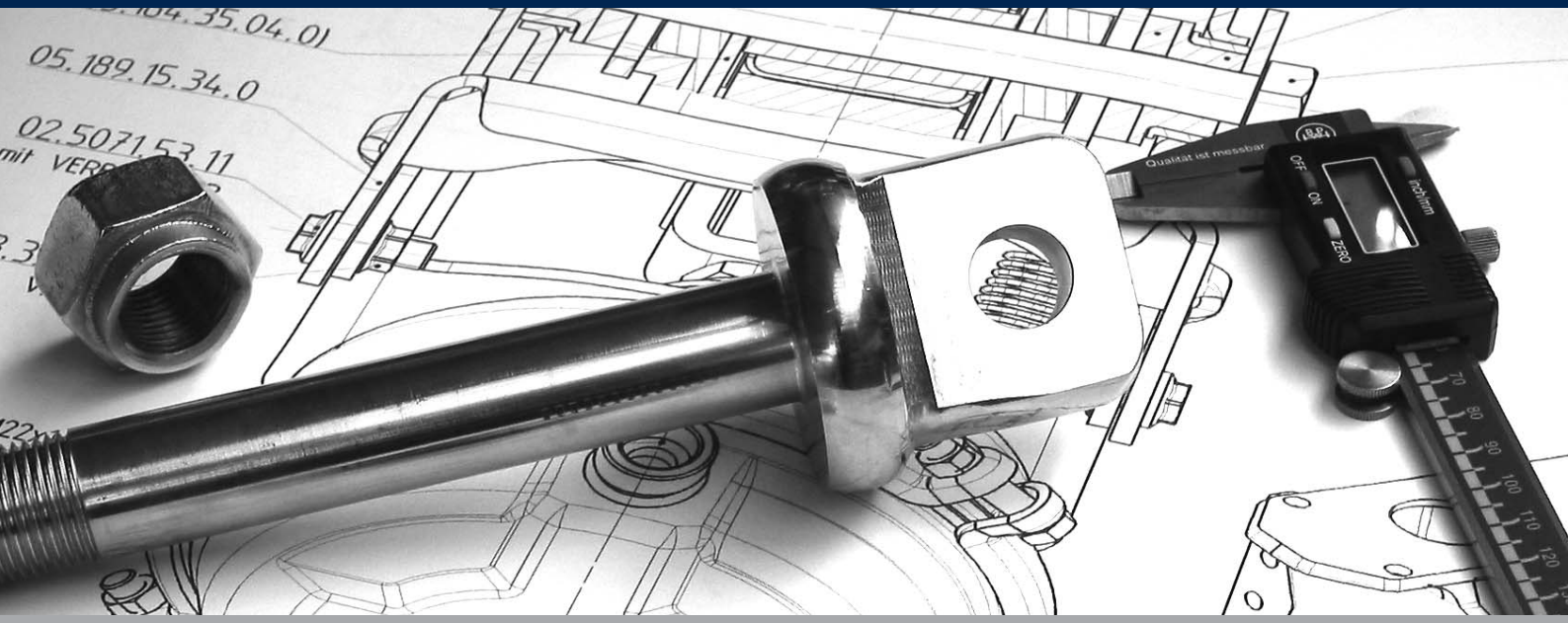
Installation instruction
Air suspension

BPW BERGISCHE ACHSEN



BPW axles with air suspension
Series O / SL / AL

O

SL

Installation instruction

AL

Overview of important changes starting from September 2007 production year!

- Steel air suspension hanger brackets from the Airlight II series are now also available in a variant that is directly bolted onto the vehicle frame. BPW is offering this complete with all necessary connection elements.

- A new two-sided axle lift is also available to suit this bolt-on hanger bracket.

- All air suspension units in the Airlight II range (weld-on steel hanger brackets, bolt-on steel hanger brackets, aluminium hanger brackets, channel crossmembers, stainless steel hanger brackets and axle lifts) get a modified spring bolt mounting with reduced spring bolt diameter (M 24 instead of M 30). The proven functional principle of the mounting with integrated track adjustment is maintained. The following components have been changed:

  - Spring bolts and lock nuts (M 24)
  - Weld-in bushes of the hanger bracket (for spring bolt M 24)
  - Wear discs (for spring bolt M 24)
  - Connecting link discs (for spring bolt M 24)
  - Disc (for spring bolt M 24)

- Air suspension units in the SL range (100 mm wide trailing arm) continue to be equipped with the M 30 spring bolt.

Content Notes

These installation instructions for BPW air suspension axles 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.

Page 10 - 13 contains a list of equations and calculation examples from BPW to assist 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).

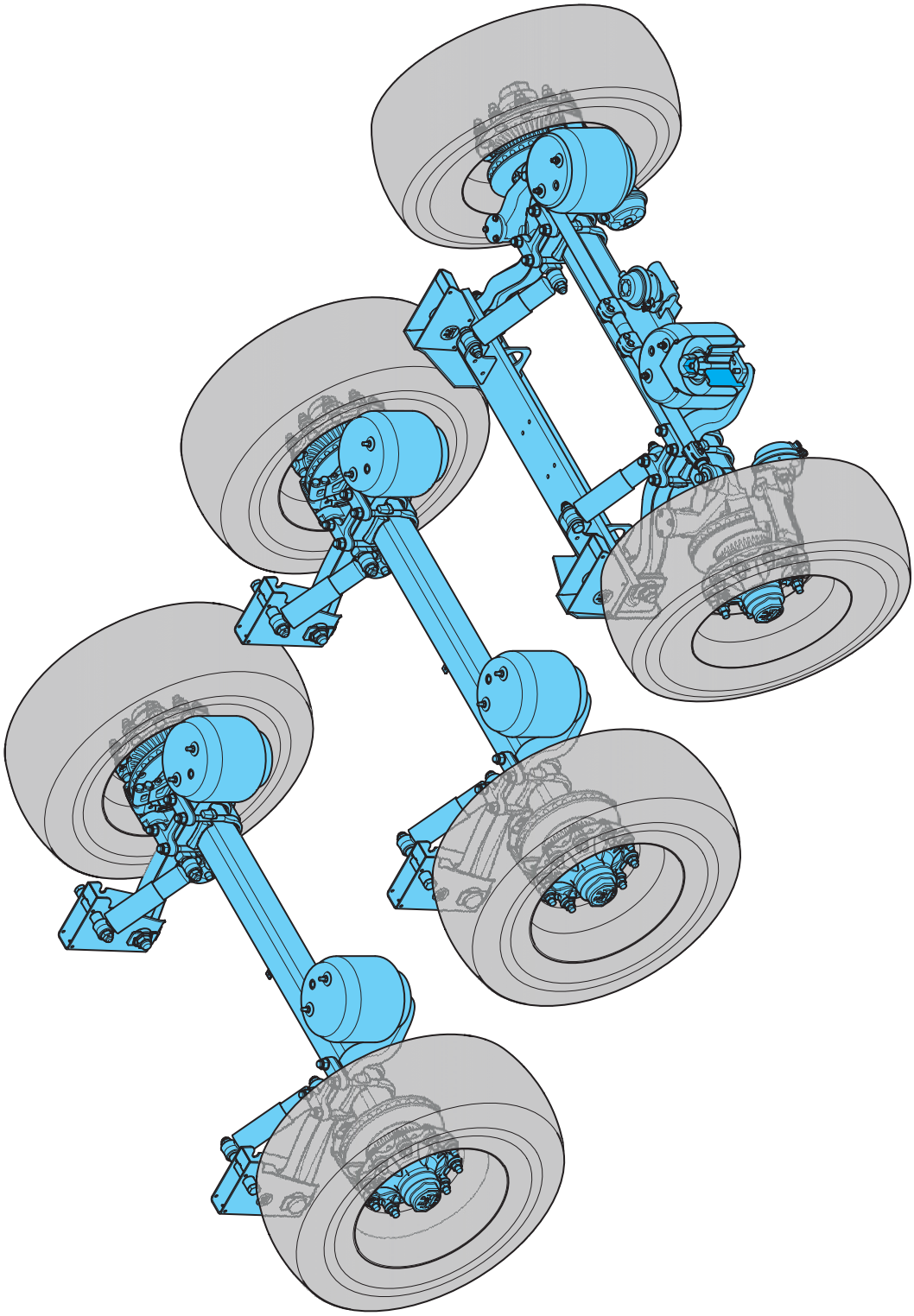
Important for all welding work!

The trailing arms, air bags and plastic pipes are to be protected against sparks and weld splashes when carrying out all welding work. The earth terminal must not be attached to the trailing arm or the hub. No welding on the trailing arms!

Status: 01.08.2007
Subject to modification!

2 Contents

3.1 Tri-axle unit with self-steering axle



General

BPW axles with air suspension can be used as single axles or as multi-axle units. The axles are connected to the vehicle chassis via trailing arms, hanger brackets and air bags.

Trailing arm

The rolled parabolic trailing arms control the tracking movements and braking forces. The U-shape configuration of axle beam and trailing arms operates as a stabilizer to counteract tilting of the superstructure during angular acceleration.

Vertical forces

The vertical forces are introduced through the hanger brackets and air bags into the vehicle chassis.

Transverse forces

The transverse forces are only introduced into the chassis through the hanger brackets. They therefore have to be reinforced to ensure that the admissible torsion loads of the chassis longitudinal member are not exceeded. To minimise the torsion stresses, the hanger brackets of the most common BPW air suspension systems are short, thus giving the transverse forces a small lever arm.

Lateral Stability

Well matched vibration dampers and trailing arms have a positive effect on lateral stability and travel comfort. The air suspension counteracts severe vibrations from the frame and roadway. This ensures a uniform wheel force on the road at all times.

Equalisation of static and dynamic axle loads

The air bags are connected to each other via air lines to ensure equalisation of static and dynamic axle loads under all operational conditions:

- uniform axle loads on uneven road surfaces and with the superstructure at a large inclination, e.g. through different fifth-wheel heights of the tractor units
- uniform braking action on all axles
- quiet running, also during braking
- uniform road adhesion and reduced locking tendency, less wear on tyres
- uniform brake cylinder sizes and lever length on all axles.

Remarks:
To guarantee good axle load equalisation, the air lines connecting the air bags must not have an internal diameter of less than Ø 8 (e.g. Ø 12 x 1.5 or Ø 10 x 1).

Raising and lowering - more flexibility

The vehicle can be raised and lowered with a switching valve / rotary slide valve to quickly attach and detach semi-trailers or to adapt to different ramp heights.

Additional acessories

Further accessories and system solutions are contained in the BPW technical documentation.

Dimensions

These installation instructions only contain general dimensions and design drawings. Your contact at BPW will be only too pleased to give you any further advice you may need.

3.2 Equipment features for BPW air-sprung running gear

BPW offers air suspension systems tailored to the application. The table on page 9 shows the equipment features recommended by BPW for the various applications.

Notes on the table:

1. Definition of on-road / off-road

On-road is defined as using a road which has a sealed and consolidated surface, i.e. asphalt or concrete surfaces. Consolidated gravel roads are taken as being off-road. Off-road operation also applies when the vehicle departs from consolidated surfaces even for short periods during the course of its operation. Off-road use is deemed to apply in all cases for vehicles registered in or driving in the national territories of Albania, Armenia, Azerbaijan, Belarus, Bosnia Herzegovina, Bulgaria, Estonia, Finland, Georgia, Iceland, Kazakhstan, Latvia, Lithuania, Macedonia, Moldavia, Montenegro, Norway, Rumania, Russia, Sweden, Serbia, Slovak Republic, Ukraine, Uzbekistan as well as for tippers and vehicles with comparable applications.

2. Features of BPW air suspension series:

2.1 AL II air suspension units (Airlight II):

- 70 mm wide trailing arms
- Axle load up to 10 t with single wheels
- With adjustable track as standard (adjustable air suspension hanger brackets)
- M 24 spring bolts (M 30 up to August 2007)

2.2 SL air suspension units:

- 100 mm wide trailing arms
- Axle load up to 14 t with HD version
- With / without adjustable track (adjustable air suspension hanger brackets or tracking plates)
- M 30 spring bolt

Note:

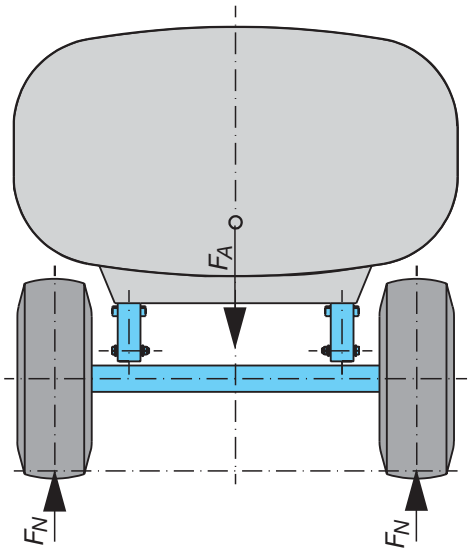
The BPW warranty only covers complete ECO Plus air suspension running gear systems that have been selected appropriately for the use in question (see table on page 9). Refer to the applicable service and maintenance regulations for more information.

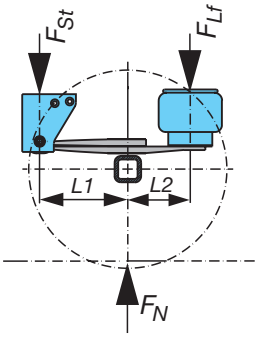
Conditions	Axle load	Air suspension series	Tyre	Spring centre	Trailing arm 70 mm	Trailing arm 100 mm	Hanger brackets	Shock absorber	Air bag	Axle beam	Axle clamping	Remarks
Standard use in Western Europe, on-road	9 t	**AL II**	S	≥ 1200	1 x 56		Standard	Standard	Ø 300 / Ø 360	120 x 10	clamped	for container and coil vehicles: check straps or quick release valves
			Z	< 1200	1 x 62					120 x 15		
	10 t		S	≥ 1100					Ø 360	120 x 15 150 x 10		
		SL	Z	< 1100		1 x 57 / 2 x 43						
	12 t		Z				Standard / HD			150 x 16		
Mega trailers (1)	9 t/ 10 t	**SL**	S / Z			1 x 58 / 1 x 60	Standard	Standard	Ø 360*	120 x 10	clamped	* = Long-stroke air bag 36-1
Eastern Europe or comparable operational conditions	9 t	**AL II**	S	≥ 1200	1 x 62		Standard	HD	Ø 360 with reinforced disc	120 x 15	clamped	
		SL	Z	< 1200		1 x 57 / 2 x 43	HD					
	10 t		S / Z							150 x 16		
Tippers (2) **Western Europe** simple applications	9 t	**AL II**	S	≥ 1200	1 x 62		Standard	Standard	Ø 300 / Ø 360 with reinforced disc	120 x 15	clamped	Check straps or quick release valves
Tippers (2) **severe heavy duty** - e.g. behind all-wheel drive tractor units	9 t	**SL**	S	≥ 1200		1 x 57 / 2 x 43	Standard / HD	Standard	Ø 360 with reinforced disc	120 x 15	clamped	Check straps or quick release valves
			Z	< 1200			HD					
	10 t		Z							150 x 16	welded	
(2) **Timber transport**	9 t	**SL**	S	≥ 1200		1 x 57 / 2 x 43	HD	Standard / HD	Ø 360 with reinforced disc	120 x 15	clamped	
			Z	< 1200								
	10 t		Z							150 x 16	welded	

S = Single tyres
Z = Twin tyres
HD = HD = Heavy duty version
(1) = On-Road
(2) = Off-Road

Axle and axle unit combinations for use outside Europe require the approval of the BPW Order Design Department.

3.3 Straight-line driving





G_A = Axle load (kg)
g_n = Acceleration due to gravity (9.81 m/s²)
F_A = Axle force (N)
F_N = Wheel force on ground (N)
$L1$ = Front trailing arm length (mm)
$L2$ = Rear trailing arm length (mm)
F_{St} = Force on hanger bracket (N)
F_{Lf} = Force on air bag (N)

Straight line travel:
(without consideration of unsprung masses)

$$F_A = G_A \times g_n$$

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

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

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

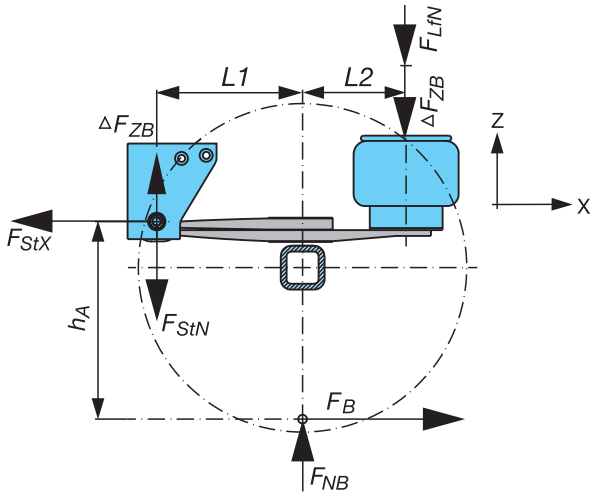
Example HSFALM 9010 30 K:

$L1$ = 500 mm
$L2$ = 380 mm
F_A = 9000 x 9.81 = 88290 N

$$F_N = \frac{88290}{2} = 44145 \text{ N}$$

$$F_{St} = 44145 \times \frac{380}{500 + 380} = 19063 \text{ N}$$

$$F_{Lf} = 44145 \times \frac{500}{500 + 380} = 25082 \text{ N}$$



F_{NB} = Wheel force on ground during braking (N)
ΔF_A = Axle load displacement when braking (N)
(Depending upon design of vehicle, particulary with drawbar trailer front axles)
F_{StN} = Hanger bracket force of wheel force on ground (N)
F_{LfN} = Air bag force of wheel force on ground (N)
F_B = Braking force (N)
z = Braking performance (%)
ΔF_{ZB} = Reaction force of braking moment (N)
h_A = Height of deflection over road surface
F_{StX} = Total force on the hanger bracket in direction “X”
F_{StZ} = Total force on the hanger bracket in direction “Z”
F_{LfZ} = Total force on the air bag in direction “Z”

Normal forces of axle load:

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

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

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

Braking force:

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

Forces of braking moment support:

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

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

$$F_{StX} = F_B$$

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

$$F_{StZ} = F_{StN} - \Delta F_{ZB}$$

Total force on the air bag in direction “Z”:

$$F_{LfZ} = F_{LfN} + \Delta F_{ZB}$$

Example HSFALM 9010 30 K:

F_A = 88290 N
ΔF_A = Zero is assumed in example

$$FNB = \frac{88290}{2} = 44145 \text{ N}$$

$$F_{StN} = 44145 \times \frac{380}{500 + 380} = 19063 \text{ N}$$

$$F_{LfN} = 44145 \times \frac{500}{500 + 380} = 25082 \text{ N}$$

z = 80 %
F_B = 0,8 x 44145 = 35316 N

h_A = 600 mm

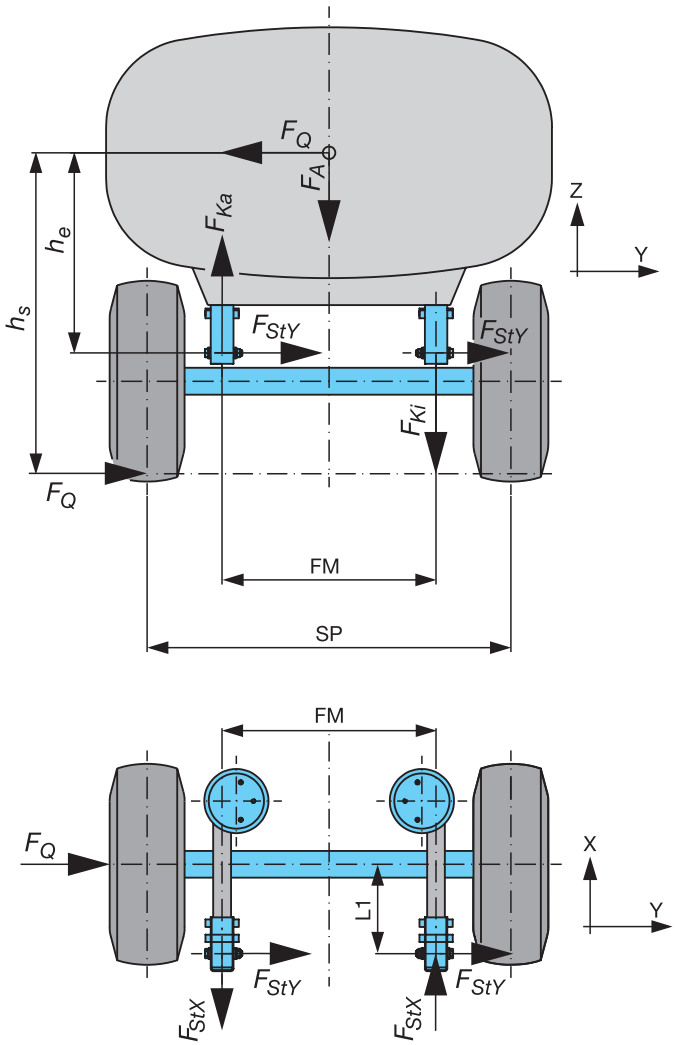
$$\Delta F_{ZB} = \frac{35316 \times 600}{880} = 24079 \text{ N}$$

F_{StX} = 35316 N

F_{StZ} = 19063 - 24079 = -5016 N

F_{LfZ} = 25082 + 24079 = 49161 N

3.5 Cornering



Point at which trailer will over-balance:
(without considering effect of springs and weight of unsprung masses proximity calculation)

$$F_Q = \frac{F_A \times SP}{h_S \times 2}$$

Hanger bracket forces:

$$F_{Ka} = \frac{F_A}{2} + \frac{F_Q \times h_e}{FM}$$

$$F_{Ki} = \frac{F_A}{2} - \frac{F_Q \times h_e}{FM}$$

$$F_{StY} = \frac{F_Q}{2}$$

$$F_{StX} = \frac{F_Q \times L1}{FM}$$

F_Q = Centrifugal force at point of over-balance (N)
F_{Ka} = Support force at bend outer side (N)
F_{Ki} = Support force at bend inner side (N)
h_S = Centre of gravity height above road surface
h_e = Centre of gravity height above trailing arm eye
F_{StY} = Lateral force on the hanger bracket
F_{StX} = Longitudinal force on the hanger bracket
F_M = Spring centre
S_P = Track width

Example HSFALM 9010 30 K:

SP = 2040 mm
FM = 1300 mm
h_S = 2000 mm
h_e = 1400 mm

$$F_Q = \frac{88290 \times 2040}{2000 \times 2} = 45028 \text{ N}$$

$$F_{Ka} = \frac{88290}{2} + \frac{45028 \times 1400}{1300} = 92637 \text{ N}$$

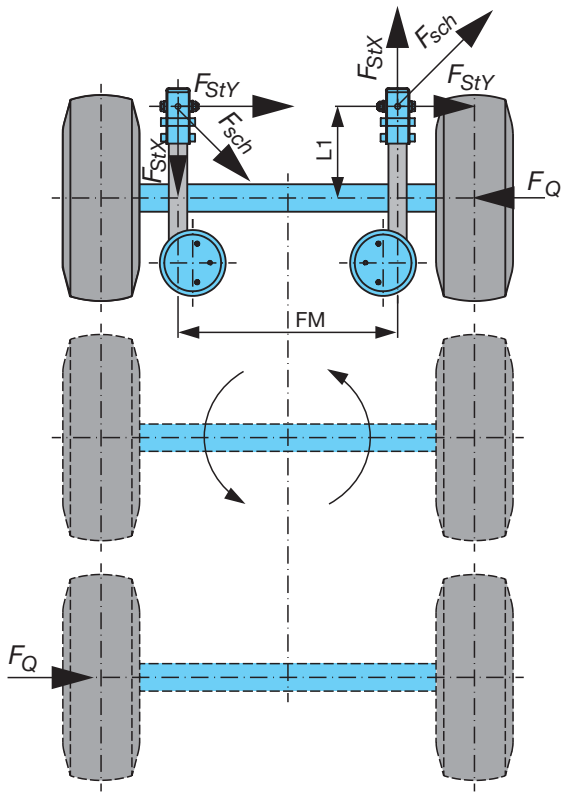
$$F_{Ki} = \frac{88290}{2} - \frac{45028 \times 1400}{1300} = -4347 \text{ N}$$

$$F_{StY} = \frac{45028}{2} = 22514 \text{ N}$$

$$F_{StX} = \frac{45028 \times 500}{1300} = 17318 \text{ N}$$

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

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



$$F_Q = F_A \times \mu_Q$$

$$F_{StX} = \frac{F_Q \times L1}{FM}$$

$$F_{StY} = \frac{F_Q}{2}$$

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 HSFALM 9010 30 K:

FM = 1300 mm
$L1$ = 500 m
F_A = 9000 x 9.81 = 88290 N
μ_Q = 1.6
F_Q = 88290 x 1.6 = 141260 N

$$F_{StX} = \frac{141260 \times 500}{1300} = 54331 \text{ N}$$

$$F_{StY} = \frac{141260}{2} = 70630 \text{ N}$$

4.1 BPW Hanger Brackets - Airlight II air suspension (examples)

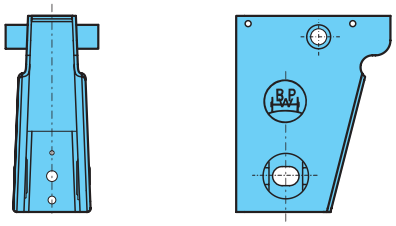
Features of Airlight II air suspension units:

- Trailing arms 70 mm wide
- Axle load up to 10 t with single wheels
- Integral track adjustment included as standard (adjustable air suspension hanger brackets, page 46)
- Loose wear discs as standard (page 27)

Modified spring bolt mounting in all Airlight II air suspension units from build year 9/2007 onwards!

Starting from the September 2007 build year, **all Airlight II air suspension** units will be equipped with a modified spring bolt mounting. The former functional principle of the mounting with integrated track adjustment is maintained in this case. The following components are modified:

- Spring bolt and nut (M 30 in M 24)
- Weld-in bushes of the hanger bracket (for Ø 24)
- Wear discs (for Ø 24)
- Connecting link discs (for Ø 24)
- Disc (for Ø 24)

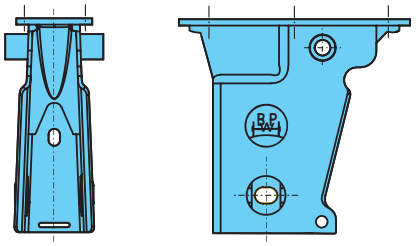


Airlight II air suspension hanger bracket

- Attached to the bottom flange by welding
- Trailing arms 70 mm wide
- Upper shock absorber attachment with bolt and lock nut
- With integrated track adjustment, spring bolt diameter M 24, (from 09/07 onwards).

Steel air suspension hanger brackets, trailing arms 70 mm wide (Airlight II air suspension)

The dimensions are given in the technical documents for each version and ride height.



Airlight II air suspension hanger bracket

- Attachment to the bottom flange by bolting with bottom boom width of 120 mm or more
- Trailing arms 70 mm wide
- Upper shock absorber attachment with bolt and lock nut
- With integrated track adjustment, spring bolt diameter M 24, (from 09/07 onwards).

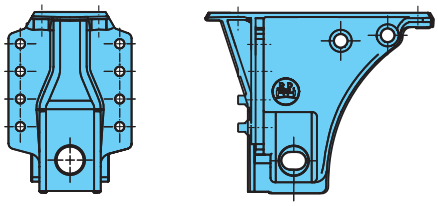
Bolted steel air suspension hanger brackets, trailing arms 70 mm wide (Airlight II air suspension)

Bolted air suspension hanger brackets are a component of the Airlight II range. Further information on the use of bolted air suspension hanger brackets can be found on page 24.

The dimensions are given in the technical documents for each version and ride height.

Remarks:

It is not permitted for the hanger brackets to be heated for straightening work. Use new spring bolts and lock nuts when renewing hanger brackets. Comply with the welding guidelines (see page 18).



Airlight II air suspension hanger bracket

- Attachment to the bottom flange by welding / bolting
- Trailing arms 70 mm wide
- Upper shock absorber attachment with bolt and lock nut
- with integrated track adjustment, spring bolt diameter M 24, (from 09/07 onwards).

Aluminium air suspension hanger brackets, trailing arms 70 mm wide (Airlight II air suspension), for axle loads up to 9 t

The aluminium air suspension hanger bracket (version A) is intended for use on aluminium tanker vehicles or aluminium bulk container vehicles.

The cast version is designed so that straightforward attachment onto the aluminium frame of the vehicle is possible by welding or bolting. The existing weld preparation ensures that optimum installation is possible.

The flange functions as a means of fastening in order to bolt on a transverse strut (see page 23).

The dimensions are given in the technical documents for each version and ride height.

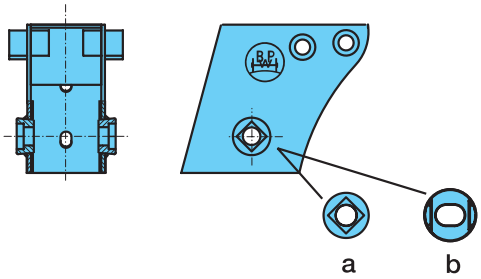
Remarks:

It is not permitted for the hanger brackets to be heated for straightening work.
Use new spring bolts and lock nuts when renewing hanger brackets.
Comply with the welding guidelines (see page 18).

4.2 BPW Hanger Brackets - SL air suspension (examples)

Features of SL air suspension units:

- Trailing arms 100 mm wide
- Axle load up to 14 t with HD version
- With / without adjustable track (adjustable air suspension hanger brackets / tracking plates, page 46 / 47)
- With / without loose wear discs (page 27)



Straight steel air suspension hanger bracket

- Attached to the bottom flange by welding
- Trailing arms 100 mm wide
- Upper shock absorber attachment with bolt and lock nut
- Without / with track adjustment (a, b), spring bolt diameter M 30.
- Suitable for welding-on drawbar connections

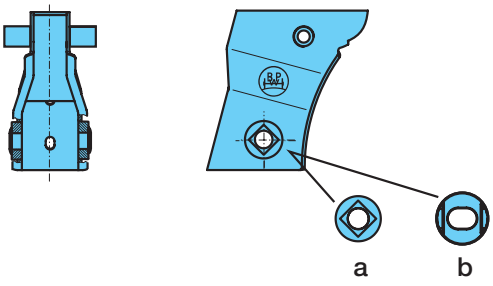
Straight steel air suspension hanger brackets, trailing arms 100 mm wide (SL air suspension)

BPW air suspension hanger brackets are rectangular in a welded or curved shape, and are supplied without a top plate as standard (version E). On request, the enclosed version with top plate (version D) is also available.

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. BPW air suspension hanger brackets are short. This means light bracing struts are possible.

The dimensions are given in the technical documents for each version and ride height. HD versions are provided for extreme conditions or axle loads above 12 t.



Narrow steel air suspension hanger bracket

- Attached to the bottom flange by welding
- Trailing arms 100 mm wide
- Upper shock absorber attachment with bolt and lock nut
- Without / with track adjustment (a, b), spring bolt diameter M 30.

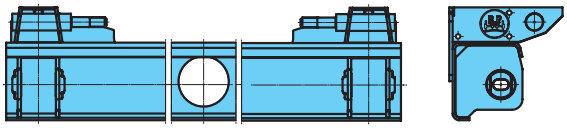
Narrow steel air suspension hanger brackets, trailing arms 100 mm wide (SL air suspension)

BPW supplies the narrow air suspension hanger bracket (version S) with integrated track adjustment (version V) on request.

The dimensions are given in the technical documents for each version and ride height.

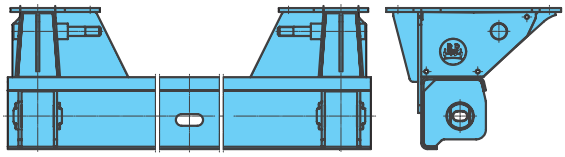
Remarks:

It is not permitted for the hanger brackets to be heated for straightening work.
Use new spring bolts and lock nuts when renewing hanger brackets.
Comply with the welding guidelines (see page 18).



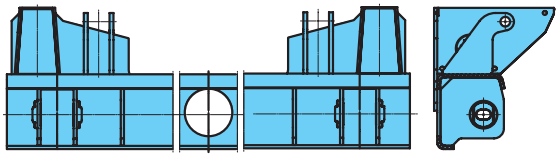
Channel crossmember for 70 mm wide trailing arms (Airlight II air suspension)

- Shock absorber attachment on the threaded bolt

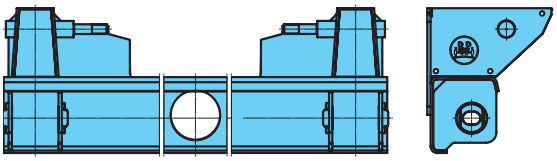


Channel crossmember (bolted-on) for 70 mm wide trailing arms (Airlight II air suspension)

- Shock absorber attachment on the threaded bolt



Channel crossmember for self-steering axles with laterally offset trailing arms (70 mm wide) incl. shock absorber mount (Airlight II air suspension).



Channel crossmember for 100 mm wide trailing arms (SL air suspension)

- Shock absorber attachment on the threaded bolt

Advantages for the vehicle builder:

Low-cost, optimum support for the forces applied to the frame.

Channel crossmember, application range up to 10 t

The open, narrow hanger brackets on the channel crossmember are 90 mm wide (80 mm in individual cases) and can also be welded onto very narrow bottom flanges. The forces applied to the channel crossmember from the wheels via the axle are absorbed by the BPW components and transmitted upwards into the frame.

There are no flexural forces which have to be channelled into the frame via gusset plates.

Depending on the frame design, it is possible to dispense with additional cross struts in the area of the suspension unit (see page 22).

The channel crossmember cannot take on the function of the upper frame reinforcement.

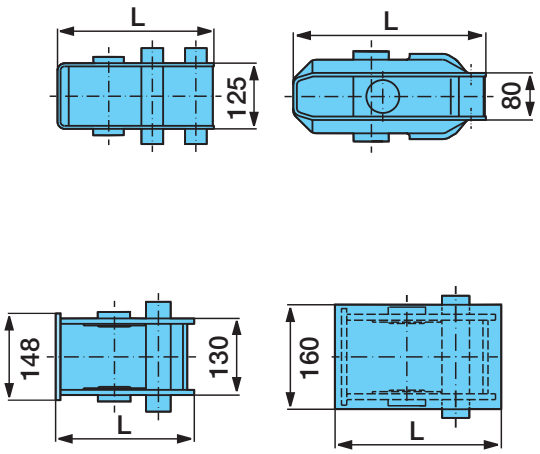
No "overhead" welds are required during installation with the vehicle on its back.

All channel crossmembers are adjustable and allow the track to be corrected.

When self-steering axles are used with laterally offset trailing arms, the shock absorbers can be secured to the channel crossmember.

The dimensions are given in the technical documents for each version and ride height.

4.4 BPW Hanger Brackets - Attachments



Steel hanger brackets / C-member

Welding method:

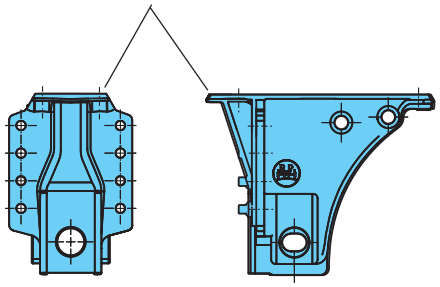
- Inert gas welding
  Weld wire quality G 4 Si 1 (DIN EN 440)
- Manual arc welding
  Rod electrodes E 46 2 (DIN EN 499)

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.

All-round weld preparation



Aluminium hanger brackets

Welding method:

- MIG or TIG welding

  Similar additive material Al Si 5

  Clean thoroughly prior to welding, e. g. P 3 - T 768, material No. 25-109

  temperature approx. 50 - 60°C.

  Recommendation: Pre-heat to approx. 100-150°C.

  Weld thickness a 8 ◺ (DIN EN ISO 10042)

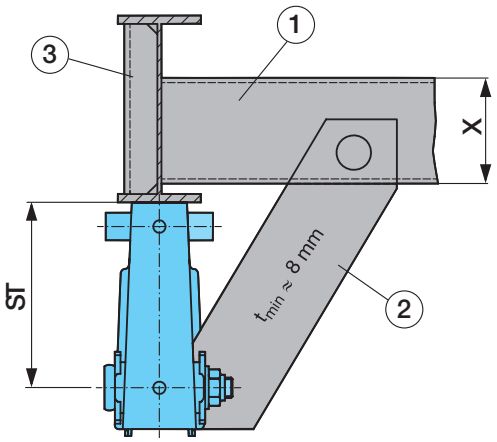
The air suspension hanger brackets can be bolted to the frame if required.

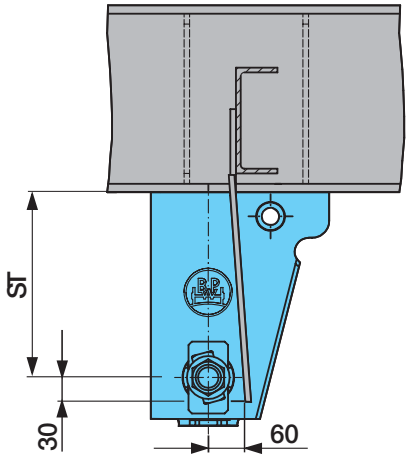
To reduce the torsional stress on the vehicle frame, the air suspension hanger brackets must be reinforced according to the forces that will be applied (see drawing C-04.00.501516).

Remarks:

The trailing arms, air bags and plastic piping should be protected against sparks and weld splashes during all welding work. The earth terminal must under no circumstances be attached to the trailing arm or hub.
It is not permitted to heat the air suspension hanger brackets for alignment work.

Example of reinforcing a vehicle frame that is subject to longitudinal torsion (tilt trailers, curtainsiders etc.) with taper mounted hanger bracket.





1 Crossmembers

The developed forces when travelling around bends are transmitted via the hanger brackets and gusset plates as bending forces to the crossmembers or C-member. The crossmember must have adequate dimensions particularly regarding dimension X.

Crossmembers with torsional flexibility and of adequate bending values (Wx) should be used.

Torsionally stiff sections should be avoided as crossmembers (risk of tearing at the welded connections).

2 Gusset plates

The lateral forces are channelled into the crossmember via the bracing plates as compressive and tensile stress. The lateral forces are channelled into the frame starting from the spring bolt (ST), therefore the bracing plate must be continued in the rearward direction of travel to 30 mm below the middle of the spring bolt.

A possible diaphragm action should be prevented by overlapping the gusset plate and inner web plate.

The welding of the hole in the gusset plate in the illustration is solely a recommendation, not a stipulation.

3 Vertical profiles

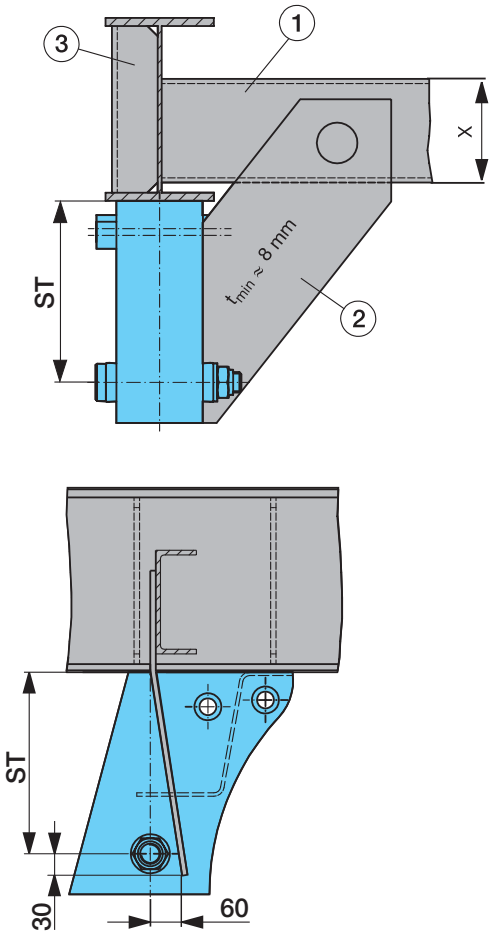
If relatively thin main beam web profiles are used, a vertical profile needs to be incorporated to reinforce the frame in the area of the hanger bracket.

Remarks:

With vehicle frames that are subject to torsion, an elastic and torsional reinforcement of the air suspension hanger brackets is necessary.

4.5.2 Struts / SL air suspension

Example of reinforcement to a vehicle frame that is subject to longitudinal torsion (tilt trailers, curtainsiders etc.) with standard hanger bracket.



1 Crossmembers

The developed forces when travelling around curves are transmitted via the hanger brackets and gusset plates as bending forces to the crossmembers or C-member. The crossmember dimensions must be suitable for the application, particularly dimension X.

Crossmembers with torsional flexibility and of adequate bending values (Wx) should be used.

Torsionally stiff sections should be avoided as crossmembers (risk of tearing at the welded connections).

2 Gusset plates

The lateral forces are channelled into the cross member via the bracing plates as compressive and tensile stress. The lateral forces are channelled into the frame starting from the spring bolt (ST), therefore the bracing plate must be continued in the rearward direction of travel to 30 mm below the middle of the spring bolt.

A possible diaphragm action should be prevented by overlapping the gusset plate and inner web plate.

The welding of the hole in the gusset plate in the illustration is solely a recommendation, not a stipulation.

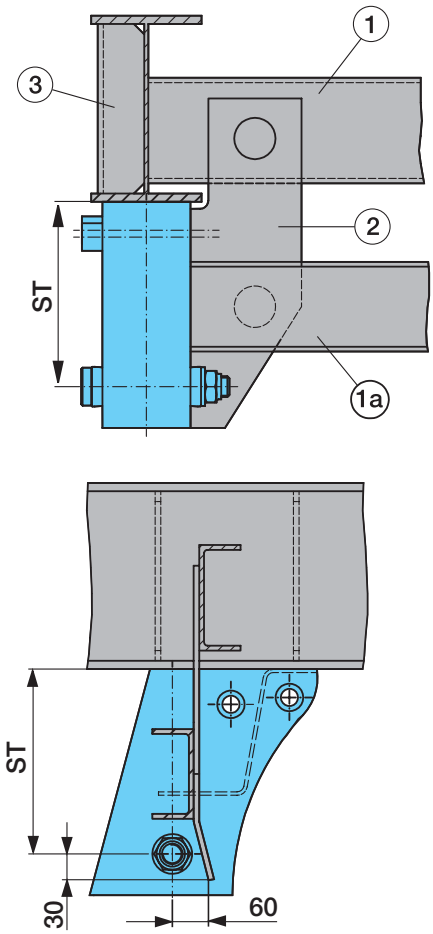
3 Vertical profiles

If relatively thin main beam web profiles are used, a vertical profile needs be incorporated to reinforce the frame in the area of the hanger bracket.

Remarks:

With vehicle frames that are subject to torsion, an elastic and torsional reinforcement of the air suspension hanger brackets is necessary.

Example of reinforcing a vehicle frame that is torsionally stiff. (Road tankers, bulk powder tankers, vans) with normal hanger bracket



1/1a Crossmembers

The developed forces when travelling around curves are transmitted via the hanger brackets and gusset plates as bending forces to the crossmembers or C-member. The bending forces from the hanger brackets are partly counteracted by the crossmember 1a.

The gusset plates counteract torsional forces in the vehicle frame. Both crossmembers can therefore be designed with smaller dimensions (Wx).

2 Gusset plates

The lateral forces are transmitted via the gusset plates as compressive / tensile loads to the crossmember. As the lateral forces from the spring pivot bolt are transmitted to the frame (ST), the gusset plate needs to be continued to the bottom edge of the hanger bracket.

Attachment at spring pivot bolt centre is desirable.

A possible diaphragm action should be prevented by overlapping the gusset plate and inner web plate.

3 Vertical profiles

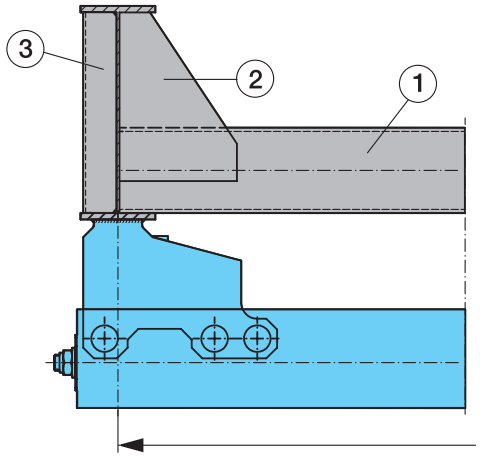
If relatively thin main beam web profiles are used, a vertical profile should be incorporated to reinforce the frame in the region of the hanger bracket.

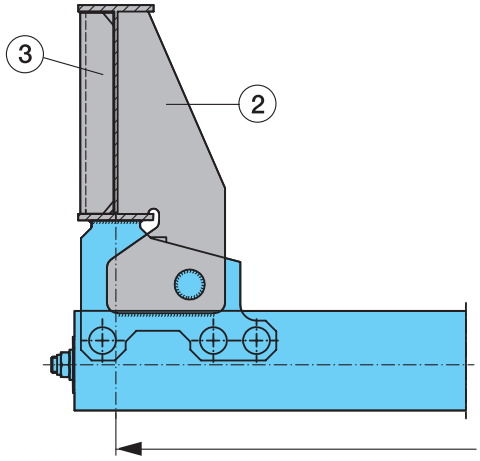
Remarks:

With vehicle frames that are torsionally stiff, the reinforcement of the air suspension hanger brackets can also be rigid and torsionally stiff.

4.5.4 Struts / channel crossmember

Example of reinforcing a vehicle frame that is subject to longitudinal torsion (tilt trailers, curtainsiders etc.) with C-member.





1 Crossmembers

The transverse forces which arise during cornering are absorbed within the C-member structure. The frame end deformations occurring in vehicle frames subject to torsion have to be absorbed by the frame crossmembers. The crossmember should have sufficient dimensions particularly (Wx).

Crossmembers with torsional flexibility and of adequate bending values (Wx) should be used.

Torsionally stiff sections are to be avoided as crossmembers (risk of tearing at the welded connections).

2 Gusset plates

The transverse forces and frame end deformations occurring during cornering are directed via the gusset plates into the C-member structure. In order to ensure good adhesion with the frame, the gusset plate must be extended to the top flange and welded onto the bottom and top flanges.

The preferred method of attachment to the C-member is on the face end using a plug weld.

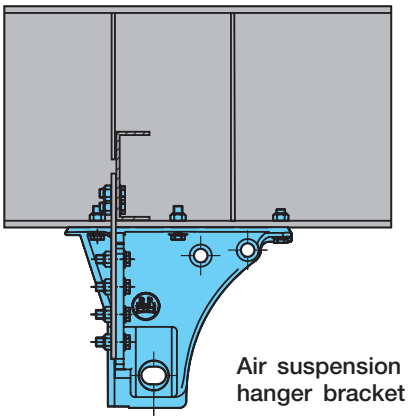
3 Vertical profiles

If relatively thin main beam web profiles are used, a vertical profile should be incorporated to reinforce the frame in the region of the hanger bracket.

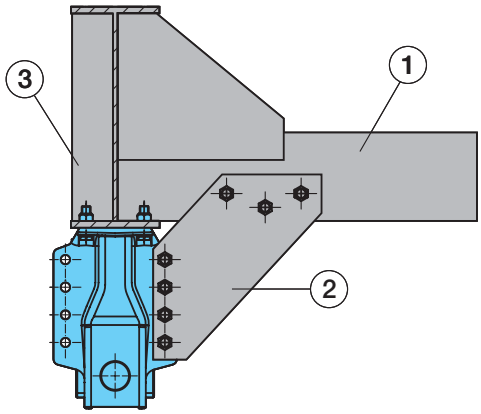
Remarks:

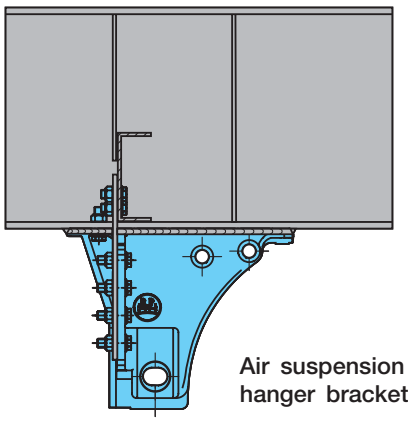
With vehicle frames that are subject to torsion, an elastic and torsional reinforcement of the air suspension is necessary.

Example of struts in welded / bolted aluminium air suspension hanger brackets with torsionally rigid vehicle frame in the longitudinal direction (aluminium frame in self-supporting vehicles).



Air suspension bolted hanger bracket





Air suspension welded hanger bracket

1 Crossmember

The lateral forces that occur during cornering are carried by the hanger brackets and bracing plates as a flexural load and channelled into the crossmember and/or channel crossmember. The size of the crossmember must be of a sufficient size (Wx).

2 Bracing plates

A substantial bracing plate corresponding to the hanger bracket height must be bolted on at both sides between the hanger bracket flange and crossmember. The bracing plate should extend from the head of the hanger bracket to the bush of the spring bolt mounting. All bolted connections of the hanger bracket to the vehicle frame and to the bracing plate must be made using M16 8.8 hexagon bolts with flange according to DIN EN 1665.

3 Vertical sections

When the bottom flange sections of the longitudinal member are relatively thin, a vertical profile must be attached in the area of the hanger bracket in order to stiffen the frame.

Remarks:

In torsionally rigid vehicle frames, the struts for the air suspension hanger brackets can be made with a corresponding level of stiffness.

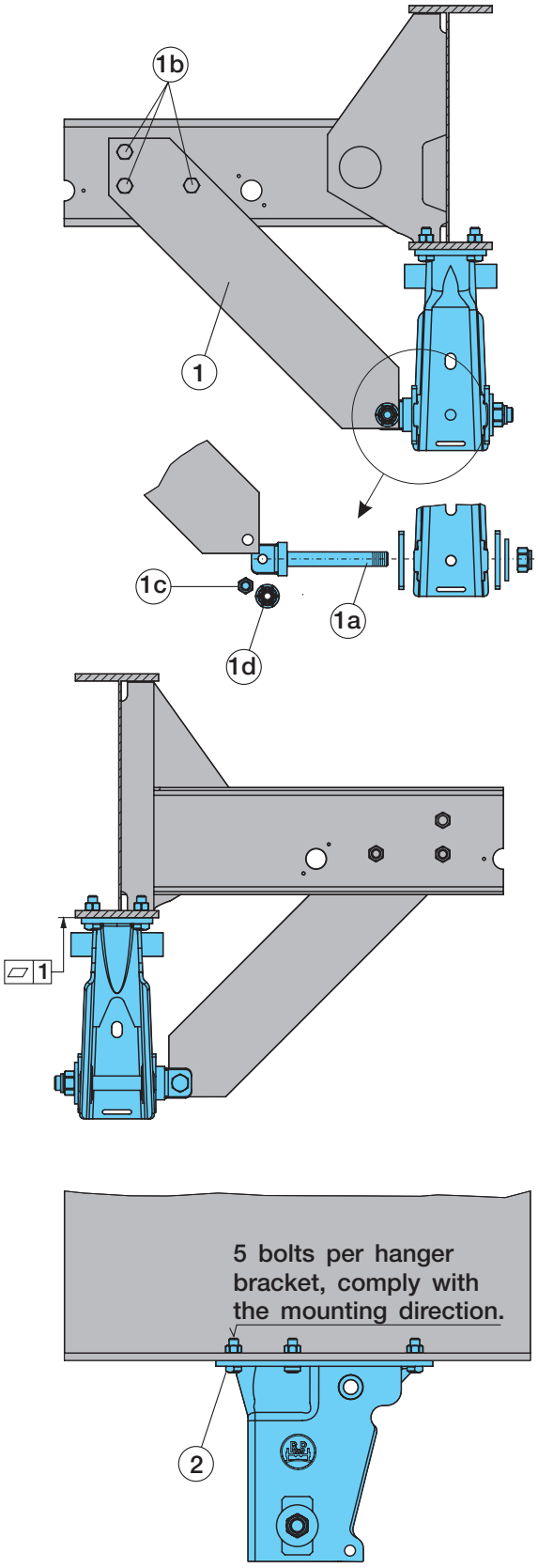
When the bottom flanges are exposed to flexural loadings, it is not permitted for the aluminium air suspension hanger brackets to be welded on!

See also page 18 for welding information.

Other details can be seen in the drawing C-04.000.501516.

4.5.6 Struts / bolted steel air suspension hanger brackets

Example of struts in bolted steel air suspension hanger brackets.



General

With the new, bolted Airlight II air suspension hanger bracket, BPW is offering the opportunity of prefabricating compact vehicle frames without air suspension hanger brackets, coating them and not assembling them to the complete axle unit until the final assembly stage. The actual configuration is only defined when it comes to mounting the suspension units. The bolted system therefore offers the vehicle manufacturer logistical advantages and increases flexibility in production.

1, 1a, 1b Bracing plate screw connections

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

Hole in the crossmember: Ø 16 mm

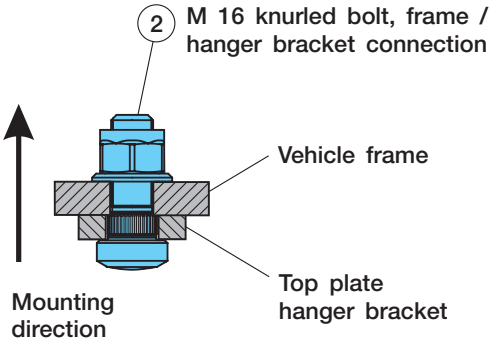
Hole in the bracing plate: Ø 18 mm

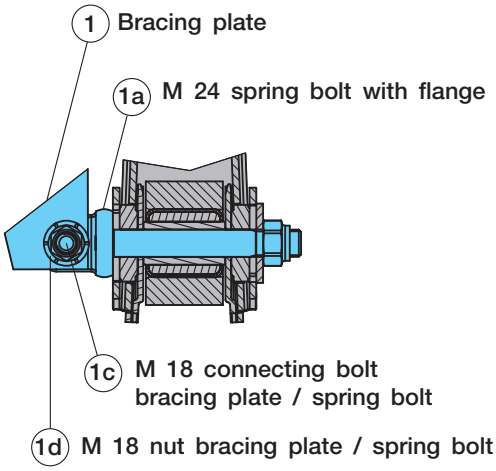
2 Hanger bracket bolt connections

Each of the hanger brackets is secured onto the vehicle frame with 5 knurled bolts (comply with the mounting direction!). The knurling on the bolts serves as a torsion lock. In addition, the special bolts have a flattened area on their head so they can be mounted directly adjacent to the hanger bracket. The flatness of the longitudinal member must be max. 1 mm in the hanger bracket area. Other details can be seen in the drawing C-04.00.509610.

Remarks:

The torsion lock for the screw connection is achieved using the flange of the spring bolt, therefore the bolt must always be attached to the frame of the vehicle using a bracing plate.





Mounting sequence with bolted air suspension hanger brackets:

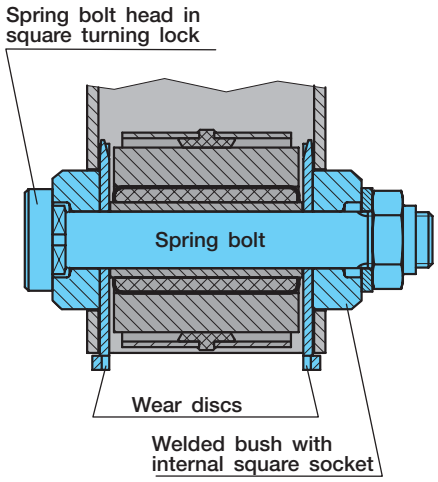
1. Bolt the hanger bracket onto the vehicle frame using M 16 knurled bolts. Tightening torque 260 Nm (240 - 285 Nm).
2. Pre-mount the spring bolt loosely.
3. Pre-mount the bracing plate with at least three M 16 10.9 bolts (top) and an M 18 bolt (bottom). Pre-mount the corresponding nuts.
4. Tighten the M 18 connecting bolt (bracing plate-spring bolt) to approx. 50 Nm.
5. Tighten the M 24 spring bolt loosely until all components have been brought into contact.
6. Set the track.
7. Tighten the M 24 spring bolt. Tightening torque 650 Nm (605 - 715 Nm).
   Do not use an impact driver!
8. Tighten the M 18 connecting bolt (bracing plate-spring bolt). Tightening torque 420 Nm (390 - 460 Nm)
9. 9. Tighten the top connecting bolts M 16, 10.9 (bracing plate/crossmember) to the max. permitted tightening torque (not supplied by BPW).

Remarks:

Tracking is established in the usual way and does not require any additional tools.

Contact surfaces for bolted connection parts:
- Coat thickness for painting, max. 30 µm,
- coat thickness for hot-dip galvanising max. 100 µm.

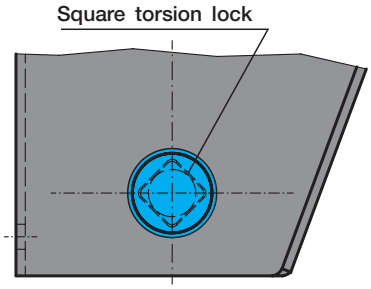
5 Spring bolt mountings



Spring bolt mounting - rigid hanger brackets M 30

In BPW air suspension axles fitted with non-adjustable hanger brackets, the head of the spring bolt is secured in a square recess to prevent turning. The spring bolt should be mounted from the outside (wheel side) towards the inside.
Use the washers shown in the figures during mounting.

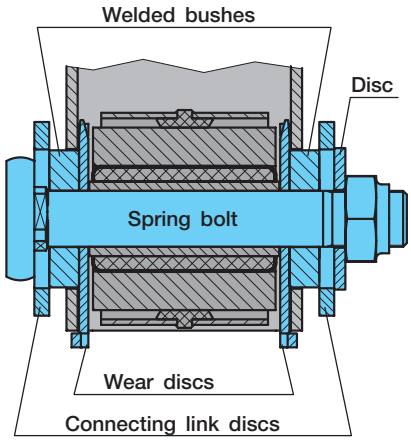
Tightening torques, see last page.



Modified spring bolt mounting in all Airlight II air suspension units from build year 9/2007 onwards!

From the September 2007 build year onwards, all Airlight II air suspension units will be provided with a modified spring bolt mounting. The former functional principle of the mounting with integrated track adjustment is maintained in this case. The following components are modified:

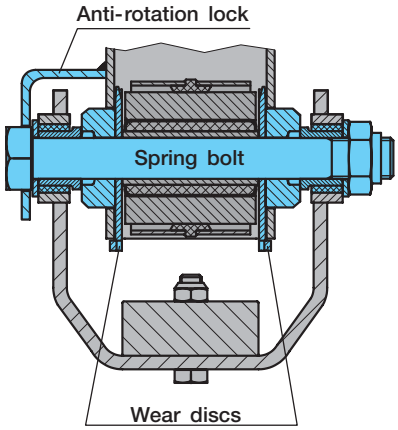
- Spring bolt and nut (M 30 to M 24)
- Welded bushes in the hanger bracket (for Ø 24)
- Wear discs (for Ø 24)
- Connecting link discs (for Ø 24)
- Disc (for Ø 24)



Spring bolt mounting - adjustable hanger brackets M 24 / M 30

In BPW air suspension hanger axles fitted with adjustable hanger brackets, the head of the spring bolt is secured to prevent it from turning by means of a square profile in the connecting link disc. The spring bolt should be mounted from the outside towards the inside. When mounting, use the washers and connecting link discs shown in the figures. Make sure that the correct wear discs are used (see page 27).

Tightening torques, see last page.

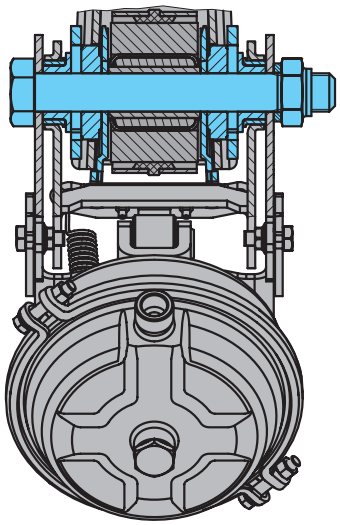


Make sure there is sufficient clearance between the axle lift and tyres!

Spring bolt mounting - single-sided axle lift devices

In BPW air suspension axles with a single-sided axle lift device, the head of the spring bolt is prevented from turning by a shaped plate welded onto the hanger bracket. The spring bolt should be mounted from the outside (wheel side) towards the inside. Use the washers shown in the figures during mounting.

Tightening torques, see last page.



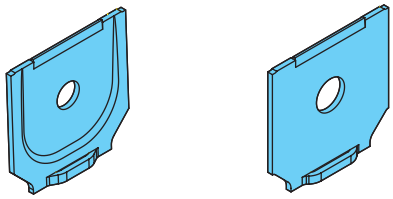
Spring bolt mounting - two-sided lift for welded hanger brackets

Use the washers shown in the figures during mounting.

Tightening torques, see last page.

Remarks:

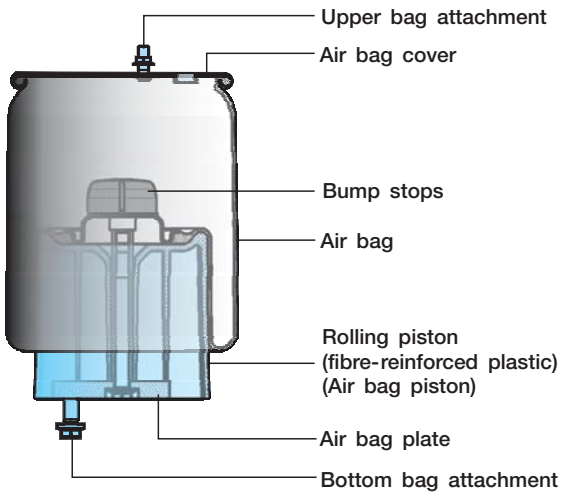
The various designs (and different spring bolt diameters) in Airlight II steel hanger brackets and Airlight II channel crossmembers mean there are different types of wear disc. Wear discs with an impression are required for hanger brackets with angled side walls. Wear discs without an impression are used for hanger brackets and channel crossmembers with perpendicular side walls!



With impression Without impression

A max. paint coat thickness of 30 µm in the area of the bolt contact surfaces must not be exceeded!

6.1 Air bag



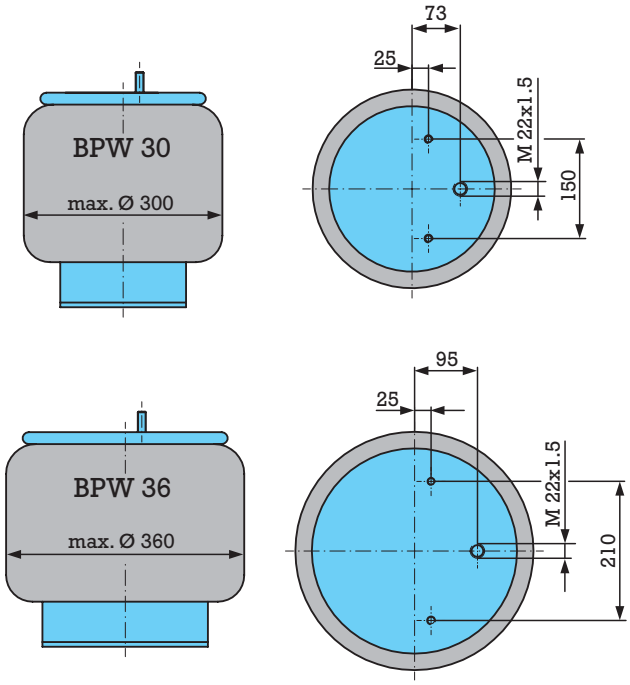
BPW air bags are firmly rolled into the top air bag cover and are bonded onto the clamping plate at the bottom by vulcanisation.

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. The air bag piston at the bottom is bolted onto the trailing arm using two M16 securing bolts.

Tightening torques, see last page.

The maximum lateral offset between the top and bottom attachment must not exceed 10 mm. The top and bottom bag attachments must not be installed with any rotational misalignment.

The clearance between the air bag and tyres or the brake cylinder with the maximum bag diameter should be min. 30 mm.



Designs:

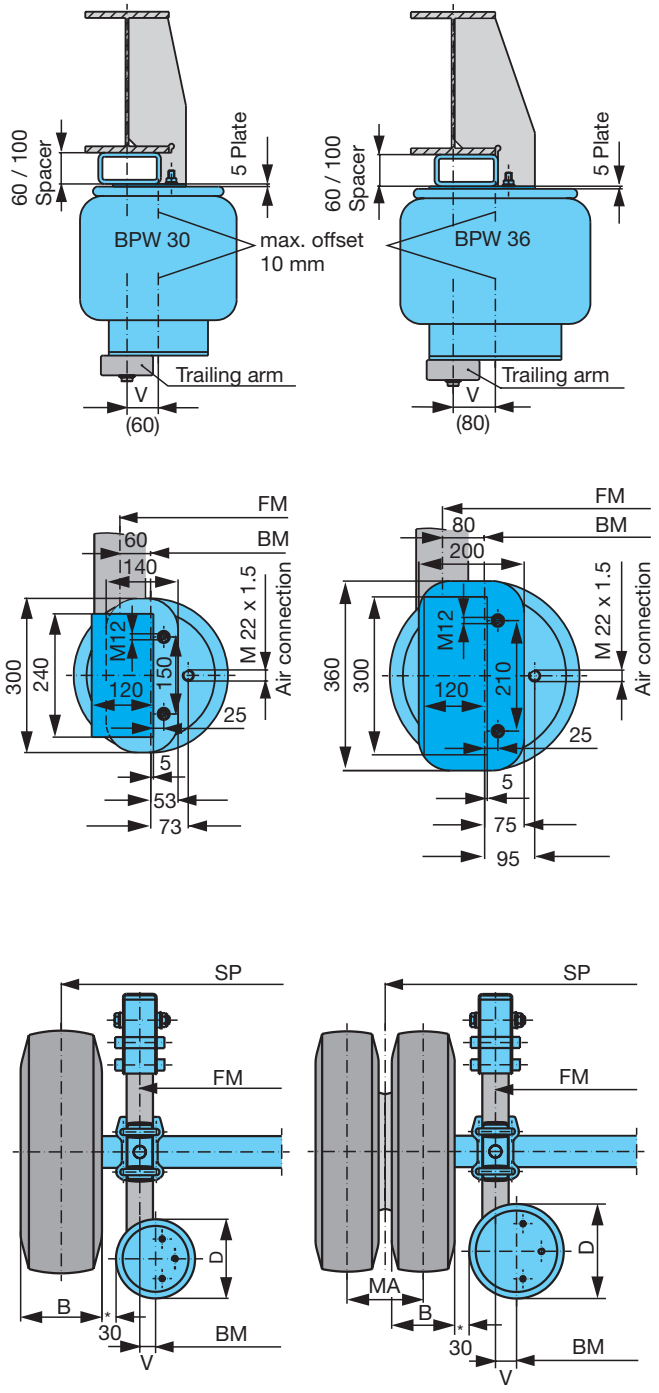
a:
- BPW 30 for 200 mm stroke at axle centre
- BPW 30 K for 180 mm stroke at axle centre

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 (series)

b:
- BPW 36 for 200 mm stroke at axle centre
- BPW 36-1 for up to 340 mm stroke at axle centre
- BPW 36-5 for up to 380 mm stroke at axle centre
- BPW 36-2 for up to 450 mm stroke at axle centre
- BPW 36 K for 180 mm stroke at axle centre

Diameter max. 360 mm at approx. 5 bar
Air bag specific pressure
0.000156 bar / N (at ride height)
Bag offset V = 80 mm (series)
V = 45 mm

Air bags with a reinforced base plate must be used for tipper vehicles!



* 30 mm is minimum dimension

With spacer

Air bag top plates with a spacer can be welded to the bottom flange allowing the air bag to be offset.

For dimensions of the spacer, see technical documentation.

The maximum lateral offset between the upper and lower attachments must not exceed 10 mm.

General

With offset air bags, bending forces become significant which have to be reacted by gusset plates welded into the main beam.

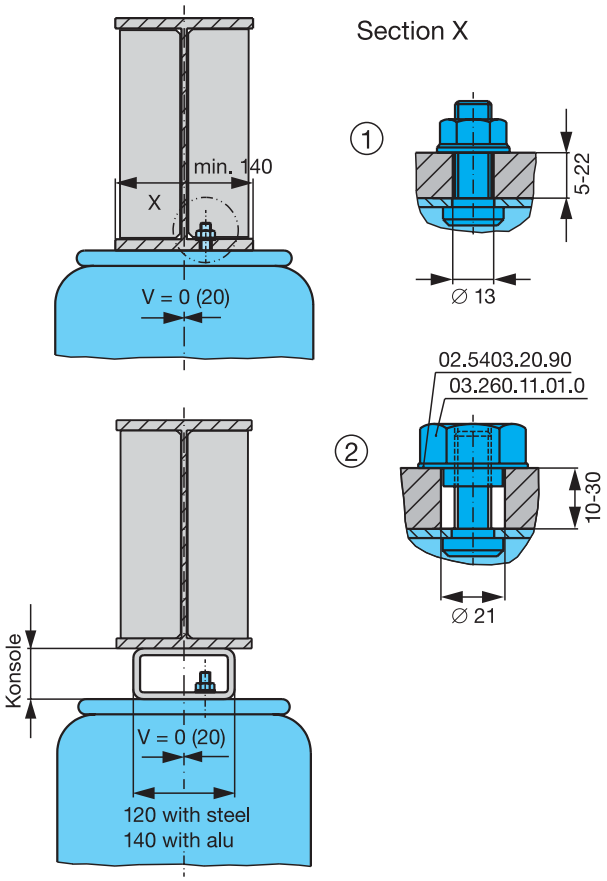
The necessary free movement of the air bag must be checked when establishing the design and the air bag offset.

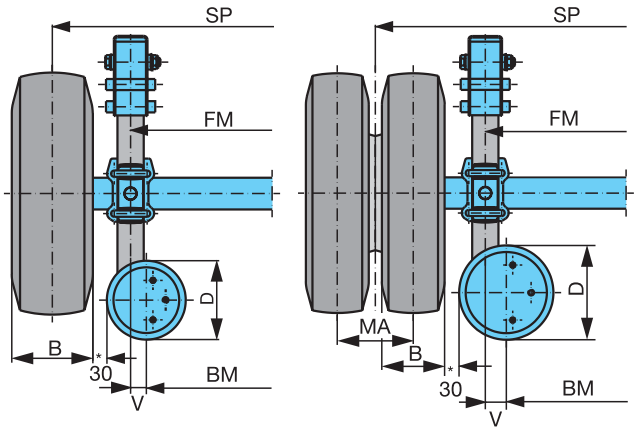
SP = Track on the ground
FM = Trailing arm centre
BM = Air bag centre
D = Air bag diameter
(∅ 300 with BPW 30, 30 K)
(∅ 360 with BPW 36, 36-1, 36 K)
V = Air bag offset
(60; 80 mm as per design)
B = Tyre width
(consider wheel rim width)
MA = Distance between wheel rim centres

Remarks:

The gap between the air bag and tyres or brake cylinder should be at least 30 mm with the maximum air bag diameter.

6.3 Air bag at frame centre (in-line)





* 30 mm is minimum dimension

Without spacer

When installing air bags without a spacer at frame centre (V = 0 or V = 20), the bottom flange of the vehicle frame should be drilled to accommodate M 12 bolt (Fig. 1).

The air bag top plate support area should be at least 140 x 200 mm (BPW 30). If the frame width is less than 140 mm, a standard plate can be installed between the frame and the air bag top plate. If the lower member thickness exceeds 22 mm, shaft nuts with spring washers are to be used. Drill hole Ø 21 mm (Fig. 2).

With spacer

The spacer is welded to the frame bottom flange. The air bag top plate can then be bolted to the spacer.

The spacer dimension can be seen in the technical documentation.

General

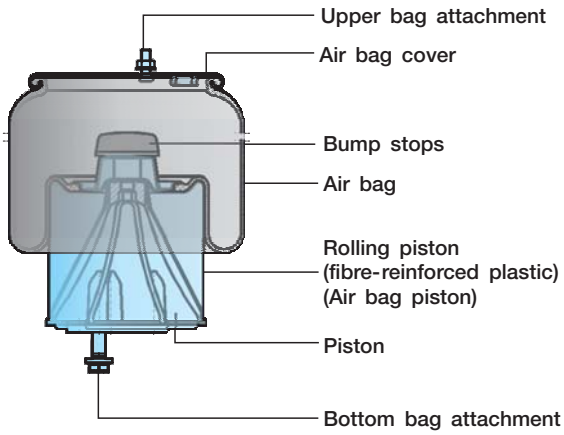
With air bags at frame centre, air bag offset V = 0, there are no generated bending forces, and only minor bending forces with air bag offset V = 20.

The necessary unrestricted motion of the air bag is to be ensured when determining the design and air bag offset.

SP = Track on the ground
FM = Trailing arm centre
BM = Air bag centre
D = Air bag diameter
(∅ 300 with BPW 30, 30 K)
V= Air bag offset
(0; 20 mm as per design)
B = Tyre width
(consider wheel rim width)
MA = Distance between wheel rim centres

Remarks:

The gap between the air bag and tyres or brake cylinder should be at least 30 mm with the maximum air bag diameter.



Split Piston

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

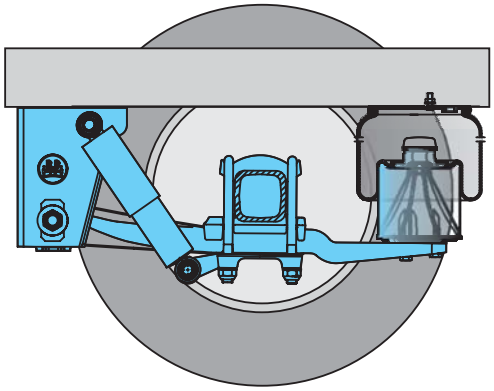
The functional principle is simple. The trailing arms and the air suspension airbags are in two parts: The trailing arms have a conical adapter, and the air bags have a special piston.

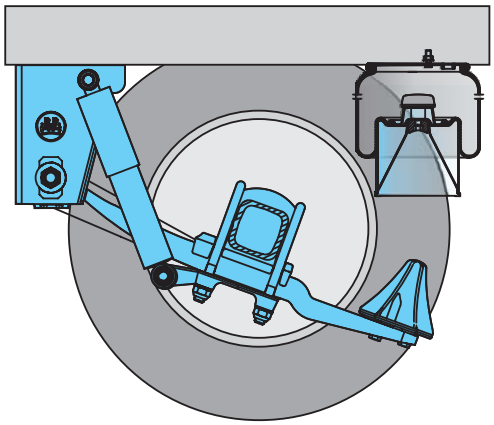
If the vehicle is raised after the air is exhausted from the suspension, the axles move downwards. The air bags remain in the rest position, the trailing arms with the adapter move downwards.

When the vehicle is lowered to the ground, the air suspension unit recombines 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.



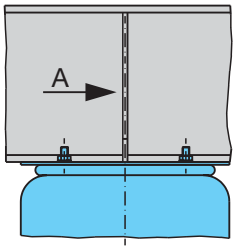


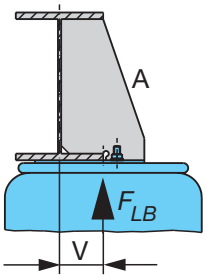
Remarks:

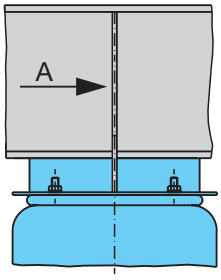
The shock absorber acts as an end stop in this configuration, therefore it is necessary to ensure that shock absorbers with a corresponding length and loading capacity are installed.

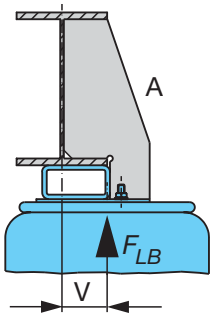
Split air bags are available as BPW 30 K or BPW 30.

6.5 Installing







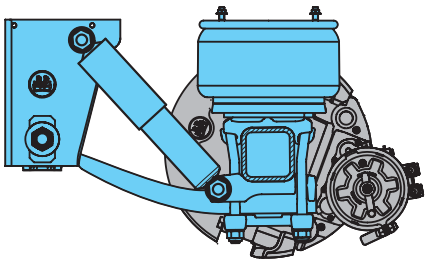


The air bag offset must be considered. The bending forces (Mb) generated by the offset (V) must be counteracted by adequate gusset plates or crossmembers.

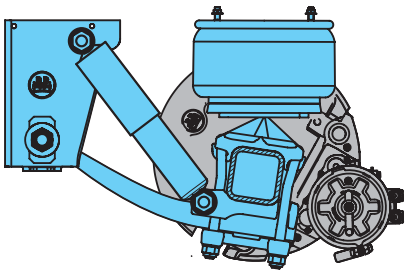
Bending moment from air bag $M_{bLB} = F_{LB} \times V$

BPW 30	BPW 36
BPW 30:	BPW 36:
Specific air bag pressure	Specific air bag pressure
0.00023 bar/N	0.000156 bar/N
(at ride height)	(at ride height)
$F_{LB} = \frac{p}{0.00023}$ (N)	$F_{LB} = \frac{p}{0.000156}$ (N)
V = 60 mm	V = 80 mm

F_{LB} = Force of air bag (N)
p = Air bag pressure (bar)
V = Air bag offset



Combination air bag joined



Combination air bag separated

General

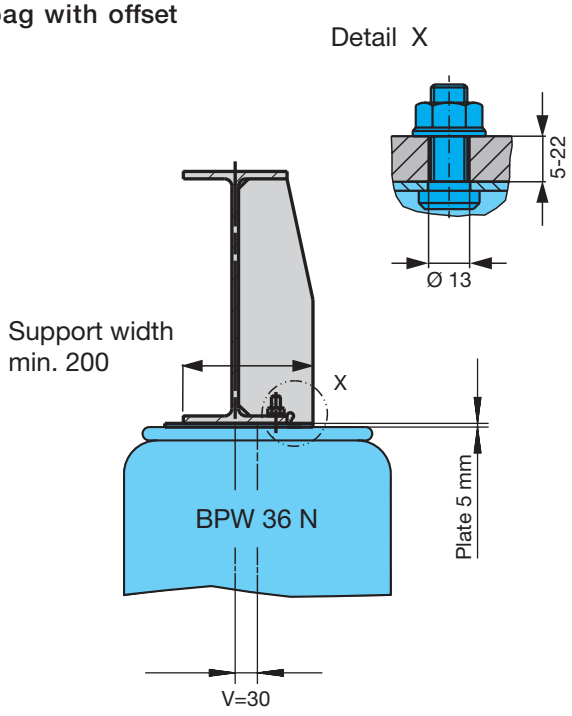
The Airlight^{Direct} unit is particularly well suited to intermodal transport because it is equipped with an integrated split air bag as standard. In addition, it is characterised by a high level of comfort and low weight.

With **conventional air suspensions** the axle load is distributed partly through the air bag and partly through the hanger bracket. The proportion through each is determined by the ratio of the trailing arm.

In the **new Airlight^{Direct} air suspension** system from BPW, the air bag is located directly above the axle, so that the air bag absorbs 100 % of the axle load. This adds up to a comfortable suspension, combined with low superstructure acceleration values.

Airlight^{Direct} is fitted with air bags that have a split piston as standard. Automatic separation and joining of the axle and air bag means there is no risk of the bags creasing and therefore becoming damaged in the course of railway or ferry transshipment.

Air bag with offset

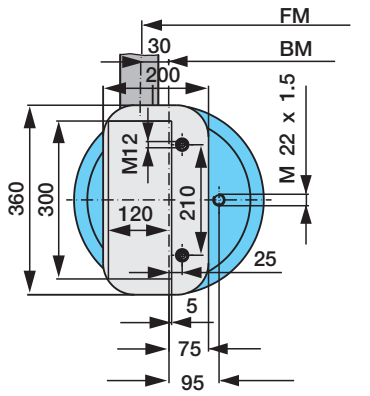


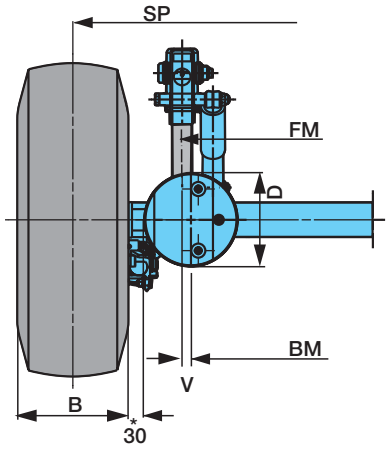
Witout spacer

When installing the air bag (V = 30), drill through the bottom flange of the vehicle frame in order to accommodate the M 12 fixing bolt (Detail X).

In order to support the airbag, the bottom flange width should be at least 200 mm. If it is less, a plate must be installed between the frame and the top plate of the bag.

6.6 AirlightDirect





∗ 30 mm is minimum dimension

General

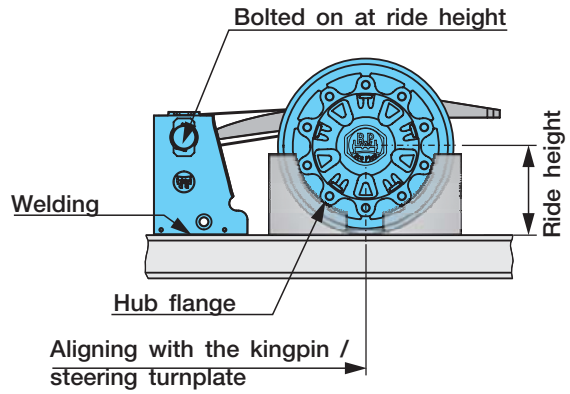
With offset air bags, bending forces become significant which have to be reacted by gusset plates welded into the main beam.

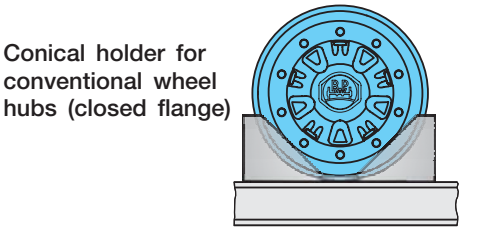
The necessary free movement of the air bag must be checked when establishing the design and the air bag offset.

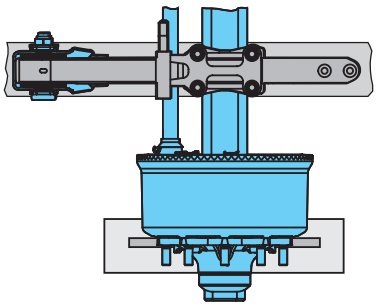
SP = Track on the ground
FM = Trailing arm centre
BM = Air bag centre
D = Air bag diameter
(∅ 360 with BPW 36 N)
V = Air bag offset = 30 mm
B = Tyre width
(consider wheel rim width)

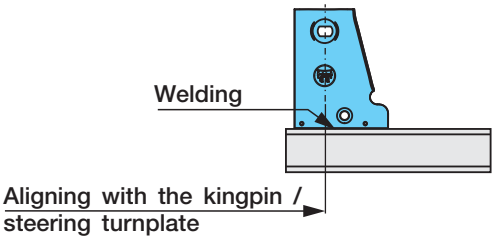
Remarks

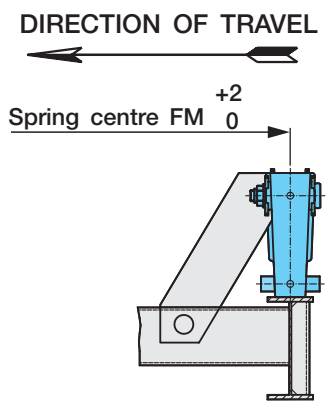
The gap between the air bag and tyres or brake cylinder should be at least 30 mm with the maximum air bag diameter.











General

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

Mounting axles and air suspension assemblies

Air suspension axles with mounted trailing arms and hanger brackets are generally picked up at the hub flange, arranged according to the vehicle design and aligned accurately in relation to the longitudinal centre line of the vehicle by means of the middle of the kingpin or steering turnplate. The centring aid on the hub flange differs between lightweight hubs and conventional hubs. The hanger brackets are welded onto the bottom flange of the vehicle frame.

Mounting loose air suspension hanger brackets

It is also possible to attach loose, hanger brackets separately. In this case, the spring bolt mounting points of the hanger brackets are aligned in relation to the longitudinal centre line of the vehicle by means of the middle of the kingpin or steering turnplate.

In this installation position, the tolerances of the spring centres and trailing arm 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 pages 44, 45).

Remarks:

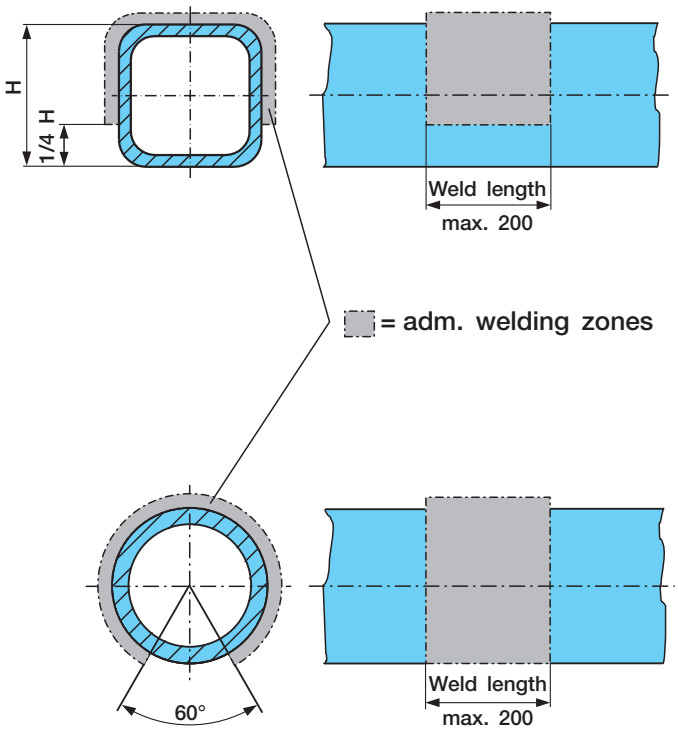
Heating the air suspension hanger brackets for straightening work is not permitted

Important for all welding work!

The trailing arms, air bags and plastic pipes must be protected against flying sparks and weld spatter during all welding work. The earth terminal must never be attached to the trailing arm or the hub. Do not perform any welding on the trailing arms!

7.2 Welding guidelines for axle beams

Material: S 355



General

When installing trailer axles, it may be necessary to subsequently weld components 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 4 Si 1 (DIN EN 440)
- Manual arc welding
  Rod electrodes E 46 2 (DIN EN 499)

  The mechanical quality values must correspond to the base material S 460.

  Max. weld thickness a 5 ◺ (DIN EN ISO 5817)

  Avoid end craters and undercuts.

Miscellaneous:

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.

It is not permitted to heat the air suspension hanger brackets for alignment work.

Important for all welding work!

The trailing arms, air bags and plastic pipes must be protected against flying sparks and weld spatter during all welding work. The earth terminal must never be attached to the trailing arm or the hub. Do not perform any welding on the trailing arms!

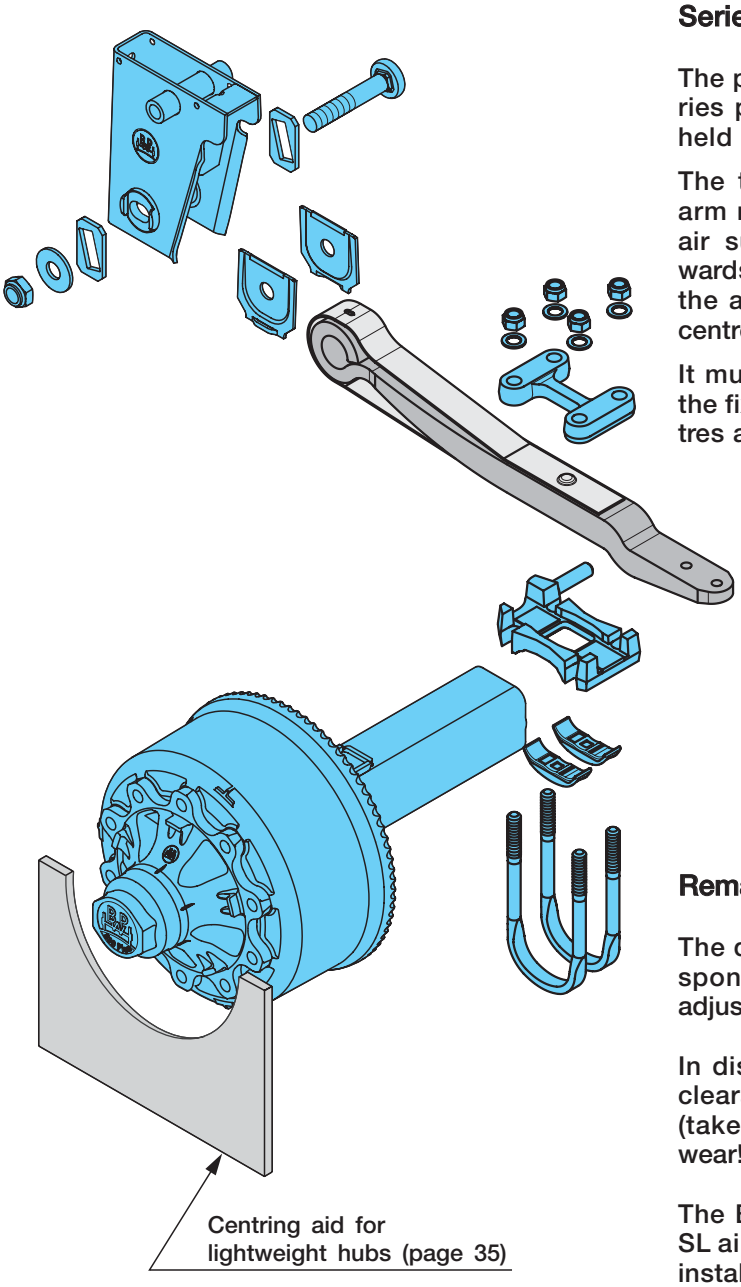
Maintenance-free axle connection with Airlight II air suspension systems.

Disassembly of axle connection will invalidate warranty claims.

General

Since the end of 1992 BPW has been supplying air suspension systems with a clamped axle connection. The spring seats are centred by a square ring welded onto the axle beam.

This axle connection permits the use of different spring and shock absorber attachments.

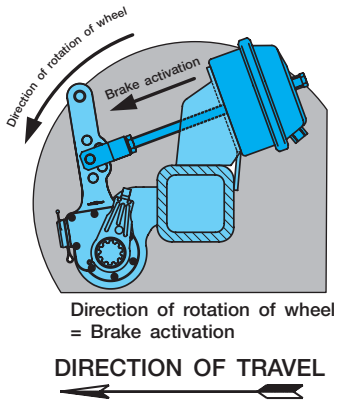


Series assembly

The positive axle connections are assembled in series production in an assembly fixture. The axle is held on the outside diameter of the hub flanges.

The two trailing arms are mounted at the trailing arm rolled end with bolts Ø 30 (∅ 24 for Airlight II air suspension units from build year 9/2007 onwards) in the assembly fixture at the exact length of the axle centre, the same height and exact spring centre.

It must be possible to adjust the holding points of the fixture to suit different track widths, spring centres and trailing arm lengths.



Remarks:

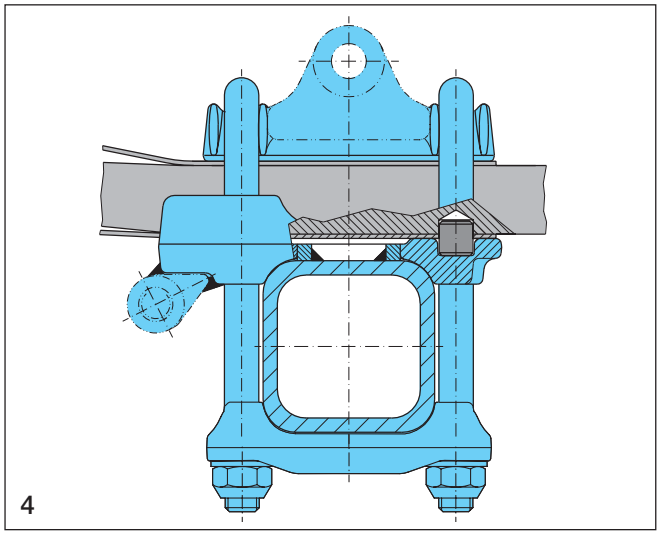
The direction of rotation of the wheel must correspond to the direction of activation of the slack adjuster.

In disc-braked axles, make sure there is sufficient clearance for the brake cylinders and brake callipers (take account of the change due to brake pad wear!)

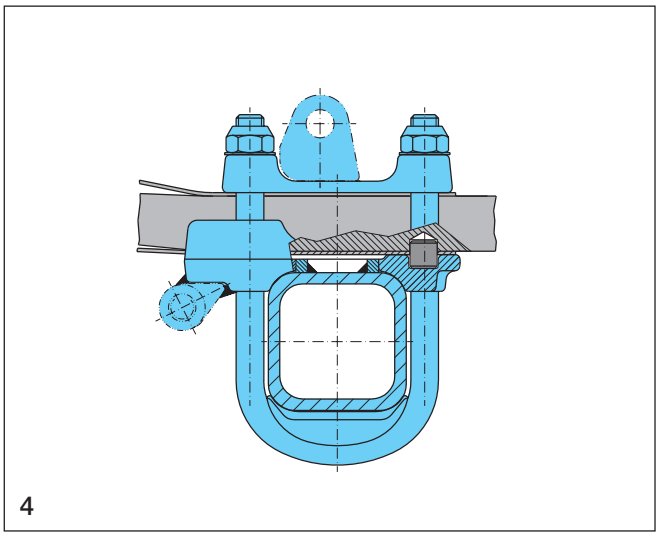
The BPW warranties for new, externally assembled SL air suspension systems are only valid if the BPW installation instructions and the installation manual are observed.

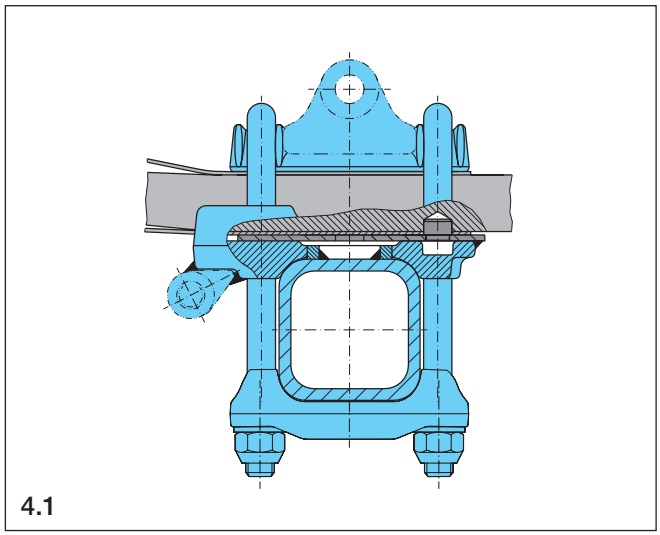
7.3.1 Over-slung Version (trailing arms above axle)

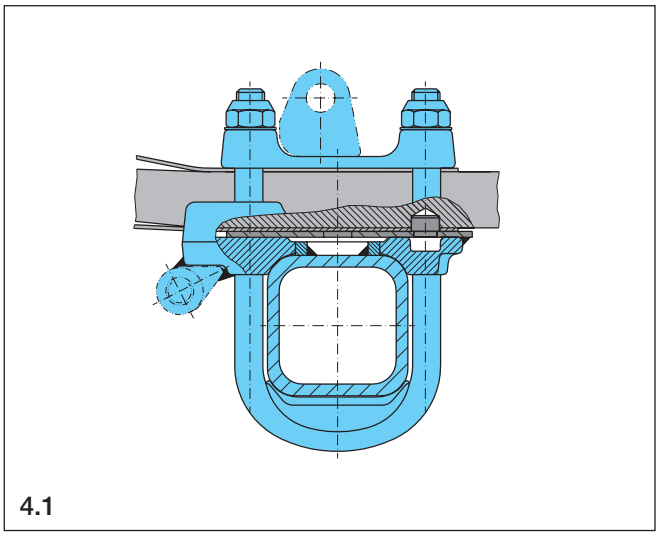
Spring U-bolts mounted from above

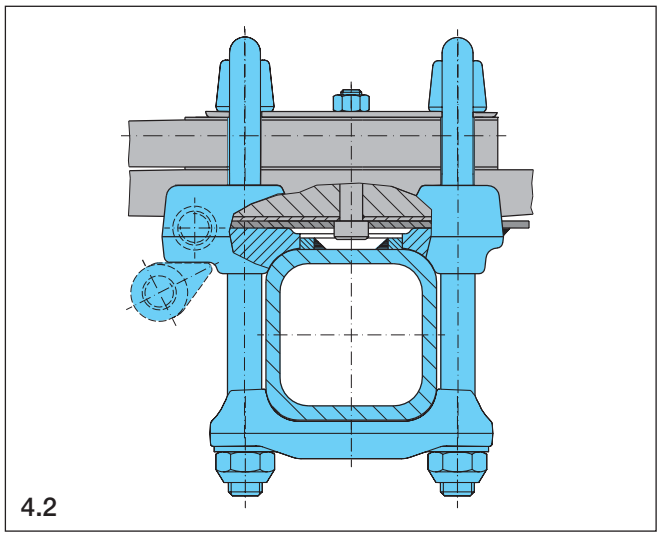


Spring U-bolts mounted from below









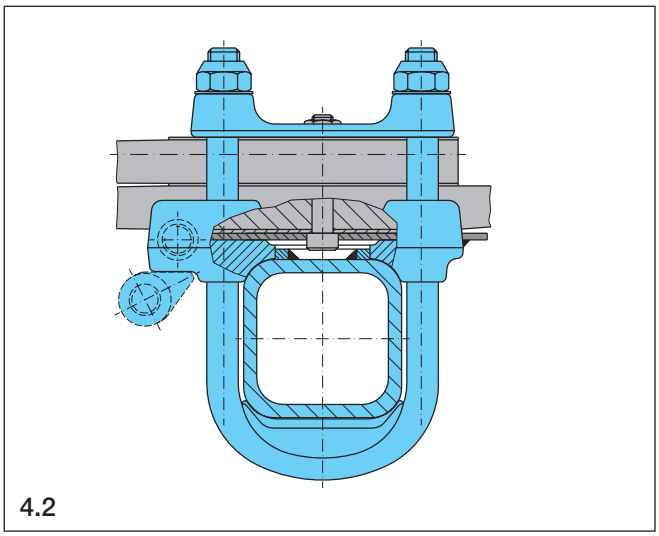


Illustration 4.1 / 4.2: Weld the tracking plate in place after aligning (see page 39).

Trailing arms above axle

1. Insert the axle with the hub flanges into the fixture. All contact surfaces on the axle beam and axle connection must be clean and free from weld spatter.
2. Place the spring pads in the correct position on the square centring frame of the axle beam.
3. Mount trailing arms - including catch plate for single-leaf springs - on the spring eye with pin ∅ 30 (∅ 24 for Airlight II air suspension units from build year 9/2007 onwards).
4. Mounting without tracking plate (only with single-leaf spring for centring pin):
   Insert the centring pin into the trailing arm / catch plate hole.

4.1 Mounting with tracking plate:
(with single-layer trailing arm for centring pin):
Insert tracking plate 05.281.... with mounted centring pin into the trailing arm / catch plate hole.

4.2 With single and double-leaf trailing arms with spring bolt: Insert tracking plate 03.281.... into the spring pads.

5. Insert trailing arms (with the centring pin or tracking plate) into the spring pads.
6. Mount the spring U-bolt and segments.
7. Fit the spring plates.
8. Grease the spring U-bolt thread, fit washers and screw the lock nuts onto the spring U- bolts by hand.
9. Use a driver to tighten the lock nuts slightly - always one spring U-bolt at a time - until all components make even contact. (The spring pads only make contact at the radii of the axle beam.) There must be no uneven tensioning due to one-sided tightening of the lock nuts.
10. Use a driver to tighten the lock nuts slightly - always one spring U-bolt at a time - until all components make even contact. (The spring pads only make contact at the radii of the axle beam.) There must be no uneven tensioning due to one-sided tightening of the lock nuts.Otherwise, the connection must be corrected by loosening and retightening the spring U-bolts. Now the hanger brackets and shock absorbers can be mounted.

    Tightening torques, see last page.

    When mounting the spring without the fixture, the permitted tolerances of the spring eye centre, spring eye height, spring length and rectangular alignment must be measured.
11. When mounting with a tracking plate, illustration 4.1 / 4.2:

    Weld the tracking plates onto the rear end of the spring pads after installation and alignment of the air suspension axles on the vehicle. Weld a 4 ◺ x 80.

Remarks:

With the introduction of the Airlight II air suspension, a second spring U-bolt with M 22 (32 mm) was launched onto the market in addition to the familiar M 24 spring U-bolt (36 mm).

This Airlight II axle connection with spring U-bolt diameter M 22 (32 mm) is tightened with a torque and 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.
In all other air suspension types and in Airlight II air suspension systems used off-road, the U-bolt connections must be checked regularly and re-tightened if necessary because of the high loadings.
This involves checking the U-bolt connection is firmly tightened at the specified intervals. For more information about the maintenance intervals, please refer to the applicable maintenance regulations or workshop manuals.

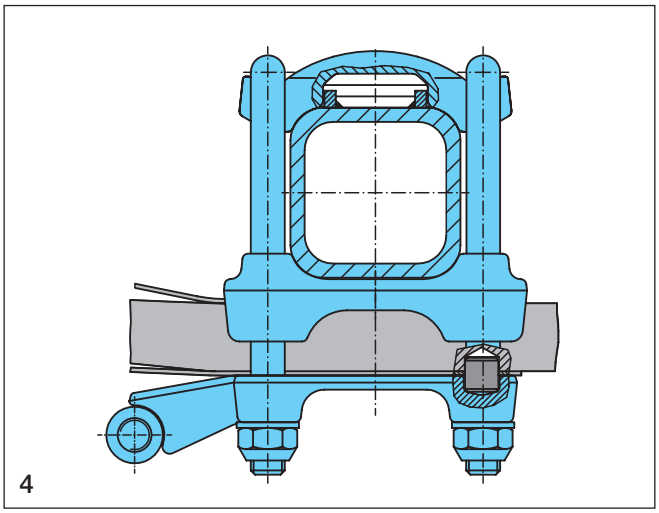
The specified tightening torques are mandatory in order to prevent damage to the components.

Important for all welding work!

The trailing arms, air bags and plastic pipes must be protected against flying sparks and weld spatter during all welding work. The earth terminal must never be attached to the trailing arm or the hub. Do not perform any welding on the trailing arms!

7.3.2 Under-slung Version (with the trailing arms under the axle)

Spring U-bolts mounted from above



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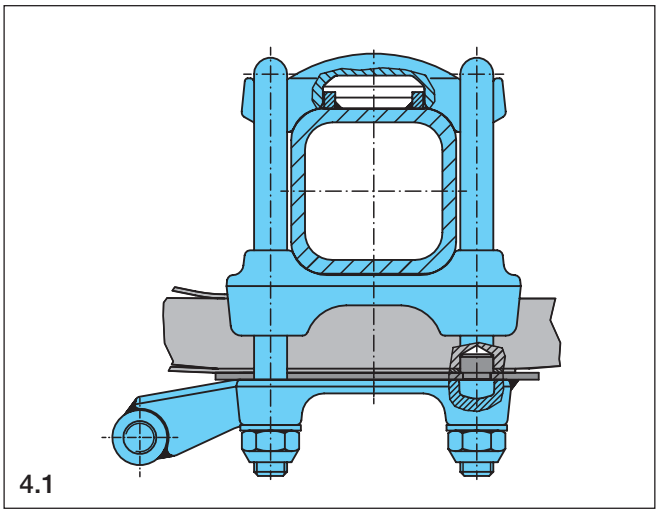
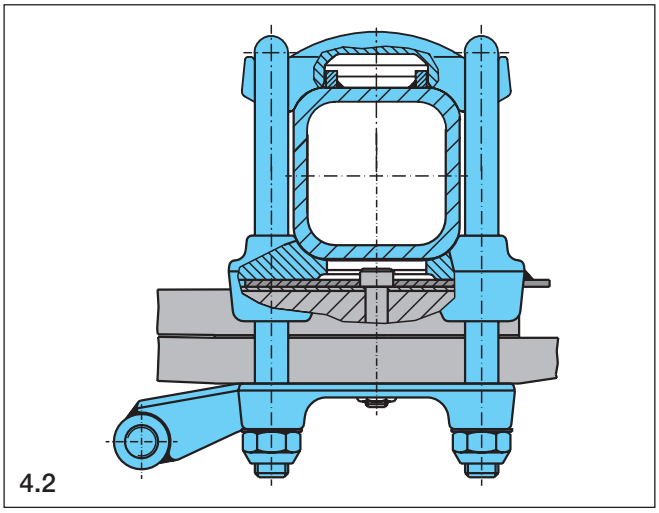


4.1



4.2

Illustration 4.1 / 4.2: Weld the tracking plate in place after aligning (see page 41).

Trailing arms under the axle

1. Insert the axle into the fixture in the rear position at the hub flanges. All contact surfaces on the axle beam and axle connection must be clean and free from weld spatter.
2. Place the spring pads in the correct position on the axle beam.
3. Mount trailing arms - including catch plate for single-leaf springs - on the spring eye with pin ∅ 30 (∅ 24 for Airlight II air suspension units from build year 9/2007 onwards).
4. Mounting without tracking plate (only with single-leaf spring for centring pin):
   Insert the trailing arms into the spring pads. Insert the centring pin into the trailing arm / catch plate hole.

4.1 Mounting with tracking plate:
(with single-leaf trailing arm for centring pin):
Insert the trailing arms into the spring pads. Insert the tracking plates 05.281.... into the trailing arm / catch plate holes with the centring pins mounted.

4.2 For single and double-leaf trailing arms with spring bolt:
Insert tracking plates 03.281.... into the spring pads. Insert the trailing arms into the spring pads.

5. Lay the segment plates (spring plates) on the square profile centring frames of the axle beam and mount the spring U-bolt.
6. Fit the spring plates.
7. Grease the spring U-bolt thread, fit washers and screw on the lock nuts by hand.
8. Use a driver to tighten the lock nuts slightly - always one spring U-bolt at a time - until all components make even contact. (The spring pads only make contact at the radius of the axle beam.) There must be no uneven tensioning due to one-sided tightening of the lock nuts.
9. Use a torque wrench to tighten the lock nuts in several cycles - always one spring U-bolt at a time - until the prescribed tightening torque is reached. Make sure the spring eyes are at the same height! The pins in the spring eyes must slide easily out of the fixture! Otherwise, the connection must be corrected by loosening and retightening the spring U-bolts. Now the hanger brackets and shock absorbers can be mounted.

   Now the hanger brackets and shock absorbers can be mounted.

   Tightening torques, see last page.

   When mounting the spring without the fixture, the permitted tolerances of the spring eye centre, spring eye height, spring length and rectangular alignment must be measured.
10. When mounting with a tracking plate, illustration 4.1 / 4.2:
    Weld the tracking plates onto the rear end of the spring plates or spring pads after installation and alignment of the air suspension axles on the vehicle. Weld a 4 x 80.

Remark:

With the introduction of the Airlight II air suspension, a second spring U-bolt with M 22 (32 mm) was launched onto the market in addition to the familiar M 23 spring U-bolt (36 mm).

This Airlight II axle connection with spring U-bolt diameter M 22 (32 mm) is tightened with a torque and 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.

In all other air suspension types and in Airlight II air suspension systems used off-road, the U-bolt connections have to be checked regularly and retightened if necessary because of the high loadings.

This involves checking the U-bolt connection is firmly tightened 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 are mandatory in order to prevent damage to the components.

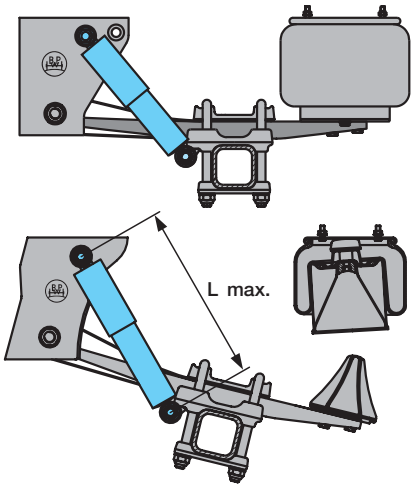
Important for all welding work!

The trailing arms, air bags and plastic pipes must be protected against flying sparks and weld spatter during all welding work. The earth terminal must never be attached to the trailing arm or the hub. Do not perform any welding on the trailing arms!

8 Shock absorber

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



BPW standard shock absorber

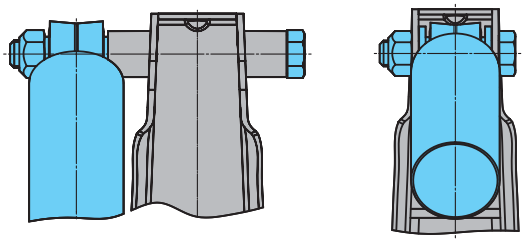
BPW shock absorbers operate according to the twin-tube principle. In the compression stage (corresponding to upward travel), the oil is pressed into the working space at the top, which then flows back into the working space at the bottom during the rebound travel (corresponding to downwards movement).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

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

Shock absorber mounts

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

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



Lateral arrangement

Central arrangement

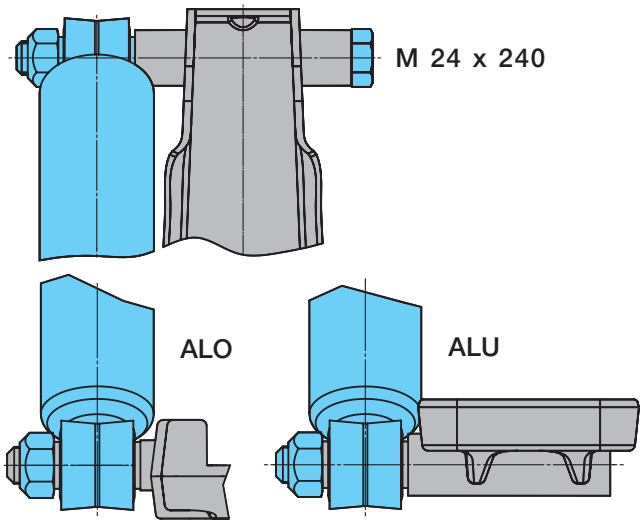
The shock absorbers are attached using hexagonal bolts or weld-on threaded bolts with lock nuts. Depending on the version, it may be necessary to use additional rings, discs and sleeves for installation.

The following depictions provide an overview of the current versions.

Tightening torques, see last page.

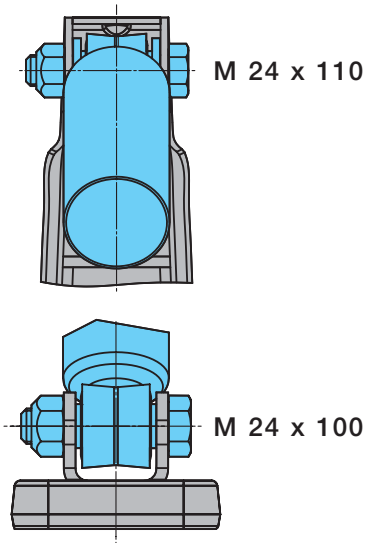
Lateral shock absorber mount on air suspension hanger brackets (series AL II, 70 mm wide).

Top attachment:
Bolt and lock nut (M 24)
Bottom attachment:
Thread bolt and lock nut (M 24)



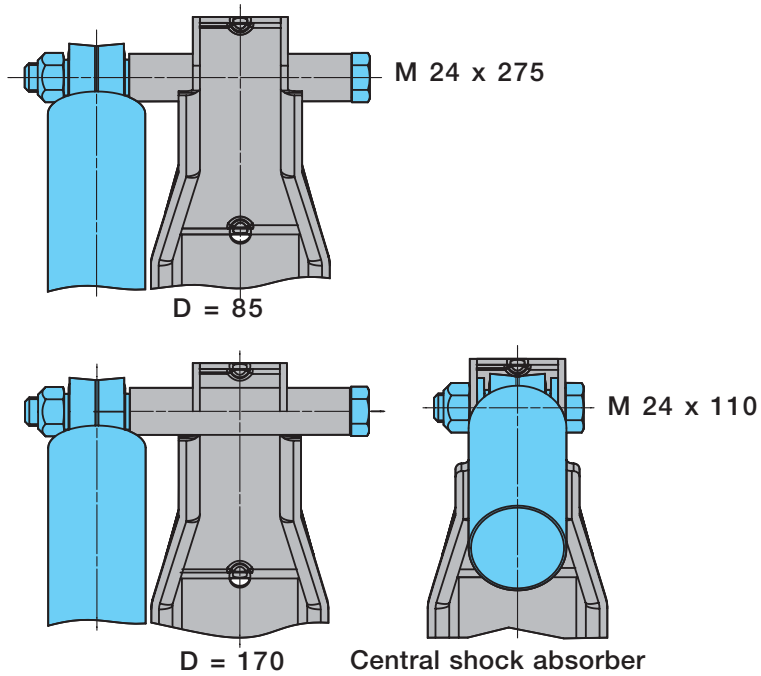
Central shock absorber mount on air susp. hanger brackets (series AL II, 70 mm wide trailing arm).

Top attachment:
Bolt and lock nut (M 24)
Bottom attachment:
Bolt and lock nut (M 24)

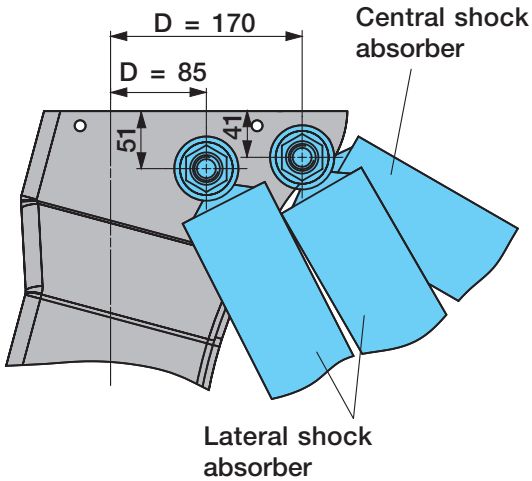


Lateral / central shock absorber mount on air suspension hanger brackets (series SL, 100 mm wide trailing arm).

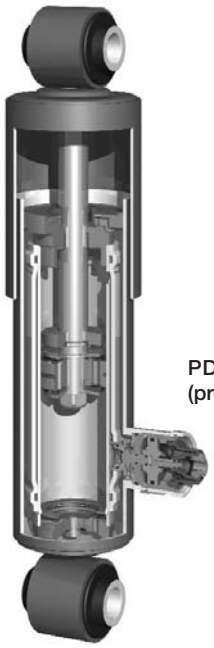
Top attachment (lateral):
Bolt and lock nut (M 24)
Bottom attachment (lateral):
Threaded bolt and lock nut (M 24).



Top attachment (central):
Bolt and lock nut (M 24)
Bottom attachment (central):
Bolt and lock nut (M 24)



8 PDC shock absorber

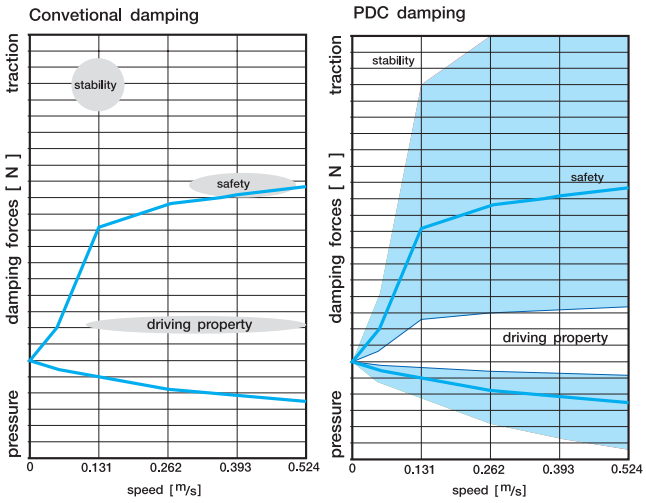


BPW PDC shock absorber

BPW PDC shock absorbers permit load-dependent damping and guarantee a constantly high level of safety and driving comfort irrespective of the loading condition.
The infinitely variable damping adaptation to the particular loading condition is achieved by a pneumatically adjustable proportional valve on the shock absorber.
The PDC system is based on standard air suspension and does not require any additional control electronics, therefore PDC shock absorbers can be integrated with, or retrofitted to existing BPW air suspension units without difficulty.

The PDC shock absorber is available in two versions, matched to the bag pressures of BPW 30 and BPW 36 air bags. The installation must be adapted to the shock absorber lengths.

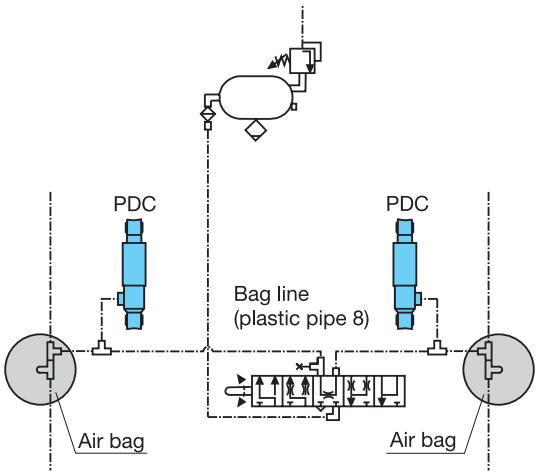
Make sure there is sufficient clearance from the air suspension hanger bracket during installation.



Shock absorber mounts

The depictions on page 45 provide an overview of the current versions.

Tightening torques, see last page.

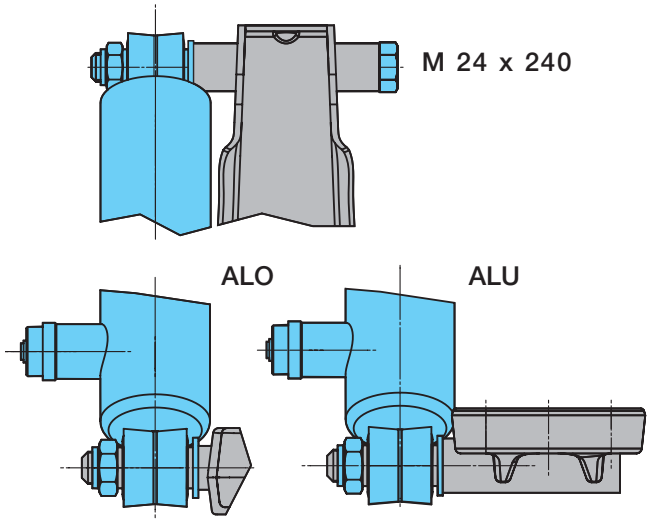


Remarks:

Shock absorbers should only be fitted and changed as a complete axle set. A multiple axle vehicle can be fitted with different units on individual axles.

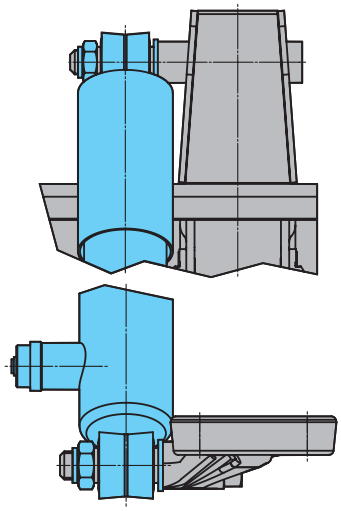
Lateral shock absorber mount (PDC) on air suspension hanger brackets (series AL II, 70 mm wide trailing arm).

Top attachment:
Bolt and lock nut (M 24)
Bottom attachment:
Threaded bolt and lock nut (M 24).



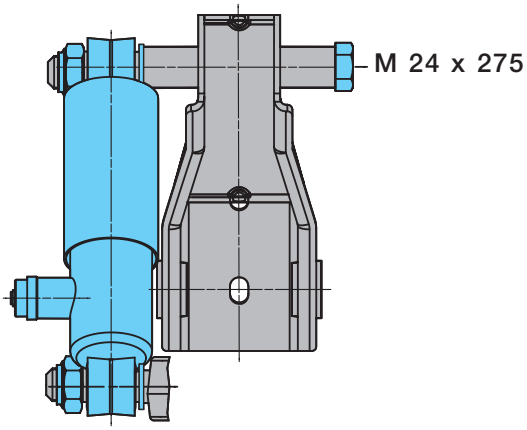
Lateral shock absorber mount (PDC) on channel crossmembers (series AL II, 70 mm wide trailing arm).

Top attachment:
Bolt and lock nut (M 24)
Bottom attachment:
Threaded bolt and lock nut (M 24).



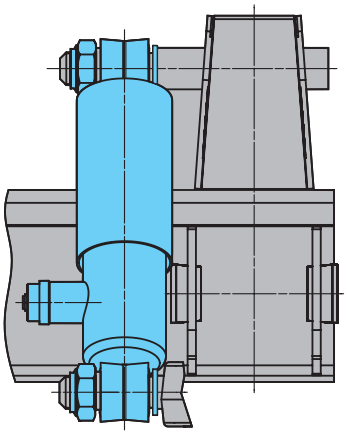
Lateral shock absorber mount (PDC) on air suspension hanger brackets (series SL, 100 mm wide trailing arm).

Top attachment:
Bolt and lock nut (M 24)
Bottom attachment:
Threaded bolt and lock nut (M 24).



Lateral shock absorber mount (PDC) on channel crossmembers (series SL, 100 mm wide trailing arm).

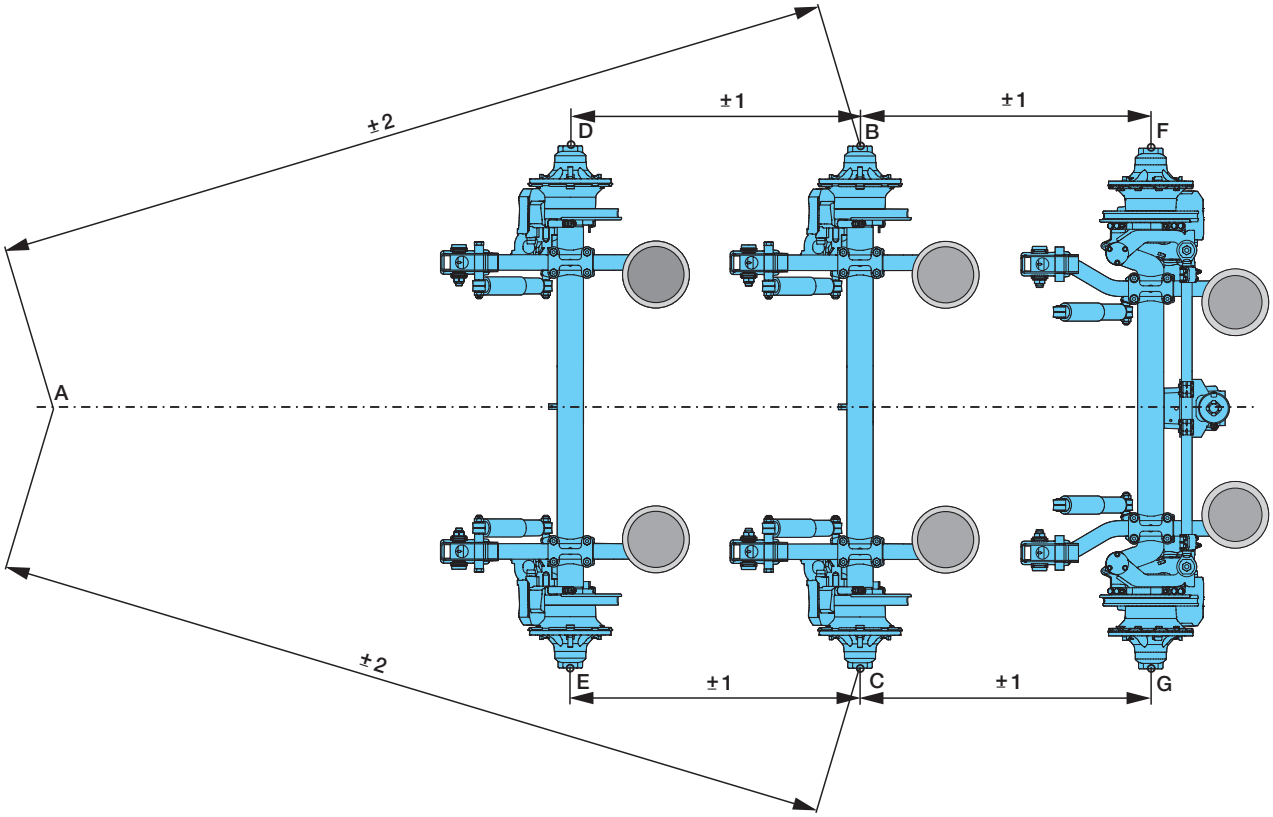
Top attachment:
Bolt and lock nut (M 24)
Bottom attachment:
Threaded bolt and lock nut (M 24).



Remarks:

When using PDC shock absorbers, a shim must be installed between the bracket (channel crossmember) or spring pads and each PDC, also shorter lock nuts must be used.

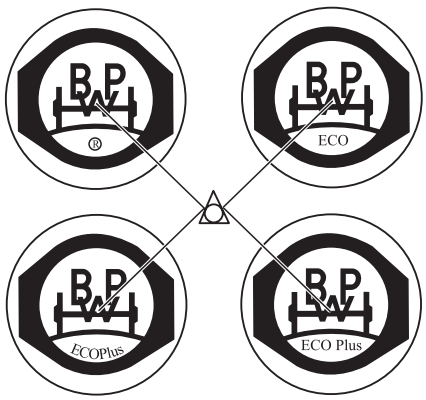
9.1 Track settings Conventional



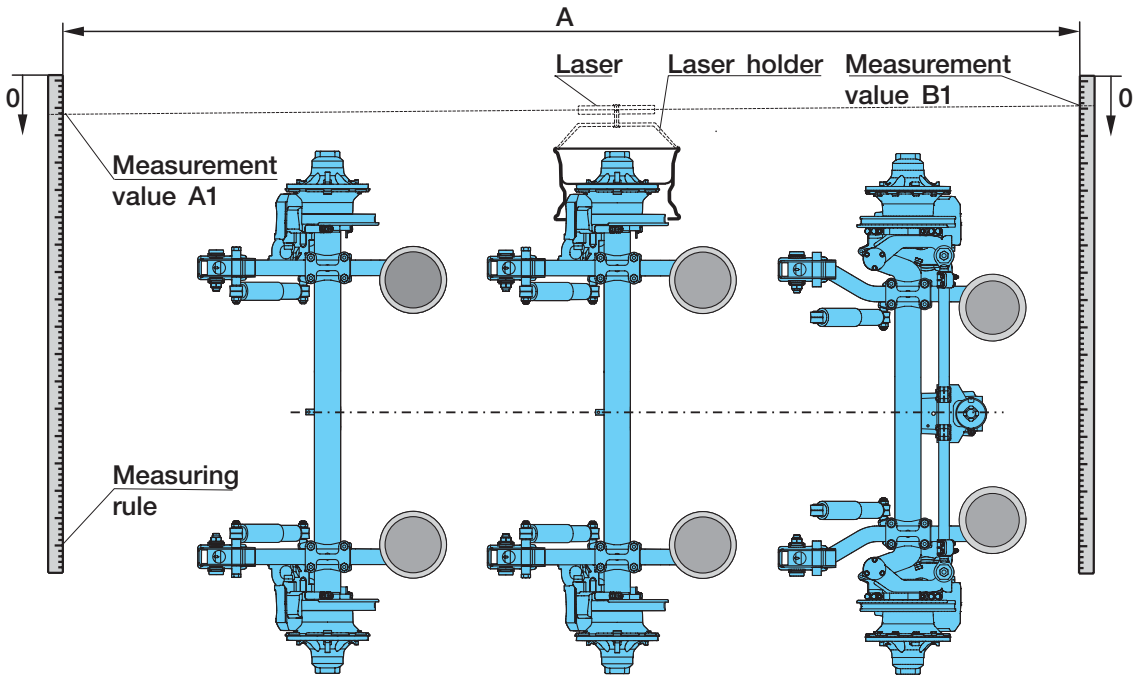
The track settings are to be checked and corrected if necessary to equalize production tolerances.
The diagonal dimensions **A - B** and **A - C** of the centre axle (reference axle) must be checked via comparison measurements (tolerance ± 2 mm).
Check the wheel base measurements **B - D** and **C - 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 ± 10 mm for tracking plates and ± 5 mm for adjustable hanger brackets.

The triangle in the BPW logo is located centrally if a ® (1989), ECO (1994), ECOPlus (2000) or ECO Plus (2007) is stamped in below the BPW logo.



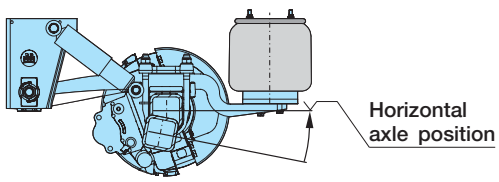
Mount ruler and laser acc. to manufacturers assembly instructions!



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 ± 10 mm for tracking plates and ± 5 mm for adjust-able hanger brackets.



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

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

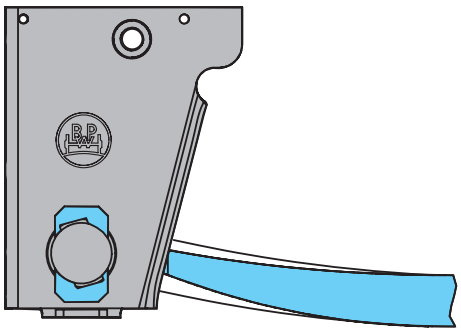
Positive value = toe-in
Negative value = toe-out

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.

Remarks:

The tracking tolerances defined by BPW must be maintained. Only by maintaining these tolerances can low-wear operation of the vehicle be assured. The tracking values are set for steered axles at the factory and the steering rod must not be adjusted. Tolerances for rigid or steering axles can be downloaded from the BPW website (www.bpw.de/download/News), or found in TE sheet TE-4120.0.

9.3 Track correction at air suspension axles with adjustable hanger bracket



General

It is necessary to check the tracking accuracy during installation as well as after repairs on axles, brackets or trailing arms.

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

The diagonal measurements must be checked as described on page 46.

Remarks:

The spring U-bolts must not be undone in the case of air suspension axles with adjustable hanger brackets.

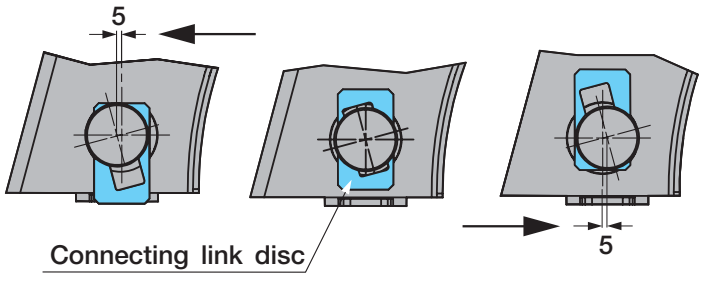
Modified spring bolt mounting in all Airlight II air suspension units from build year 9/2007 onwards!

From the September 2007 build year onwards, all Airlight II air suspension units will be provided with a modified spring bolt mounting. The former functional principle of the mounting with integrated track adjustment is maintained in this case. The following components are modified:

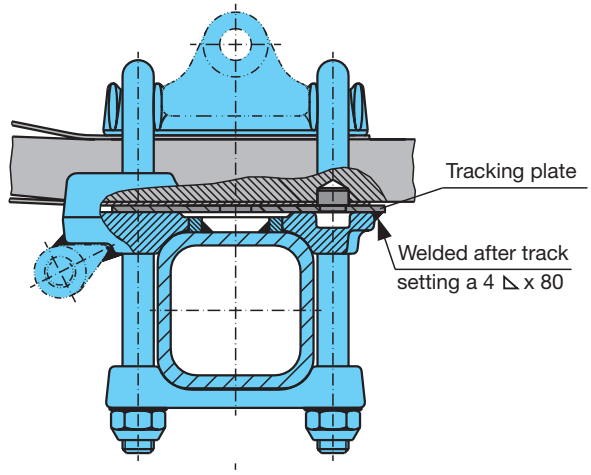
- Spring bolt and nut (M 30 to M 24)
- Welded bushes in the hanger bracket (for Ø 24)
- Wear discs (for Ø 24)
- Connecting link discs (for Ø 24)
- Disc (for Ø 24)

Track correction

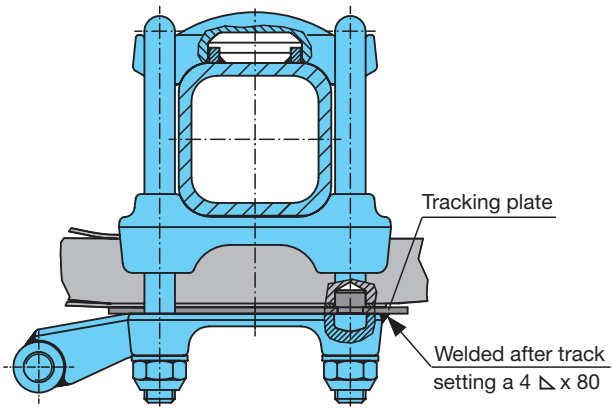
1. Raise and support the vehicle frame
2. Exhaust the air out of the air bags
3. Slacken the lock nuts on the spring pivot bolt
4. Align the centre axle (reference axle)
5. Slide the connecting linkage on both sides, as required, upwards or downwards with light hammer blows (see fig.)
6. Make sure the inner and outer connecting linkages on each hanger bracket are adjusted symmetrically!
7. Tighten lock nut on the spring pivot bolt to the specified torque
8. Check the track settings of the front and rear axles and re-align if necessary
9. Remove supports from underneath the vehicle and inflate the air bags



Series SLO / SLM / ALO / ALM



Series SLU / ALU



General

It is necessary to check the tracking accuracy during installation as well as after repairs on axles, brackets or trailing arms.

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

The diagonal measurements must be checked as described in page 46.

Track correction

1. Raise and support the vehicle frame
2. Exhaust the air out of the air bags
3. Loosen the spring U-bolts
4. If necessary, grind off the weld seam on the tracking plate and spring seat
5. Align the centre axle (reference axle)
6. Tighten U-bolt lock nuts uniformly and alternately (see page 51 for tightening torques)
7. Check the track settings of the front and rear axles and re-align if necessary
8. Tighten spring U-bolt lock nuts uniformly and alternately and weld tracking plates to the spring seats
9. Remove supports from underneath the vehicle and inflate the air bags

On Airlight II air-sprung axles:

Maintenance-free axle connection, do not unfasten the spring U-bolts.

Important for all welding work!

The trailing arms, air bags and plastic pipes must be protected against flying sparks and weld spatter during all welding work. The earth terminal must never be attached to the trailing arm or the hub. **Do not perform any welding on the trailing arms!**

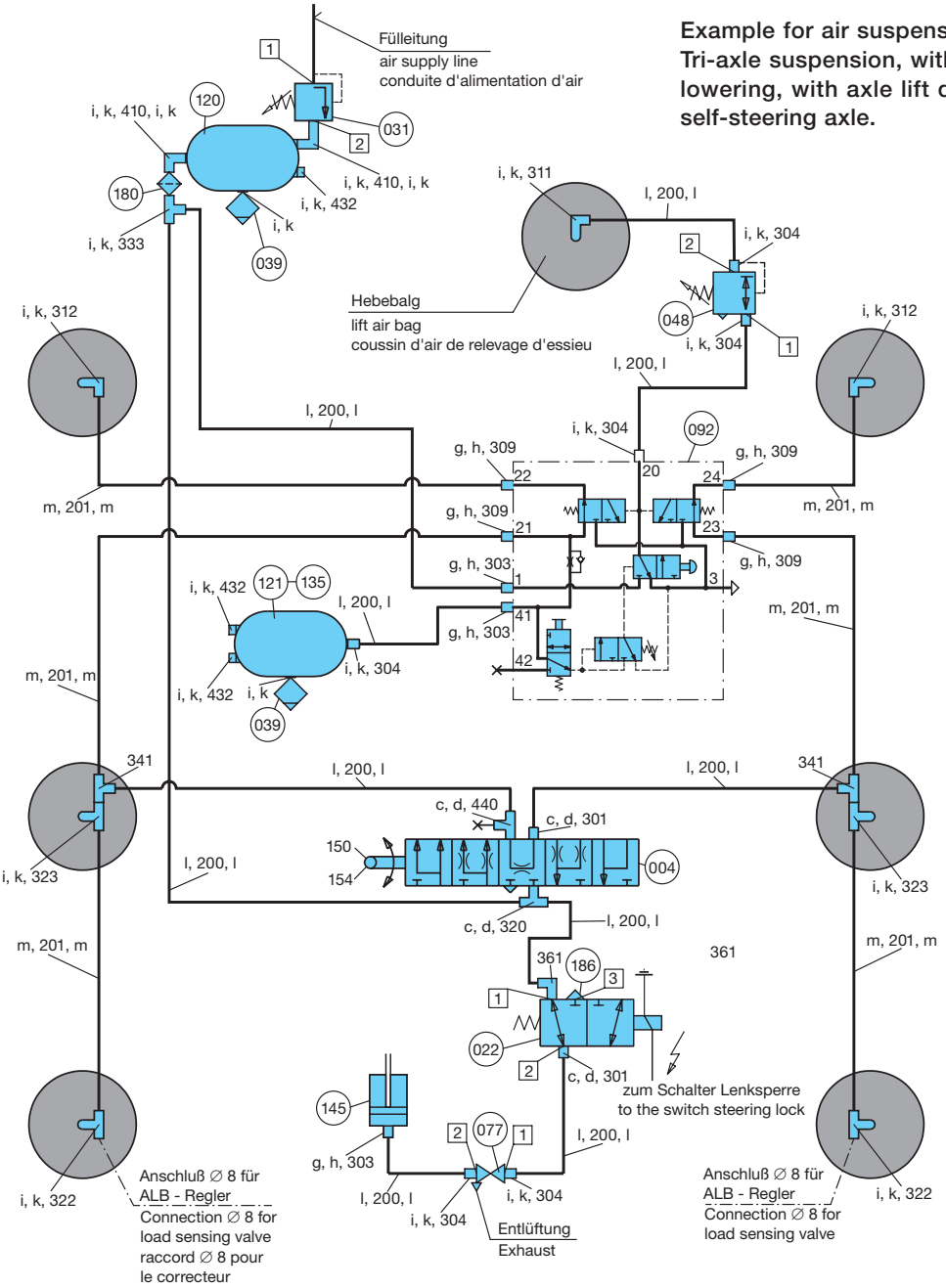
10.1 BPW air suspension installation

The necessary installation kit and installation drawings are supplied by BPW for the appropriate application. BPW installation drawings identify the valves using the ISO illustration method.

The figures and letters that are enclosed in a box in the installation drawings are identical to the identification codes on the valves themselves, thereby simplifying the installation substantially. 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 (6 bar) from the compressed air braking system. The air tank pressure is approx. 7.5 to 8.5 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 (e.g. Ø 12 x 1.5 or Ø 10 x 1).

Example for air suspension installation: Tri-axle suspension, without lifting and lowering, with axle lift device and LL self-steering axle.

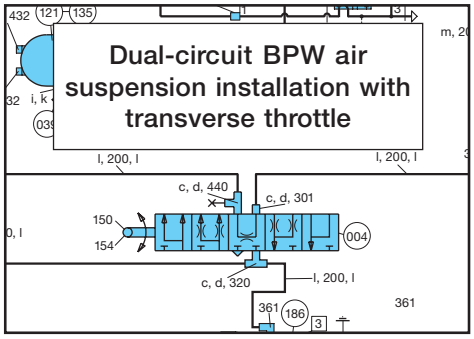


BPW air suspension systems possess a high roll stability for low transverse inclination when cornering, leading to excellent road safety. This high roll stability characteristic is achieved because the body is supported when cornering not only by the air bags but also by the stabilisation effect of the axle beam to trailing arm connection.

The type of air suspension installation has a significant influence on the roll stability characteristics:

Dual-circuit version with transverse throttle:

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. During cornering, the air can only equalise itself slowly between the two sides of the vehicle. As a result, the air bags additionally assist in supporting the rolling motion of the vehicle body.



Single-circuit version without transverse throttle:

The air bags on the left and right-hand sides of the vehicle are pneumatically connected. There is no transverse throttle. During cornering, the air can equalise itself more quickly between the two sides of the vehicle. This means the rolling motion is not supported by the air bags.

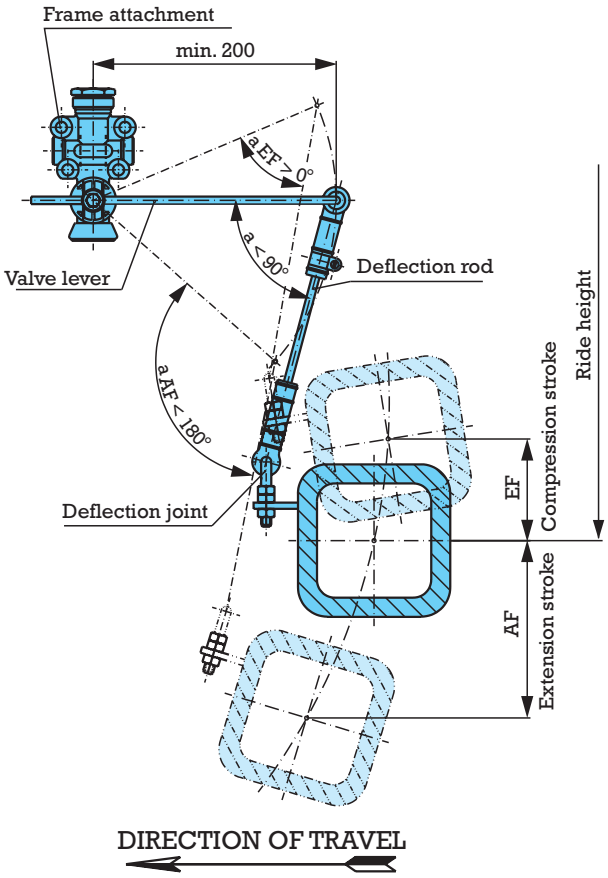
The roll stability and, therefore, road safety is consequently reduced in comparison with a dual-circuit air installation. As well as the reduction in road safety, the mechanical loads in the air suspension unit are also distributed differently. Since there is no roll stabilisation of the air bags, the axle and trailing arm combination has to undertake this portion of the stabilisation as well.

The use of single-circuit air suspension installations can lead to damage to the vehicle as a result of the higher loads. For this reason, BPW cannot offer **any warranty** for chassis and **suspension damage** resulting from this effect.

To achieve optimum function and the greatest possible road safety, in particular in critical situations, we expressly recommend using dual-circuit air suspension installations with a transverse throttle incorporated in the levelling valve.

Lifting axles are the only exception to this recommendation. In this case, it is permitted for at most one lifting axle in a three or four-axle unit to be installed with one circuit.

11.1 BPW Air Suspension Levelling Valve



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 pushrods.

The pushrods are 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.

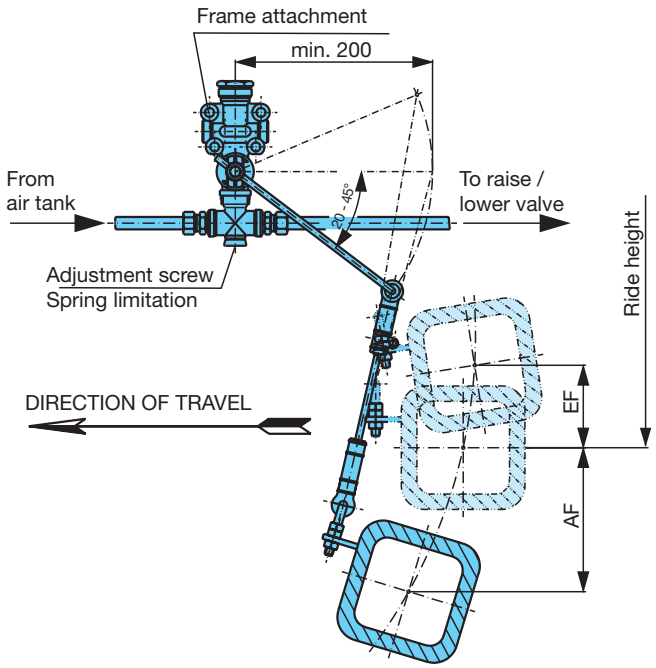
The valve lever, which is at least 200 mm long, is positioned horizontally in the direction of travel. For testing purposes, the lever is pressed slightly downwards to ensure that air is released into the atmosphere via the pressure relieve valve. If the air is directed into the air bag, the valve shaft must be rotated by 180°. The valve lever must then be repositioned. 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.

Remarks:

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, catch straps, air bag length).

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

Air levelling valve with integrated shut off



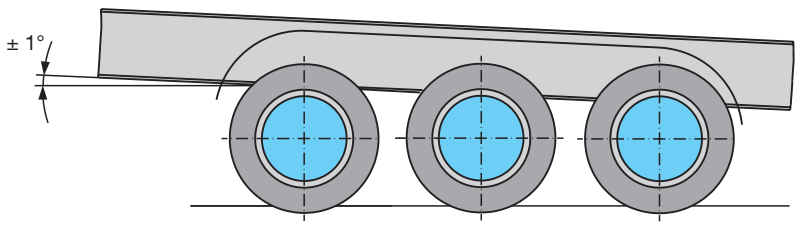
Remarks:

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.

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.

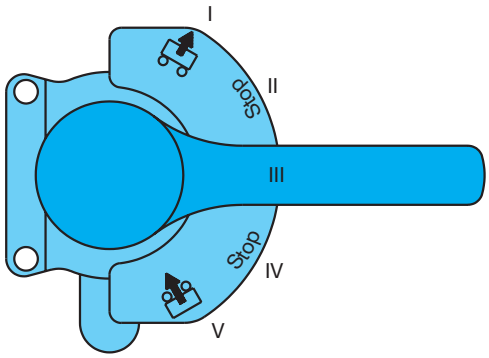
With multi-axle bogies a minimum upward travel of 70 mm is necessary.



The max. superstructure inclination of the semi-trailer must not exceed ± 1°.

12.1 Raising and Lowering

BPW air suspension axles are available with valves for raising and lowering for container chassis, semi-trailers and to equalise to different heights of loading ramps.



Raise / Lower valve

Valves to raise or lower the vehicle frame generally have 5 different settings.

I	Raise
II	Stop
III	Travel
IV	Stop
V	Lower

Prior to commencement of journey

After operating the raising or lowering system, the valve must be adjusted to the "Travel" position prior to commencing the journey. The ride height is then automatically adjusted.

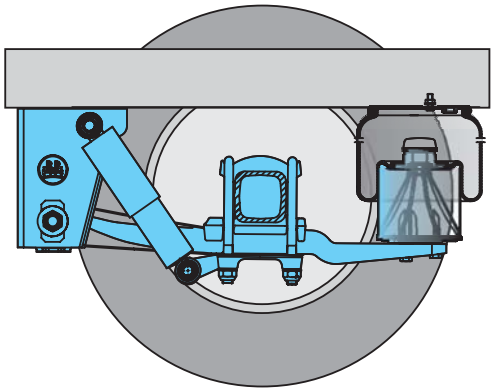
Remarks:

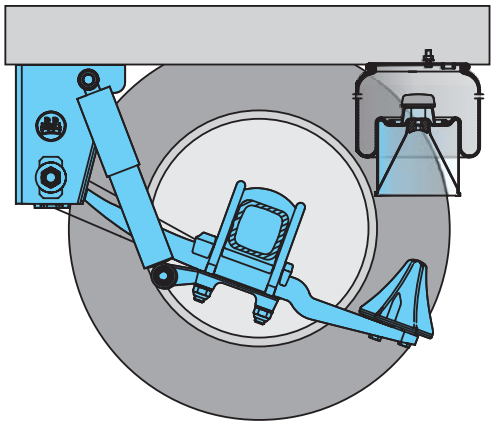
Raising the vehicle:

When raising the vehicle, make sure that the rotary disc valve is moved back to the "stop" position once the required height has been reached. Locking the valve in "raise" position can cause damage to the air bags. To prevent damage of this kind, the extension of the vehicle can be restricted using a stroke limiter (see page 55).

Particular operating conditions:

Under certain operating conditions, all extensions must be limited using a stroke limiter (see page 55.)





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 36-1, 36-5 or 36-2

Stroke limiting is required in vehicles with a lifting and lowering device and type 36-1, 36-5 or 36-2 air bags.

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

As a rule, no stroke limiting is required when type 30 K, 30, 36 K or 36 air bags are used.

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

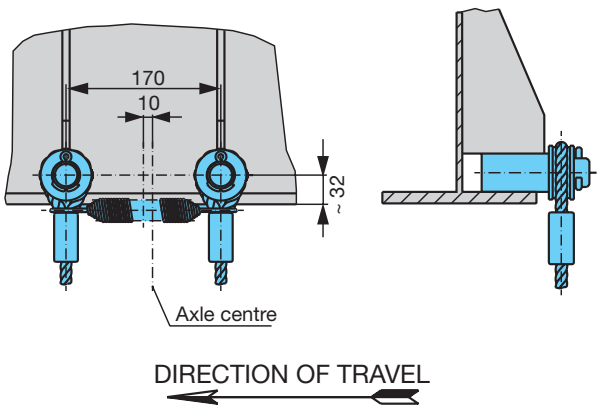
With vehicles for crane, railway or ship loading, BPW recommends air bags with a split piston, system Kombi Air bag II. If not expressly demanded in the technical documentation, no stroke limitation is needed when the Kombi Air bag is used.

Stroke limiting versions

1. The stroke limitation can be carried out via an air levelling valve with integrated shut-off (fig. Page 53) 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.
2. Stroke limitation can also be carried out via catch straps. When installing, ensure that they do not rub against the axle beam.

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 or catch straps. The shock absorbers are equipped with a travel limiter; however they are not designed to operate with airbag pressures above approx. 8.5 bar.

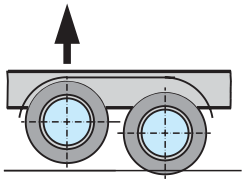
Catch straps



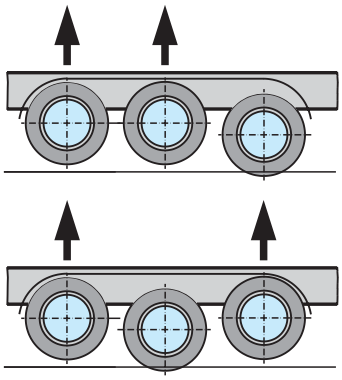
13.1 BPW Axle Lift Devices

General

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

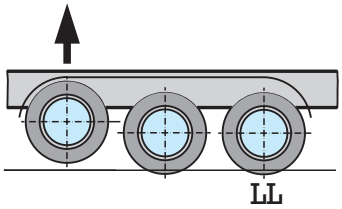


or max. two axles with tri-axle suspensions.



With self-steering axle

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



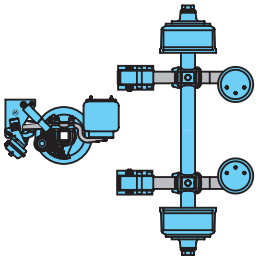
It is recommended to lift the front axle of a suspension due to the improved ground clearance (gradient of superstructure) and to the longer wheel base, thus resulting in more stable driving characteristics.

The statutory provisions regarding turning circle requirement must be observed!

Designs

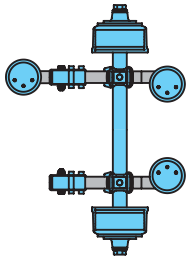
Two-sided lift device

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



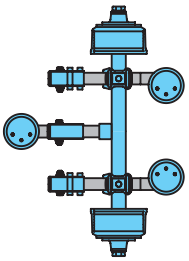
Side axle lift device

For raising the front, middle or rear bogie axle



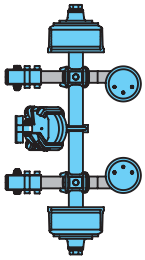
Middle axle lift

For raising the front, middle or rear bogie axle



Central axle lift

For raising the front, middle or rear bogie axle



Control

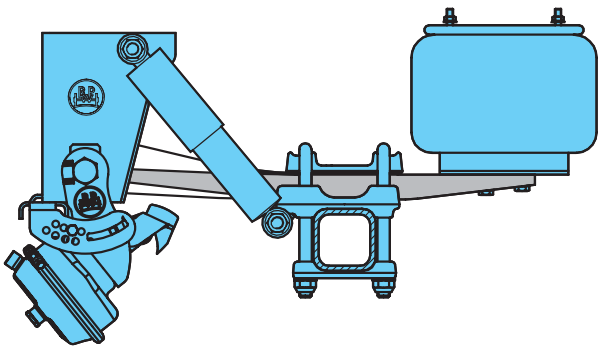
Axle lift devices operate either electrically / pneumatically via an electric switch or manually / pneumatically via a manual valve (or automatically via a compact valve).

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

Remarks:

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.



The two-sided axle lift is mounted below both the air suspension hanger brackets on each module and is therefore located within the suspension clearance. This means it does not interfere with the vehicle equipment such as pallet boxes.

The lift is supplied in a version for 9 - 10 t axle load and another version for up to 12 t axle load.

As well as the version for rigid and adjustable air suspension hanger brackets, variants for BPW channel cross members and aluminium hanger brackets are also available.

Function:

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

The pivot point for the entire structure is the spring bolt fitted on all BPW air suspension units, so that no installation preparations have to be made by the vehicle builder apart from the air installation. Retrofitting is also possible without difficulty.

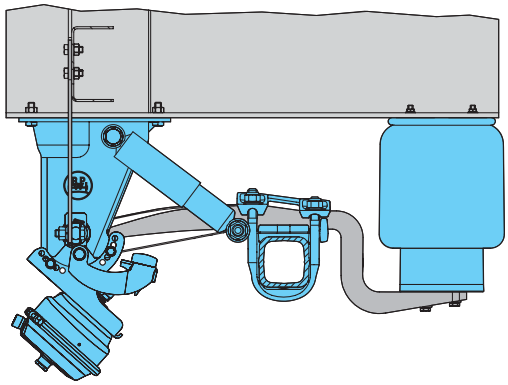
Advantages:

- 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
- Compact design, good ground clearance
- Low weight of approx. 30 kg per axle
- Installation position can be set for different suspension types
- Robust design
- Durable technology because proven brake components are used

Remarks:

The installation position and mounting of the axle lift device can be seen in the BPW technical documents and the supplied installation drawing.
The position for setting out the stop is shown in the BPW technical documents!

13.3 Two-sided lift for bolted hanger brackets



The two-sided lift for bolted hanger brackets is suitable for both disc brake axles and drum brake axles.

The design is such that the spring bolt is not required for the function of the axle lift. This means there is no need to remove the spring bolt when installing the axle lift, as would otherwise be necessary. As a result, installation is much more straightforward.

The two-sided axle lift is mounted below both air suspension hanger brackets on each module and is therefore located within the suspension clearance. This means it does not interfere with the vehicle equipment such as pallet boxes.

Function:

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

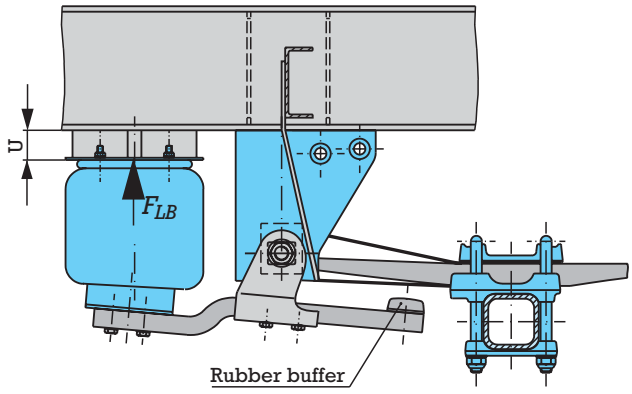
The holder is hooked onto the rear end of the hanger bracket (punched opening) and bolted onto the front end with two bolts. The lever for the lifting stroke is mounted on the holder. This means there is no need to remove the spring bolt.

Advantages:

- Can be used with disc and drum brake axles
- The installation space in front of the air suspension hanger brackets and in the middle of the vehicle remains clear
- Can easily be mounted on the hanger bracket (2 bolts) without removing the spring bolt
- No additional spring bolt assembly required
- Compact design, good ground clearance
- Low weight of approx. 32 kg per axle (approx. 16 kg per lift)
- Installation position can be set for different suspension types
- Robust construction
- Durable technology because proven brake components are used

Remarks:

The installation position and mounting of the axle lift device can be seen in the BPW technical documents and the supplied installation drawing.
The position for setting out the stop is shown in the BPW technical documents!



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 trailing arm. 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.

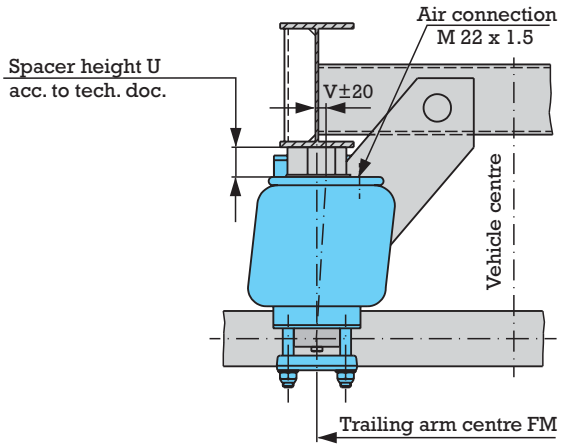
Depending upon the design, the air pressure to the lifting bag must be limited by a reduction valve!

Force of lifting bag BPW 30 - p=5.0 bar:

$$F_{LB} = \frac{5.0\ bar}{0.00023\ \text{bar}/N\ \text{(press. in bag)}} = 21750\ N$$

Force of lifting bag BPW 36 - p=3.5 bar:

$$F_{LB} = \frac{3.5\ bar}{0.000156\ \text{bar}/N\ \text{(press. in bag)}} = 22450\ N$$

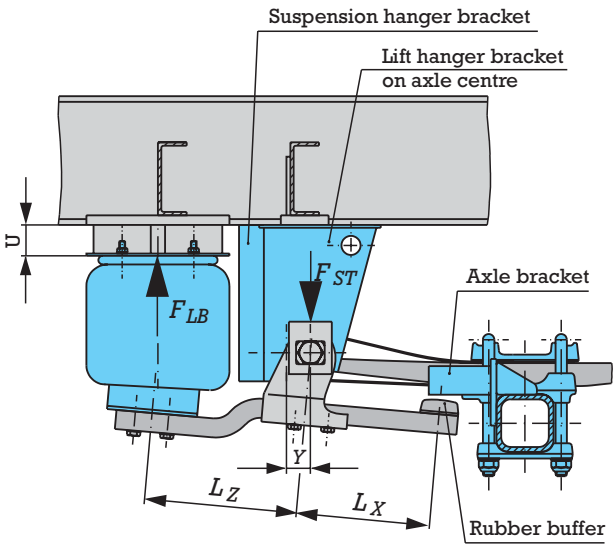


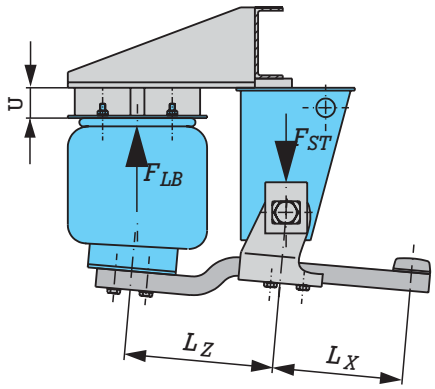
Remarks:

When retro-fitting, the bolt in the trailing arm eye must be replaced by a longer bolt (M 30). An installation drawing is supplied with every retro-fitting kit.

The positioning and installation of the axle lift device are to be carried out according to the BPW technical data and the installation drawing supplied. The length and orientation of the lifting arm can be seen in the technical documentation. After installation, the anti-rotation lock of the spring pivot bolt (M 30) should be welded to the head.

13.5 Middle axle lift





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.

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

$$F_{LB} = \frac{5.0\ bar}{0.00023\ \text{bar}/N\ \text{(press. in bag)}} = 21750\ N$$

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

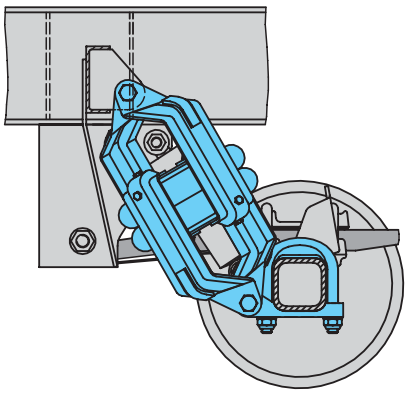
$$F_{ST} = \frac{21750\ N \times 600\ mm}{280\ mm} = 46600\ N$$

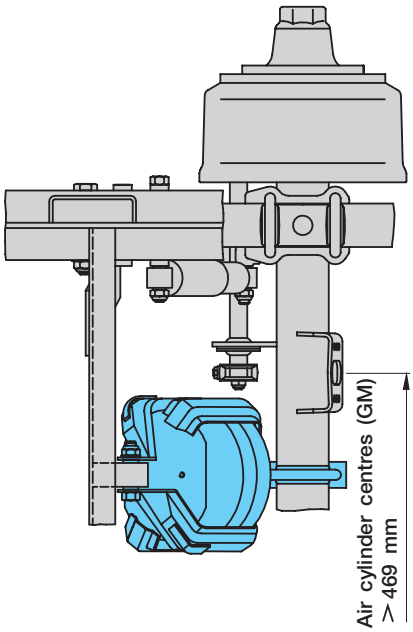
Remarks:

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

The axle bracket should be welded to the axle centre in accordance with the welding instructions.

After installation, the anti-rotation lock of the spring pivot bolt (M 30) should be welded to the head.



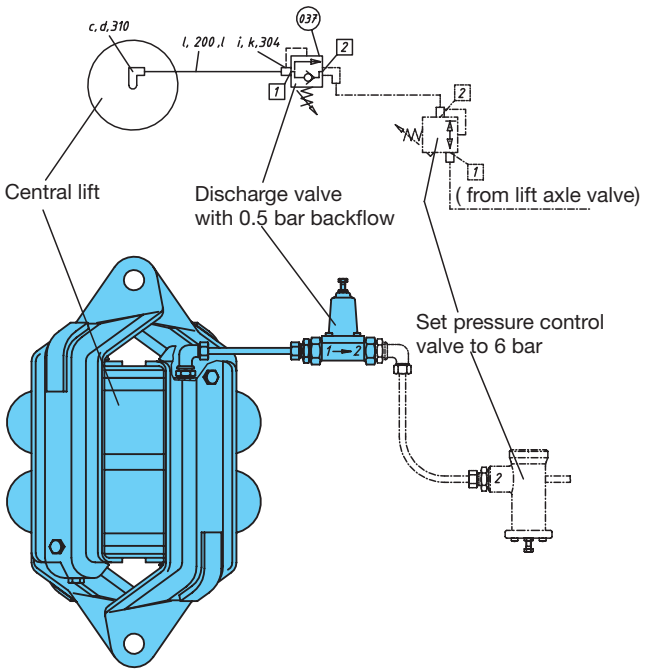


For lifting the centre or rear axle or, where there is limited space available, it is possible to use the central lift system. The centre lift is fitted on the chassis centre line. The top fixing is mounted to a chassis crossmember and the lower fixing is clamped to the axle beam.

The lifting bag forces must be counteracted by an adequately dimensioned crossmember.

Air installation:
Installation of pressure retention for central lift

The air pressure for the lift bag should be set at the pressure control valve to 6 bar!



Remarks:

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

The size of the crossmembers must be selected to offer the safety margins usual in vehicle construction.

13.7 Lifting stroke

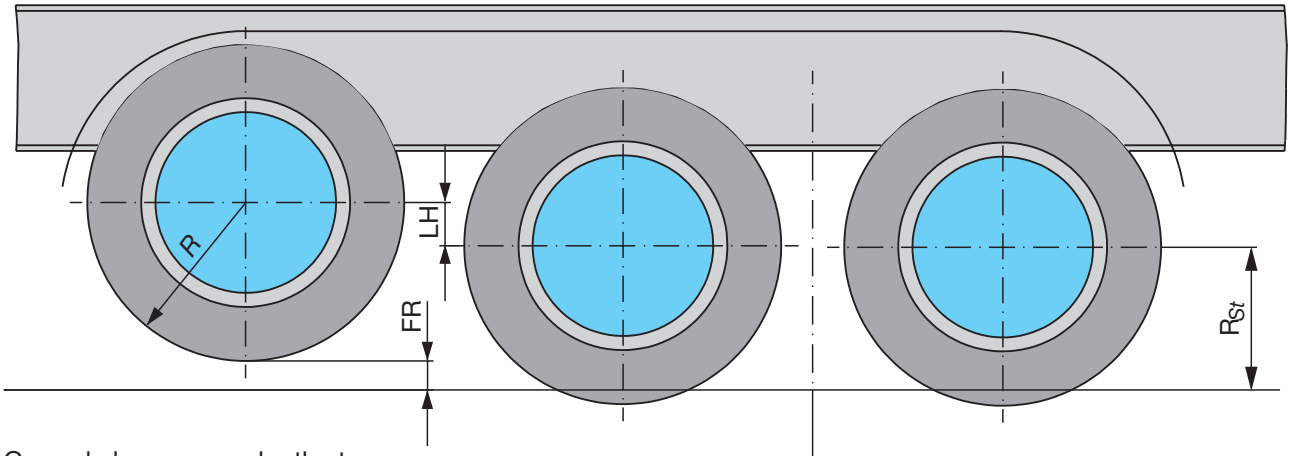
The ride height of air suspension units equipped with an axle lift should be set at a minimum of approx. 100 mm upward travel.
If the ride height cannot be set according to the minimum suspension retraction, a pneumatic cylinder can be installed on the air suspension valve.

When activating the lift device, the pneumatic cylinder is charged and the ride height is automatically increased by approx. 40 mm.

Observe total height of the vehicle!

Lifting stroke

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



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

LH min. 100 mm

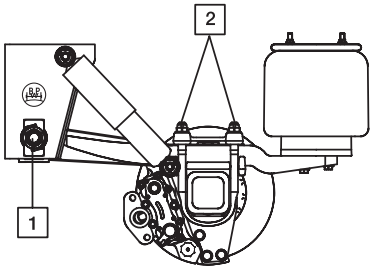
Wheel base to king pin
with raised axle

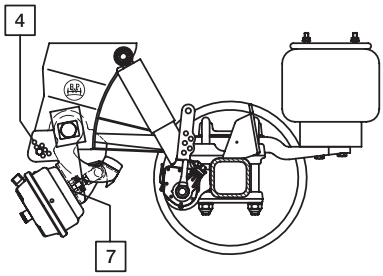
FR = Free space
LH = Lifting stroke
R_{St} = Tyre radius statically loaded
R = Tyre radius unloaded

Space for notes:

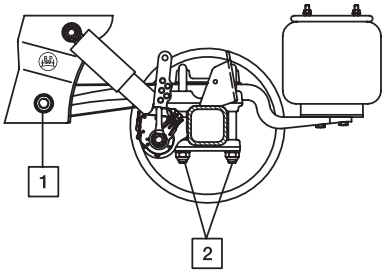
14 Important tightening torques

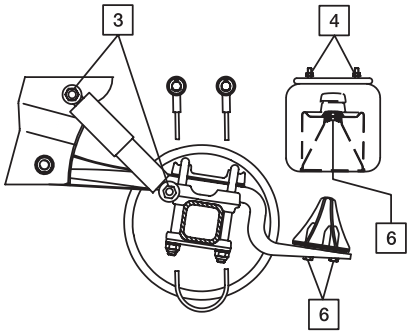
Series
O / SLO / ALO



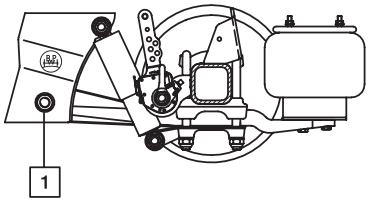


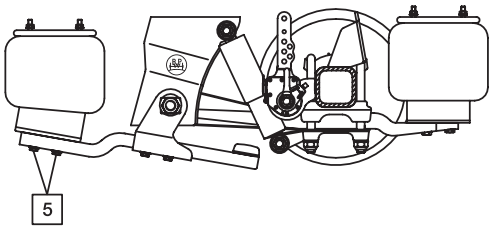
Series
OM / SLM / ALM



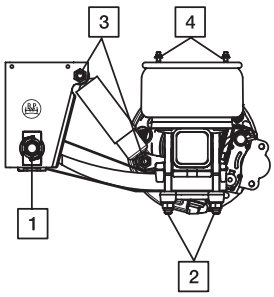


Series
OT / SLU / ALU

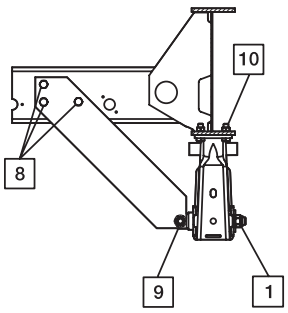


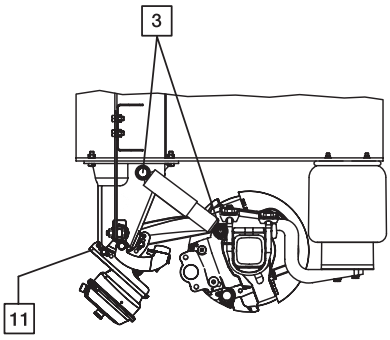


Series
DLU



Bolted hanger brackets /
Two-sided lift for bolted hanger brackets





Pos.	Attachment	Thread	Tightening torque (thread lightly greased)
1	**Spring pin**		
	Spring bolt air suspension hanger bracket up to production year 07/2001	M 30	**750 Nm** (700 - 825 Nm)
	Spring bolt air suspension hanger bracket from production year 08/2001 onwards	M 30	**900 Nm** (840 - 990 Nm)
	Spring bolt channel crossmember	M 30	**900 Nm** (840 - 990 Nm)
	Spring bolt welded hanger bracket / channel crossmember AL II from build year 09/2007 onwards [1]	M 24	**650 Nm** (605 - 715 Nm)
2	**Spring U-bolt**		
	Spring U-bolt (exchange / initial installation) [2]	M 20	**340 Nm** (315 - 375 Nm)
	Spring U-bolt (exchange / initial installation) [2]	M 24 - 10.9	**650 Nm** (605 - 715 Nm)
	Check the axle connection is firmly seated (maintenance / checking)	M 24 - 10.9	**650 Nm** (605 - 715 Nm)
	Spring U-bolt AL II (exchange / initial installation [2]	M 22 - 10.9	**550 Nm + 90° Rotational angle**
	Check the axle connection AL II is firmly seated (maintenance / checking)	M 22 - 10.9	**550 Nm** (510 - 605 Nm)
	Shock absorber		
3	Shock absorber	M 20	**320 Nm** (300 - 350 Nm)
	Shock absorber	M 24	**420 Nm** (390 - 460 Nm)
3A	Shock absorber on aluminium hanger bracket	M 24	**320 Nm** (300 - 350 Nm)
	Air bag		
4	Air bag top cover, stop two-sided lift	M 12	**66 Nm**
5	Air bag, bottom attachment	M 16	**230 Nm**
6	Air bag, central bolt	M 16	**230 Nm**
	Diaphragm cylinder		
7	Diaphragm cylinder, two-sided lift	M 16	**180 - 210 Nm**
	Bolted hanger bracket / two-sided lift for bolted hanger bracket		
8	Gusset plate / crossmember (use at least M 16!) [3]	M 16, 10.9	Max. permitted Md.
9	Gusset plate / hanger bracket	M 18 x 1.5	**420 Nm** (390 - 460 Nm)
10	Bottom flange / hanger bracket (knurled bolt)	M 16	**260 Nm** (240 - 285 Nm)
11	Two-sided lift with bolted hanger bracket		
	- Diaphragm cylinder	M 16	**180 - 210 Nm**
	- Retaining arm	M 16	**230 Nm**
	- Hexagon bolt SW 24	M 12	**100 Nm**

[1] M 24 spring bolts are coated with Geomet, no need for greasing.
[2] Apply grease to the threads of the spring U-bolts and nut contact surfaces.
[3] BPW does not supply the gusset plate / crossmember bolt connection.

BPW-EA-Luft 1023701e

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