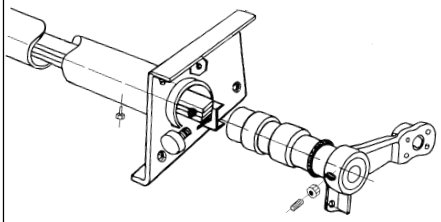
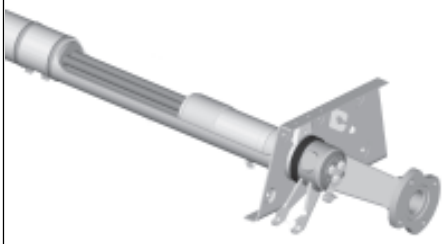
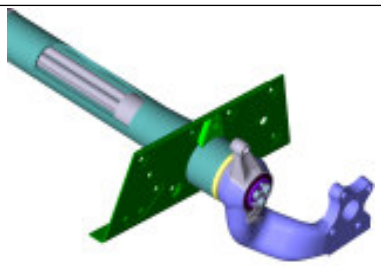
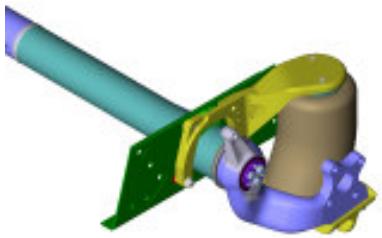
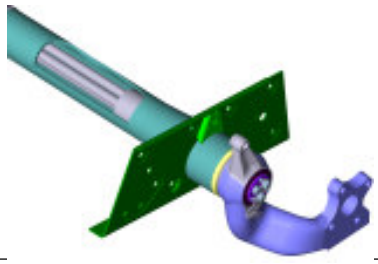
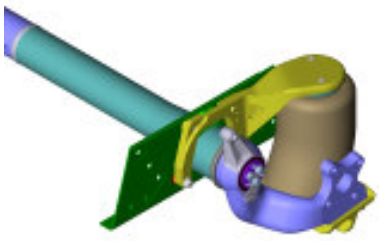
Chapter 3

amc-Axles

Table of Contents Chapter 3

3.1 amc-Axle designs

Axle model	Pictorial representation	Produced from - to	Brake Type	Maintenance Information
BT		up to approx. 08.1997	Drum	See Chapter 3.6.2 for lubrication intervals
BTR1		from approx. 08.1997 up to 05.2000	Drum	See Chapter 3.6.2 for lubrication intervals
BTR1.5		from 06.2000 up to 12.2001	Drum	See Chapter 3.6.2 for lubrication intervals
BTR2 Air suspension		from 06.2000 up to 12.2001	Drum	maintenance free swing arm bearing
BTR3		from 01.2002 up to →	Drum Disc	See Chapter 3.6.2 for lubrication intervals
CA3		from 09.2003 up to →	Drum Disc	maintenance free swing arm bearing
BTR2 Air suspension		from 01.2002 up to →	Drum Disc	maintenance free swing arm bearing
CA4 Air suspension		from 05.2003 up to →	Drum Disc	maintenance free swing arm bearing

3.2 General axle set-up

All AL-KO amc axles are longitudinal swinging arms with independent suspension.

Dependent on the suspension type a difference is made between torsion bar suspension axles (Fig 1) and air suspension axles (Fig 2).

Together with the chassis, the amc-axles fulfil the important function of the main chassis stabilising component, in addition to fufilling the demanding driving dynamic tasks.

For this reason all amc-axles are integrated in the chassis structure with the aid of high-tensile and in part interlocking bolt connections (shearing cam bolt connections).

All axle designs essentially consist of the following components (Fig 1 and 2):

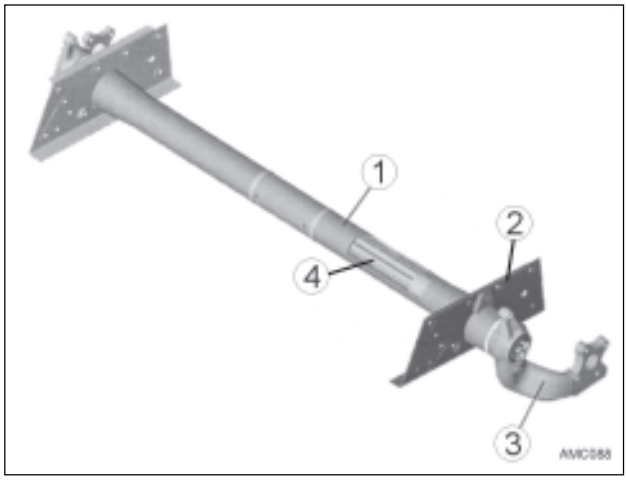


Fig. 1

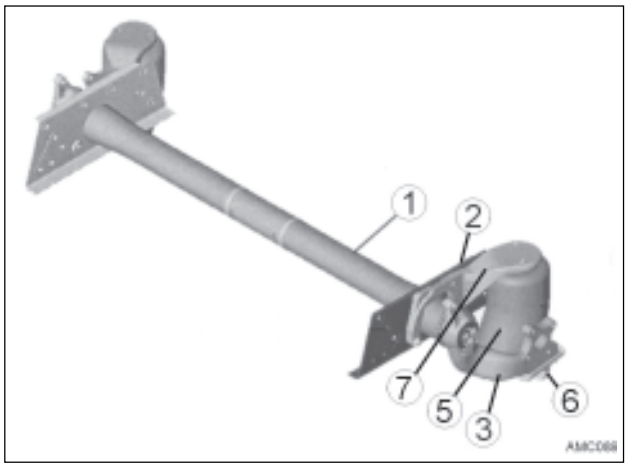


Fig. 2

Keys to Figs 1 and 2

1 Axle tube

2 Axle brackets

3 Swing arm with inner tube

4 Spring elements (torsion bars x 3 off)

(Note: Air Suspension Axles only have 2x torsion bars)

5 Air bellows

6 Bellows bracket bottom

7 Bellows bracket top

Specific axle characteristics dependent on chassis design:

- Track
- Swing arm setting (unloaded)
- Swing arm design
- Axle bracket design
- Maintenance

3.3 Function principle

The swing arm with the fitted inner tube is turned during the static or dynamic wheel load changes. The inner tube is mounted in the axle tube.

The spring assemblies (fixed by the retaining nuts (only axle model BT)) on the swing arm and axle tube side or the torsion bars, are twisted here, and thus carry out the spring work.

Keys to Figs 3 and 4

1 Axle tube

2 Axle brackets

3 Swing arm with inner tube

4 Spring elements (torsion bars x 3 off)

(Note: Air Suspension Axles only have 2x torsion bars)

5 Air bellows

6 Bellows bracket bottom

7 Bellows bracket top

For air suspension axles the spring work is taken over by the air bellows that are fitted on the relevant bellows brackets. The special torsion bars used for air suspension axles are mainly used to support the transverse forces.

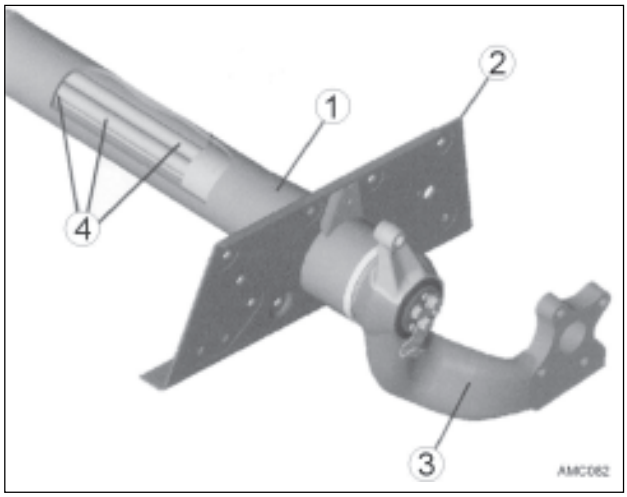


Fig. 3

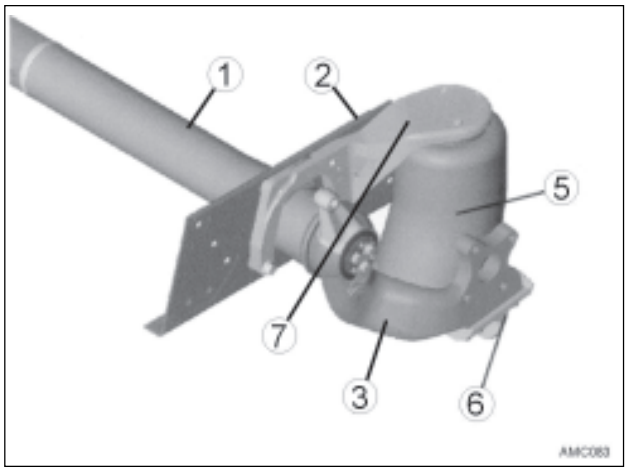


Fig. 4

3.4 Axle rating plate

Fitting location

Axle model BT/BTR1 (Fig 5)

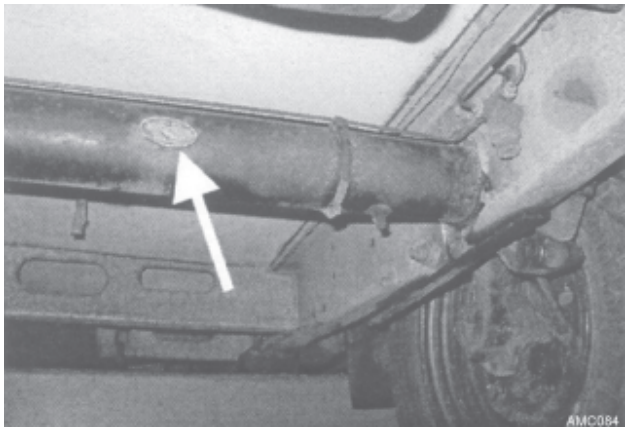


Fig. 5

Axle model BTR1.5/BTR2/BTR3/CA3/BTR4/ CA4 (Fig 6)

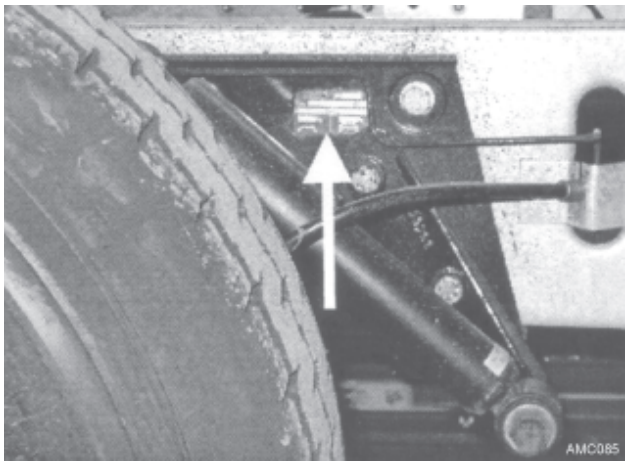


Fig. 6

Characteristic data

The axle rating plates contain the following characteristic data:

A - Axle type
B- Art.-No. and amendment status
C- Order-No.
D- Order item no./order serial no.
E- Max.permitted axle load

Fig. 7

A- no meaning
B- Axle type/Art.-No. and amendment status
C- Axle type design
D- Order no./order serial no.
E- no meaning
F- Max. permitted axle load
G- Max. permitted axle load (if tandem)

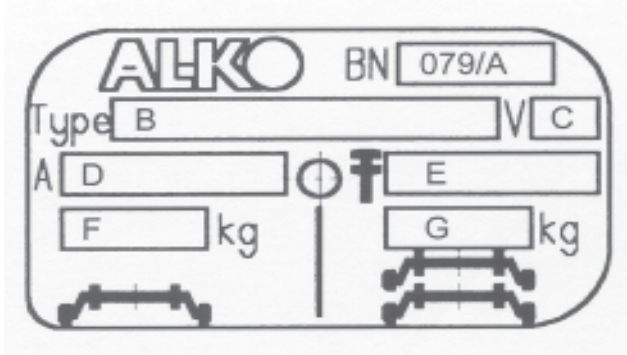


Fig. 8

3.5 Chassis measurement before and after repair work

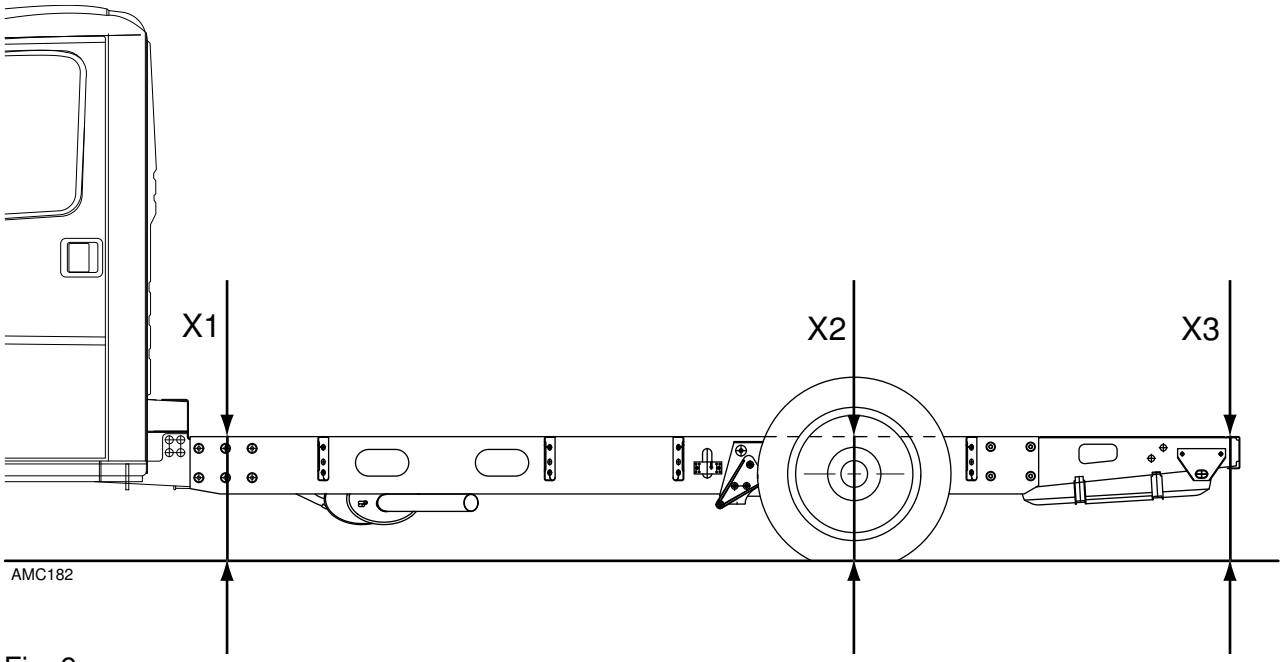


Fig. 9

Measuring points:

X1 Connection to basic vehicle
X2 Axle area
X3 End cross member

Before starting work we recommend in general that the individual axle loads are weighed.

The chassis frame heights "X1“, "X2“ and "X3“ above the road (Fig 9) must be measured in order to assess the effects on the standing height (before and after repair) when replacing the swing arm, torsion bars or axles.

3.6 Torsion bar suspension axles

3.6.1 axle types and axle components

Type BT (Fig 9)

A spring assembly made from individual spring leaves serves as a spring element (Fig 10 -1). These spring assemblies differ in respect of the cross sections, the layering of the leaves, as well as the spring clamping lengths, dependent on axle load and the spring characteristics required.

The spring deflection end stop (Fig 10-2) is positioned differently, dependent on the respective axle design or the respective swing arm setting, in an unloaded state.

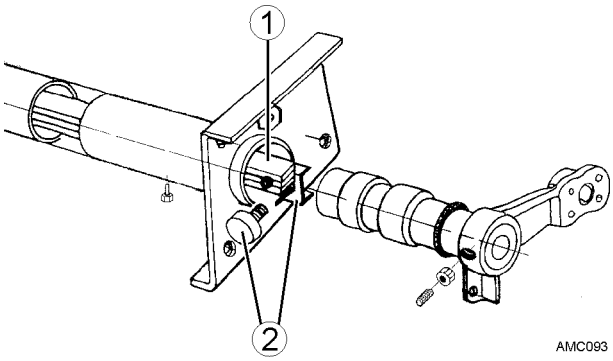


Fig. 10

Model BTR1/BTR1.5/BTR3/CA3 (Fig 11)

6 round torsion bars (Fig 11-1) per axle with spline toothed bar ends (Fig 12-1) serve as spring elements.

These torsion bars differ in their technical design dependent on the respective permitted axle load and the relevant axle side.

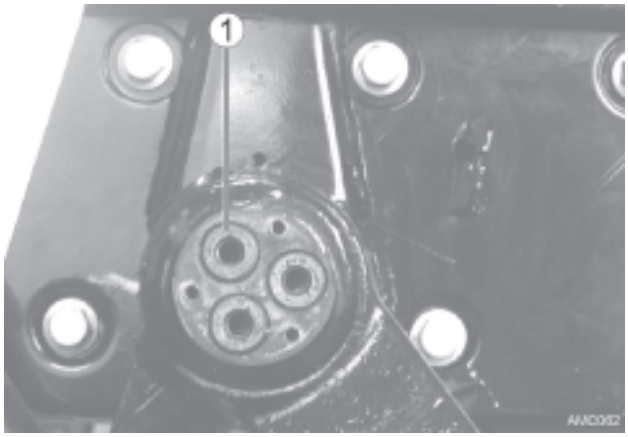


Fig. 11 BTR1 is shown as an example

Clear torsion bar identification is provided by 2 colour markings on each bar (Fig 12).

CAUTION

torsion bars must be fitted laterally reversed.

Marking (A): red = left hand side of axle
yellow = right hand side of axle

Marking (B): Axle load allocation

If required the axle load allocations can be requested via our service centre.

The function of the spring deflection end stop is taken over by the shock absorber with integrated Cellasto-additional spring - (except from models BT/BTR1).

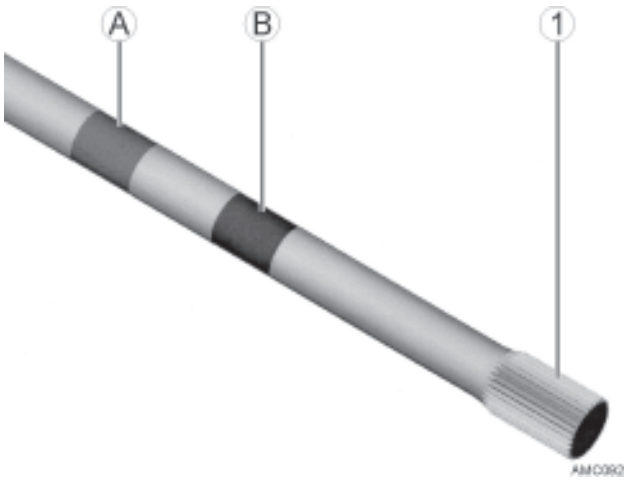


Fig. 12

3.6.2 Maintenance

The following maintenance work and information are also to be taken into consideration in addition to the technical specifications:

3.6.2.1 Greasing the torsion bar suspension axles

Greasing interval:

- every 20,000 km,
- or at least once a year

NOTE

The maintenance intervals are to be shortened where the vehicle is used under difficult conditions (e.g. use for short journeys, driving in dusty areas, mountain trips, trailer operation etc.).

All non-maintenance free torsion bar suspension axles are fitted with 2 grease nipples on the bottom of the axles (Fig. 13).

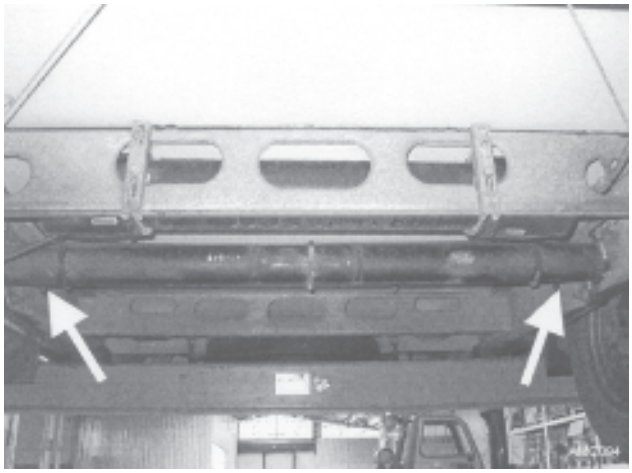


Fig. 13

Permitted grease:

- Made by CONDA: Cardex 3746 SP

(Order no. see chapter 9)

Procedure:

1. Relieve rear axle completely (i.e. tyres have no ground contact).
2. Open grease nipple protective caps.
3. Insert grease from the hand lever grease gun using 5 - 7 strokes for each grease nipple (Fig 14). An adequate quantity of grease has been inserted when resistance is felt.
4. Put grease nipple protective caps in place.
5. Apply load to rear axle again.

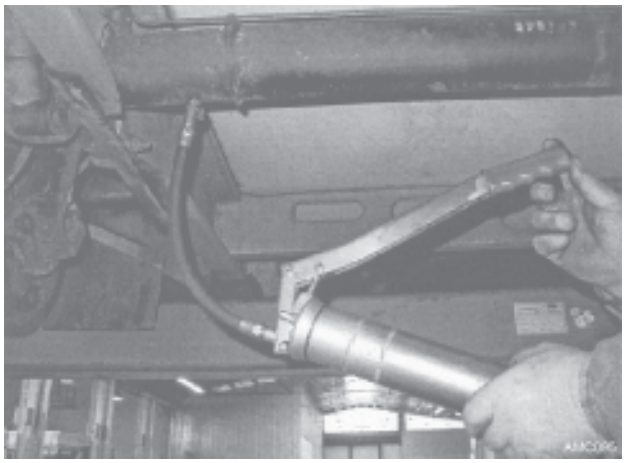


Fig. 14

3.6.3 Replacing torsion bars (Model BTR1/BTR1.5/BTR3/ CA3)

1. Measure chassis as per Chapter 3.5.

CAUTION
Always replace torsion bars on both sides.

Removal

2. Relieve rear axle completely.
3. Remove wheels.

   Fitting information (for standard steel and alloy wheels):
   Torque Settings:
   Wheel bolts 15" 160 Nm
   Wheel bolts 16" 180 Nm

4. Unscrew three hexagon bolts M10x16 (Fig 15 - 2) and remove with the brake cable holder (Fig 15 -1).

   Fitting information:
   Torque setting: 50 Nm

5. Remove shock absorber on the swing arm side, see Chapter 4.4

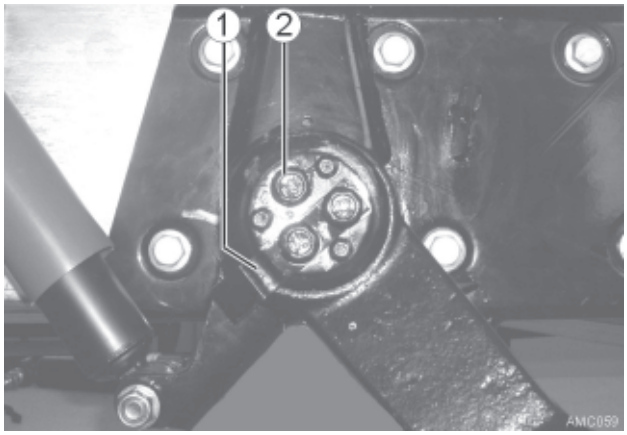


Fig. 15

6. Unscrew three hexagon socket or Torx screws (Fig 16-1) (dependent on axle design) M6x16 and remove cover washer (Fig 16-2).

   Fitting information:
   Torque setting: 10-15 Nm

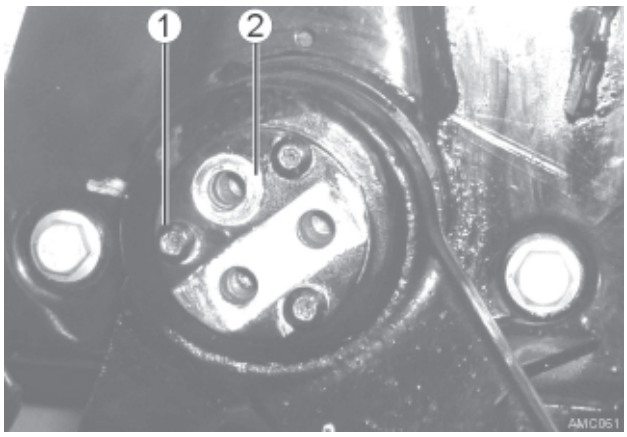


Fig. 16

Dependent on axle design:

7. Remove cover plug to remove the dowel.
8. Knock out dowel in the centre of the axle tube D=8.5mm using a pin punch.

or

9. Unscrew hexagon bolt (Fig 17-1) and remove with the seal washer.

   Fitting information:
   Torque setting: 50 Nm

⚠ CAUTION
In order to relieve the brake hose, support the swing arm on the brake drum, if necessary

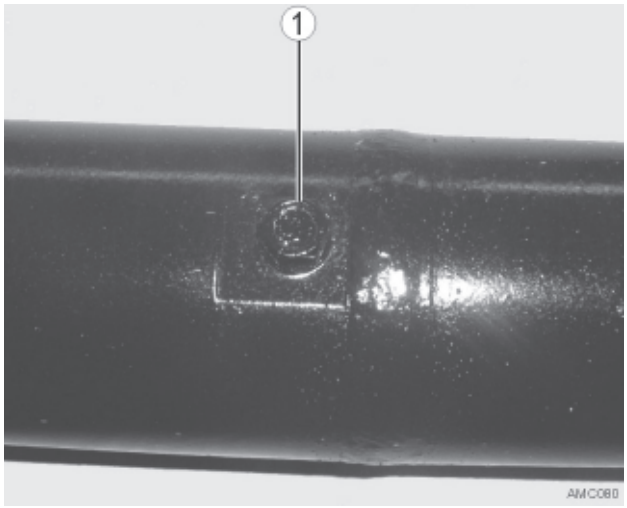


Fig. 17

1 Dowel pin

2 Hexagon bolt

3 Sealing washer

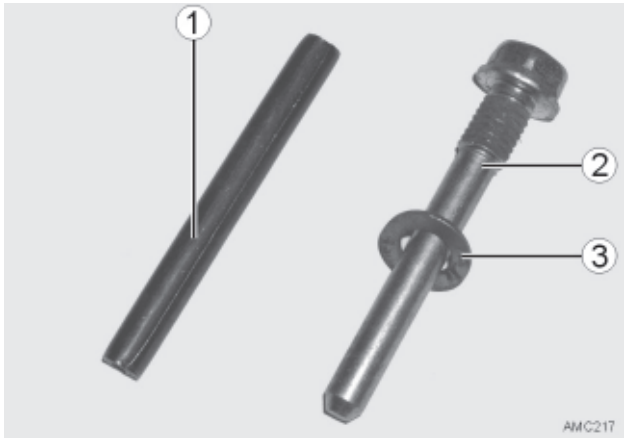


Fig. 18

10. Screw extraction tool (Fig 19 -1) into the torsion bar (Fig 19 - 3).
11. Knock impact bushing (Fig 19 -2) against the extraction tool stop in the direction of the arrow, until the torsion bar can be removed.
12. Repeat work steps 10 and 11 for the 2nd and 3rd torsion bar.

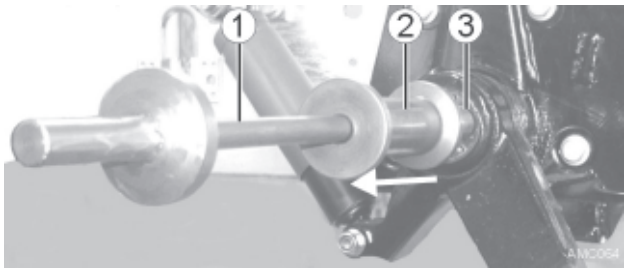


Fig. 19

Installation

13. Lay swing arm underneath, until the dimension "X“ (Fig 20) is reached.

    Dimension "X“. Top edge frame (Fig 20 - 1) -
    Stub axle centre point (Fig 20 - 2)

14. The dimension "X“ is determined using the tables and figures 22 to 25 on pages 3-15 and 3-16 (dependent on axle model and swing arm design).

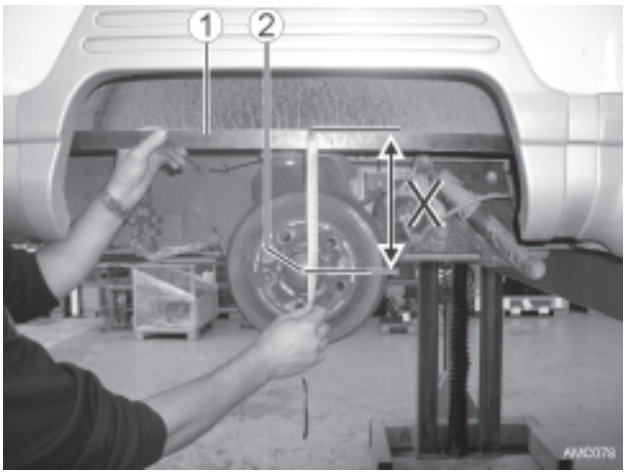


Fig. 20

CAUTION
Identification of the torsion bars:
left: red
right: yellow

15. Insert the torsion bar (Fig 21-1) in the swing arm (Fig 21-2) and turn tooth by tooth until it can be knocked in easily, using the assembly tool.
16. Knock the torsion bar (Fig 21-1) in completely using the assembly tool.
17. Check if the dowel pin or the hexagon bolt (Fig 18) fits through the drill hole in the axle tube and through the slot in the torsion bar.
18. Repeat the procedure for the 2nd and 3rd torsion bar.

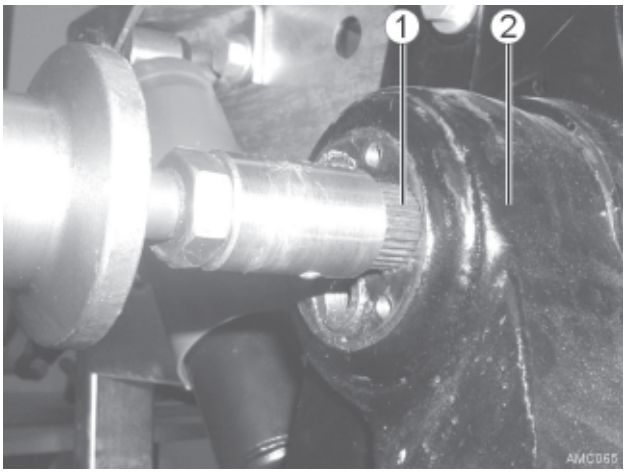


Fig. 21

The remaining assembly procedure takes place in reverse order.

19. Grease the rear axle

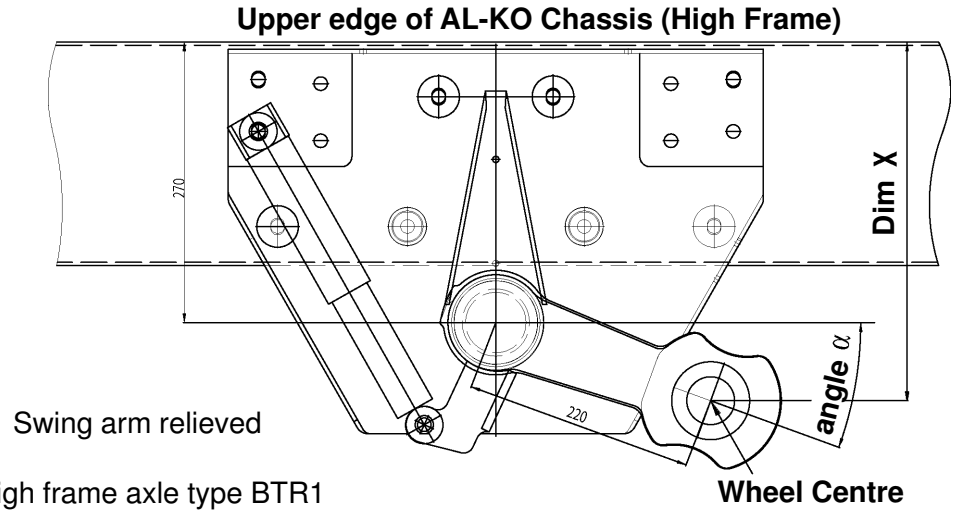


Fig. 22 High frame axle type BTR1

Angle α	Dimension X [mm]
20° ± 2°	345,2 ± 7
34° ± 2°	393,0 ± 6
40° ± 2°	411,4 ± 6
43° ± 2°	420,0 ± 6
50° ± 2°	438,5 ± 5

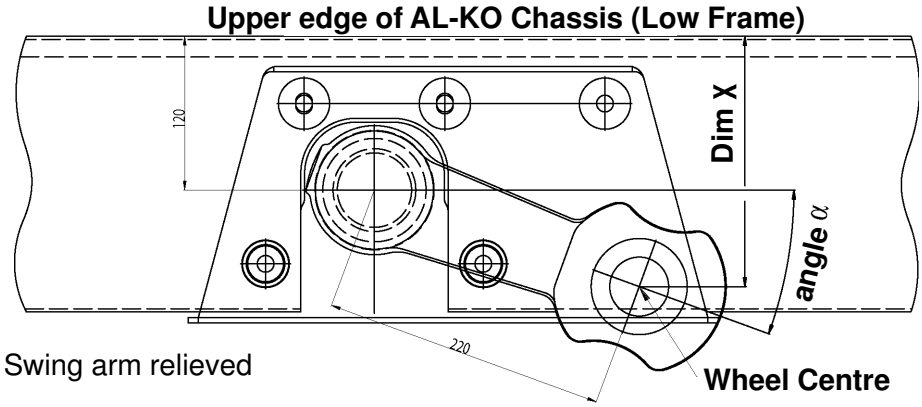


Fig. 23 Low frame axle type BTR1

Angle α	Dimension X [mm]
7° ± 2°	146,8 ± 8
14° ± 2°	173,2 +7 -8
20° ± 2°	195,2 ± 7
25° ± 2°	213,0 ± 7
34° ± 2°	243,0 ± 6
40° ± 2°	261,4 ± 6
50° ± 2°	288,5 ± 5

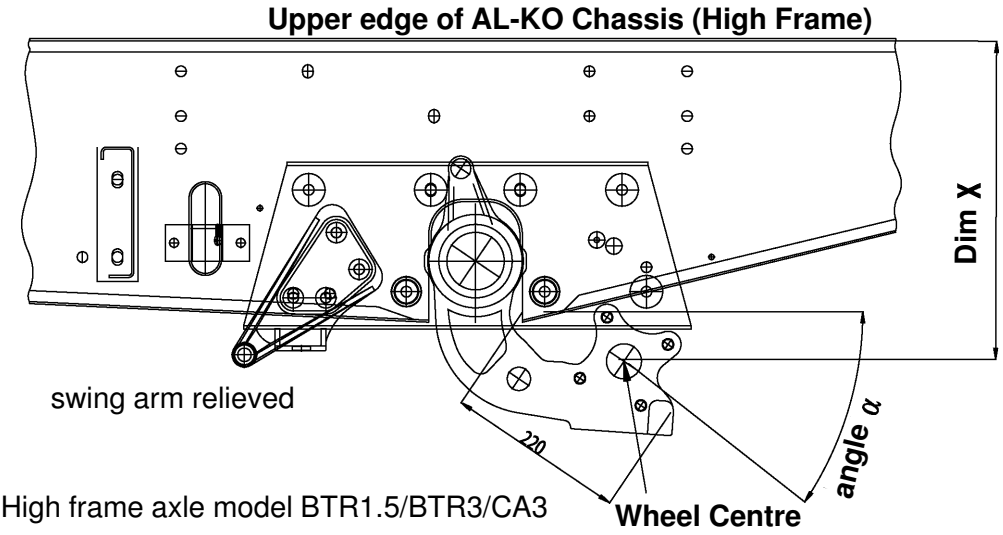


Fig. 24 High frame axle model BTR1.5/BTR3/CA3

Axle model	Spring type	Angle α	Dimension X [mm]
BTR1.5/3 CA3	Torsion bar suspension axle	4° + 2° 10° + 2° 15° + 2° 20° + 2° 34° + 2°	288 + 8 311 + 8 330 + 7 348 + 7 396 + 6

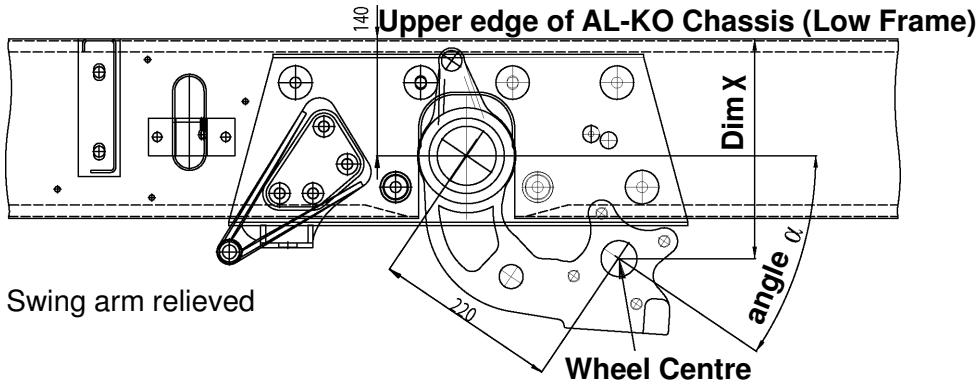


Fig. 25 Low frame axle model BTR1.5/BTR2/BTR3/CA3/BTR4/CA4

Axle model	Spring type	Angle α	Dimension X [mm]
BTR1.5/3 CA3	Torsion bar suspension axle	4° + 2° 10° + 2° 15° + 2° 20° + 2° 34° + 2°	155 + 8 178 + 8 197 + 7 215 + 7 263 + 6
BTR2/4 CA4	Air suspension (Bellows pressureless)	2° + 2° 21° + 2°	148 + 7 219 + 7

3.6.4 Replacing the swing arm

1. Measure chassis as per Chapter 3.5.
2. Relieve rear axle completely.
3. Remove wheel

   Fitting information (for standard steel or alloy wheels):
   Torque settings:
   Wheel bolts 15" 160 Nm
   Wheel bolts 16" 180 Nm

BTR1/BTR1.5/BTR3/CA3 with drum brake (work steps 5 to 9)

4. Slacken handbrake Bowden cable (Fig 26-1) by loosening the hexagon nuts (Fig 26-2) and (Fig 26-3) slackening.

   Fitting note:
   The parking brake is adjusted in accordance with Chapter 5.5.3**.**

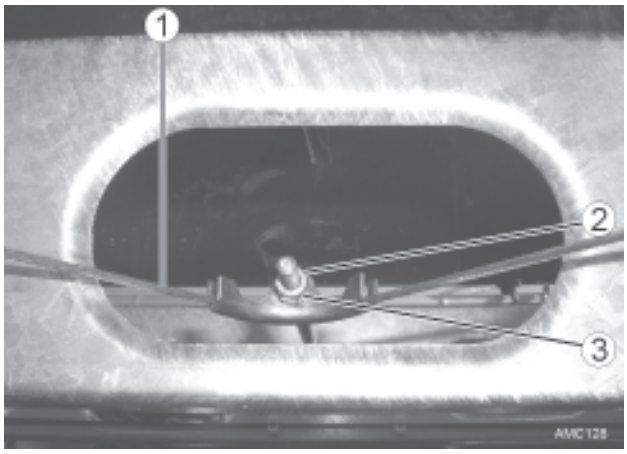


Fig. 26

5. Remove grease cap (Fig 27-1).
6. *Remove brake drum (Fig 27-2) as per assembly instructions from the basic vehicle manufacturer.*

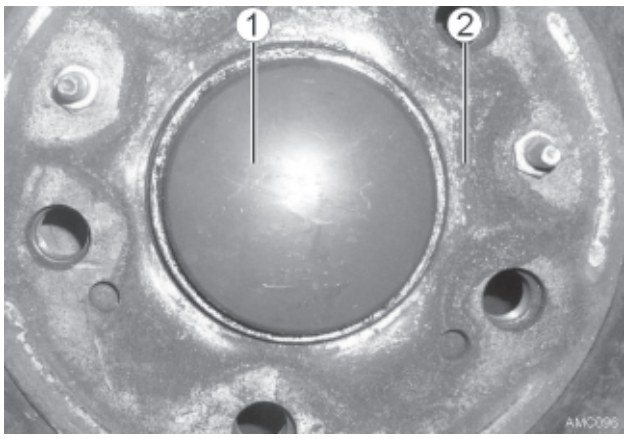


Fig. 27

7. *Dismantle the back plate (Fig 28 - 1) as well as the stub axle (Fig 28-2) as per assembly instructions from the basic vehicle manufacturer.*

   Fitting instructions:
   4 M14x1.5x55 screws (Fig 28 - 3):
   Torque setting: 150 Nm

8. Lay stub axle on one side.

NOTE
Leave back plate on the brake hose during further assembly and secure from dropping down.

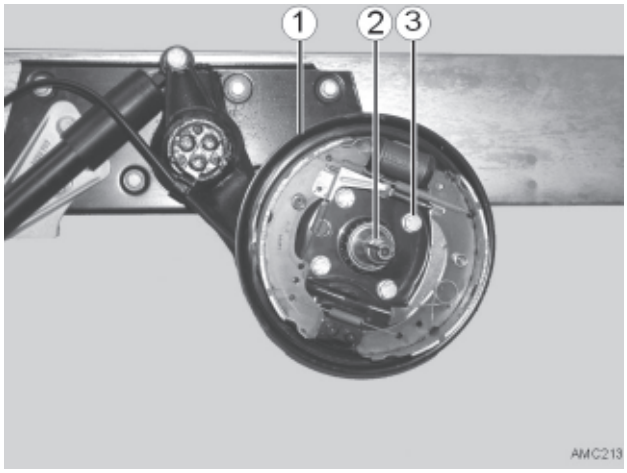


Fig. 28

BTR3/CA3 with disc brake
(Work step 10 to 15)

9. Unscrew hexagon bolt (Fig 29 -3) with washer (Fig 29 -2) and remove speed sensor (Fig 29 - 1), (if fitted).

10. Remove speed sensor cable from mount.

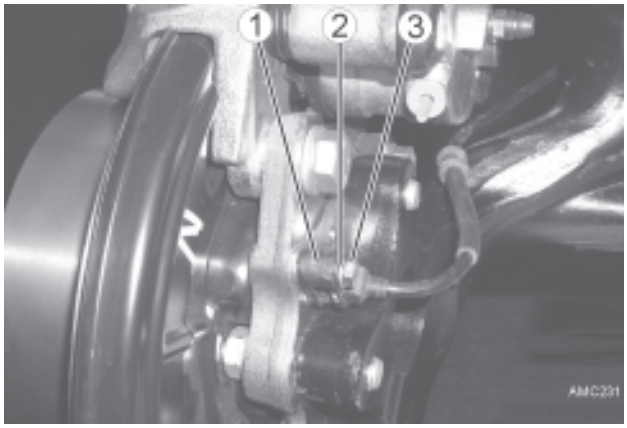


Fig. 29

11. *Remove brake calliper (Fig 30-1) as per assembly instructions from the basic vehicle manufacturer.*

    Fitting instructions
    Screw brake calliper (Fig 30 -2):
    Torque setting: 188 Nm

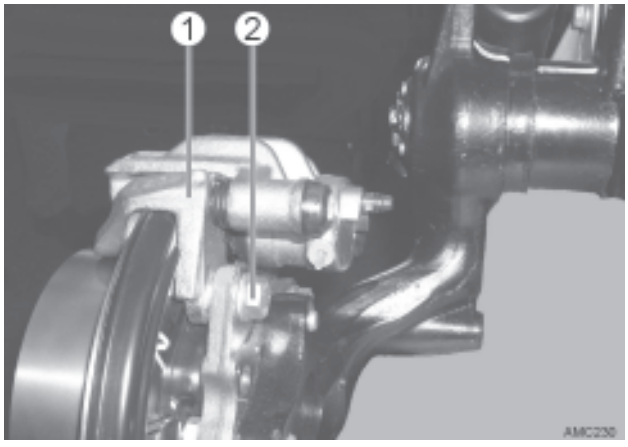


Fig. 30

12. Remove brake disc (Fig 31-1) as per assembly instructions from the basic vehicle manufacturer.

    Fitting instructions:
    Hub nut (Fig 31-2):
    Torque setting: 450 Nm

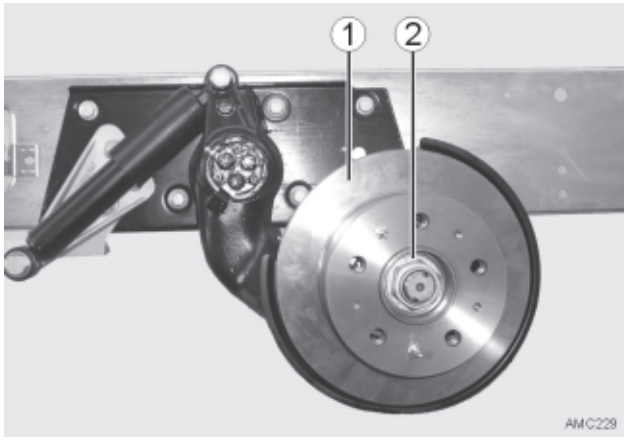


Fig. 31

13. Remove back plate (Fig 32-1) as per assembly instructions from the basic vehicle manufacturer.

    Fitting instructions
    Screws M8x16 (Fig 32 -2):
    Torque setting: 25 Nm
    Screws M16x1.5x30 screws (Fig 32 - 3):
    Torque setting: 200 Nm

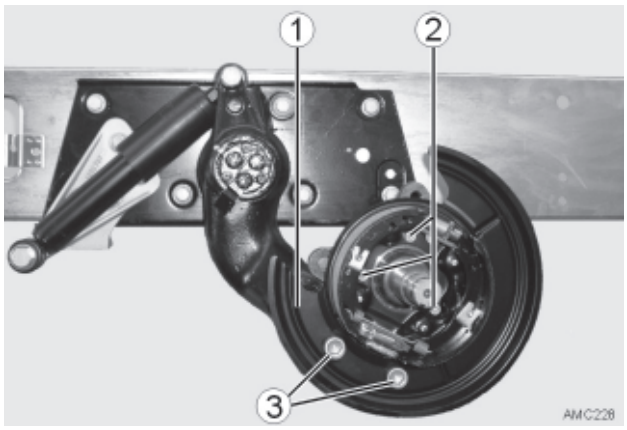


Fig. 32

14. *Remove stub axle (Fig 33-1) as per assembly instructions from the basic vehicle manufacturer.*

    Fitting instructions:
    4 M14x1.5x55 screws (Fig 33 -2):
    Torque setting: 150 Nm

15. Remove torsion bars as per Chapter 3.6.3.

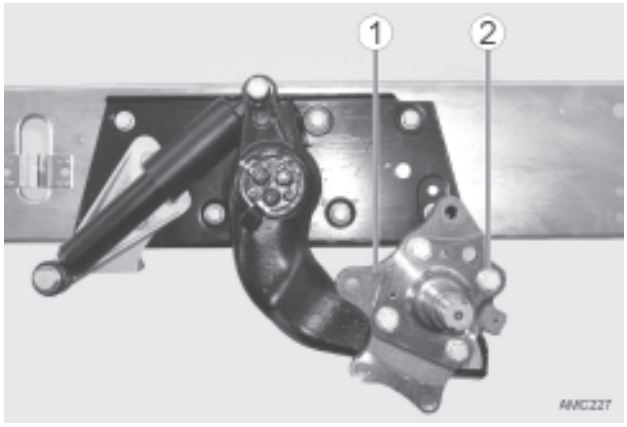


Fig. 33

16. Pull out swing arm (Fig 34-1) from axle tube (Fig 34 -4).
17. Lift sleeve (Fig 34-3) out of the slot (Fig 34 - 2) in the swing arm using a screwdriver.
18. Check sleeve (Fig 34 -3), replace if necessary.

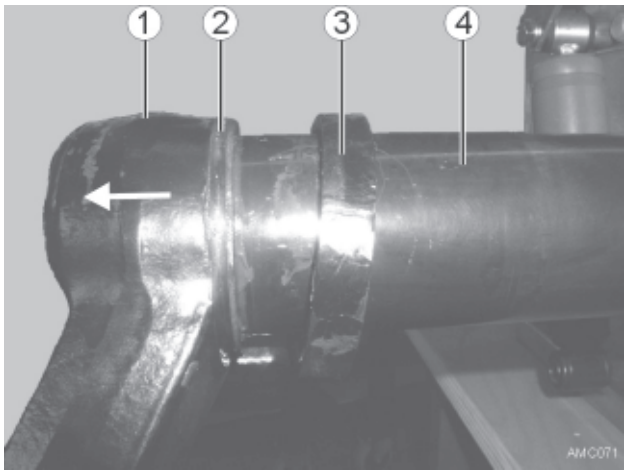


Fig. 34

19. Check sealing ring (Fig 35 -1), replace if necessary.

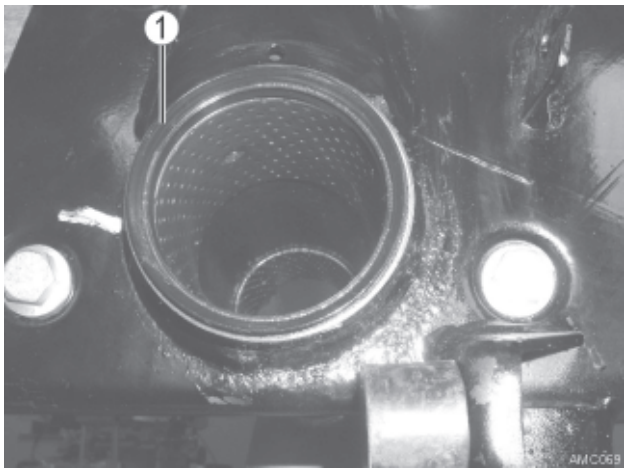


Fig. 35

Fitting takes places in reverse order.

3.6.5 Replacing axle (Model BTR1/BTR1.5/BTR3/ CA3)

1. Measure chassis as per Chapter 3.5.
2. Relieve axle completely.
3. Remove wheels.

   Fitting information (for standard steel or alloy wheels):
   Torque setting:
   Wheel bolts 15" 160 Nm
   Wheel bolts 16" 180 Nm
4. *Dismantle the wheelbrake, the back plate, as well as the stub axle as per the assembly instructions from the basic vehicle manufacturer.*

   Fitting instructions:
   M14x1.5x55 screw:
   Torque setting: stub axle: 150 Nm
5. Leave back plate on the brake hose during further assembly and secure.
6. Remove shock absorber (Fig 36 - 1) as per chapter 4.4.

⚠ CAUTION
Support axle underneath. The axle weighs approx. 70 kg!

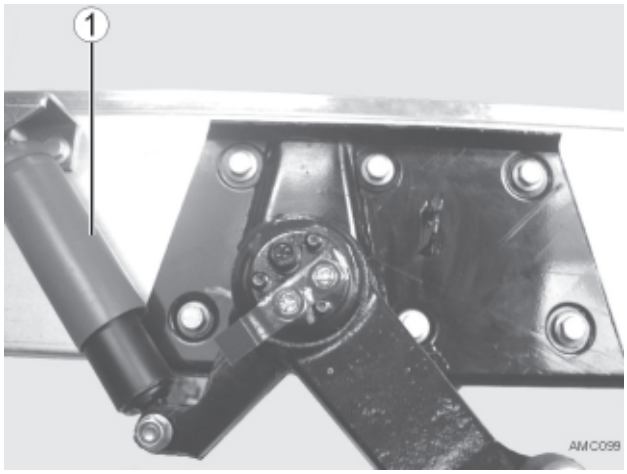


Fig. 36 Picture shows axle model BTR1

BTR1
(Work steps 7 to 13)

7. Unscrew the three upper M12 counternuts (Fig 37-5) from the inside of the frame.

   Fitting information:
   Torque setting: 86 Nm

8. Remove reinforcement plate (Fig 37-4) and DIN 125-A13 washers (Fig 37-3) from the inside of the frame.

9. Remove three M12x35 hexagon bolts (Fig 37-2) with DIN 125-A13 discs (Fig 37 - 3).

10. Unscrew the three bottom M12 counternuts (Fig 37 -5) from the inside of the frame and remove the DIN 7349-13x30x4 washers (Fig 37 - 6).

    Fitting information:
    Torque settingt: 86 Nm

11. Remove three M12x35 hexagon bolts (Fig 37-2) with DIN 125-A13 washers (Fig 37 - 3).

12. Remove axle (Fig 37-1).

13. Check damping rubber(Fig 37—7), replace if necessary:
    Unscrew M8 hexagon nut (Fig 37 -9), remove B8 spring washer (Fig 37 - 8) and damping rubber(Fig 37 - 7).

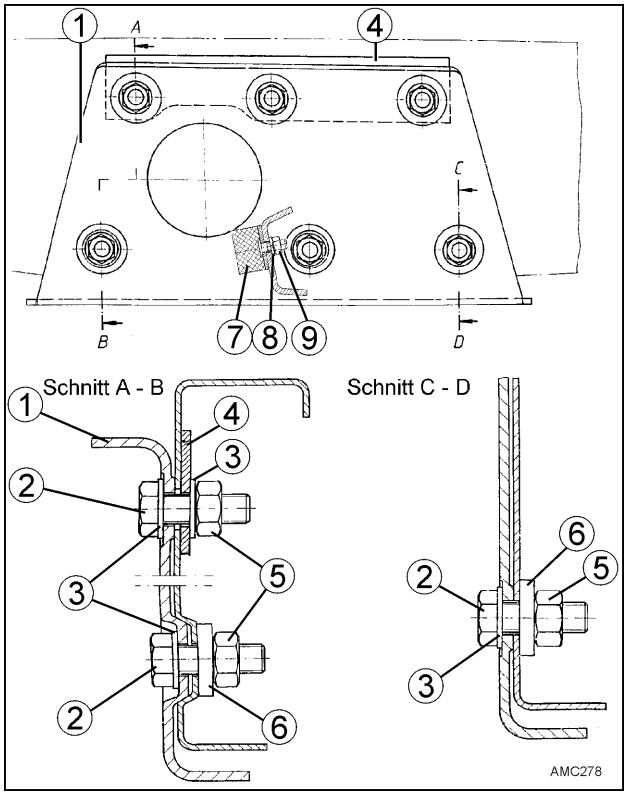


Fig. 37

BTR1.5/BTR3/CA3
(Work steps 14 to 18)

14. Unscrew four M12x1.5 counternuts (Fig 38 - 6) from the inside of the frame.

    Fitting information:
    Torque setting: 120 Nm

15. Remove M12x1.5x40 hexagon bolts (Fig 38-5) with shock absorber mount (Fig 38-4) and angle (Fig 38 -7).

⚠ CAUTION
Support axle underneath. The axle weighs approx. 70 kg!

16. Unscrew three M12x1.5 counternuts (Fig 38 -9) from the inside of the frame.

    Fitting information:
    Torque setting: 120 Nm

17. Remove reinforcement plate (Fig 38 - 10) from the inside of the frame and take out M12x1.5x35 hexagon bolts (Fig 38 - 8).

18. Unscrew four M12x1.5 counternuts (Fig 38 - 3) from the inside of the frame.

    Fitting information:
    Torque setting: 120 Nm

19. Remove M12x1.5x35 hexagon bolts (Fig 38-2) and take the complete axle off (Fig 38 - 1).

Fitting takes place in reverse order.

20. Bleed the braking system as per chapter 5.3 and check function.

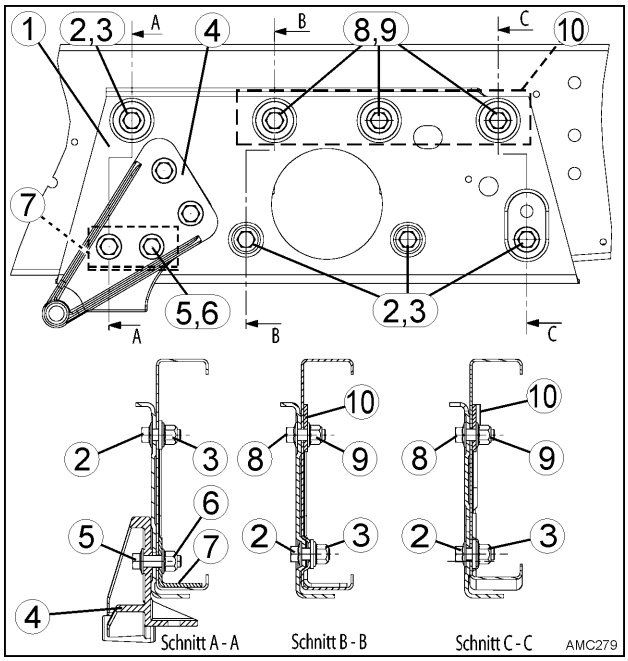


Fig. 38

3.7 Air suspension axles

3.7.1 axle types and axle components

Model BTR2/BTR4/CA4 (Fig 39)

The spring work for air suspension axles is taken over by the air bellows (Fig 39 -2) that are fitted on the relevant bellows brackets (Fig 39 - 6 and 7). The special torsion bars used for air suspension axles are mainly used to support the transverse forces.

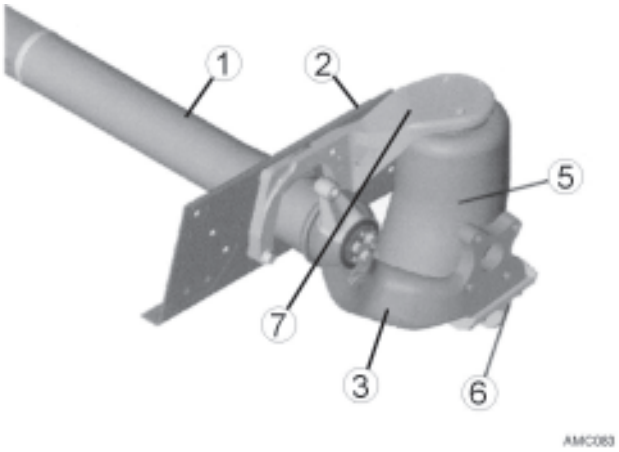


Fig. 39

3.7.2 Maintenance

3.7.2.1 Air suspension

The swing arm bearings as well as the air suspension components are maintenance free.

3.7.3 Replacing torsion bars

1. Measure chassis as per Chapter 3.5.
2. Remove wheels.

   Fitting information (for standard steel or alloy wheels):
   Torque setting:
   Wheel bolts 15" 160 Nm
   Wheel bolts 16" 180 Nm
3. Depressurise air bellows, see Chapter 7.2, work step 3.
4. Further removal of the torsion bars takes place as described in chapter 3.6.3, work steps 4 - 12.

Fitting takes place as described in Chapter 3.6.3, Work Steps 13-18.

3.7.5 Replacing the swing arm

1. Measure chassis as per Chapter 3.5.
2. Remove wheels.

   Fitting information (for standard steel or alloy wheels):
   Torque setting:
   Wheel bolts 15" 160 Nm
   Wheel bolts 16" 180 Nm
3. Remove air bellows as per Chapter 7.2.
4. Remove torsion bars as per Chapter 3.6.3, Work Steps 4-12.

BTR3/CA4 with disc brake (Work steps 5 to 14)

5. *Remove brake calliper (Fig 40-1) as per assembly instructions from the basic vehicle manufacturer.*

   Fitting information (screws brake calliper)
   Torque setting: 188 Nm

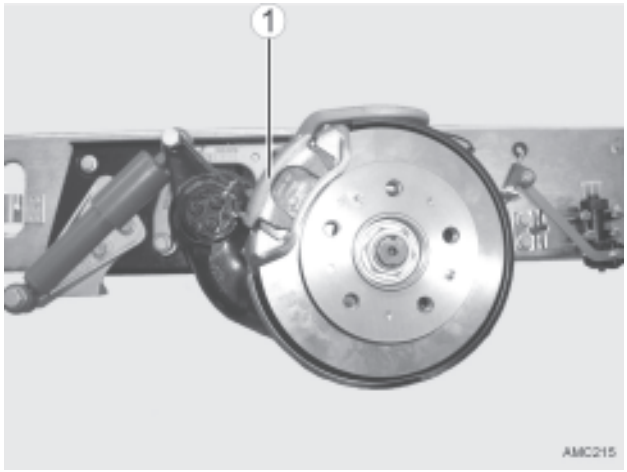


Fig. 40

6. *Remove brake disc (Fig 41-1) as per assembly instructions from the basic vehicle manufacturer.*

   Fitting instructions:
   Hub nut (Fig 41-2):
   Torque setting: 450 Nm

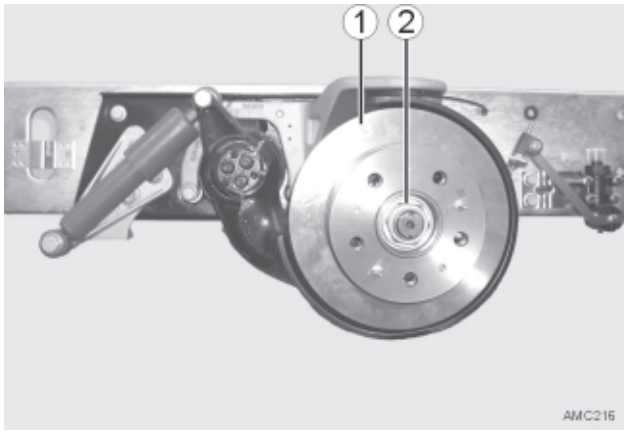


Fig. 41

7. *Remove back plate (Fig 40-1) as per assembly instructions from the basic vehicle manufacturer.*

   Fitting instructions
   3 screws M8x16 (Fig 42 -2):
   Torque setting: 25 Nm
   Screws M16x1.5x30 (Fig 42 - 3):
   Torque setting: 200 Nm

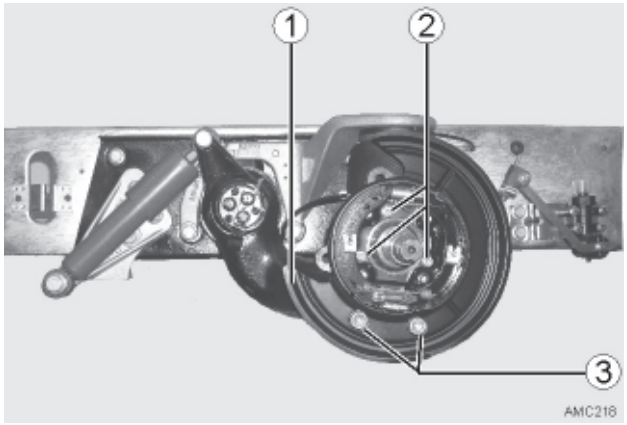


Fig. 42

8. *Remove stub axle (Fig 43-1) as per assembly instructions from the basic vehicle manufacturer.*

   Fitting instructions:
   4 M14x55 screws (Fig 43 -2):
   Torque setting: 150 Nm

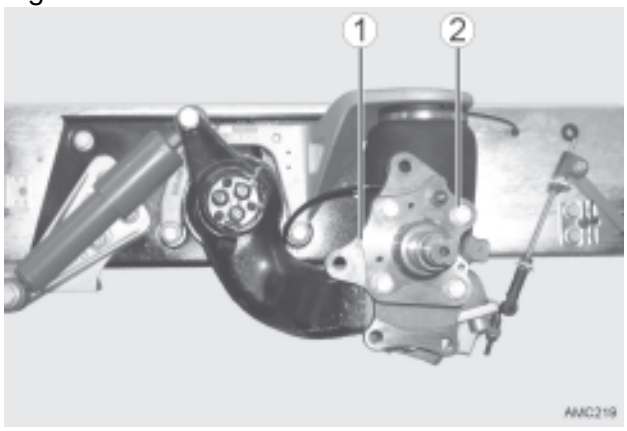


Fig. 43

9. Unscrew hexagon bolt (Fig 44 -3) with washer (Fig 44 -2) and remove ABS sensor (Fig 44 -1), (if fitted).

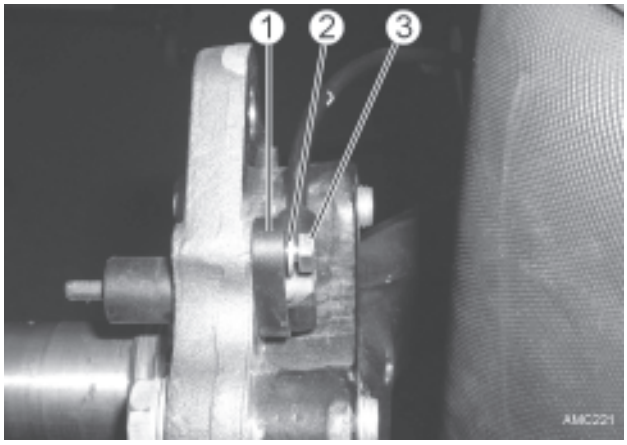


Fig. 44

10. Remove ABS sensor cable (Fig 45 - 1) from mount (Fig 45-2).

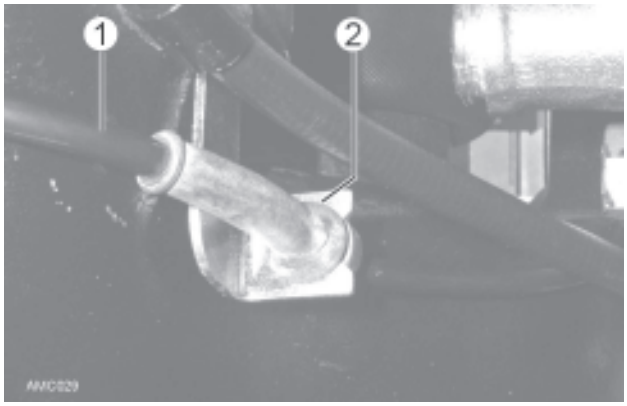


Fig. 45

11. Remove air bellows (Fig 46 - 1) as per chapter 7.2.

12. Unhook air sensor (Fig 46 -3) for the path sensor rod assembly (Fig 46 -2) (Fig 46 - Arrow).

13. Unscrew two M16x1.5x30 socket head cap bolts (Fig 46 - 4) from the bottom air bellows (Fig 44 -5).

    Fitting Instructions:
    - Torque setting: 180 Nm
    - Secure hexagon bolts using Loctite.

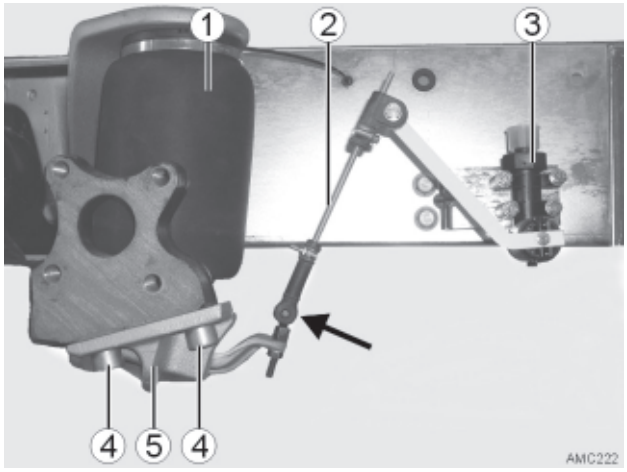


Fig. 46

14. Unscrew one M14x1.5x40 hexagon bolt (Fig 47 - 1) and remove the bottom bracket (Fig 47 - 2).

    Fitting information:
    Torque setting: 135 Nm

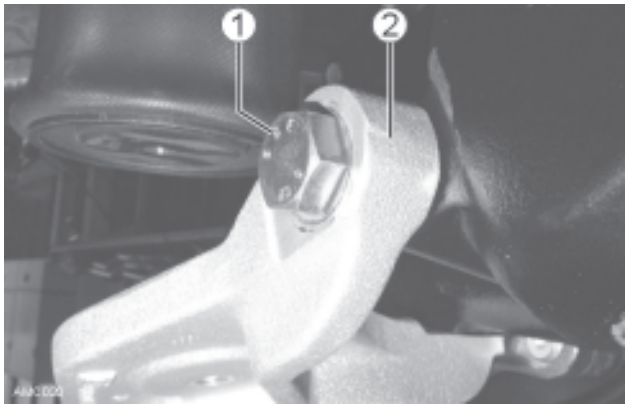


Fig. 47

BTR2/BTR4/CA4 with drum brake (Work steps 15 to 22)

15. Slacken handbrake Bowden cable (Fig 48-1) by loosening the hexagon nuts (Fig 48 - 2 and 3).

    Fitting note:
    The parking brake is adjusted as per Chapter 5.5.3.

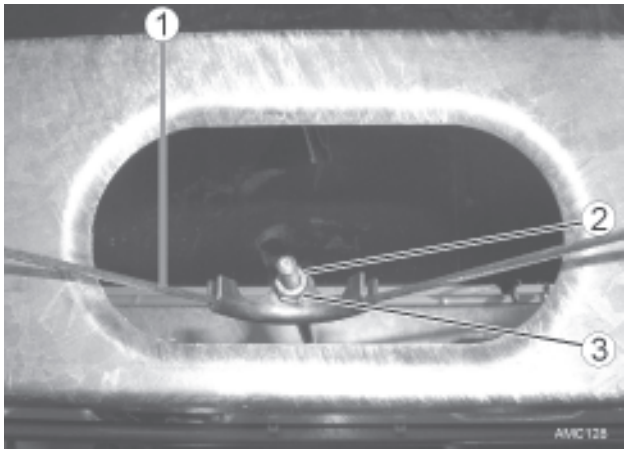


Fig. 48

16. Remove grease cap (Fig 49-2)

17. *Remove brake drum (Fig 49-2) as per assembly instructions from the basic vehicle manufacturer.*

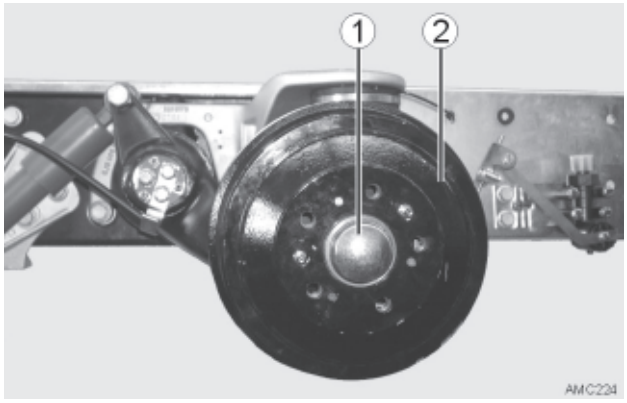


Fig. 49

18. *Dismantle the back plate (Fig 50 - 1), as well as the stub axle (Fig 50 - 2) as per assembly instructions from the basic vehicle manufacturer.*

    Fitting instructions:
    M14x1.5x55 screws (Fig 50 - 3):
    Torque setting: 150 Nm

NOTE
Leave back plate on the brake hose during further assembly and secure.

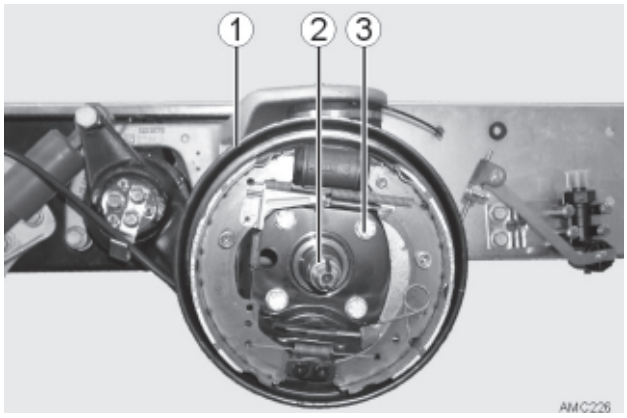


Fig. 50

19. Remove air bellows (Fig 51 - 1) as per chapter 7.2.

20. Unhook air sensor (Fig 51 -3) for the path sensor rod assembly (Fig 51 -2) (Fig 51 - Arrow).

21. Unscrew two M16x1.5x30 socket head cap bolts (Fig 51 - 4) from the bottom air bellows (Fig 51 -5).

    Fitting Instructions:
    - Torque setting: 180 Nm
    - Secure hexagon bolts using Loctite, medium tight.

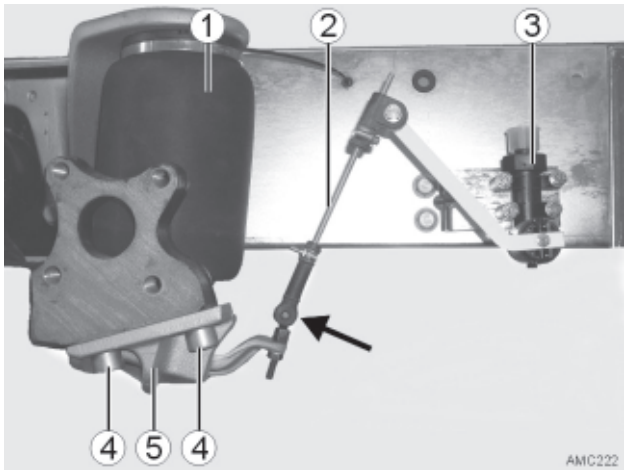


Fig. 51

22. Unscrew one M14x1.5x40 hexagon bolt (Fig 52 - 1) and remove the bottom bracket (Fig 52 - 2).

    Fitting Instructions:
    - Torque setting: 135 Nm
    - Secure hexagon bolts using Loctite, medium tight.

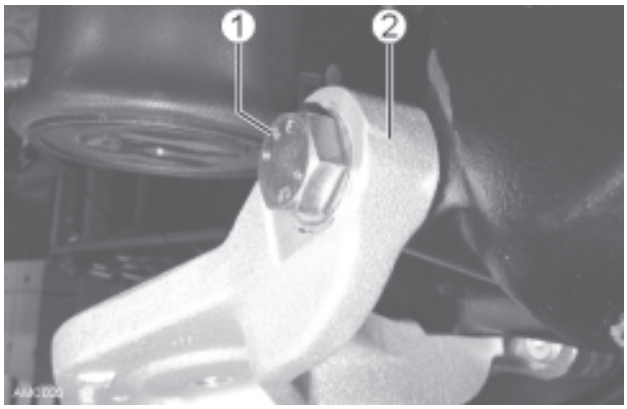


Fig. 52

23. Further removal of the swing arm takes place as described in Chapter 3.6.4, work steps 16 to 19.

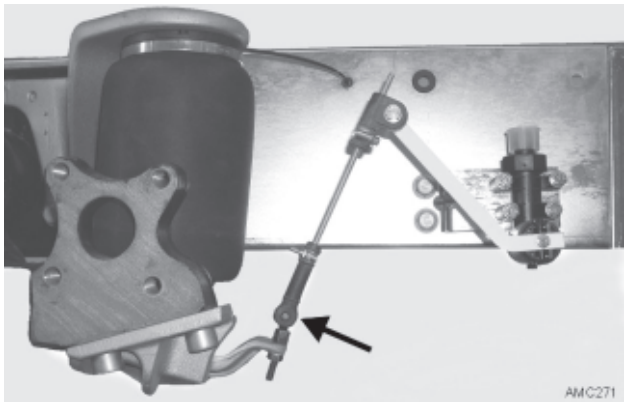
Fitting takes place in reverse order

3.7.6 Replacing the axle

1 Remove brake drum, brake calliper, parking brake with back plate, bottom air bellows bracket as per Chapter 3.7.5.

2. Unhook path sensor rod assembly (Fig 53 - arrow)

3. Remove air bellows as per Chapter 7.2.



Picture 53

4. Unscrew two M12x1.5x40 hexagon bolts with flange (Fig 54-1) from the upper air bellows bracket (inside frame).

    Fitting Instructions:
    - Torque setting: 65 Nm
    - Secure hexagon bolts using Loctite, medium tight.

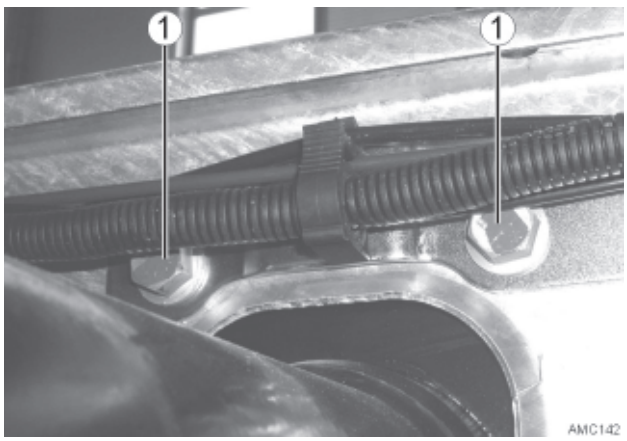


Fig. 54

5. Unscrew two M12x1.5 counternuts (Fig 55-1) from the inside of the frame, from the M12x1.5x65 hexagon bolts (Fig 55 -2) and remove the upper bellows bracket (Fig 55-3).

   Fitting information:
   Torque setting: 120 Nm

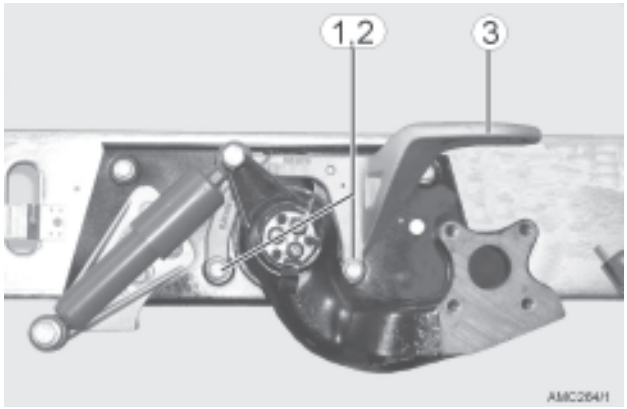


Fig. 55

6. Remove shock absorber (Fig 56 - 1) as per chapter 4.3.

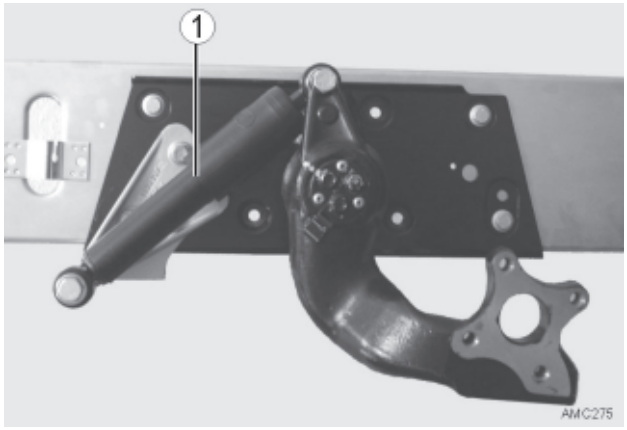


Fig. 56

7. Unscrew four M12x1.5 counternuts (Fig 57-2) from the inside of the frame, remove the angle (Fig 57-4), remove the M12x1.5x40 hexagon nuts (Fig 57 -3) with shock absorber mount (Fig 57-1).

   Fitting information:
   Torque setting: 120 Nm

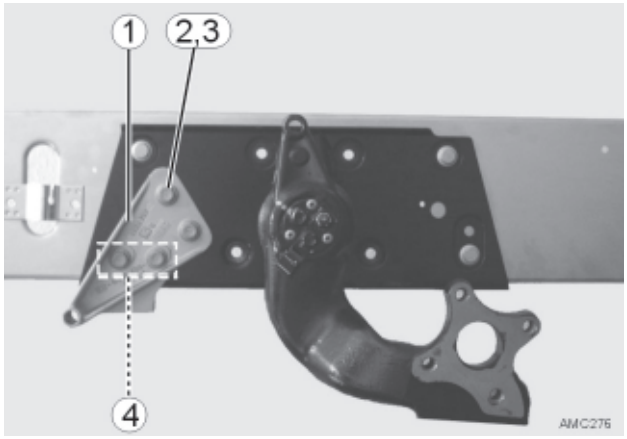


Fig. 57

CAUTION
Support axle underneath. The axle weighs approx. 70 kg!

8. Remove M12x 1.5 counternuts (Fig 58 -5) from the inside of the frame and take out M12x1.5x35 hexagon bolt (Fig 57 -2).
9. Remove reinforcement plate (Fig 58-4) from the inside of the frame.

   Fitting information:
   Torque setting: 120 Nm
10. Unscrew two M12x1.5 counternuts (Fig 58 -1) from the inside of the frame, remove M12x1.5x65 hexagon bolts (Fig 58 -2) and remove the complete axle (Fig 58-3).

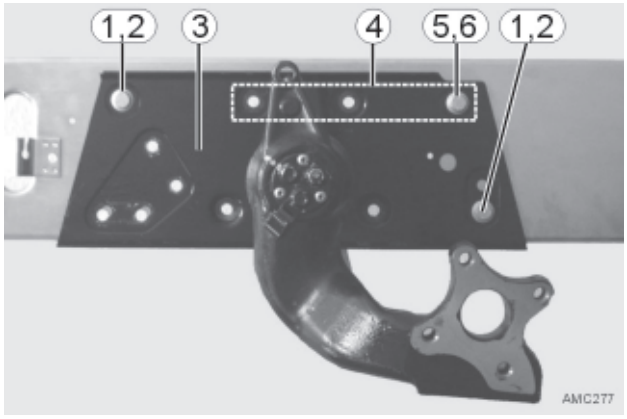


Fig. 58

Fitting takes place in reverse order.

3.8 Replacing wheel bearings

- *Dismantling and assembling the wheel bearings as per assembly instructions from the basic vehicle manufacturer.*