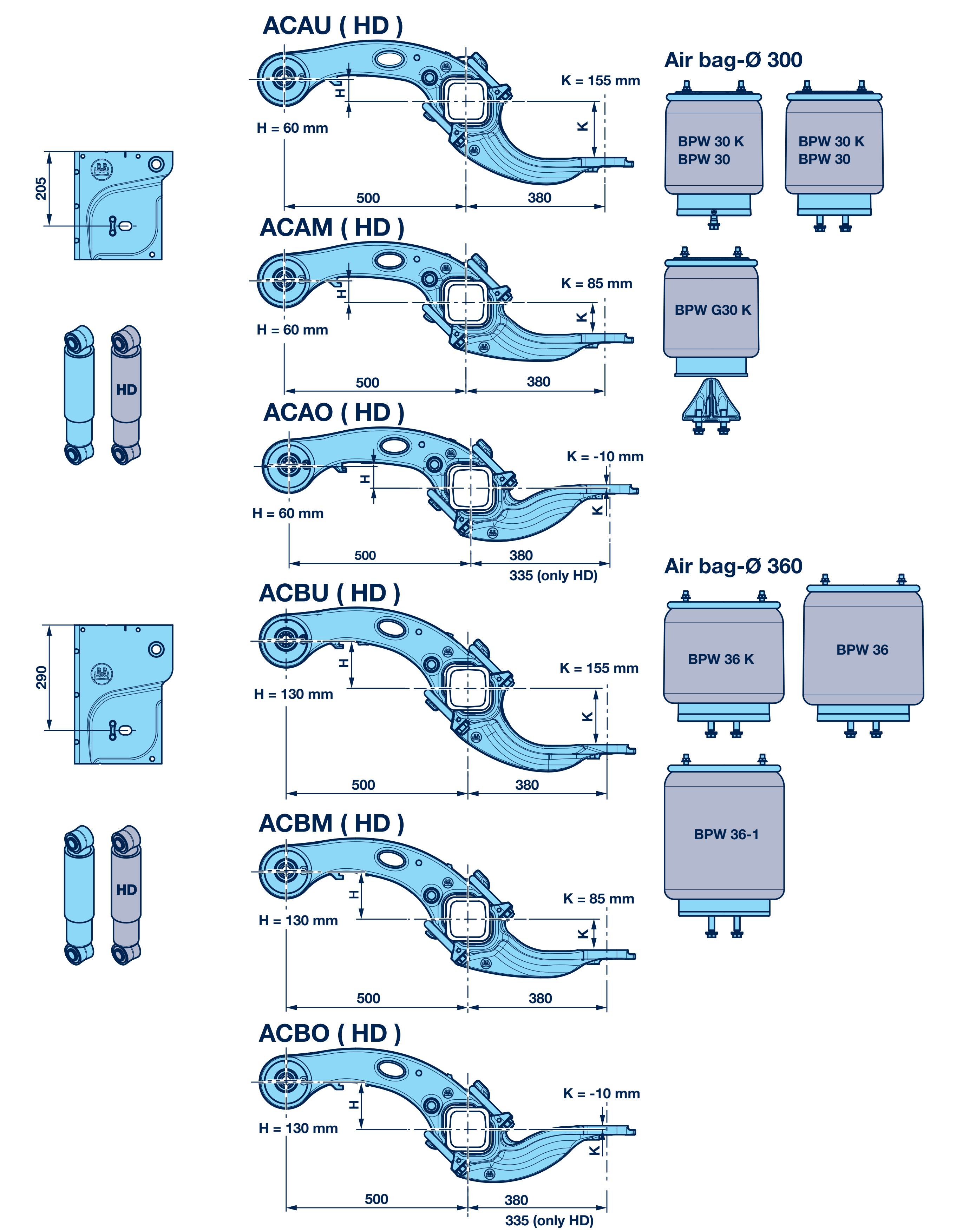
☞ The BPW Guarantee is <u>only</u> valid for the complete ECO Plus air-sprung running gear systems, which have been selected appropriately for their respective use.

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

ECO Air COMPACT running gear systems 1

General 1.2

Construction kit



2 Design description

General

The combination of axle and air suspension can be used in the vehicle both as a single and multi-axle unit.
The modular BPW concept of multi-part axle/trailing arm assembly enables the broadest adaptation opportunities.
The integrated height stop (bump stop in the air bag) has the effect that the connection of the running gear to the vehicle frame must only be established using the hanger brackets and the bags.

Trailing arm and stabilisation function

The trailing arms (between axle and hanger brackets) transmit the wheel forces to the hanger brackets and are robustly designed to resist bending and torsion forces.

The trailing arm mount in the hanger brackets contains a large, durable rubber bush. While the vertical movement has air suspension, vehicle rolling movements and the unilateral passing over road humps and pot holes are compensated by the arm mount (torsion bush suspension). The U-shaped group consisting of the axle beam and both trailing arms acts as a stabiliser against the side tilt of the vehicle in the case of lateral acceleration.

Axle and brake load equalisation

All air bags are interconnected via air pipes. Uneven roads or vehicle tilt angles therefore do not lead to different axle loads inside the multi-axle unit. The braking forces are also distributed evenly across all the axles. BPW air-suspension running gears thus offer maximum driving safety and minimum tyre wear.

Suspension and absorption

To achieve the best possible combination of drive safety and travel comfort with minimum wear, the air bags and shock absorbers are precisely tailored to each other in terms of their characteristics and installation position. The oscillating movements (vertical and rolling) are effectively attenuated; the wheels maintain best possible contact with the road.

Vertical, longitudinal and transverse forces

Vertical forces are exerted on hanger brackets and bags. By contrast, longitudinal forces (from uneven roads and due to braking) and transverse forces are introduced exclusively through the hanger brackets in the vehicle frame. Without an effective bracing, which must be created properly by the vehicle manufacturer, the transverse forces cannot be transferred from the hanger bracket to the frame.

Lifting and lowering – Axle-lifting device

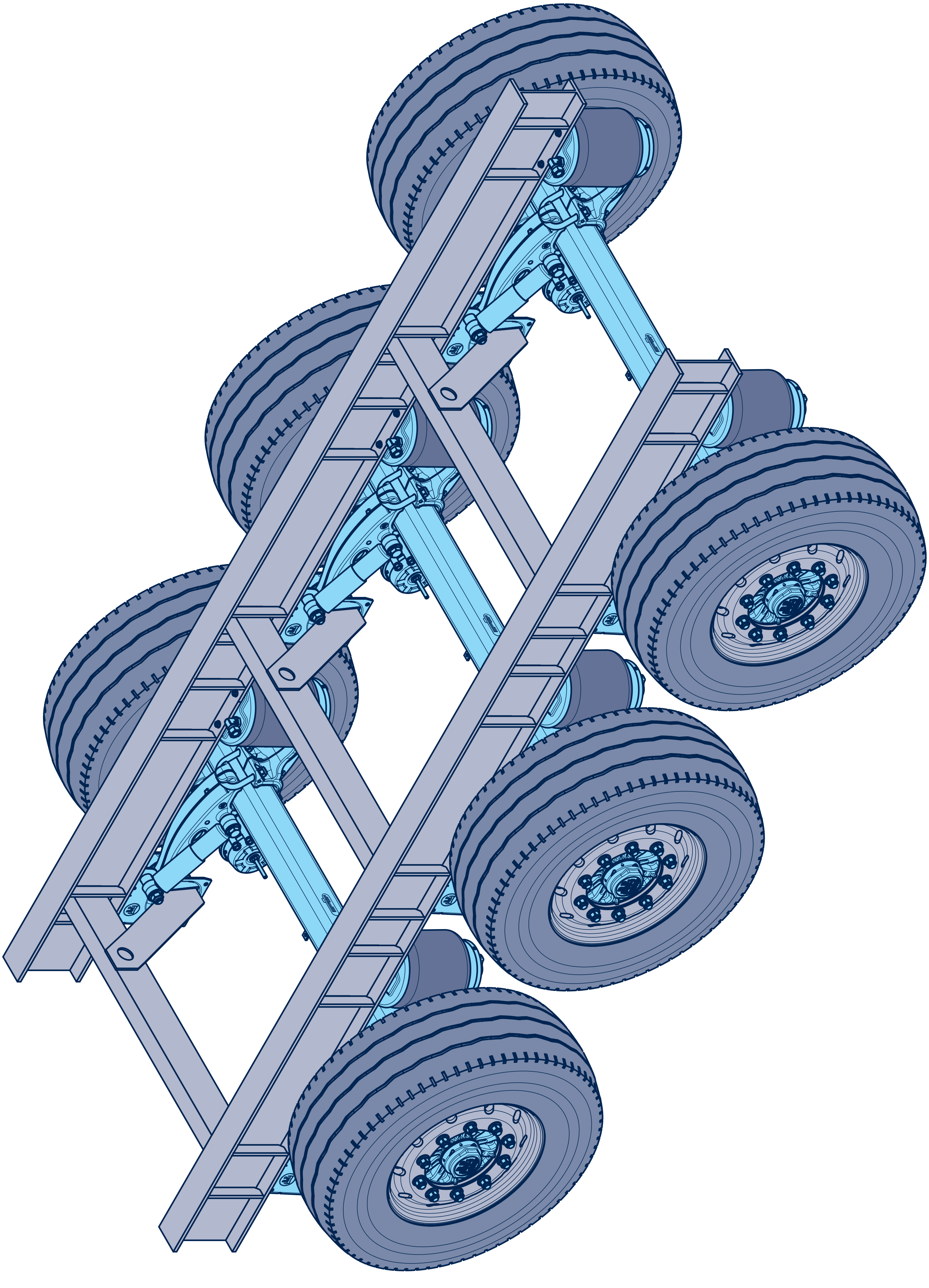
The air suspension enables quick adjustment of the ride height through a switch valve / rotary slide valve for different loading/unloading operations. Typical in this regard are adjustments for loading ramps and lowering for safe tipping.
The axle-lifting device (axle lift – which is also optional) for one or multiple axles has an influence on axle-load distribution in articulated lorries and also the spatial requirements for turning circles. In addition, tyre wear and fuel consumption are reduced during partly laden journeys and manoeuvrability is improved.

Installation and tracking

BPW running gear components are designed for seamless installation and maintenance. A tracking device integrated in the hanger bracket enables quick adjustment of the wheel track when necessary. BPW offers a fixing device for the initial installation. See section 10.4 for optimum hanger bracket and bag holder positioning.

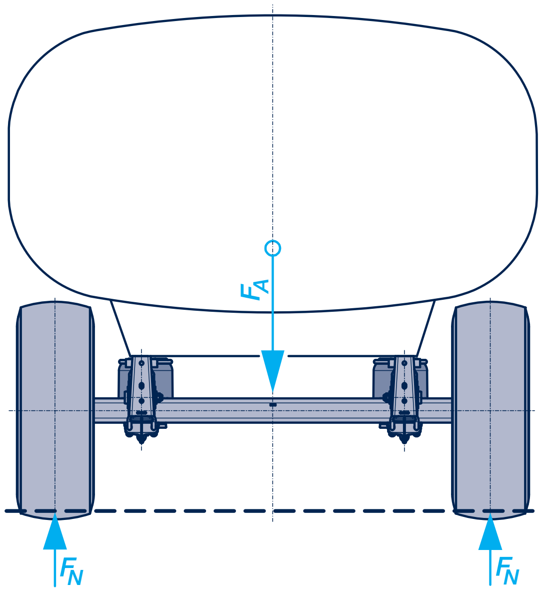
Your BPW contact partner will be happy to answer any further questions you may have.

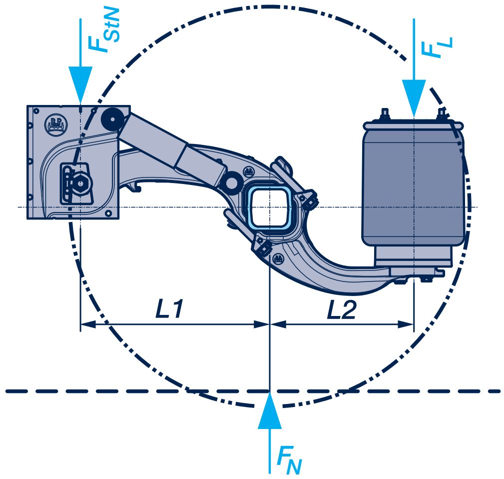
Design description 2



3 Calculation of forces

3.1 Straight-line driving





G_A = Axle load (kg)

g = Acceleration due to gravity (9.81 m/s²)

F_A = Axle force (N)

F_N = Wheel force on ground (N)

$L1$ = Front guide link length (mm)

$L2$ = Rear air bag beam arm length (mm)

F_{StN} = Force on hanger bracket (N)

F_L = Force on air bag (N)

Straight line travel:
(without consideration of unsprung masses)

$$F_A = G_A \times g$$

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

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

$$F_L = F_N \times \frac{L1}{L1 + L2}$$

Example: SHBFACAM 9010 V 30K ECO Plus 3

$L1$ = 500 mm

$L2$ = 380 mm

F_A = 9,000 kg x 9.81 m/s² = 88,290 N

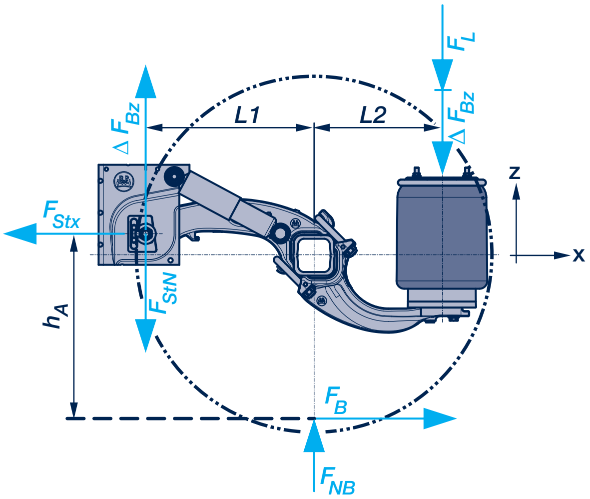
$$F_N = \frac{88{,}290\ \text{N}}{2} = 44{,}145\ \text{N}$$

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

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

Calculation of forces 3

Braking forces 3.2



F_{NB} = Wheel force on ground during braking (N)

ΔF_A = Axle load displacement when braking (N) (Depending upon design of vehicle, particularly with drawbar trailer front axles)

F_{StN} = Hanger bracket reaction of wheel force on ground (N)

F_L = Force on air bag (N)

F_B = Braking force (N)

z = Braking performance (%)

ΔF_{Bz} = Reaction force of braking moment (N)

h_A = Height of deflection above road surface

F_{Stx} = Total force on the hanger bracket in direction “X” (N)

F_{Stz} = Total force on the hanger bracket in direction “Z” (N)

$F_{Lges.}$ = Total force on the air bag (N)

Normal forces of axle load:

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

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

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

Braking force:

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

Forces of braking moment support:

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

Total force on the hanger bracket in direction “X”:

$$F_{Stx} = F_B$$

Total force on the hanger 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: SHBFACAM 9010 V 30K ECO Plus 3

F_A = 88,290 N

ΔF_A = Zero is assumed in example

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

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

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

z = 80 %

F_B = 0.8 x 44,145 N = 35,316 N

h_A = 600 mm

$$\Delta F_{Bz} = \frac{35{,}316\text{ N} \times 600}{880} = 24{,}079\text{ N}$$

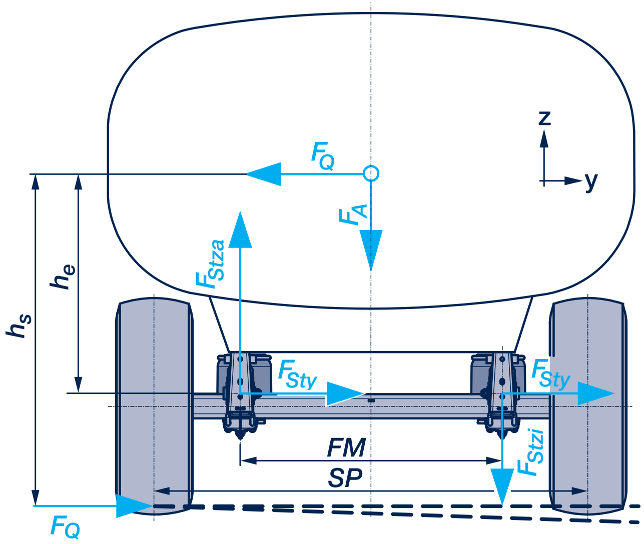
F_{Stx} = 35,316 N

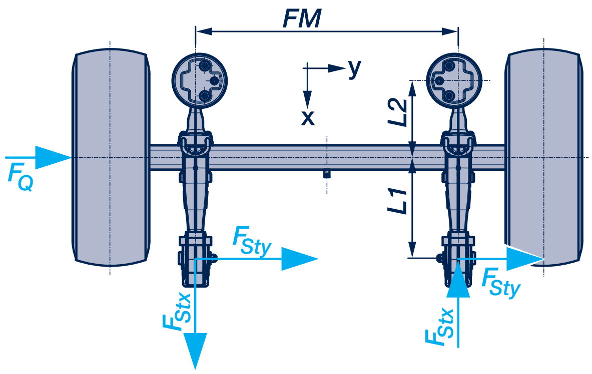
F_{Stz} = 19,063 N - 24,079 N = -5,016 N

F_L = 25,082 N + 24,079 N = 49,161 N

3 Calculation of forces

3.3 Cornering





Point at which trailer will overturn:
(without considering effect of springs and weight of unsprung masses approximate calculation)

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

Hanger bracket forces:

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

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

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

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

F_A = Axle force (N)
F_Q = Centrifugal force at point of over-balance (N)
F_{Stza} = Support force at curve outer side (N)
F_{Stzi} = Support force at curve inner side (N)
h_S = Centre of gravity height above road surface
h_e = Centre of gravity height above guide link eye
F_{Sty} = Lateral force on the hanger bracket
F_{Stx} = Longitudinal force on the hanger bracket
FM = Spring centre
SP = Track width
g = Acceleration due to gravity (9.81 m/s²)
a_{quer} = Lateral acceleration at point of over-balance (m/s²)

Example: SHBFACAM 9010 V 30K ECO Plus 3

SP = 2,040 mm
FM = 1,300 mm
h_S = 2,000 mm
h_e = 1,400 mm
F_A = 88,299 N
$L1$ = 500 mm
$L2$ = 380 mm

$$F_Q = \frac{88{,}290 \text{ N} \times 2{,}040}{2{,}000 \times 2} = 45.028 \text{ N}$$

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

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

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

$$F_{Stx} = \pm\frac{45{,}028 \text{ N} \times 500}{1.300} = \pm 17{,}318 \text{ N}$$

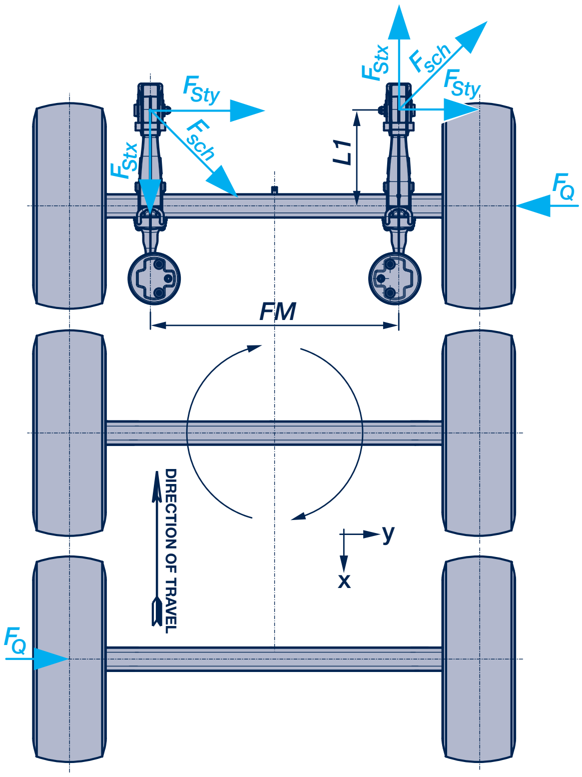
* A precise calculation of a_{quer} as per ECE R 111 can be provided by BPW upon request (tipping stability calculation).

Calculation of forces 3

Turning when stationary 3.4

1st or 3rd axle of rigid tri-axle suspension unit

The side forces are transmitted by the outer axles. The central axle turns on its own axis and does not transmit side forces.



$$F_Q = F_A \times \mu_Q$$

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

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

F_{sch} = Resulting force (N)

F_Q = Side force on the axle (N)

μ_Q = Adhesion coefficient when turning (from tests: $\mu_Q = 1.6$)

Example: SHBFACAM 9010 V 30K ECO Plus 3

FM = 1,300 mm

$L1$ = 500 mm

F_A = 9,000 N x 9.81 = 88,290 N

μ_Q = 1.6

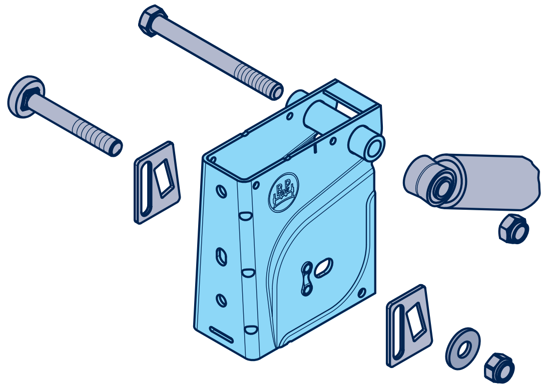
F_Q = 88,290 N x 1.6 = 141,260 N

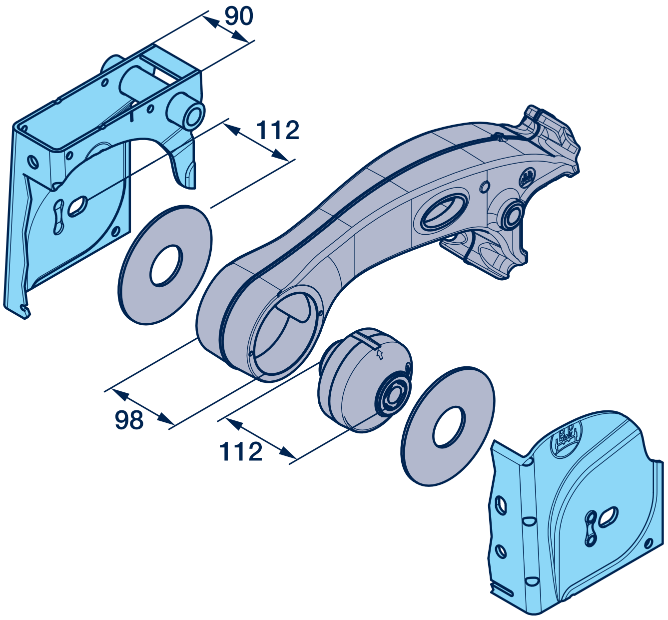
$$F_{StX} = \frac{141{,}260 \text{ N} \times 500}{1{,}300} = 54{,}331 \text{ N}$$

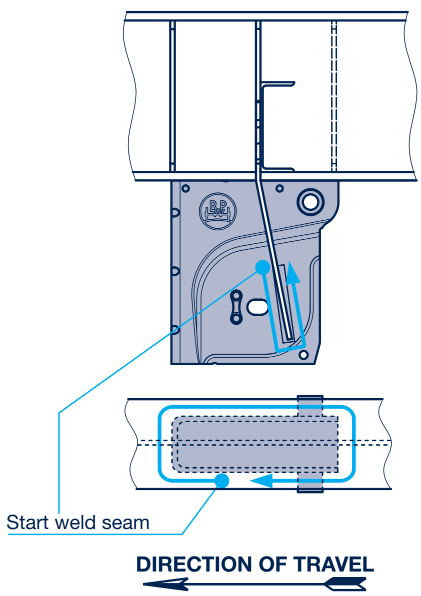
$$F_{StY} = \frac{141{,}260 \text{ N}}{2} = 70{,}630 \text{ N}$$

4 BPW Air suspension hanger brackets

Attachments, welding methods







ECO Air COMPACT hanger bracket

The rectangular, smooth surfaces are easy to connect to the vehicle frame, and bracing struts can be attached without problem.

The box construction in connection with the low height of the hanger brackets offers an extremely high level of torsional rigidity. This means light bracing struts are possible.

- Attached to the vehicle bottom flange by welding
- Guide link width 98 mm (Bush 112 mm), upper hanger bracket width 90 mm
- Upper shock absorber attachment with bolt and lock nut
- With integrated track adjustment, spring bolt diameter Ø 24 mm (see chap. 10.3)

Welding method

(Welding of hanger brackets to the vehicle frame)

- Inert gas welding
  Weld wire quality G 46 2 (DIN EN ISO 14341)
- Manual arc welding
  Rod electrodes E 46 2 (DIN EN ISO 2560)

Mechanical quality values must be equivalent to basic material S 420 or S 355 J 2

Weld thickness a 4 ◺ (DIN EN ISO 5817)

Avoid end cavities and undercutting!

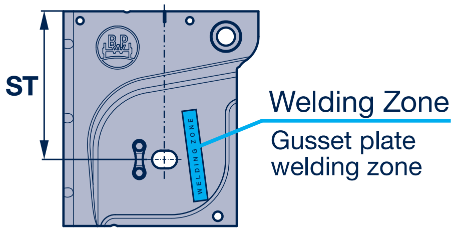
The guide links, air bag beams, spring U-bolts, air bags, shock absorbers and plastic pipings must be protected against sparks and weld splashes during all welding work.

The earth terminal must under no circumstances be attached to the guide links, air bag beams, spring U-bolts or hubs.

No welding at guide links or air bag beams!

BPW Air suspension hanger brackets 4

Attachments, welding methods

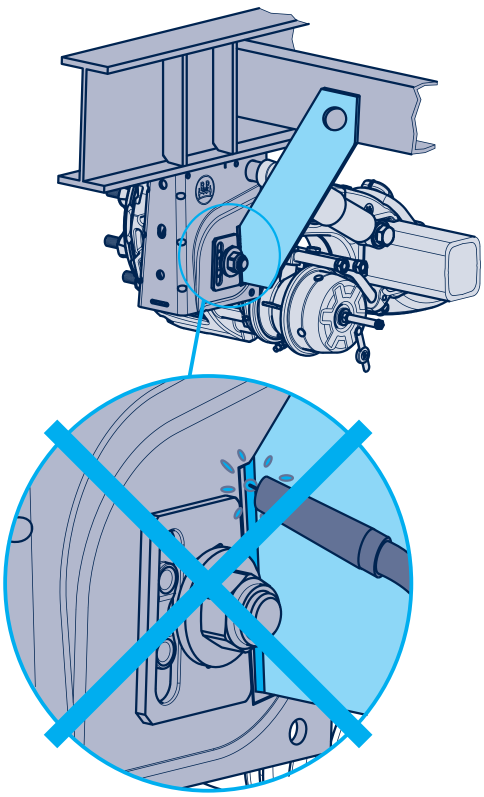


ECO Air COMPACT hanger brackets

What is referred to as a **WELDING ZONE** is engraved on both sides of the ECO Air COMPACT air suspension hanger brackets. In order to guarantee optimum stress flow, braces should only be welded onto the hanger bracket in this zone.

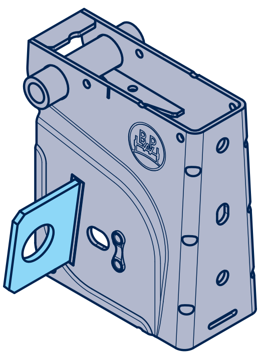
Each hanger bracket must be braced with a gusset plate.

Attention: In the case of welded-on gusset plates, no other position on the air suspension hanger bracket may be selected except that determined by the welding zone.



For BPW fixing device, see chapter 10.4.

☞ Cross braces should not be welded to the hanger bracket when a guide link is assembled, as the wearing plates between the guide link and the hanger bracket can be damaged through the heat which is generated.
You can use bolted-on gusset plates here (see chapter 5.2) or hanger brackets with welding lugs (see below).



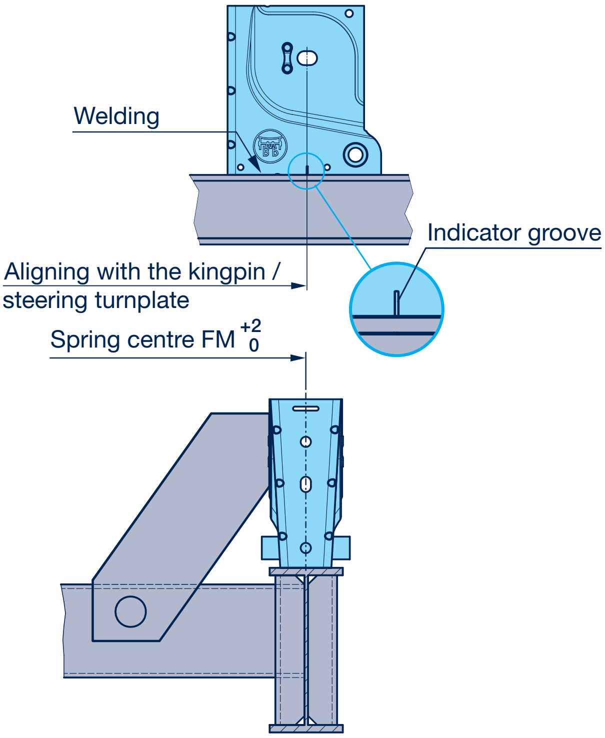
Hanger bracket with welding lug

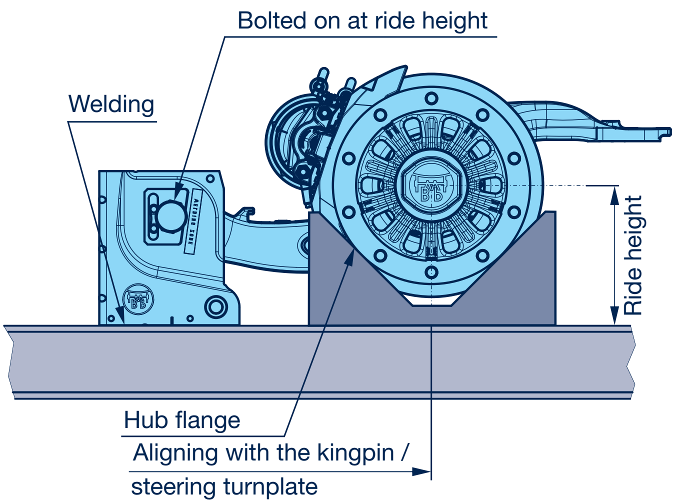
Hanger brackets with welding lugs are supplied upon request. Without detaching the connection suspension arm /hanger bracket (spring pivot bolt) a brace can be welded on to this via plug welding.

Adequate weld protection must be ensured when welding on hanger brackets mounted with shock absorbers.

4 BPW Air suspension hanger brackets

Attachments, welding methods





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

Welding on of loose air suspension hanger brackets

When installing ECO Air COMPACT running gear systems with loose hanger brackets, the hanger brackets are first welded to the vehicle chassis / subframe.

In this case, the spring bolt mounting points of the hanger brackets are aligned in relation to the longitudinal centre line of the vehicle taken from the middle of the kingpin or steering turntable.

An indicator groove is located precisely over the spring pivot bolt eye in the upper area of the hanger bracket as an aid for positioning. By using this indicator, the hanger bracket can be positioned precisely on the vehicle chassis / subframe and then welded.

The braces can then be welded on.

In this installation position, the tolerances of the spring centres and guide links lengths must be taken into account.

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. Check the track and correct if necessary after welding on the hanger brackets or mounting the axles (see alignment, chap. 10).

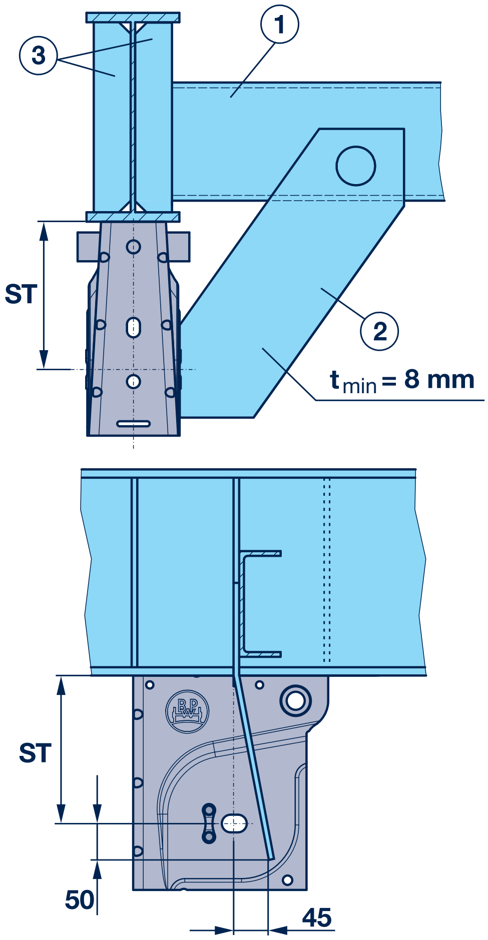
Installation of pre-assembled air spring modules

ECO Air COMPACT running gear systems with assembled guide links and hanger brackets are generally incorporated 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 hanger brackets are welded on to the bottom boom of the vehicle chassis/subframe.

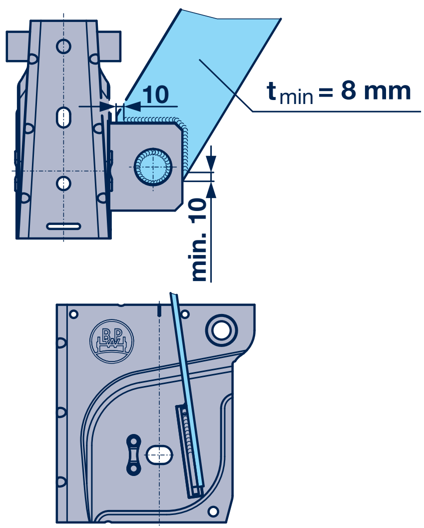
5 Struts

5.1 Welded on gusset plates

Example of general bracing suggestion with weld-on gusset plates



Hanger bracket with welding lug



General

In the case of vehicle frames flexible to torsion, one must ensure an appropriately elastic, torsion-friendly bracing of the air suspension hanger brackets in particular.

① Crossmembers

The forces encountered when cornering, for example, are transmitted via the hanger brackets and gusset plates into the crossmember.
This must be appropriately dimensioned.
One must ensure an appropriate connection to the longitudinal beam. The connection of torsion-resistant, closed crossmember profiles to the torsion-flexible double longitudinal T-beam must be designed with particular care, since there is a risk of cracks in the case of variations in rigidity.

② Gusset plates

The gusset plates transfer the transverse forces to the crossmember as torsional/pressure loads.
The gusset plate must be positioned laterally, inside on the hanger bracket behind the spring bolt, so as to brace the open hanger bracket to the rear as best as possible. The gusset plate should reach 50 mm lower than the centre of the spring bolt. On the frame side, positioning the gusset plate in the centre of the spring bolt is recommended.
The ‚welding zone‘ of the air suspension hanger bracket should be used in this process.

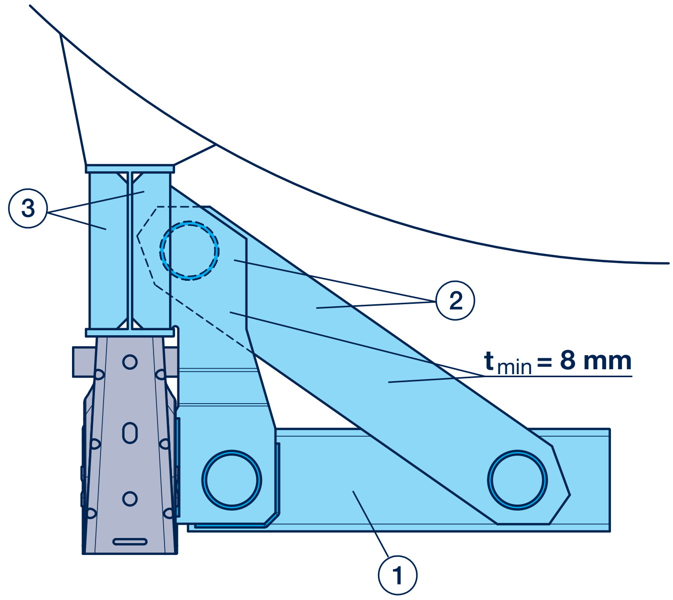
③ Vertical profiles

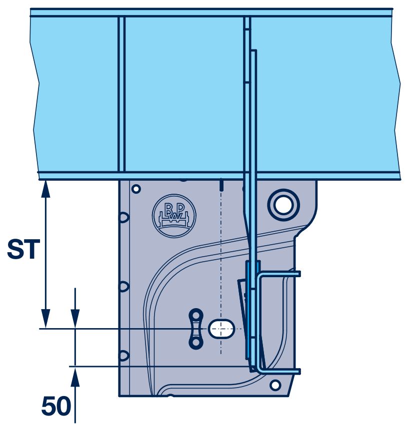
Suitable vertical profiles and ribs are to be provided on the vehicle frame for bracing.

Struts 5

Welded on gusset plates 5.1

Example of special bracing suggestion for vehicle frames with torsion resistance in the driving direction (e.g. tanker, silo)





General

The design example shown pays special attention to spatial conditions for tankers or silo vehicles.

① Crossmembers

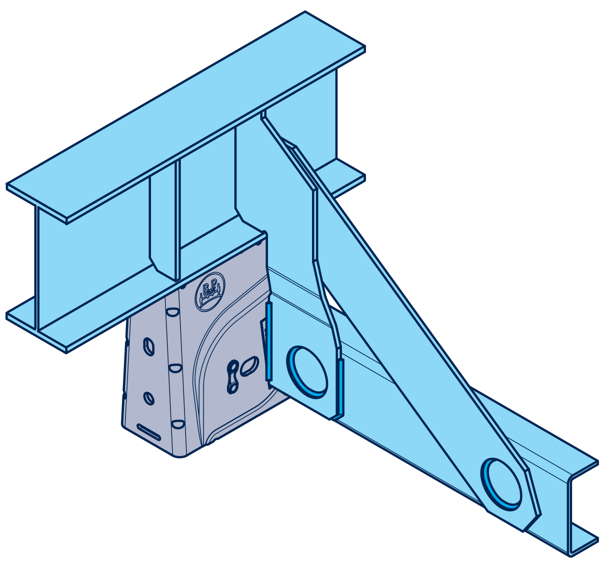
The forces encountered when cornering, for example, are transmitted via the hanger brackets and gusset plates into the crossmember. This must be appropriately dimensioned. One must ensure an appropriate connection to the longitudinal beam.

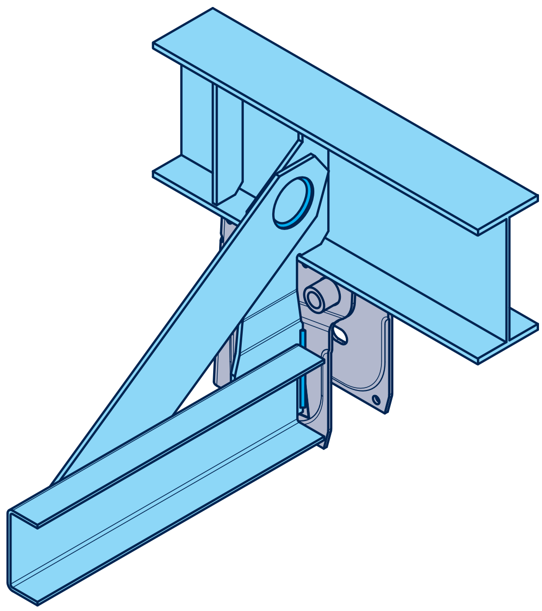
② Gusset plates

The gusset plates transfer the transverse forces to the crossmember as torsional loads.
The gusset plate on the hanger bracket side must be positioned laterally, inside on the hanger bracket behind the spring bolt, so as to brace the open hanger bracket to the rear as best as possible.
The gusset plate should reach 50 mm lower than the centre of the spring bolt. The weld-on area stretches upwards beyond the ‚welding zone' at a maximum.
A second gusset plate establishes the bracing between vehicle frame longitudinal beam and crossmember.

③ Vertical profiles

Suitable vertical profiles and ribs are to be provided on the vehicle frame for bracing.

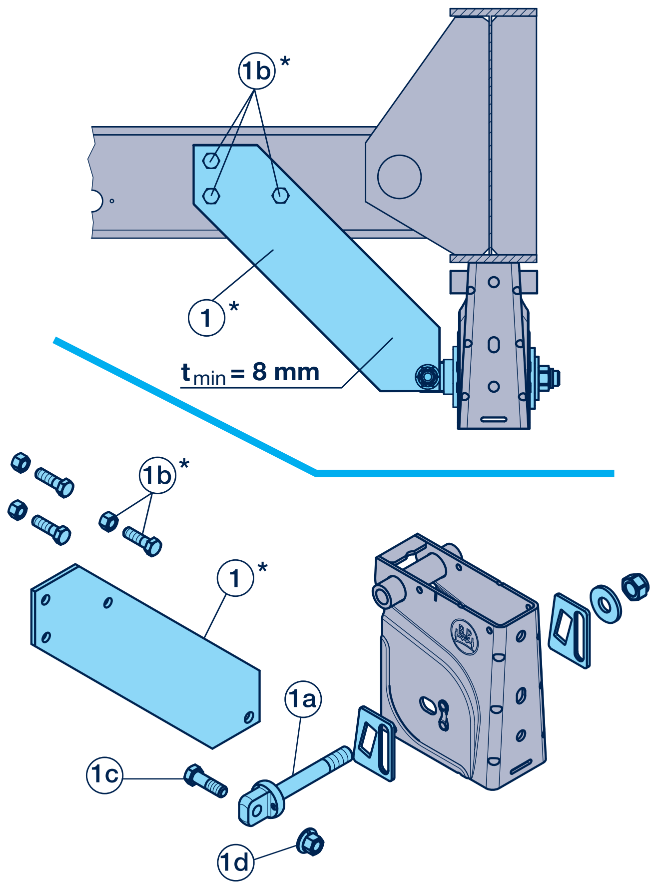




5 Struts

5.2 Bolted on gusset plates

Example of general bracing suggestion with screwed-on gusset plates



* not supplied by BPW

The holes in the components must have the following diameters:

Hole in the crossmember: Ø 16 mm

Hole in the bracing plate: Ø 18 mm

Gusset plate bolt 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 torsion lock.

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).

Installation instructions for bolt on gusset plates:

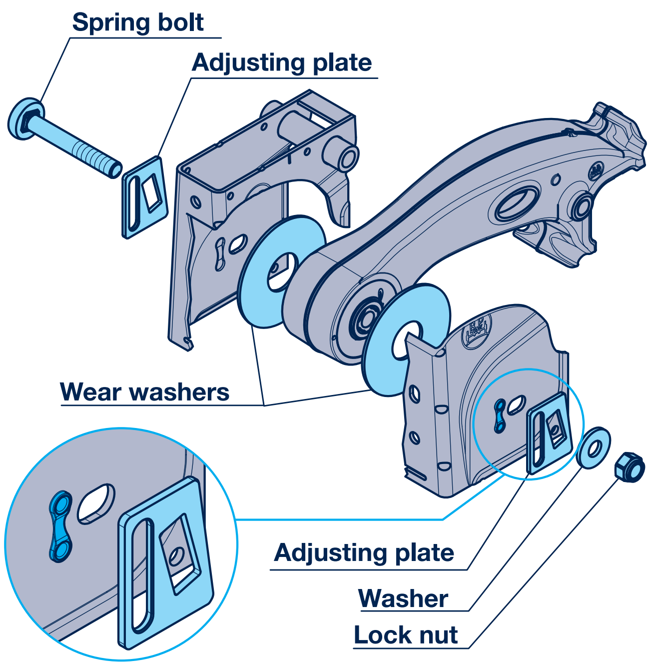
1. Pre-mount the spring bolt (1a) loosely.
2. Pre-mount the gusset plate (1) with at least three M 16 10.9 bolts (1b) (top) and an M 18 bolt (1c) (bottom).
   Pre-mount the corresponding nuts.
3. Tighten the M 18 connecting bolt (1c) (bracing plate-spring bolt) to approx. 50 Nm.
4. Tighten the M 24 spring bolt loosely until all components have been brought into contact.
5. Set the axle alignment.
   (see chap. 10)
6. Tighten the M 24 spring bolt.
   Tightening torque 650 Nm (605 - 715 Nm).

Do not use an impact driver!

7. Tighten the M 18 connecting bolt (1c) (gusset plate-spring bolt).
   Tightening torque 420 Nm (390 - 460 Nm).
8. Tighten the top connecting bolts M 16, 10.9 (1b) (gusset plate/crossmember) to the max. permitted tightening torque (not supplied by BPW).

Tightening torques see chap. 13.

Spring bolt bearings 6

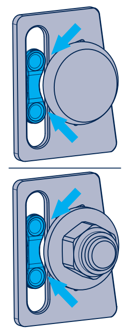


With ECO Air COMPACT running gear systems, the head of the spring bolt is secured from rotating by means of a profiled lot in the adjusting plate.

The adjusting plates are secured, both against horizontal movement as well as rotation, by the guide elements press formed into the hanger bracket.

☞ Check for correct fitting of the connecting link discs on the guide elements (arrows) of the air suspension hanger brackets. Attach both connecting link discs with the same orientation.
The square lock-bush on the spring pivot bolt head (torsion protection) must be seated in the slot of the adjusting plate.

Before tightly screwing down the locking nuts, the axle position must be brought to ride height – otherwise the rubber bush will become permanently strained.

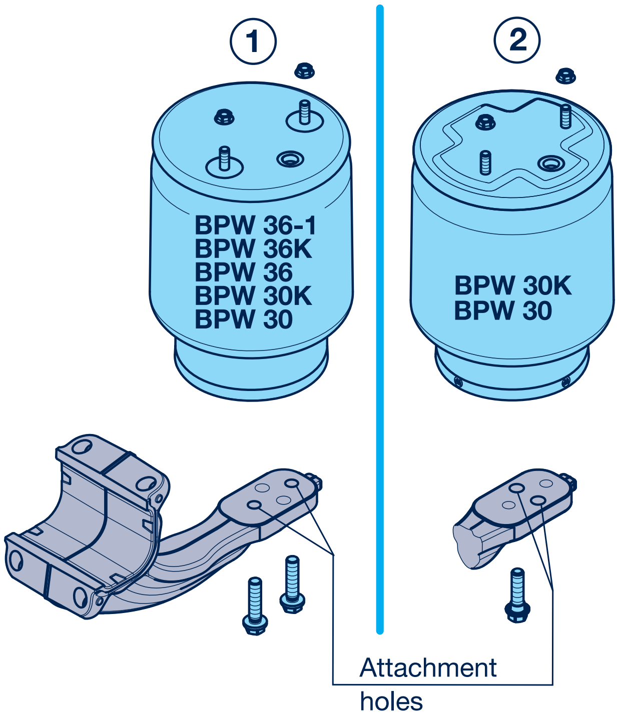


☞ For attaching a unilateral axle lift, see section 12.3.

Tightening torques see chap. 13.

7 Air bags

7.1 General



Two versions of air bags are used with ECO Air COMPACT running gear systems.

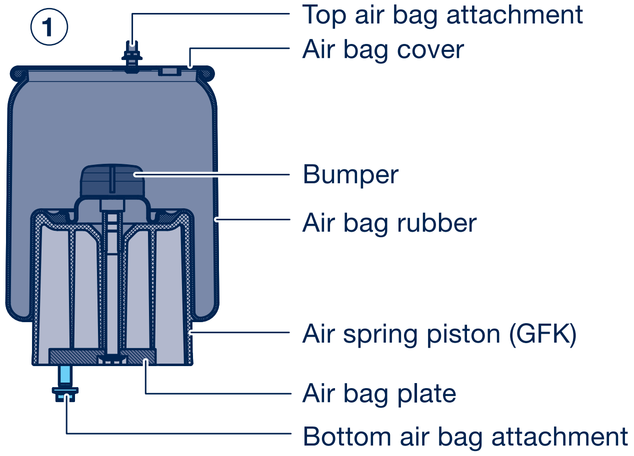
① Air bag with bolted attachment plate or disc (BPW 36-1) in the air bag piston.

The air bag assembly is connected to the air bag beam with **two** fixing bolts.
The following offset dimensions are achieved with the attachment plate:
0 / 20 / 60 mm with a bellow **Ø 300**
45 / 80 mm with a bellow **Ø 360**

② Air bag with central bolt connection (Ø 300)

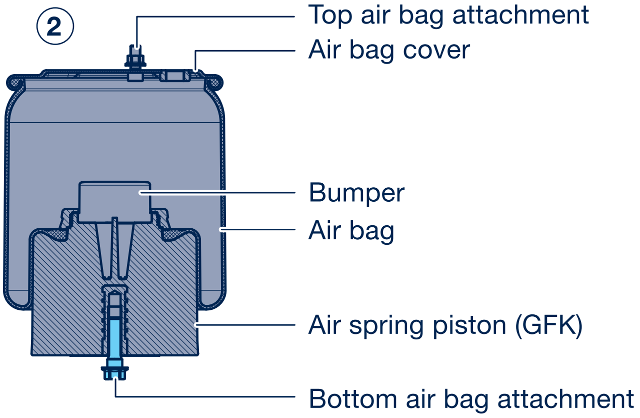
The air bag assembly is connected to the air bag beam with **one** fixing bolt.
Offset dimensions of **20 mm** are achieved through the holes in the bellows brackets.

> ☞ 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.



BPW air bags are firmly rolled into the top air bag cover and are bonded onto the clamping plate at the bottom by vulcanisation.

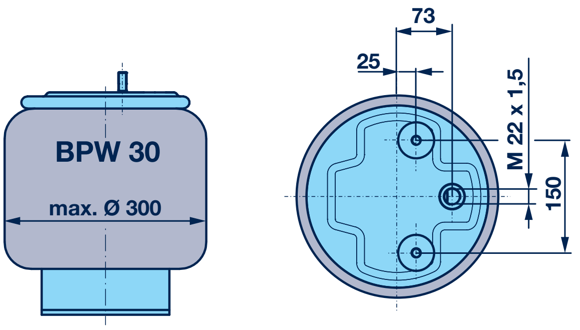
Depending on the version, a plate or bracket is welded onto the vehicle frame for securing the upper air bag cover. The air bag cover is bolted onto it using two M 12 securing nuts.

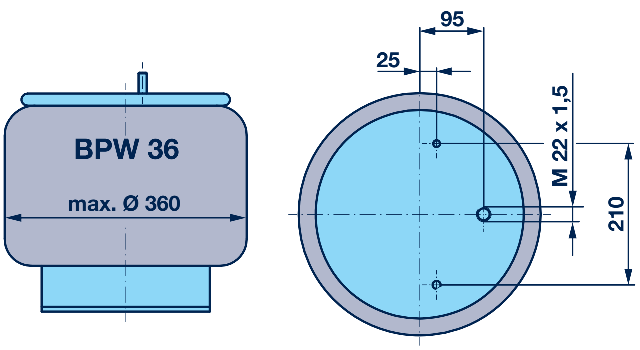


Tightening torques see chap. 13.

Air bags 7

Designs 7.2





Designs

a: BPW 30 for 220 mm stroke at axle centre

BPW 30 K for 180 mm stroke at axle centre

Diameter max. 300 mm at approx. 5 Bar

Air bag specific pressure
0.00023 Bar / N (at ride height)

Air bag offset V = 0, 20, 60 mm
at air bag with buttom plate

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

b: BPW 36 for 220 mm stroke at axle centre

BPW 36 K for 190 mm stroke at axle centre

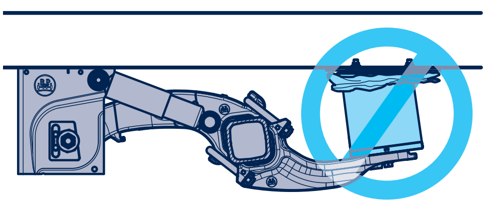
BPW 36-1 for 260 mm stroke at axle centre

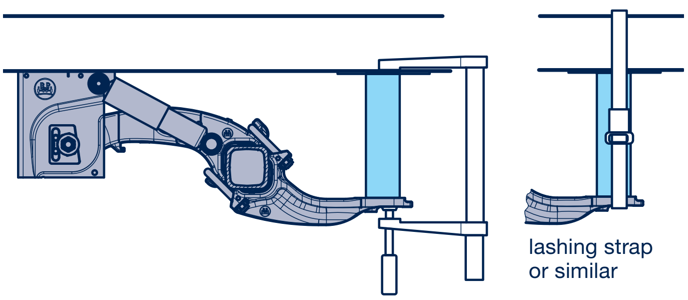
Diameter max. 360 mm at approx. 3.5 Bar

Air bag specific pressure
0.000156 Bar / N (at ride height)

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

Air bag offset V = 45 / 80,
reinforced air bag buttom plate with t = 20 mm





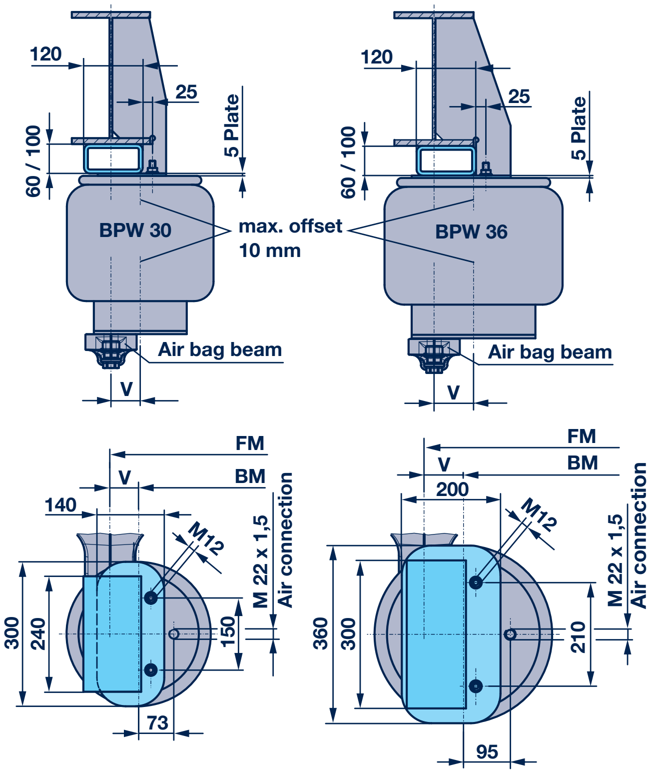
☞ The rubber roll bag is a sensitive component and must be protected against damaging influences during the vehicle production process, the same as with a tyre.

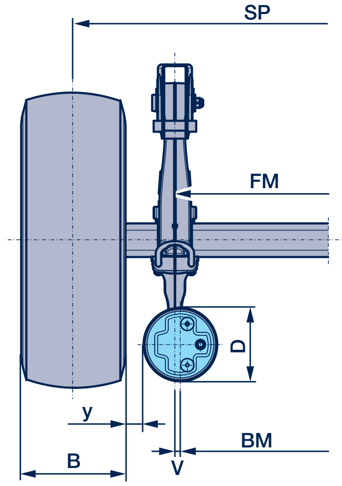
The bag should always be installed with the rubber in a rolled-up condition. Under no circumstances may the rubber wrinkle, as the folds will become permanent and negatively impact subsequent unrolling behaviour and service life.

If the semi-finished vehicle or chassis is moved on its own axis – for the purpose of painting, for example – attaching a strut as a bag substitute is recommended. The bag must not be covered to protect against the paint and is only installed during final assembly.

7 Air bags

7.3 Air bag with offset





* 30 mm is minimum dimension

Tightening torques see chap. 13.

General

Force transmission between air bag and vehicle frame must be ensured through appropriate design. In the case of installation with lateral offset in particular, the arising bending moment must be absorbed by ribs and gusset plates or even by crossmembers. A calculation of the bellows force is described in sections 3.1 and 3.2. If necessary, the load situation „loaded without air" must also be taken into account. In special situations (e.g. ferry loading of a trailer or unloading a rear tipper), the axle-load proportion to be supported by the bag buffer may be considerably above the static value.

During installation the centre of the bag at the top (on the vehicle frame) must not deviate from the centre of the bag at the bottom (axle side) by more than 10 mm. A skewed installation between the top and bottom bag fixing is to be avoided.

Installation/bracing example with console

In the example illustrated, in addition to the square tube and the rib, a bellows plate with the following minimum dimensions must be provided:

Air bag BPW 30: 300 mm x 140 mm

Air bag BPW 36: 360 mm x 200 mm

Installation/bracing example without console

Bellows plates are to be provided with the aforementioned minimum dimensions here, too.

Clearance between air bag and tyres

The clearance between air bag and tyres should be at least 30 mm and can be calculated as follows:

y = 0.5 x (SP – FM – B – D) + V

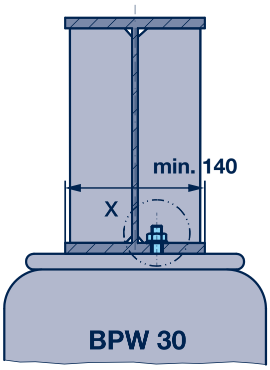
SP = Track on the ground
FM = Guide link centre
D = Air bag diameter
V = Air bag offset
B = Tyre width

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

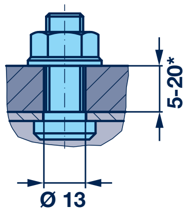
The clearance between the air bag and brake cylinder must be at least 30 mm.

Air bags 7

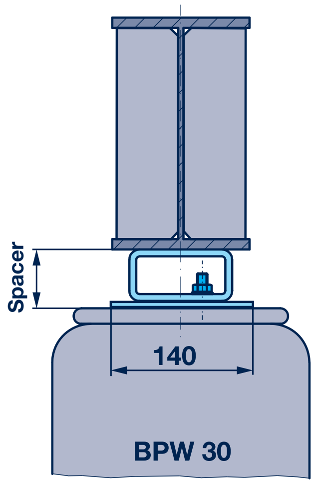
Air bag at frame centre (in-line) 7.4

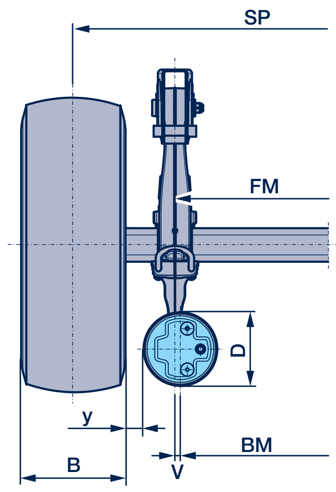


Section X



* For bottom flange thicknesses between 18 and 20 mm, the nut protrudes beyond the stud end





* 30 mm is minimum dimension

Tightening torques see chap. 13.

General

Force transmission between air bag and vehicle frame must be ensured through appropriate design. A calculation of the bellows force is described in sections 3.1 and 3.2. If necessary, the load situation „loaded without air“ must also be taken into account. In special situations (e.g. ferry loading of a trailer or unloading a rear tipper), the axle-load proportion to be supported by the bag buffer may be considerably above the static value.

During installation the centre of the bag at the top (on the vehicle frame) must not deviate from the centre of the bag at the bottom (axle side) by more than 10 mm. A skewed installation between the top and bottom bag fixing is to be avoided.

Installation/bracing example without console

When installing the air bag in the centre of the frame with little or zero offset (V = 0 or 20 mm), the bottom boom of the vehicle frame can be drilled through to take the M12 stud bolts. For the BPW 30 bag, the dimensions of the bag support (plate or wide bottom boom) are at least 140 mm x 200 mm.

Installation/bracing example with console

Here, too, the dimensions of the bag support (plate or wide bottom boom) for the BPW 30 bag are at least 140 mm x 200 mm.

Clearance between air bag and tyres

The clearance between air bag and tyres should be at least 30 mm and can be calculated as follows:

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

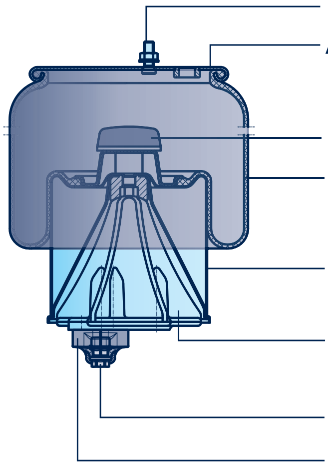
SP = Track on the ground
FM = Guide link centre
D = Air bag diameter
V = Air bag offset
B = Tyre width

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

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

7 Air bags

7.5 Air bag with split piston (Combi Air bag)



Split piston

This design means there are no restrictions on using vehicles with air suspension for intermodal transport.

The functional principle is simple. The guide links and the air suspension airbags are in two parts: The conical adapters at the air bag beams and the air bags with the pistons.

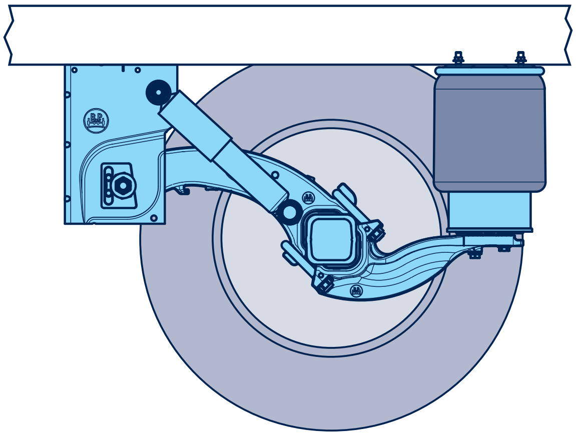
If the vehicle is lifted after de-aeration, the axles move downwards due to their own weight.
The air bags remain in the rest position, the air bag beams with the adapters move downwards.

When the vehicle is lowered to the ground, the air suspension unit re-aligns with absolute safety.

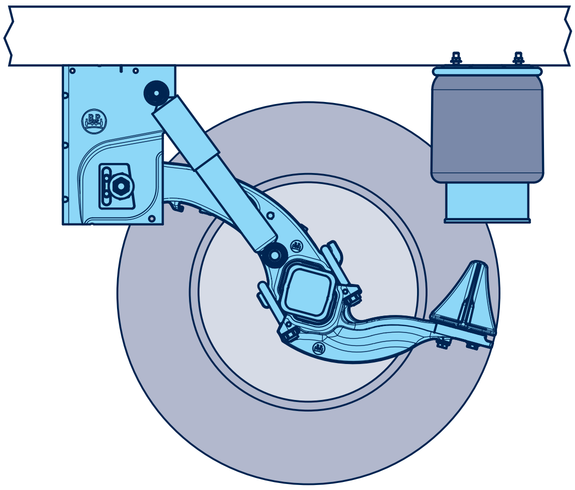
The air bags can neither fold nor crease.
This means a long service life is guaranteed.

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

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



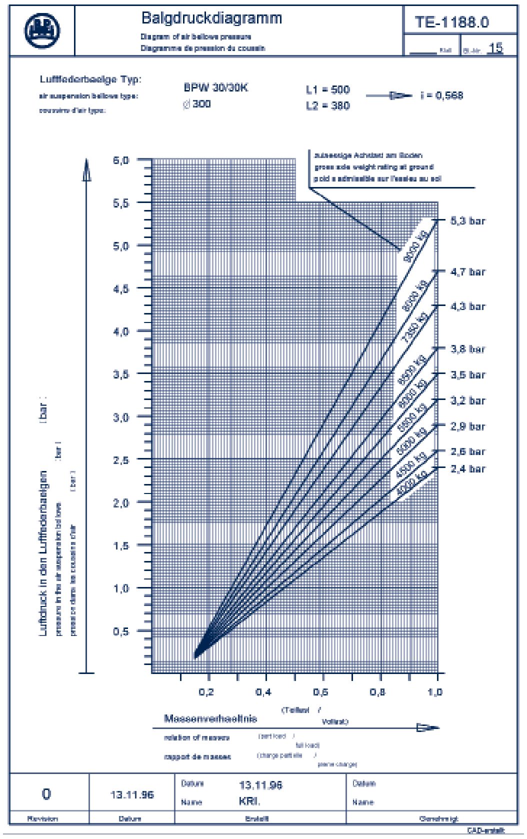
☞ The shock absorber acts as an end stop in this configuration, therefore it is necessary to ensure that shock absorbers with a corresponding length and loading capacity are installed.
Please refer to the instructions on the air spring installation / raising and lowering (Chapter 11.5).

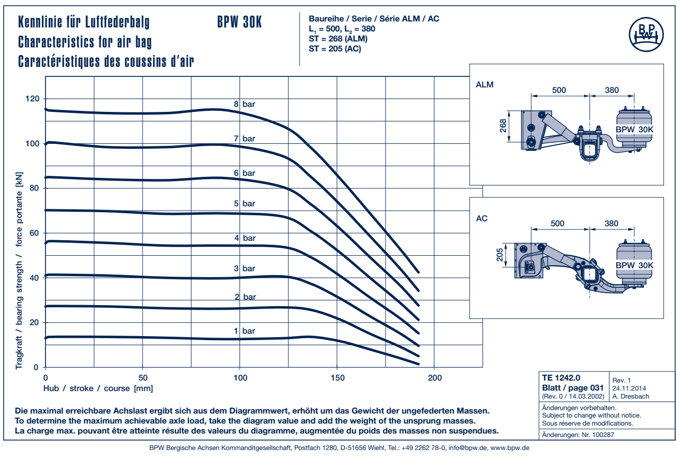


The relevant series models are listed in the EAC data sheets (My BPW).

Air bags 7

Other 7.6





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

TE-1188.0 Air bag pressure diagrams

The curves are for determining the bag pressures depending on the load conditions of the axles. There is a chart for each bag type and each trailing arm conversion ratio (L1, L2). The lines are assigned to the maximum axle loads and describe the relationship between air pressure in the bags and the mass ratio (partial load: full load of the axle loads on the ground GA).

* My BPW is the customer portal of BPW.

TE-1242.0 Characteristics curves

The characteristics are used for estimating the falling load-bearing capacity of the bags through the stroke; e.g. in the case of the lifting/lowering function. There is a chart for each bag type and each trailing arm conversion ratio (L1, L2).

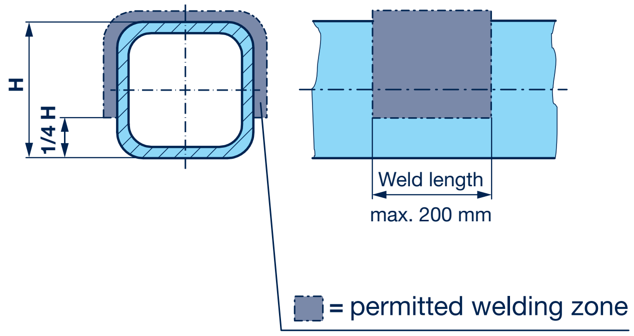
The isobars (from 1 bar to 8 bar bag pressure, from TE-1188.0) describe the relationship between load capacity (the sprung mass per axle) and stroke in terms of the axle spring deflection between minimum ride height (empty without air) and maximum ride height (fully extended bag).

The sprung mass or axle load (axle load on the floor minus the weight force of the axle, wheels and a portion of the suspension) is approximately: $FA_{gef} = FA \times 0.92$.

8 Axle beams

Welding guidelines for axle beams

Material: S 420 or S 355 J 2



General

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

BPW axles are therefore made of weldable material. The axle beams do not need to be heated prior to welding.

The load-bearing strength and perfect functioning of the BPW axles are not reduced by welding work if the following points are observed.

Welding methods:

- Inert gas welding
  Welding wire quality G 46 2 (DIN EN ISO 14341)
- Manual arc welding
  Rod electrodes E 46 2 (DIN EN ISO 2560)

  Mechanical quality values must be equivalent to basic material S 420 or S 355 J 2

  Weld thickness a 5 ◺ (DIN EN ISO 5817)

  Avoid end cavities and undercutting!

Do not alter the camber or tracking of the axles except within BPW tolerances. Observe the welding zones and weld lengths shown in the adjacent diagram.

No welding must be undertaken in the lower tensile area of the axle beam!

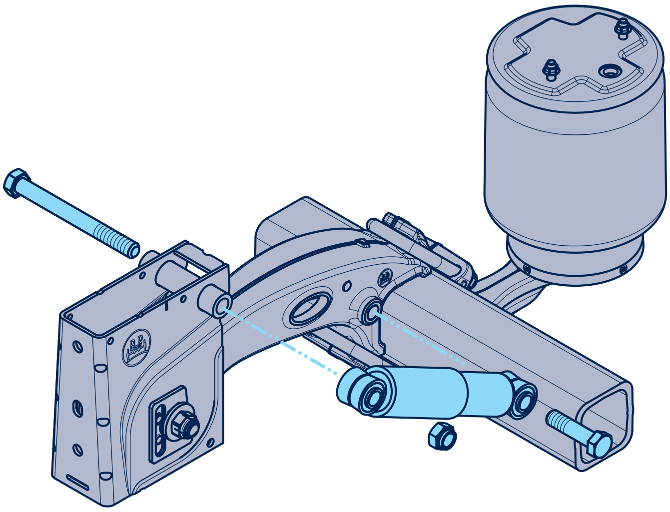
The guide links, air bag beams, spring U-bolts, air bags, shock absorbers and plastic pipings must be protected against sparks and weld splashes during all welding work.

The earth terminal must under no circumstances be attached to the guide links, air bag beams, spring U-bolts or hubs.

No welds at the axle-integration area, cast iron trailing arm or cast iron air bag beam.

Shock absorbers 9

General, attachments



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 ground contact. In turn, this ground contact is responsible for the tracking stability and braking properties of the vehicle.

BPW shock absorbers are matched to the vehicle, ride height, installation position and range of applications. For air suspension systems with split pistons (Combi Air bag), the shock absorbers are provided with an end stop to prevent further lowering of the axles.

Shock absorber attachments

The shock absorbers are located on the side next to the air suspension hanger brackets with ECO Air COMPACT running gear systems.

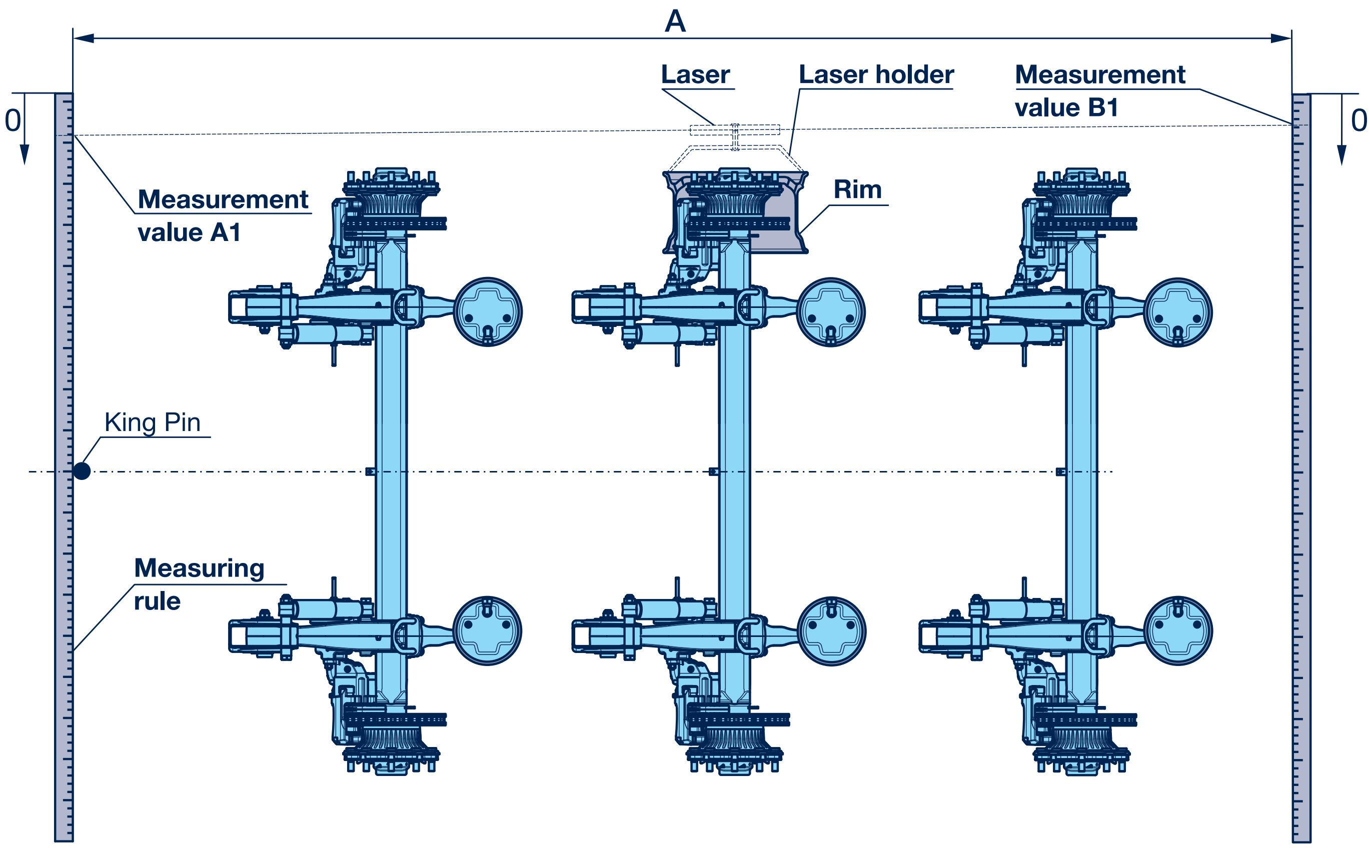
The upper attachment of the shock absorbers is secured using hexagon bolts with lock nuts.

In the case of the lower attachment, the shock absorber is simply connected to the guide link by means of a hexagon bolt.

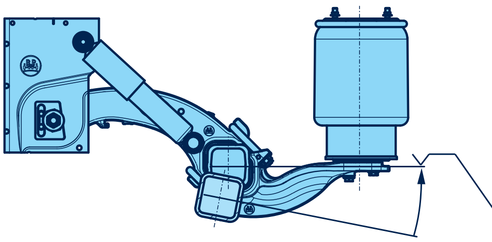
Tightening torques see chap. 13.

10 Track settings

10.1 Track settings with laser measuring system



If laser measuring systems are used, care must be taken to ensure that the axle is aligned **horizontally** with the base in order to obtain a correct measurement as otherwise the camber values will affect the result.



The operating and setting instructions of the system manufacturer must be adhered to!

The maximum possible wheelbase correction per axle is ± 5 mm for adjustable hanger brackets (see track settings with adjustable hanger brackets).

Calculation of the toe-in and toe-out settings

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

Positive value = toe-in

Negative value = toe-out

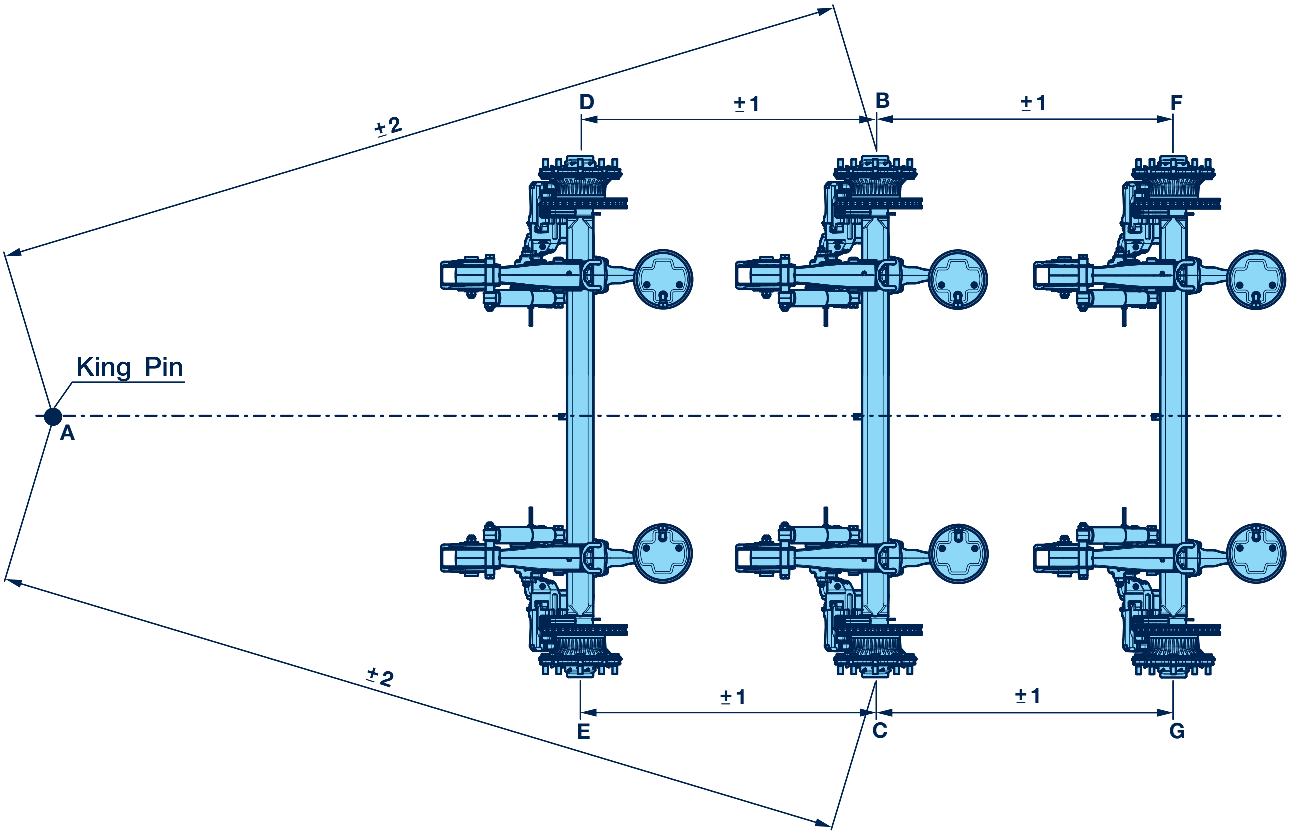
The measurement must be performed on both sides of the axle. The measurement values are then added together.

The total of the values is the toe-in/toe-out value of the axle and must be within the permitted tolerance range (-1 to +5 mm/m).

☞ The tracking tolerances defined by BPW must be maintained. Only by maintaining these tolerances can low-wear operation of the vehicle be assured.

Track settings 10

Track settings conventional 10.2



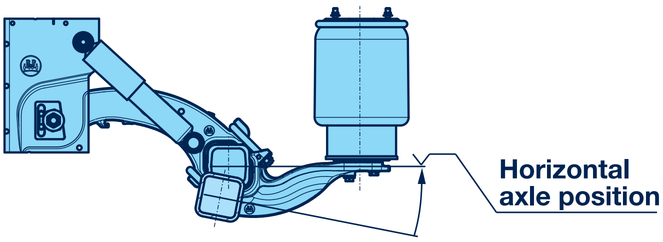
The track settings are to be checked and corrected if necessary to equalize production tolerances.

The diagonal dimensions **A - B** and **A - C** of the centre axle (reference axle) must be checked via comparison measurements (tolerance ± 2 mm).

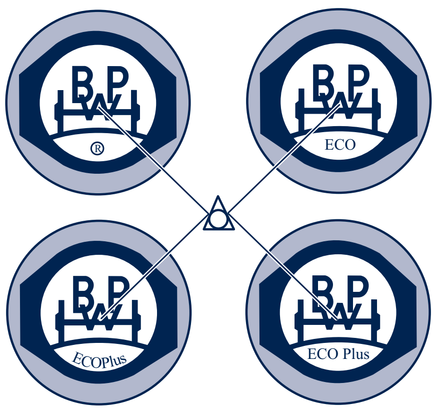
Check the wheel base measurements **B - D** and **C - E** of the front axle, and **B - F** and **C - G** of the rear axle and correct if necessary (tolerance max. ± 1 mm). Measurements are generally carried out between the hub cap centres (fig.), but can also be carried out between screw-on measuring tubes.

The maximum possible wheelbase correction per axle is ± 5 mm for adjustable hanger brackets.

Horizontal axle positioning (ride height) must be ensured for tracking.

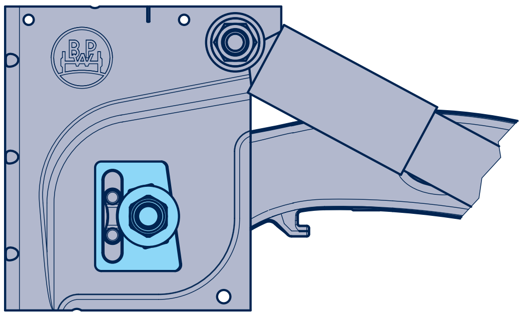


The triangle in the BPW logo is located centrally.



10 Track settings

10.3 Track correction with adjustable hanger brackets



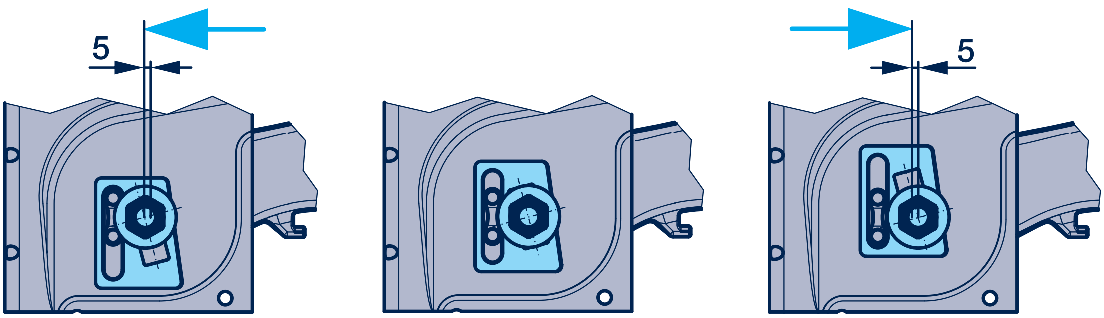
General

It is necessary to check the tracking accuracy during installation as well as after repairs on axles, brackets or guide links:

Track correction

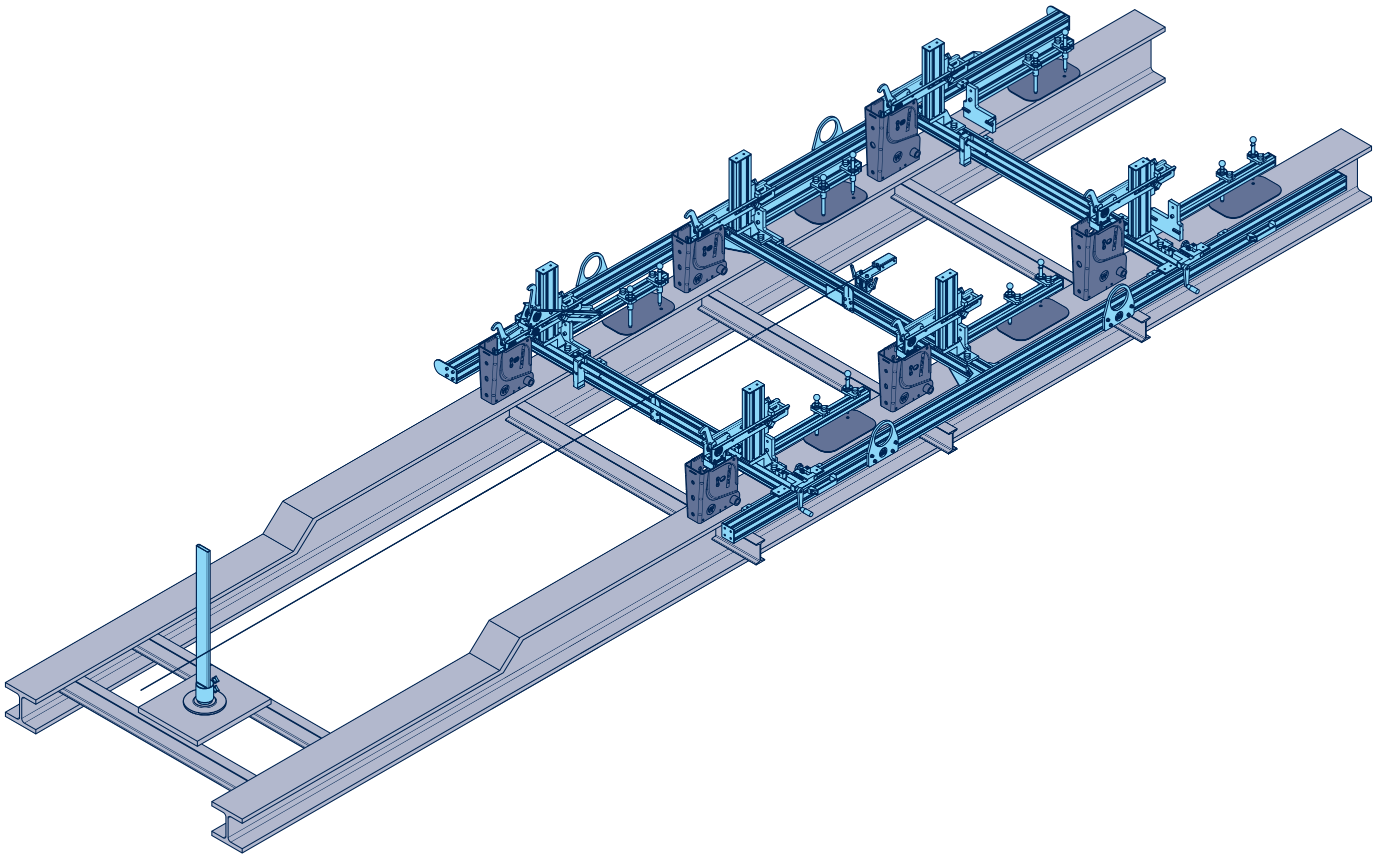
1. Raise and support the vehicle frame.
2. Exhaust the air out of the air bags.
3. Slacken the lock nuts on the spring pivot bolt.
4. Slide the connecting linkage on both sides, as required, upwards or downwards with light hammer blows (see fig.).
5. **Make sure the inner and outer connecting linkages on each hanger bracket are adjusted symmetrically!**
6. Tighten lock nut on the spring pivot bolt to the specified torque.
7. Inflate the air bags and remove supports from underneath the vehicle.

Tightening torques see chap. 13.



Track settings 10

BPW tack welding & track setting device 10.4



Tack welding & track setting device

For the quick and precise positioning of hanger brackets and bellows plates, BPW offers a special device which can be used to fix the components onto the frame with a high degree of positional accuracy.

To do this, the vehicle frame of the trailer is first built with the underside facing upwards. The fixing device consists of a rigid, stable aluminium frame with clamping and positioning devices for various air suspension hanger brackets and bellows plates and is placed on the vehicle frame.

After the alignment to the kingpin using a laser, the device is clamped between the longitudinal beams. Six air suspension hanger brackets and bellows plates are simultaneously placed on the frame for fixing through appropriate fitting holders.

Once the device is removed, the hanger brackets and bellows plates can be welded on.

The subsequent attachment of the air suspension unit will ideally enable the omission of the additional tracking process, since the axles are already in alignment with each other and with the kingpin through the defined position of the hanger brackets.

11 Air installation

11.1 General

On demand BPW delivers installation kits and installation drawings. BPW installation drawings identify the valves using the ISO illustration method.

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

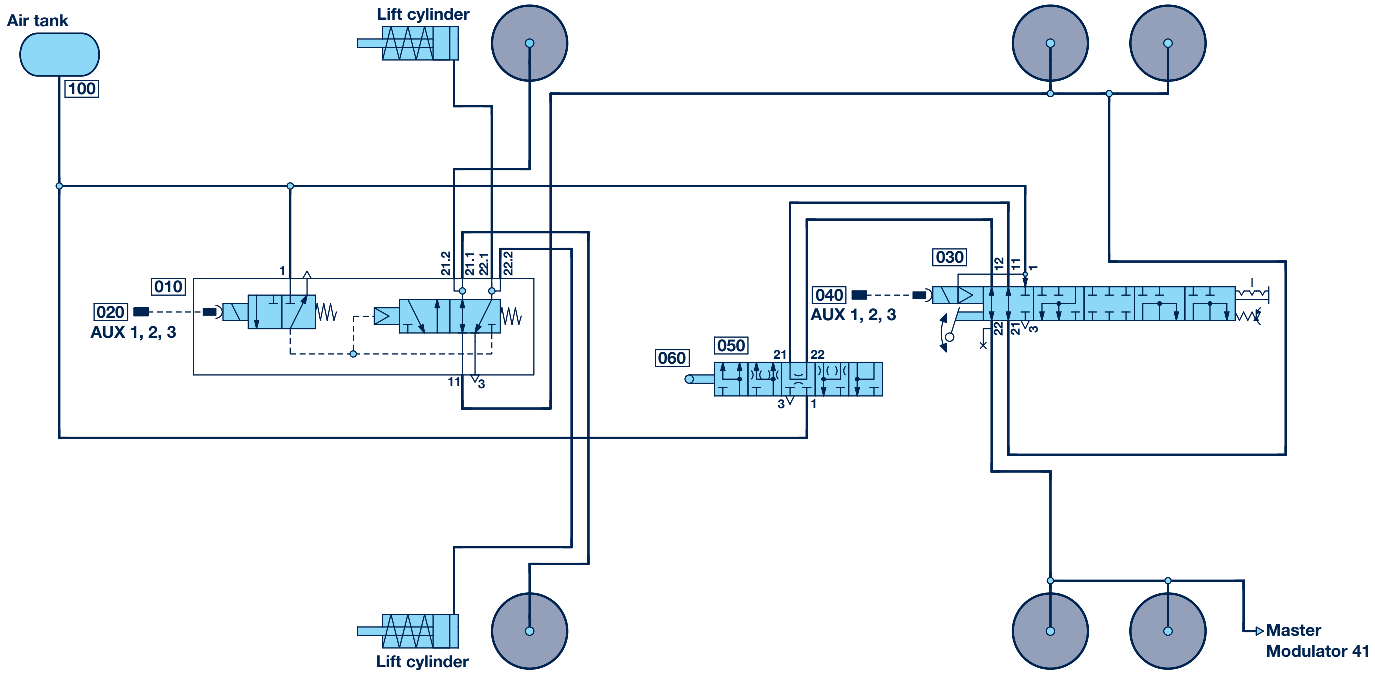
The air suspension is fed via an overflow valve from the compressed air braking system.
The air tank pressure is approx. 6.5 Bars. An air supply of 20 litres is required for each axle, lifting and lowering demands correspondingly more.

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

☞ To achieve good axle load equalisation, the air lines connecting the air bags must not have an internal diameter of less than Ø 8 mm (e.g. Ø 10 x 1).

Example for air suspension installation:

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



Item	Designation
010	Lifting axle valve
020	Connecting cable EBS
030	Raise and lower valve
040	Connecting cable EBS
050	Air suspensiom levelling valve
060	Linkage at axle beam (see chap. 11.3)
100	Air tank

Air installation 11

Single and dual-circuit air suspension installation 11.2

BPW air suspension has little side tilt when taking corners due to its high degree of rolling stability, thus offering top driving safety. This high degree of rolling stability is achieved because the structure is mainly supported when taking corners by the arm-axle beam-arm group.

An additional, albeit smaller, influence on the support is provided by the air bags.

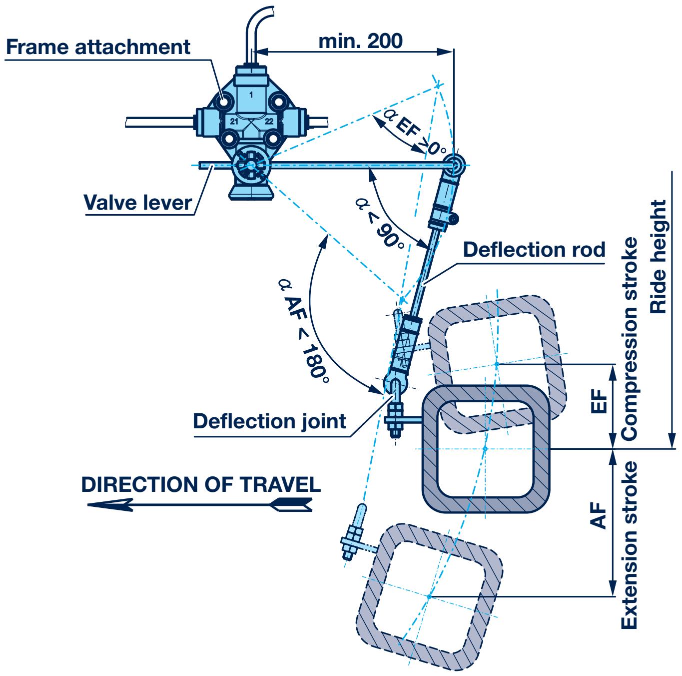
In dual-circuit air-suspension systems, the right and left sides of the vehicle are pneumatically separated and are only connected via a transverse throttle in the air suspension valves. As a result, the air pressure can only equalise slowly when turning. When corners are taken in quick succession, an additional stabilisation effect is thus obtained.

In a single-circuit air-suspension system (e.g. through a manifold block), this additional stabilisation effect does not apply.

Thanks to many years of usage experience, which now also includes single-circuit suspension installations, these single-unit systems can be approved for standard applications without restriction.

11 Air installation

11.3 Air suspension levelling valve / Height sensor



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 chap. 11.5.

General

BPW air suspension axles are prepared for use with a levelling valve.

This regulates the air bag pressure according to the respective load, thereby holding the vehicle at a constant level.

The levelling valve is fixed to the vehicle frame and connected to the axle via pushrod.
The pushrod is activated at the centre of the axle. With tri-axle suspensions they are fitted to the centre axle and with tandem-axle suspensions to the rear axle.

Under special circumstances (e.g. axle lift device or extreme vehicle inclinations), the levelling valve can also be linked 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 to ensure that air is 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 then be re-positioned.
The ride height is set by carrying out adjustments to the rubber joints of the pushrod and by adjusting the locking nuts.

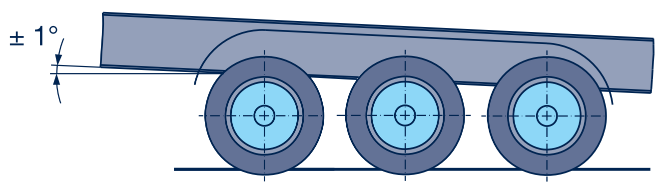
All adjustments, either on an empty or fully laden vehicle, must be carried out when the vehicle is standing on level ground.
It can be performed with an empty or laden vehicle.
Electronic ride height measuring instruments can also be installed.

Ride heights

The ride height of the air suspension axles should be set to the permitted range indicated in the appropriate BPW data.

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 ± 1°.



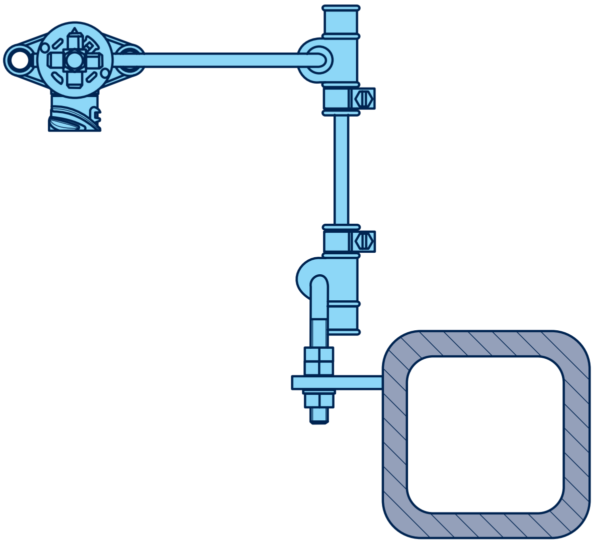
☞ The air suspension can be checked by activating the compression stroke to the air bag bump stop, and then the extension stroke to its limits (shock absorber, air bag length).

The stipulated angles must be conformed to. Otherwise the valve pushrod could reverse its direction.

Due to the strong stabilisation effect, the use of two air suspension valves is not recommended for lateral control.

Air installation 11

Electronic air suspension 11.4



In addition to the conventional air suspension valves actuated via lever mechanisms, electronic air suspension modules are encountered often on the market. Here a conventional air suspension valve is replaced with a robust ride height sensor and supplemented with a multi-functional air suspension block.

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

The ride height is controlled in a closed control loop, which offers advantages over the ride height control of conventional air suspension in terms of parameter assignment capability and diagnostics capability for vehicle manufacturer.

Mechatronic ride height control also offers additional advantages over conventional valve technology:

- Low air consumption, since level control decoupled from dynamic deflection/rebound operations
- Simple possibility of achieving multiple ride heights
- Reset-to-Ride function without additional valve technology
- Quick lifting and lowering due to large valve cross-sections
- Lift-axle control with residual pressure retention often integrated within the valve block for start-up and manoeuvring support
- Ability to operate the trailer suspension from the truck or via mobile devices
- Installation benefits of reduced wiring and piping

11 Air installation

11.5 Lifting and lowering

Lifting and lowering

In addition to their original function of lifting and lowering the ride height of a vehicle from the drive level, lifting and lowering valves, often also referred to as rotary slide valves, today also often provide extra functions and a switch position for influencing the ride height.

Depending on the air suspension valve installed, lifting/lowering valves can come in single-circuit or dual-circuit versions. The lifting/lowering valve is set downstream of the air suspension valve and connects the support bellows of the axles with the air suspension valve.

Drive position function

The drive level is usually insured by the air suspension valve, which is constantly kept within limits by the aerating and de-aerating of the support bellows based on the ride height of the drive level. To do this, the connection of the support bellows of the axles with the air suspension valve is maintained.

Stop function

In this switch position there is an interruption between the air suspension valve and support bellows. The last ride height set with the lifting/lowering valve is maintained. Changes to the ride height arising due to aeration or de-aeration are not offset.

Lifting function

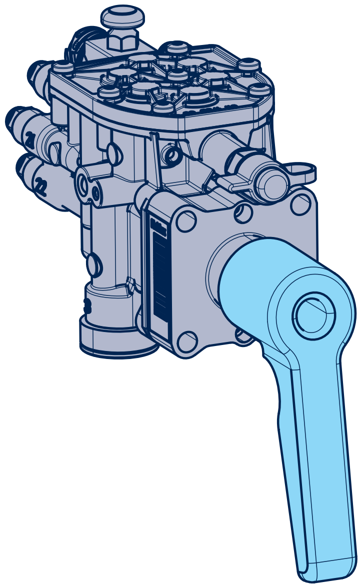
To raise the ride height the connection of the support bellows with the air suspension valve is interrupted by the lifting and lowering valve, and the support bellows are charged with supply pressure for lifting.

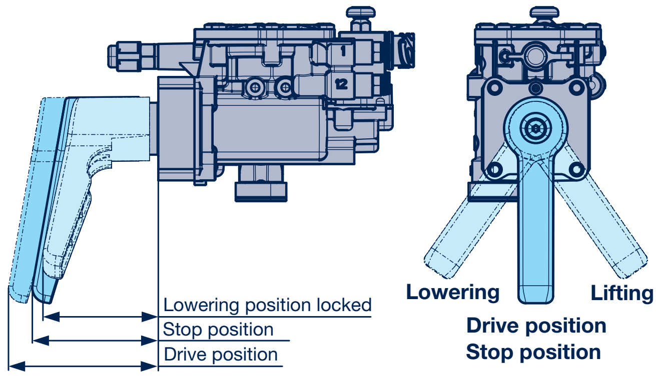
Lowering function

To lower the ride height the connection of the support bellows with the air suspension valve is interrupted by the lifting and lowering valve, and the support bellows are de-aerated for lowering.

Dead man‘s switch

The so-called dead man‘s switch ensures that lifting or lowering only takes place if the user keeps the actuation lever in the relevant lifting/lowering position. After releasing the lever, this automatically reverts back to the stop position. This prevents the uncontrolled lifting/lowering of the vehicle structure.





Lowering function locking

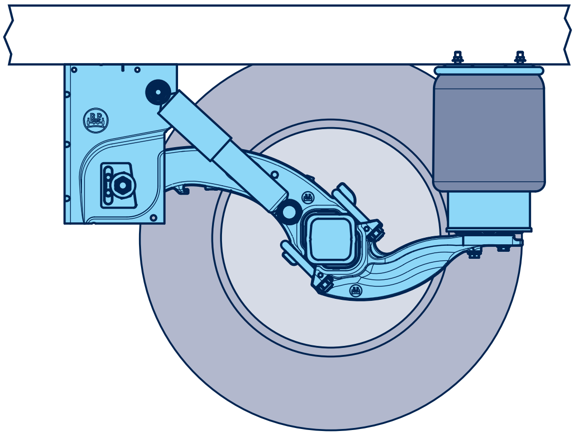
To load or fix vehicles in intermodal transport, it may be necessary to lower the vehicle down to the bag buffer and to maintain this condition for the entire duration of vehicle transport. This function is often also referred to as the Ro-Ro function (Roll on, Roll off).

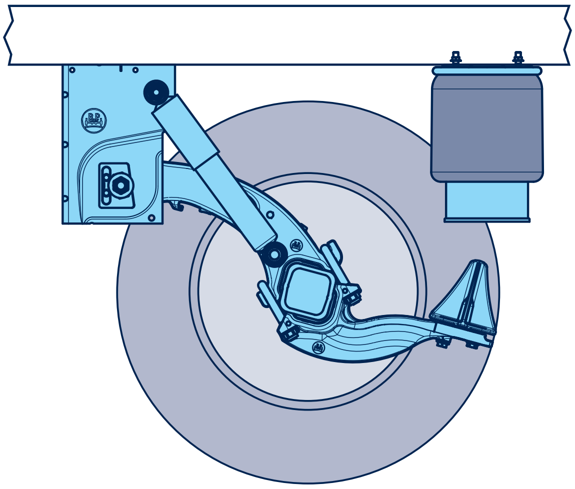
Resetting to drive level

Resetting to drive level (often referred to as the reset-to-ride function) is mostly triggered by a switch pulse of the brake system. The switch pulse of the ABS/EBS occurs when a given velocity is exceeded (e.g. 15 km/h) and actuates a solenoid valve integrated in the lifting/lowering valve. This solenoid valve brings the actuation lever back into the drive position, thus ensuring that the support bellows are connected to the air suspension valve again for the journey.

Air installation 11

Lifting and lowering 11.5





Stroke limitation

The spring deflection is limited by a rubber stop inside the air bag. Under certain operating conditions the rebound travel must be limited.

Air bag Type 30, 30 K, 36 or 36 K

When air bags type 30, 30 K, 36 or 36 K are used, no stroke limitation is required providing a raise/lower control valve with a dead man feature is installed.

Air bag Type 36-1

Stroke limiting is required in vehicles with a lifting and lowering device and type 36-1 air bags.

Rapid unloading

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

Crane, railway or ship loading

With vehicles for crane, railway or ship loading, BPW recommends air bags with a split piston, system Combi-Airbag II. If not expressly demanded in the technical documentation, no stroke limitation is needed when the Combi-Airbag is used.
Vehicles with split air bag (combi-airbag) must not be moved in the unvented condition when manoeuvring in traffic.

Stroke limiting versions

The stroke limitation can be carried out via an air levelling valve with integrated shut-off (fig. chap. 11.3) or a separate shut-off valve. The shut-off valve is fixed to the vehicle frame and the valve plunger is connected to the axle via a spring.
After the maximum stroke is achieved, the air supply to the air bags is interrupted in order to limit the length of the stroke.

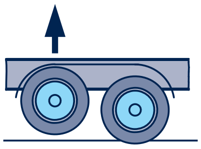
Depending on the version, the limiting function is in the shock absorbers in axles with a lifting and lowering device without stroke limiting by shut-off valves.
The shock absorbers are equipped with a travel limiter; however they are not designed to operate with airbag pressures above approx. 8.5 bar.

12 BPW Axle lift devices

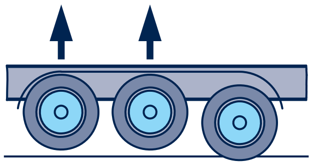
12.1 General

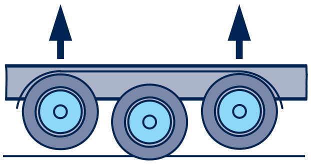
General

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



or max. two axles with tri-axle suspensions.





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

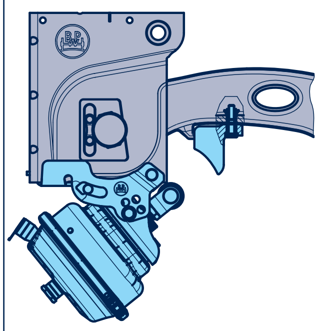
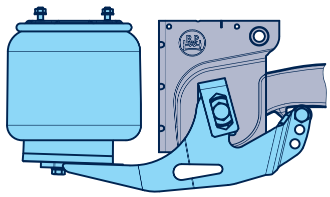
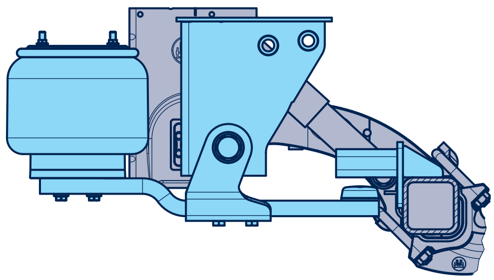
In the case of vehicles with axle lift devices, ground clearance for the raised axle must be ensured.

The statutory provisions regarding turning circle requirement must be observed!

Ovserve the ground clearance depending on the tyre, ride height and hanger bracket design!

> BPW air suspensions and axle lift devices only operate as well as the installation of the air suspension: The reliable functioning of the axle lift device and the correct rolling of the air bags should be ensured by means of the air system and its activation times.
>
> The BPW warranty becomes null and void if the system is installed incorrectly.

Designs

<table>
<tr><th>Two-sided lift</th><th>Side axle lift</th></tr>
<tr><td>Can be used on all axles, the space in front of the air suspension hanger brackets and in the vehicle centre remains free.</td><td>For raising the front bogie axle.</td></tr>
<tr><td></td><td></td></tr>
<tr><th colspan="2">Middle axle lift</th></tr>
<tr><td colspan="2">For raising the front, middle or rear bogie axle.</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Control

Axle lift devices operate either EBS-controlled, electrically / pneumatically via an electric switch or manually / pneumatically via a manual valve (or automatically via a compact valve).

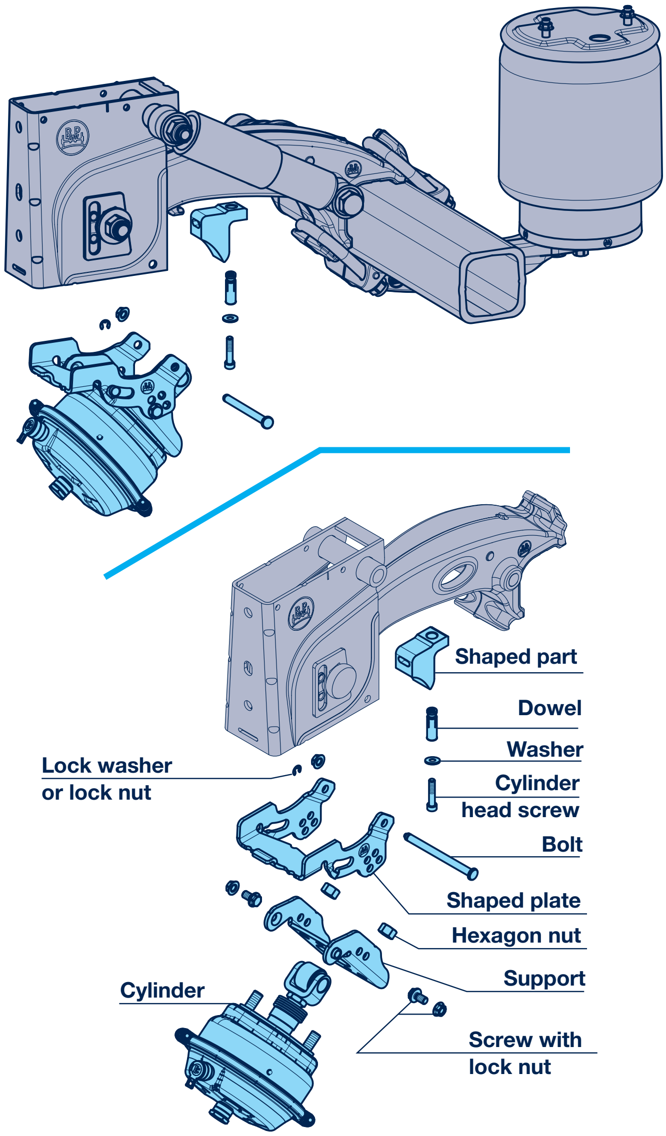
An overload protection device, which is a legal requirement, is included in the BPW installation kit.

In the EBS version, the lift axles must only be controlled via EBS.

With ABS or conventional braking systems it is optional. The correct functioning of the ALB (automatic load-dependent brake system) must be maintained.

BPW Axle lift devices 12

Two-sided lift 12.2



Two-sided lift

The two-sided lift is suitable for disc and drum brakes.

The construction is designed in such a way as to ensure that the spring bolt is not required for the function of the axle lift.
This means that when assembling the axle lift, dismantling of the spring bolt, which is otherwise required, is not necessary. This simplifies the assembly process considerably.

The two-sided axle lift is assembled below both air suspension hanger brackets per module and is therefore located within the free space of the suspension and therefore does not collide with any vehicle equipment such as pallet boxes.

Function:

In this axle lift, the lifting force is generated by an integrated diaphragm cylinder on each side.

Assembly:

The shaped plate is hooked onto the front side of the hanger bracket (punched recess) and connected to the hanger bracket on the reverse side with a bolt.

The pre-assembled support with diaphragm cylinder is then connected to the shaped plate with 2 screws and lock nuts.

The position for setting out the stop is shown in the BPW technical documents!

The shaped part is placed onto the projection on the lower side of the suspension arm, the dowel is knocked in and then secured using the cylinder cap screw (with washer).

Should a TSB 3709 or TSB 4309 with spring brake cylinder be built in on the axle, this has to be dismantled so that the shaped part can be secured to the lower side of the suspension arm with the cylinder cap screw.

Tightening torques see chap. 13.

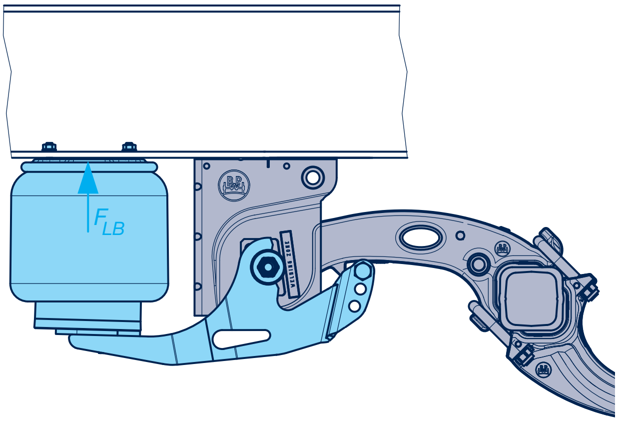
An overview of the advantages

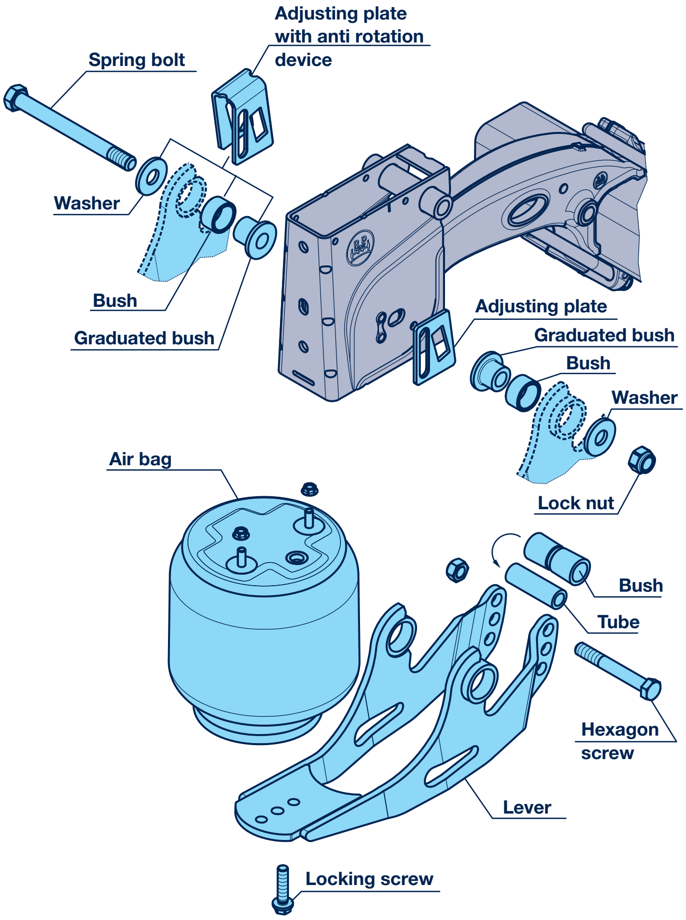
- Can be used with disc or drum brake axles
- The installation space in front of the air suspension hanger brackets and in the middle of the vehicle remains clear
- Retrofitting possible without difficulty. No need to remove hanger pivot bolt.
- Compact design, good ground clearance
- Low weight, robust design
- Installation position can be set for different suspension types

☞ The installation position and mounting of the axle lift device can be seen in the BPW technical documents and the supplied installation drawing. Only the pinning position appropriate for the design and ride height (holder with shaped plate through screw) ensures flawless functioning.

12 BPW Axle lift devices

12.3 Side axle lift





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

Side location is suitable for lifting the front axle of the suspension unit. The lifting arm is attached to the front air suspension hanger bracket underneath the guide link.

The air bag sits centrally on the lever arm (V = 0 mm) and is attached under the vehicle chassis trail. Additional lateral supports are not necessary.

The top plate of the lifting bag can be offset by ± 20 mm.

Depending upon the design, the air pressure to the lifting bag must be limited by a reduction valve at 5 Bar!

Force of lifting bag BPW 30 (p = 5.0 Bar):

$$F_{LB} = \frac{5.0 \text{ Bar}}{0.00023 \text{ Bar / N (press. in bag)}} = 21{,}750 \text{ N}$$

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.

Assembly:

In the event of retro-fitting, the spring bolt in the spring eye is replaced by a longer hexagon bolt (M 24).

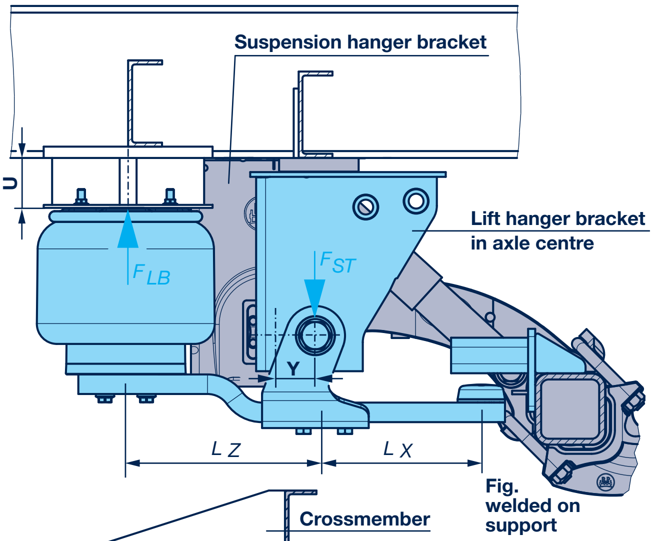
The spring bolt is secured against rotating by the use of an adjusting plate with anti-rotation lock.

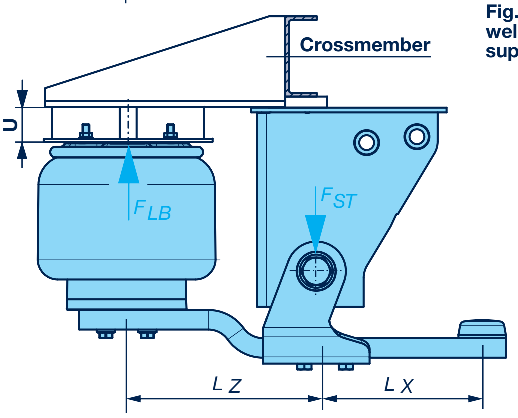
1. Remove the old spring bolt.
2. Position the bush and stepped bush in the lever, attach the adjusting plate with anti-rotation lock and add the disc.
3. Insert the new spring bolt (hexagon bolt).
4. Pre-assemble the other side in the same manner (if necessary, fix the adjusting plate on the hanger bracket with grease).
   The old spring bolt can be used an assembly aid.
5. Lift the lever until the holes in the lever and hanger bracket are aligned and push the spring bolt through the hanger bracket.
6. Insert the disc, screw on the lock nut while counter-holding the spring bolt.
7. Assemble the air bag.

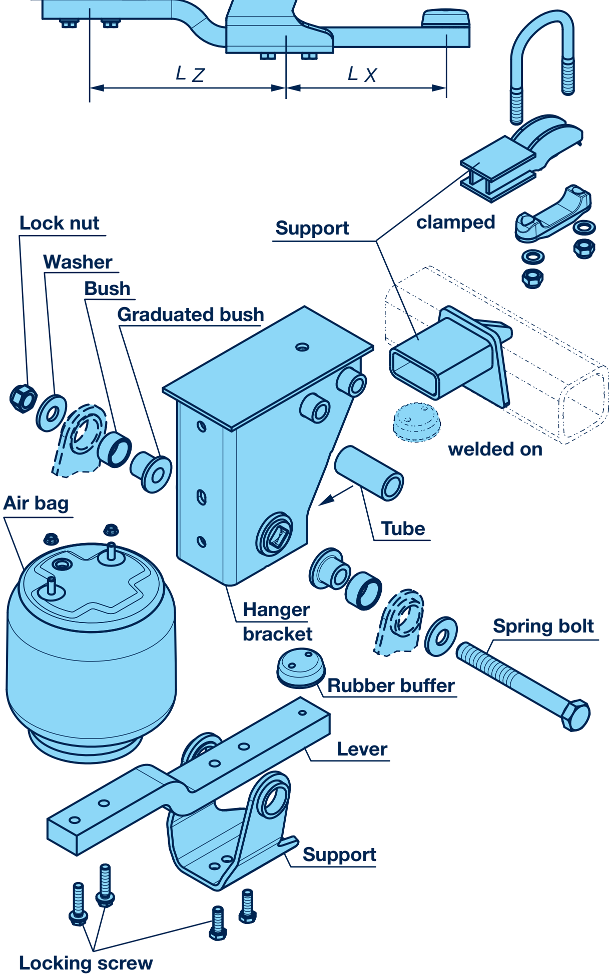
Tightening torques see chap. 13.

BPW Axle lift devices 12

Middle axle lift 12.4







Central location is for lifting the centre (rear) axle of the suspension, or when installation space is restricted.

This axle lifting device is located on the vehicle centre line and is attached to the crossmember via an additional hanger bracket.

The length of the hanger bracket can be seen in the technical documentation.
The lifting bag forces are also to be counteracted by a lateral crossmember.

The air pressure for the air bag should be limited by a reducing valve at 5 Bar, depending on the design!

Example:

Axle lift device with lifting bag BPW 30

Pressure reduction valve set at 5 Bar.

Lever lengths L_X = 280 mm (from BPW tech. doc.)
L_Z = 320 mm

Force of lifting bag BPW 30 (p = 5.0 Bar):

$$F_{LB} = \frac{5.0 \text{ Bar}}{0.00023 \text{ Bar / N (press. in bag)}} = 21{,}750 \text{ N}$$

Force of hanger bracket BPW 30 (p = 5.0 Bar):

$$F_{ST} = \frac{21{,}750 \text{ N x } 600 \text{ mm}}{280 \text{ mm}} = 46{,}600 \text{ N}$$

If the crossmember over the lifting bag is not fitted, the torsion moment (F_{LB} x L_Z) of the lifting hanger bracket crossmembers must be counteracted.
The lateral crossmember and gusset plate must be dimensioned according to standard safety reserves in automotive engineering.

Tightening torques see chap. 13.

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

Clamped supports (stop) are also available.

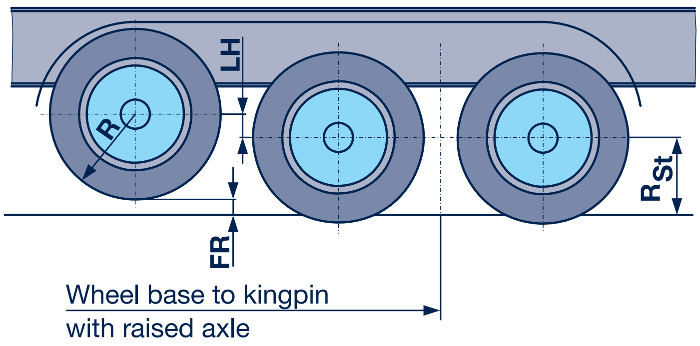
12 BPW Axle lift devices

12.5 Lifting stroke

For air suspension units with an axle-lifting device the ride height is to be configured to a minimum suspension of approx. 100 mm in order to ensure sufficient floor clearance below the lifted axle.

If setting the ride height to the minimum suspension is not possible, adequate ground clearance must be ensured with appropriate air suspension valve technology using a second ride height.

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

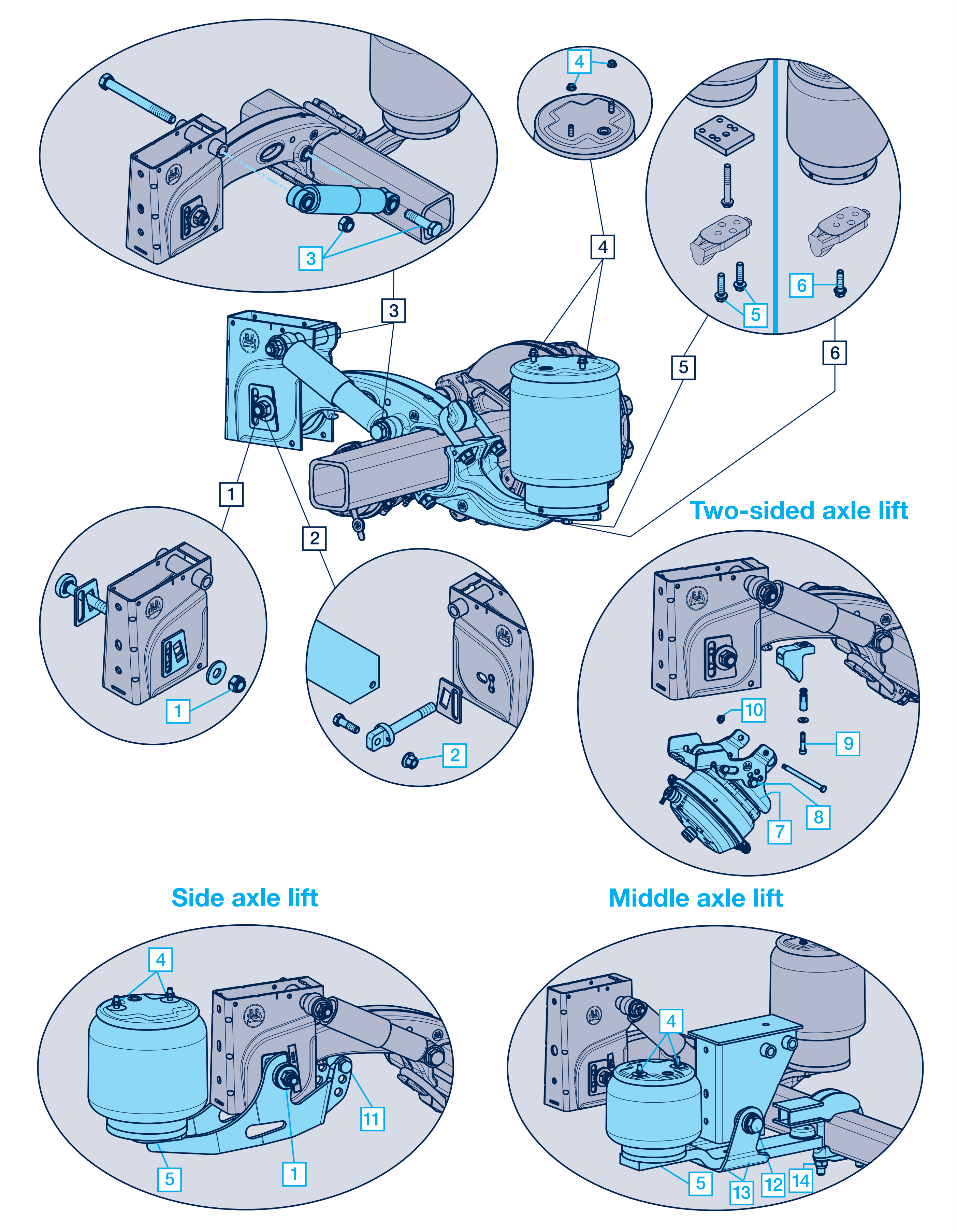


FR = Free space
LH = Lifting stroke
R_{St} = Tyre radius statically loaded
R = Tyre radius unloaded

Ground clearance under the tyre
$FR = LH - (R - R_{St})$

LH min. 100 mm

13 Tightening torques



Tightening torques 13

Area	Item	Attachment	Thread	**Tightening torque** (thread lightly greased)
Spring pivot bolt				
	1	Spring pivot bolt	M 24	**650 Nm** (605 - 715 Nm)
	2	Spring pivot bolt / gusset plate	M 18 x 1.5	**420 Nm** (390 - 460 Nm)
Shock absorber				
	3	Upper and lower attachment	M 24	**420 Nm** (390 - 460 Nm)
Air bag				
	4	Attachment top cover	M 12	66 Nm
	5	Bottom attachment	M 16	230 - 300 Nm
	6	Central bolt		300 Nm
Axle lift device				
	7	Two-sided lift devise, attachment diaphragm cylinder	M 16	180 - 210 Nm
	8	Two-sided lift devise, attachment shaped plate / support	M 12	75 Nm
	9	Two-sided lift devise, attachment shaped part at guide link	M 10	50 Nm
	10	Two-sided lift devise, attachment two-sided axle lift	M 10	38 Nm
	11	Side axle lift device, attachment roller at lever	M 20	350 Nm
	12	Middle axle lift device, spring pivot bolt	M 30	**900 Nm** (840 - 990 Nm)
	13	Middle axle lift device, attachment support	M 16	230 Nm
	14	Middle axle lift device, clamped support	M 24	650 Nm (605 - 715 Nm)

14 Surface treatment

BPW running gears have a KTL+Zn corrosion protection coating (cathode-immersion paint with zinc phosphating), which is tested in accordance with DIN EN ISO 9227 over 504 hours of salt spray testing. Practical experience has shown that this KTL+Zn surface treatment is even more corrosion-resistant than a conventional priming with subsequent top coat.

This means top coats can be omitted for KTL+Zn-treated components – provided there are no special colour or gloss requirements.

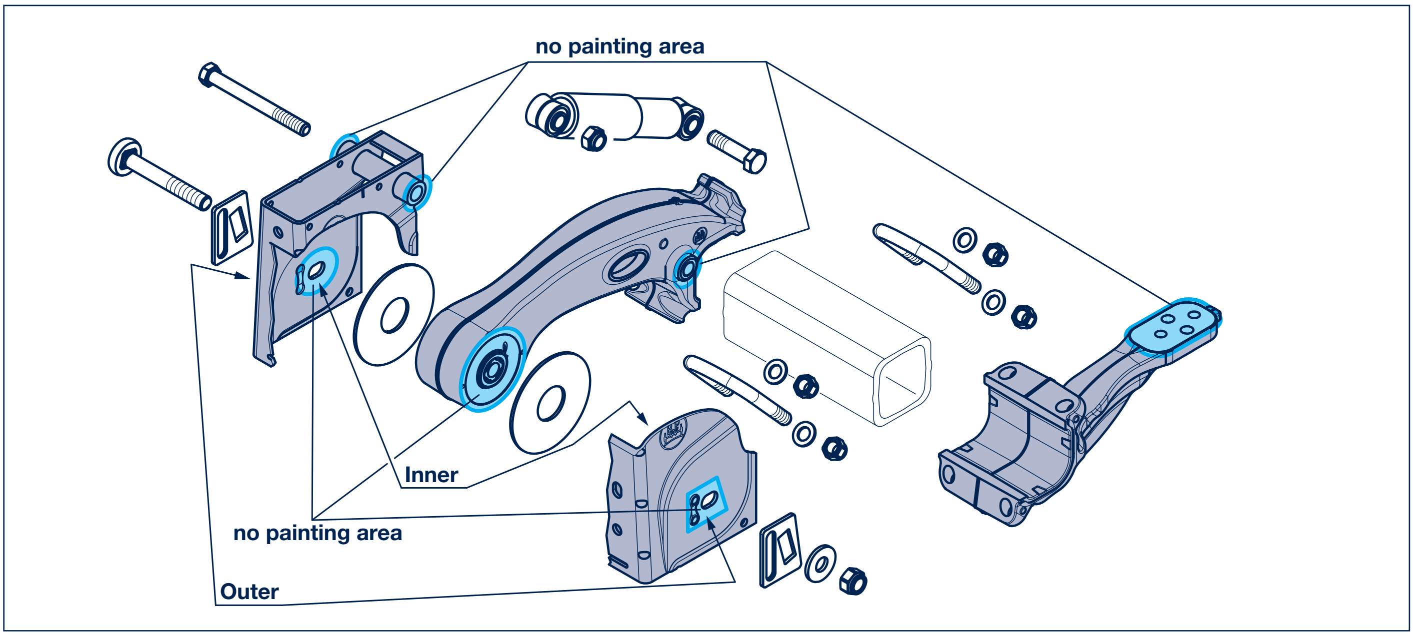
The KTL+Zn coat can always be applied with single-component, air-drying resin paints for vehicle running gear, as well as with dual-component, solvent-based / water-soluble paint systems. Emulsion paints, architectural paints or nitrocellulose paints must not be used, however.

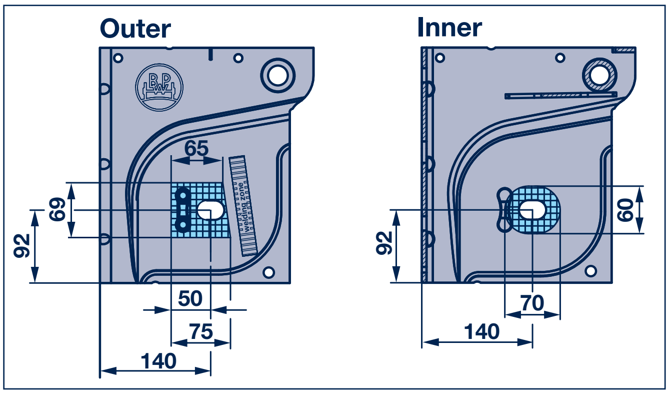
With top coats, one must remember that the following areas of the running gear have to be covered/masked in advance: Wheel contact surfaces, contact surfaces on the base plates for the drum brake cylinders and their fastening nuts, brake discs, the brake lining shaft, exciter rings, ABS sensors, contact surfaces of the disc brake cylinders (if not already attached), all contact surfaces of air suspension hanger brackets (internal and external) and the screw connection parts of the spring bolt bearings, screw elements of the absorbers and the supports of the air bag bells on the bellows supports.

The reason for this is that contact surfaces between components that are dynamically loaded and screwed together are subjected to micromovements which lead to the destruction of the paint coating and subsequent gap formation. The clamping grip may loosen as a result.

The overall coat thickness of the paint must not exceed 30 µm at the contact surfaces of the screw connection parts of the air suspension hanger brackets. In the case of hot-dip galvanised hanger brackets, the maximum coating thickness around the screw connection parts is 100 µm.

Surface treatment 14





15 Air installation data sheets

Air installation data sheets EAC

BPW provides a detailed data sheet collection regarding the air-suspension running gears offered on its website (My BPW). These data sheets describe the most efficient solutions according to technical requirements.

The table „Equipment Features“ describes the requisite usage recommendations in the categories on-road use, standard off-road use and heavy off-road use. Depending on the axle load required, the appropriate air suspension programs are immediately referred to (EAC(HD), AL II or SL).

The citing of data sheet serial numbers and lines unambiguously defines a particular air suspension version. The axle design shown with tyre recommendation indicates the common standard. Special designs requiring additional cost can be investigated upon request.

The weight tables follow a ride height-related overview. The configuration sheets are sorted according to EAC / EAC HD, brake type and size (TSB4309, TSB3709, SN4218), as well as according to air bag design (standard, long-stroke, combi air bag). The last sheets describe the axle-lifting devices.

The adjustable ride heights (vertical distance between axle centre and top edge of air suspension hanger bracket) are stated separately for individual axles (for single-axle trailers, but also for turntable drawbar trailers) and for multi-axle units. For these a larger lower ride height limit for 10 mm of additional suspension is therefore recommended.

This is required due to the possible vehicle incline (+/- 1°).

If an axle-lifting device has to be provided, set minimum ride heights must not be compromised so that sufficient lifting capability remains. „Empty without air“ describes the minimum ride height in a depressurised state of the support bellows with an empty vehicle. The „loaded without air“ ride height value is 15 mm lower with a fully laden vehicle due to the mechanical deformation of the components. The total spring deflection is determined by the air bag and describes the vertical axle path between the „empty without air“ ride height and the maximum achievable rebound.

The stated centre of gravity heights of the trailer are limited by the mechanical stresses of the running gear components. The roll stiffness of the running gear is independent of this.

Type 30 bags are operated at a higher pressure level than type 36. Quicker force development is achieved with the 36-type bags due to the lower pressure. They are therefore especially suited to applications in which there is quick lifting or lowering of the vehicle. At larger lifting heights, 36-type bags also have greater power reserves.

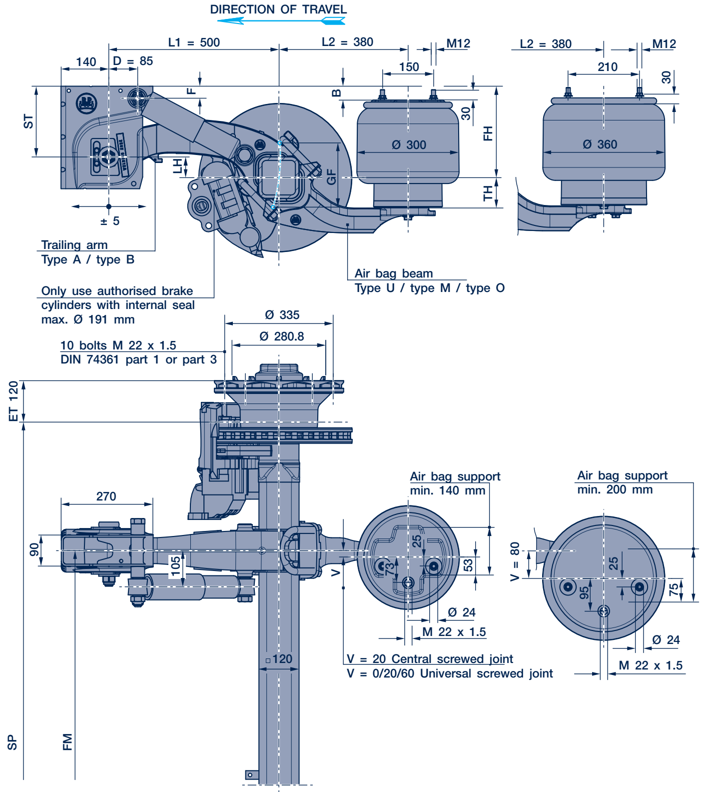
The various bag lengths (normal, K, -1) deliver spring deflections and lifting heights of varying magnitudes (190 mm, 220 mm, 260 mm in axle centre). For off-road use, larger spring deflections are always better suited for ensuring the required axle-load balancing.

Air installation data sheets 15

ECO Air COMPACT Air suspension axles with disc brake TSB 4309

Ride height 205 - 510 mm
Standard air bags

AC
Sheet 1a



Line	Serie AC..	adjustable ride height FH: for single axles	for axle units	min. FH with axle raised	empty without air	loaded without air	Total spring travel GF [1]	Air bag type BPW	Shock absorber 02.37....	Trailing arm: LH	Typ	Air bag beam: TH	Typ	Hanger bracket: ST	F	Packer B [2]
1	AU	205-255	215-255	245	145	130	190	30K / 36K	..22.79.02	60	A	155	U	205	35	0
2		235-305	245-305	275	175	160	220	30 / 36								
3	AM	245-295	255-295	285	185	170	190	30K / 36K				85	M			
4		275-345	285-345	315	215	200	220	30 / 36	..22.89.02							
5	BM	300-370	310-370	340	240	225	220	30 / 36	..22.83.02	130	B					
6	BO	330-380	340-380	370	270	255	190	30K / 36K				-10	O			
7		360-425	370-425	400	300	285	220	30 / 36								
8		390-460	400-460	430	330	315	220	30 / 36						290	67	
9		415-485	425-485	455	355	340	220	30 / 36	..22.88.02							40
10		450-510	460-510	490	390	375	220	30 / 36								100

[1] Lifting heights acc. to TD-1242.0
[2] The packer is not included in supplied package.

Axle type	Track SP	Spring centre FM	Tyres recommended	Height of centre of gravity [3]
SHBF 9010	2040	1200	385/65 R22,5 385/55 R22,5	2500
	2095	1300		2700
	2140	1400		2850

[3] Calculation reference: 0.4 g acceleration at right angles, side tilt body approx. 3.5° without taking account the tipping limit and tyre damping

- Max. inclination angle of the semitrailer under full load and lowest adjustable ride height ±1°
- Bag pressures acc. to TE-1188.0 sheet 15 (30/30K), sheet 11 (36/36K)
- The hanger brackets, air bag supports and the frame must be reinforced so that the forces applied can be absorbed. See the current BPW installation instructions.

Example name SKHBFACAU 9010 V30K

SHBF	ACAU	9010	V	30K
Axle type	Serie Air suspension	Axle type	Hanger bracket, adjustable	Air bag type

Rev. 3 (8)	05.05.2017
Subject to change without notice	

Tipping stability calculation

BPW will create a vehicle tipping stability calculation based on ECE R111 upon request. The biggest influence on the tilt angle have track width and centre of gravity height.

The calculation also takes account of the geometric running gear design (arm, anti-roll bar) and the rigidity of arms, axle beams, bellows and tyres. The result of the calculation is the lateral acceleration at the tipping limit and the attachment incline angle.

BPW EA-ECO Air COMPACT 37231902e

LLOYD'S REGISTER LRQA IATF 16949

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
Postbox 12 80 · 51656 Wiehl, Germany · Phone +49 (0) 2262 78-0
info@bpw.de · **www.bpw.de**