FRONT AND REAR BRAKES

GROUP 22

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TRADITIONAL BRAKING SYSTEM

- The hydraulic circuit is supplied by a tandem brake master cylinder, mounted co-axially on the vacuum brake servo unit.
- Brake servo operates through vacuum generated in inlet manifold for gasoline engines and in vacuum pump for diesel engines, to facilitate brake master cylinder actuation.
- The front master cylinder section acts on front brake caliper circuit and directs a pressure signal to load proportioning valve.
- The rear master cylinder section acts on rear brake caliper circuit through load proportioning valve.
- The system, consisting of two independent circuits, ensures braking should either one of the two circuits fail and, through load proportioning valve, provides increased stability during braking in that it prevents rear wheel locking.
- Hand brake acts on rear brake calipers through a mechanical linkage consisting of cable and clearance adjuster.
BRAKE SYSTEM BLEEDING

WARNING:

a. Check that fluid level does not fall below minimum during bleeding.
b. Do not reuse fluid after draining.
c. Brake fluid is harmful to paintwork: avoid contact.
d. Carry out operation simultaneously on front and rear brake calipers, first on one side, then on the other.

1. Place car on a lift.
2. If necessary, fill up reservoirs with the recommended fluid (ATE "S" or AGIP Brake Fluid Super or IP Auto Fluid FR).
3. Raise car and remove dust excluders from brake caliper bleed points.
4. Connect a flexible hose to bleed screws ① and ② and dip the other hose end in a container filled with the recommended brake fluid.

5. Slacken bleed screws and pump the brake pedal; allow brake pedal to return and pause a few seconds between each stroke and the next; keep pumping until issuing fluid is free from air bubbles. Fully depress brake pedal and tighten bleed screws.
6. Remove hoses, install dust excluders and top up reservoir.
7. If bleeding has been carried out correctly, no sponginess should be felt after initial free travel. If pedal sponginess is felt repeat the bleeding operation.

BRAKE HYDRAULIC SYSTEM LINES

INSPECTION

Check brake system lines (pipes and hoses) for distortion, cracks or external oxidation. Replace any defective parts.

REMOVAL AND INSTALLATION

WARNING:

a. Prior to removing and installing brake lines, draw fluid from brake and clutch system reservoir by means of a syringe.
b. When removing lines, plug ends to prevent the entry of foreign matter.
c. After installation, check that front and rear hoses are not twisted. For checking, refer to supplier's identification mark on rear hose periphery or to light stripe on front hoses.
d. After assembly, top up reservoir and bleed (see Brake System Bleeding).

 Tightening torques
Brake hydraulic system hose fittings
10 to 15 N·m
(1 to 1.5 kg·m)
(7.4 to 11.1 ft·lb)
Brake hydraulic system pipe fittings
10 to 12 N·m
(1 to 1.2 kg·m)
(7.4 to 8.9 ft·lb)
PEDALS

REMOVAL
1. Disconnect brake fluid level indicator cables 3 from engine compartment, remove plug 2 and filter from reservoir 1 and draw clutch and brake fluid by means of a syringe.

2. Back off screws retaining windscreen washer reservoir to body and move reservoir sideways.

3. Six cylinder cars only. Slacken reservoir hose clamp 2 and move reservoir 1 sideways.

4. Disconnect brake servo vacuum port pipe from check valve.

5. Disconnect cable 1 pin from accelerator control lever 2, remove cable with sheath from housing and disconnect from sheath retainer on pedal support, behind brake servo.

1 Brake fluid reservoir
2 Plug
3 Brake fluid level indicator cables

1 Power steering fluid reservoir
2 Hose clamp

1 Accelerator control cable
2 Accelerator control lever
6. Disconnect pipe fittings 3 from load proportioning valve 4 and clutch and brake master cylinders 2 and 1.

9. From car interior take sheath off accelerator cable previously disconnected.

10. Six cylinder cars only.
   a. Remove cotter 1 with associated washer on both pedals and take off pin 2, disconnect clutch and brake pedals 3 and 4 from associated forks.
   b. Remove cups 5 and retrieve springs 6

WARNING:
Brake fluid is harmful to paintwork.

1. Brake master cylinder
2. Clutch master cylinder
3. Brake and clutch system pipes
4. Load proportioning valve

7. Six cylinder cars only.
Disconnect 5th and 6th cylinder spark plug cables; disconnect wiring harness from terminal board to permit pedal removal.
8. Back off nut and disconnect motor level 1 from motor 2, rotate lever in direction arrowed and remove pedal assembly.

11. Back off nuts retaining pedal support to body.
12. Take off pedal support assy from engine compartment.

DISASSEMBLY
Disassembly pedals as follows:
1. All models, six cylinder cars excluded.
   a. Remove coppers 1 and take off washers 2 and pins 3 connecting pedals to associated brake servo 4 and clutch master cylinder 5 actuating forks.
4. Remove pin 1 and take off pedal pin 2 from pedal support 3.

**INSPECTION**

1. Check bushings and associated housings on pedals, pin and spacer for wear and seizure, and replace as necessary.
2. Check return springs for weakness and replace if necessary.

**ASSEMBLY**

Assemble pedals reversing the disassembly sequence and adhering to the instructions given below.

- Apply a film of the recommended grease (ISECO Molykote Longterm no. 2) to sliding parts and return springs.
- Apply recommended jointing compound (LOWAC Perfect Seal) to brake/pedal support surfaces. Tighten nuts retaining brake servo to pedal support to the specified torque.

**INSTALLATION**

Install by reversing the removal sequence and adhering to the instructions given below.

- Lubricate accelerator cable and before connecting to throttle valve actuating lever and adjust travel (see Group 04 — Accelerator Cable Adjustment).
- Replace seal between pedal support and body after thoroughly cleaning surfaces in contact.
- Fill reservoir with the recommended fluid (ATE Blau S; AGIP Brake Fluid Super; IP Auto Fluid FR).
- Adhere to the following tightening torque.

**Tightening torque**

- Brake and clutch hydraulic system pipe fittings
  - 10 to 12 N·m
  - (1 to 1.2 kg·m)
  - (7.4 to 8.9 ft·lb)

- Bleed brake system (see: Brake system bleeding) and clutch system (see Group 12 - Hydraulic Control - Hydraulic system Bleeding).

5. Disassemble pedals 1, take out associated bushings 2 and retrieve spacer 3.

1. Pin
2. Pedal pin
3. Pedal support

1. Pedals
2. Bushings
3. Spacer
BRAKE MASTER CYLINDER

REMOVAL
1. Disconnect brake fluid level indicator cables (2).
2. Remove plug (4) from reservoir (5), remove filter and draw fluid using a syringe.
3. Disconnect pipe (6) from reservoir (5) and plug.
4. Disconnect fittings (10) from brake master cylinder (6).
5. Back off nuts (7) and screw (8); remove load proportioning valve bracket.

DISASSEMBLY
(ATE MASTER CYLINDER)
Clamp master cylinder in a vice provided with jaw liners and carry out the following operations:
1. Separate brake fluid reservoir (1) from master cylinder body (2) and take off rubber hoses (3) from two connections.
4. Remove master cylinder from vice and overturn to take out and disassemble plunger.

INSPECTION
1. Thoroughly clean all parts using alcohol or brake fluid and blow dry with compressed air.
2. Check master cylinder body sleeve inner surface for score marks or corrosion spots. Replaces if necessary.
3. Check internal components, replace worn or damaged parts and always replace seals.

CAUTION:
On intermediate plunger assembly, check that stop screw engages plunger groove correctly.

INSTALLATION
Install by reversing the removal sequence and adhering to the instructions given below:
- Ensure that retaining ring is inserted between master cylinder and brake servo.
- Adhere to the following tightening torques.

1: Tightening torques
Pipes/brake master cylinder fittings
10 to 12 N·m
(1.0 to 1.2 kg·m)
(7.4 to 8.9 ft·lb)

Brake master cylinder/brake servo retaining nuts
12 to 15 N·m
(1.2 to 1.5 kg·m)
(8.9 to 11.1 ft·lb)

- Fill reservoir with the recommended fluid (ATE Blau S; AGIP F1 Brake Fluid Super HD; IP Auto Fluid FR).
- Bleed brake system (see Brake System Bleeding).

BRAKE SERVO

INSPECTION
Check brake servo operation proceeding as follows.

CAUTION:
Before testing, check that vacuum system non-return valve is efficient (see: Vacuum System).
FRONT AND REAR BRAKES

1. With engine shut off and no vacuum in brake servo (after operating brake pedal 5 to 6 times) slightly depress brake pedal and maintain in this position.
2. Start engine.
3. Applying a constant pressure on pedal and with a good vacuum and engine running, the pedal should lower.
4. If pedal kicks back against driver’s foot, brake servo is inefficient.

REMOVAL
1. Proceed as per “Brake master cylinder removal” up to para. 4.
2. From car interior, remove cotter 2 with associated washer and pin 1, and disconnect pedal 4 from brake servo actuating fork.
3. Remove spring cup 3 and retrieve spring 5.
4. Back off 4 nuts 6 and remove brake master cylinder/break servo unit.

INSTALLATION
Install by reversing the removal sequence and adhering to the instructions given below:
- Ensure that retaining ring is inserted between master cylinder and brake servo.
- Lubricate pin connecting pedal to brake servo control fork using the recommended grease (AGIP F1 Grease 15).
- Adhere to the following tightening torques.

T: Tightening torques
Pipes/break master cylinder fittings
- 10 to 12 N·m
- (1 to 1.2 kg·m)
- (7.4 to 8.9 ft·lb)
Brake servo/pedal support retaining nuts
- 12 to 15 N·m
- (1.2 to 1.5 kg·m)
- (8.9 to 11.1 ft·lb)
Brake master cylinder/break servo retaining nuts
- Fill reservoir with the recommended fluid (ATE Blau S; AGIP F1 Brake Fluid Super, IP Auto Fluid FR).
- Bleed brake system (see: Brake system Bleeding).

VACUUM SYSTEM
1. Visually check lines for obstructions and/or damage and hose clamps for looseness.
2. Remove non-return valve if necessary.
3. Check valve operation; valve must allow air to flow in the direction indicated by arrow only.

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4. On assembly, position non-return valve, with arrow pointing toward vacuum actuator.

FRONT BRAKES

PAD REPLACEMENT
1. Place car on a lift and slacken front wheel retaining nuts.
2. Raise front end of car and apply support stands; remove front wheels.
3. Using a punch, remove one of pins ①, take off cross spring ② and remove the other pin.

CAUTION:
- With pads removed do not depress brake pedal to prevent piston ejection from housing in caliper body.
- Replace pads on both calipers using genuine spare parts.
- Do not lubricate pad seats in contact with brake caliper.
- Partially draw brake fluid from reservoir using a syringe to prevent brake fluid overflow when moving pistons backward.
- Prior to disassembling pads which do not need replacing, apply reference marks to facilitate subsequent assembly.

7. Proceed in the reverse order for assembling.
8. Top up reservoir with the recommended brake fluid (ATE Blau S; AGIP F1 Brake Fluid Super HD; IP Auto Fluid FR).

BRAKE CALIPER

Removal
1. Using a syringe, draw brake fluid from reservoir.
2. Remove pads as per "Pad Replacement", apply suitable reference marks to facilitate subsequent assembly.
3. Back off pipe fitting ④, disconnect from hose fitting ① and plug.
4. Back off screws ② and remove caliper ③ and bracket ⑤.

Inspection
Clean all parts.

CAUTION:
Do not use mineral oil base detergents or metallic tools.
FRONT AND REAR BRAKES

Check each component for wear or damage and replace if necessary. Always replace bellows and associated retaining rings.

Installation
1. Install dust bellows (if previously removed) applying the recommended grease (ATE Bremszylinder Pasta) and secure by means of retaining rings.
2. On Ate brake caliper, check brake actuating piston position using a 20° angle gauge: if piston is not correctly positioned rotate piston using suitable pliers.

CAUTION:
Brake calipers are not interchangeable as bleed fitting must be at the top on both calipers.

3. Install adopting a reversal of the removal sequence and adhering to the instructions given below.
   • Check that pad thickness is correct (see Inspection Specifications - Checks and Adjustments).
   • If the same pads are installed, align the marks applied on removal.
   • Adhere to the following tightening torques.

   tightening torques
   Brake caliper to steering knuckle screws
   
   | 74 to 83 N · m |
   | (7.5 to 8.5 kg · m) |
   | (54.6 to 61.2 ft · lb) |
   
   Pipe fittings
   
   | 10 to 12*N · m |
   | (1 to 1.2 kg · m) |
   | (7.4 to 8.9 ft · lb) |

   • Fill reservoir with the recommended fluid (ATE Blau S; AGIP F1 Brake Fluid Super HD; IP Auto Fluid FR).
   • Bleed brake system (see Brake System Bleeding).

BRAKE DISC

Removal
1. Remove pads as per “Pad Replacement” applying suitable reference marks to facilitate subsequent installation.
2. Back off two brake caliper/steering knuckle screws without disconnecting from system. Secure brake caliper to one suspension link.

CAUTION:
Non ventilated brake disc may be removed without removing brake caliper.

3. Remove cover
4. Remove cotter, back off nut and screws

5. Remove hub and brake disc.

1 Brake disc
2 Wheel hub nut
3 Cotter
4 Wheel hub
5 Wheel hub nut cap
6 Wheel hub/brake disc screws

Inspection
1. Clean brake discs and check that working surfaces are free from score marks or porosity. Replace or grind as necessary.
2. Should working surfaces require grinding, the following instructions should be adhered to.
   a. Always grind off the same amount of material on both surfaces.
   b. Dimensions and tolerances as per “Inspection Specifications”, “Checks and Adjustments” are mandatory.

Installation
Install adopting a reversal of the removal sequence and adhering to the instructions given below.

   • Lubricate wheel hub nut thread using the recommended grease (AGIP F1 Grease 33 FD; IP Autogrease FD).
   • Adhere to the following tightening torque.

   tightening torque
   Brake caliper to steering knuckle screws
   
   | 74 to 83 N · m |
   | (7.5 to 8.5 kg · m) |
   | (54.6 to 61.2 ft · lb) |

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- Adjust wheel bearings (see Group 00 - Wheel Bearing Adjustment).

REAR BRAKES

PAD REPLACEMENT

1. Raise car on a lift.
2. Remove retaining springs ①, pad retaining pins ② and cross spring ③.
3. Push back pistons acting on screw ① using wrench A.5.0194 for outer piston and on screw ② for inner piston.
4. On cars provided with pad wear indicator, disconnect associated electrical connection.
5. Remove brake pads upward.

CAUTION:

- With pads removed do not depress brake pedal to prevent piston ejection from housing in caliper body.
- Replace pads on both calipers using genuine spare parts.
- Do not lubricate pad seats in contact with brake caliper.
- Partially draw brake fluid from reservoir using a syringe to prevent brake fluid overflow when moving pistons backward.
- Install pads positioning arrow in the direction of forward vehicle travel.

6. Proceed in the reverse order for assembling.
7. Top up reservoir with the recommended brake fluid (ATE Blau S; AGIP F1 Brake Fluid Super HD; IP Auto Fluid FR).
8. Adjust pad clearance as per "Pad Clearance Adjustment".
9. Adjust hand brake as per "Hand Brake - Hand Brake Lever Travel Adjustment".

BRAKE CALIPER

Removal

1. Using a syringe, draw brake fluid from reservoir.
2. Remove pads as per "Pad Replacement".
3. Back off fittings ① and disconnect piping ② from fitting ③.
4. Back off nut ④ and disconnect pipe from bracket ⑤.
5. Back off nuts ⑥ and disconnect cable ⑦ from levers.

6. Remove brake discs (see: Brake Disc - Removal).
7. Back off nuts ① and remove brake caliper ②.
8. If necessary, replace brake caliper bellows. To remove take off retaining ring and slide off bellows ①.
FRONT AND REAR BRAKES

Inspection
Clean all parts.

WARNING:
Do not use mineral oil base detergents or metallic tools.

Check each component for wear or damage and replace if necessary.
Always replace bellows and associated retaining rings.

Installation
Install adopting a reversal of the removal sequence and adhering to the instructions given below.
- Check that pad thickness is correct (see: Inspection Specifications - Check and Adjustments).
- Adhere to the following tightening torques.

1: Tightening torques
Brake caliper/gearbox - differential housing retaining nuts
46 to 52 N·m
(4.7 to 5.3 kg·m)
(33.9 to 38.4 ft·lb)

Pipe fittings
10 to 12 N·m
(1 to 1.2 kg·m)
(7.4 to 8.9 ft·lb)
- Top up reservoir with the recommended fluid (ATE Blau S; AGIP Brake Fluid HD, IP Auto Fluid FR).
- Adjust pad clearance as per “Pad Clearance Adjustment”.

4. Fasten the lock nut at the prescribed driving torque and refit the dust cover.

3: Driving torque of the adjustment pin - fixing locknut:
7 to 10 N·m
(0.7 to 1 Kg·m)
(5.2 to 7.4 ft·lb)

5. Draw back the two feeler gauges.
6. Restore the breaking condition by repeatedly acting on the brake pedal.

Pad Clearance Adjustment
1. Insert two 0.25 mm (0.01 in) feeler gauges between the disc and the pads.
2. Remove the dust cover and unscrew the lock nut by means of the A.5.0194 tool.
3. Acting on the pin 1 and the screw 3 bring the pads into a light contact with the two feeler gauges; in this way, the prefixed clearance is reset.

Pad clearance: 0.25 mm (0.01 in)

BRAKE DISC

Removal
1. Cars equipped with spacer (refer to Unit 00 - Use of Units in Car).
Back off screw 2 and disconnect shaft 3, back off screws 1 and disconnect spacers 4 from inner shafts.
FRONT AND REAR BRAKES

2. If working surfaces require grinding, the following instructions should be adhered to.
   a. Always grind off the same amount of material on both surfaces.
   b. Dimensions and tolerances as per “Inspection Specifications”, “Checks and Adjustments” are mandatory.

Installation
Instal by adopting a reversal of the removal sequence and adhering to the instructions given below.
- Adhere to the following tightening torques.
- Cars equipped with spacer.

 Tightening torques
Screw retaining spacer and brake disc to inner shaft (use ISECO Molykote BR2 grease)
49 to 54 N·m
(5 to 5.5 kg·m)
(36.1 to 39.8 ft·lb)

Spacer/outer shaft retaining screws
44 to 54 N·m
(4.5 to 5.5 kg·m)
(32.5 to 39.8 ft·lb)

WARNING:
Do not disassemble load proportioning valve.

Installation
Instal by adopting a reversal of the removal sequence and adhering to the instructions given below.
- When connecting pipes to load proportioning valve, match arrows on valve body.
- Adhere to the following tightening torque.

 Tightening torque
Pipes/load proportioning valve fittings
10 to 12 N·m
(1 to 1.2 kg·m)
(7.4 to 8.9 ft·lb)
- Fill reservoir with the recommended fluid (ATE Blau S; AGIP Brake Fluid Super HD; IP Auto Fluid FR).
- Bleed brake system (see Brake System Bleeding).

Inspection
1. Clean brake discs and check that working surfaces are free from score marks or porosity. Replace or grind as necessary.

Other models.
Back off screws ① and disconnect outer shafts ② from inner shafts.
1 Front brake caliper
2 Front impulse emiting wheel
3 Front impulse pick-up
4 Mic./max. pressure switch
5 Electro-pump unit
6 Accumulator
7 ABS MARK II system warning light
   anti-lock system failure
8 Brake fluid minimum level and brake pad
   wear warning light on A.R. CONTROL
9 Brake fluid tank
10 Brake master cylinder and hydraulic servo cylinder
11 Filter
12 Rear impulse emitting wheel
13 Rear brake caliper
14 Rear impulse pick-up
15 Brake pedal
16 Anti-lock system control unit
17 Brake pressure adjusting valve
18 Braking pressure modulating electro-valve unit
FRONT AND REAR BRAKES

- The (ABS) MARK II wheel antilock system is a sophisticated computerized system designed to increase driving safety and in fact constitutes the ultimate technical guarantee as regards braking.
- An impulse pick-up is assembled on each wheel and records the r.p.m. by means of an impulse emitting wheel and sends it to the electronic unit for data processing. The electronic unit takes direct action, if one or more wheels tend to lock, by means of electrovalves adjusting the braking pressure on each wheel to prevent it locking. The electronic unit thus "takes" the pressure from the brake caliper of the wheel that is locking to "return" it only when locking no longer occurs; this "giving and taking" of pressure takes place in very short intervals of time and continues until braking ends that is of course if locking persists and independent of the pressure exerted on the brake pedal.
- On a dry, or even wet, surface the ABS system may not even go into operation for thousands of kilometers. However, in the event of sudden braking due to an unexpected obstacle or immediate danger when a traditional braking system would tend to lock, the ABS system intervenes and ensures that the "correct" braking force is applied at all times to each wheel thus allowing the vehicle to stop in the shortest possible distance compatible with the road surface.
- Other important advantages offered by the ABS system are:
  - Complete vehicle control: the driver at the wheel of a vehicle equipped with the ABS system can avoid any obstacles by turning the steering wheel while the driver of a vehicle without the ABS system, in the event of wheel locking, would not be able to carry out the same manoeuvre in as much as the vehicle goes out of control and may skid dangerously.
  - More even tyre wear: as the wheels never lock; the tyres will never suffer damage due to tyre abrasion on the asphalt.
- The (ABS) MARK II wheel antilock braking system is equipped with a hydraulic servobrake; an electro.pump unit with accumulator sucks in oil directly from the tank and, having taken it to a pressure of 140 thru 180 bar (13970 thru 17960 KPa; 142.5 thru 183.2 kg/cm²; 2025.67 thru 2604.42 p.s.i.), then sends it to the hydraulic servo cylinder. During normal braking, that is when no wheels lock and therefore without antilock system activation, the hydraulic servocylinder sends oil under pressure to the brake calipers of the rear wheels only while those of the front wheels are supplied directly by the brake master cylinder (see: Operating principle).
- The instances where a high probability of ABS system activation exists are examined hereafter.

Braking on a slippery road surface

On a wet road surface, the (ABS) MARK II wheel antilock system guarantees considerable reductions in stopping distances and is particularly advantageous in the event of ACQUAPLANING (at a certain vehicle speed the water can no longer be disposed of by the tread grooves and a film of water consequently forms between the wheel and the road surface, causing the tyre to lose its grip and impeding it from absorbing braking and steering impacts). If a vehicle not equipped with the ABS system is running at such a speed that this phenomenon has not yet arisen and wheels lock during braking the outwash of water from the tread grooves is impeded and the phenomenon of acuaplaning may thus occur. The ABS system, on the other hand, removes this danger because by preventing wheel lock from occurring, it allows the disposal of water via the tread grooves to continue and the tyre remains in contact with the road surface.

Braking on a wet road surface

If, however, the phenomenon of aquaplaning has already begun, the ABS system, although intervening, is no longer able to assure efficacious control of the vehicle during braking.

Braking on a slippery road surface

The ABS system may activate more frequently on a slippery road surface since the tyre grip limit is reached immediately subsequent to brake activation. If the vehicle is to be stopped in the shortest distance possible, the brake pedal may be pressed down hard to solicit the activation of the ABS on all wheels.

Braking on loose road surface

If, on the other hand the road surface is not compact (sand, gravel, soft snow or mud), vehicles equipped with the ABS system can stop in greater distances compared to vehicles without locked wheels, in fact, penetrate deeper into the ground and allow increased tyre function surface, thus guaranteeing a shorter stopping distance; this notwithstanding, the ABS system is most useful on this type of surface because it still assures complete handling of the vehicle.

Braking on different holding coefficients

It is possible for the wheels of the same axis to be running on surfaces which have varying holding coefficients (for example, on ice at the right and dry asphalt at the left).

During braking the vehicle will tend to turn towards the dry asphalt, that is towards the side with the greater holding coefficient due to the axial of a swaying torque as compared to the vertical axis of the vehicle.

This phenomenon arises both on vehicles equipped with the ABS system and those with a traditional braking system; whereas for the latter there is no remedy, in the former steering is by no means jeopardized and the driver may compensate for the swaying torque by counter-steering the vehicle and thus keeping it straight.

Traffic conditions permitting, on these occasions it is wise not to press the brake too hard so that the driver can apply the adequate steering reaction necessary.
WARNING:
Under no circumstances should the (ABS) MARK II antilock system induce the driver to drive dangerously or take risks.
For the safety of the driver and others it is always necessary to observe speed limits, safe distances and to maintain a prudent approach to driving especially when road surface conditions so demand.

(ABS) MARK II WHEEL ANTILOCK SYSTEM COMPONENTS

The ABS system installed by Alfa Romeo on some of its cars (see: Group 00- Use of Units in Cars) is manufactured by ALFRED TEVES GmbH (ATEI): the system components are:

Hydraulic assembly: comprising a high pressure hydraulic servocylinder 3, a master cylinder 2 and braking pressure modulating electrovalves 1.

Electropump unit: comprising a pump 4 activated by an electric motor 3, an accumulator 1 containing the brake fluid at a pressure between 140 and 180 bar (13970 thru 17960 KPa; 142.5 thru 183.2 Kg/cm²; 2025.67 thru 2604.42 p.s.i.) and a pressure switch 2.

1 Braking pressure modulating electrovalve unit
2 Brake master cylinder
3 Hydraulic servocylinder

1 Accumulator
2 Pressure switch
3 Electric motor
4 Pump
Impulse pick-ups and impulse emitting wheels: assembled one on each wheel to detect r.p.m..

Electronic unit: this represents the intelligent unit of the entire system in that it is capable of processing all the input signals deriving from the impulse pick-ups and supplying in output the control signals to the braking pressure modulating electrovalves.

ABS MARK II system warning light (3): assembled on the instrument panel, it notifies the driver of ABS system auto cut off when the electronic unit has encountered a failure (which may only be temporary).

With the warning light (3) illuminated but "brake fluid minimum level and pad wear" on the A.R. CONTROL extinguished it is still possible to carry out normal servoassisted braking actions.

OPERATING PRINCIPLE

BRAKE NON APPLIED

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brake fluid tank</td>
</tr>
<tr>
<td>2</td>
<td>Accumulator</td>
</tr>
<tr>
<td>3</td>
<td>Electropump unit</td>
</tr>
<tr>
<td>4</td>
<td>Chamber with high pressure brake fluid</td>
</tr>
<tr>
<td>5</td>
<td>Adjusting valve</td>
</tr>
<tr>
<td>6</td>
<td>Leverage</td>
</tr>
<tr>
<td>7</td>
<td>Hydraulic servo cylinder</td>
</tr>
<tr>
<td>8</td>
<td>Brake pedal</td>
</tr>
<tr>
<td>9</td>
<td>Load electrovalve, normally open</td>
</tr>
<tr>
<td>10</td>
<td>Rear wheels</td>
</tr>
<tr>
<td>11</td>
<td>Drain electrovalve, normally closed</td>
</tr>
<tr>
<td>12</td>
<td>R.H. front wheel</td>
</tr>
<tr>
<td>13</td>
<td>L.H. front wheel</td>
</tr>
<tr>
<td>14</td>
<td>Braking pressure modulation electrovalves</td>
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<td>15</td>
<td>Brake master cylinder</td>
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<tr>
<td>16</td>
<td>Main electrovalve</td>
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<tr>
<td>17</td>
<td>Positioning bush</td>
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</tbody>
</table>

Accumulator pressure

Connection to tank
FRONT AND REAR BRAKES

The braking circuit is subdivided into three sections:
- Front wheels: controlled by separate hydraulic circuits.
- Rear wheels: controlled by a single hydraulic circuit.

The ABS system is thus based on INDIVIDUAL ADJUSTMENT of the front wheels and according to the SELECT-LOW principle for the rear wheels. The term select-low means that the electronic unit processes the signals coming from the impulse pick-ups of the rear wheels separately and carries out the same adjustment on both wheels according to which one tends to lock.

Bear in mind that brake fluid is always present in the accumulator ② at a pressure between 140 and 180 bar (13870 thru 17960 KPa; 142.5 thru 183.2 Kg/cm²; 2025.67 thru 2604.42 p.s.i.) and that this high pressure is exerted right up to the chamber ④ of the adjusting valve ⑤.

If braking is not in progress none of the other areas are under pressure (*)

(*) Prior to carrying out repair work involving the removal of system components, it is necessary to discharge braking system pressure as follows:
- remove the ignition key.
- press the brake pedal down repeatedly (at least 20 times) until it sticks.

BRAKING WITHOUT ANTILOCK SYSTEM ACTIVATION

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During normal braking the ABS control system is not activated in as much as none of the wheels decelerates at such a rate as to be interpreted by the electronic unit as a tendency to lock; braking therefore occurs as a normal servo assisted action. Each of the three hydraulic circuits (two front and a single rear one) is controlled by means of two electrovalves: a load one which is normally open and a drain one, normally closed.

On activation of the brake pedal, the adjusting valve opens by means of the leverage thus generating in the hydraulic servo cylinder a pressure which is proportional to the force applied to the brake pedal. This pressure is used directly to activate the rear axis brakes (DYNAMIC CIRCUIT) by means of the load electrovalve normally open. Moreover, by acting on surface A of brake pedal, this pressure produces a force which goes to the aid of that exerted by the driver on the brake pedal; these two forces simultaneously activate the master cylinder and a further braking pressure is created, in the cylinder, which is transmitted to the front brake calipers (STATIC CIRCUIT) by means of load electrovalves and, normally open.

By further increasing pressure on the brake pedal, piston reaches positioning bush, pulling it into motion. This does not affect the activation however in as much as the pressure of the spring against the bushing is very slight and therefore imperceptible at the pedal.

**BRAKING WITH ACTIVATION OF THE ANTILOCK SYSTEM**

1. Brake fluid tank
2. Accumulator
3. Electropump unit
4. Adjusting valve
5. Leverage
6. Hydraulic servo cylinder
7. Brake pedal
8. Rear wheels
9. Drain electrovalve, normally closed
10. R.H. front wheel
11. Load electrovalve, normally open
12. L.H. front wheel
13. Cylinder
14. Brake master cylinder
15. Main electrovalve
16. Chamber behind master cylinder gasket
17. Positioning bush

Accumulator pressure

Connection to tank

Dynamic and static circuits connected
FRONT AND REAR BRAKES

If, during activation of the braking system, a wheel, the front RH (10) for example, tends to lock, then the associated loading electrovalve (11) closes and the drain one (3) opens.

Following this the pressure on the brake caliper decreases, on account of the return circuit to the brake fluid tank (1) being opened.

At the same time the main electrovalve (15) is energized and the dinamic circuit (rear) is connected to the static one (front).

When the wheel being braked starts to regain speed, following the decrease in pressure at the calipers, the drain electrovalve is closed and the loading one opened again. In this way, pressure is gradually restored to the brake calipers by means of the main electrovalve (15) which connects the hydraulic servocylinder (6) to the cylinder (13), until the next tendency to lock is detected, at which point the cycle repeats itself.

During ABS control, the high pressure action on the surface of the positioning bush (17) restricts brake pedal travel. This means that, even in the event of a failure during ABS system operation, there is always a certain volume of reserve fluid. ABS control concluded (during or on termination of the braking action), the main electrovalve is de-activated, thus severing the connection between the hydraulic servocylinder and master cylinder.

Besides this, the chamber (16), at the rear of the master cylinder gasket, is reconnected to the tank and the positioning bush (17) de-activated.

Normal brake activation is thus restored.

d) Do not carry out this operation simultaneously on front and rear brake calipers, but first on one side, then on the other.
e) The electropump should never idle as this may cause damage: ensure that there is sufficient fluid in the tank.

CAUTION:
The system contains pressurized fluid; WORK WITH CAUTION.

1. Place car on a lift.
2. If necessary, fill up tanks with the recommended fluid (ATE "S" or AGIP Brake Fluid Super or IP Auto Fluid FR).
3. Raise car and remove dust excluders from brake calipers bleed points.
4. Front brake system bleeding.
   a. Connect a flexible hose to bleed screw (1) and dip the other hose end in a container filled with the recommended brake fluid.
   b. Slacken bleed screw and pump the brake pedal; allow brake pedal to return and pause a few seconds between each stroke and the next; keep pumping until issuing fluid is free from air bubbles. Tighten bleed screw and remove hose.
   c. Repeat steps a. and b. on the other front caliper.
5. Rear brake system bleeding.
   a. Turn key to IGNITION, check electropump activation and await disconnection.
   b. Connect a flexible hose to bleed screws (2) and dip the other hose end in a container filled with the recommended brake fluid.

BRAKE SYSTEM BLEEDING

WARNING:
a) Check that fluid level does not fall below minimum during bleeding, especially when working on the rear calipers as the high pressure oil tends to spurt.
b) Do not reuse fluid after draining.
c) Brake fluid is harmful to paintwork: avoid contact.

c) Slacken bleed screws and keep brake pedal slightly pressed until issuing fluid is free from bubbles. Tighten bleed screws and remove hoses.
d) Repeat the operations described at steps b. and c. on the other two rear bleed screws.
6. Reinstall dust excluders and top up level in tank.
7. If bleeding has been carried out correctly, no sponginess should be felt after initial free travel; contrarily, repeat bleeding.
PEDALS

REMOVAL

CAUTION:
Prior to removing, discharge brake system pressure; with the ignition key removed, press the brake pedal down hard repeatedly (at least 20 times) until it sticks.

1. Disconnect the battery.
2. Remove windscreen washing liquid container 3 to create greater working space.
3. Drain the clutch and brake fluid from the tank thus.
   a. Remove plug 1 from tank 2.

4. Turbodiesel vehicles only.
   Loosen the clip 2 securing the power steering fluid tank 1 and move the latter sideways.

b. Disconnect the feed hose 2, from the electropump 3 and collect fluid directly beneath the tank.

WARNING:
Clutch and brake fluid is corrosive: protect paintwork adequately.

5. Vehicles on which accelerator control cable passes through the pedal assy only.
   Detach the pawl 1 from the accelerator control lever 2 then slip out the cable complete with sheath from under the plenum chamber and release it from the sheath fastener on the pedal assy.

WARNING:
Clutch and brake fluid is corrosive: protect paintwork adequately.
7. Carry out the operations described at steps 4, 5, 6, 7, 8, and 9 - Hydraulic Assembly - Removal.
8. Six cylinder cars only. Disconnect 5th and 6th cylinder spark plug cables; disconnect wiring harness from terminal board to permit pedal removal.
9. **Alfa 75** only.
   Back off the nut and disconnect the lever 1 from the motor 2 then turn the lever as shown by the arrow to extract the pedal.

3. Extract check pin 1 and remove pedal pin 2 from the pedal support 3.

1. Cotter pin
2. Pin
3. Clutch pedal

12. Back off nuts securing pedal assy to body.
13. Extract pedal assy from engine compartment.

**DISASSEMBLY**
Disassemble pedal as follows:
1. Remove cup 4 and slip off return spring 3 of clutch pedal 1.
2. Back off and remove the two screws 5, securing the clutch master cylinder 2 and take off pump.

4. Disassemble the pedals 1, remove the bushings 2 and keep the spacer 3.

1. Pin
2. Pedal pin
3. Pedal support

10. Vehicles on which the accelerator control lever passes through the pedal assy.
    Working from within the engine compartment, slip off the cable sheath from the previously disconnected accelerator cable.
11. Remove clutch pedal 3, cotter pin 1 with washer and slide off pin 2.

1. Clutch pedal
2. Clutch master cylinder
3. Return spring
4. Cup
5. Screw

1. Pedal
2. Bush
3. Spacer

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FRONT AND REAR BRAKES

Inspection
1. Check bushings and associated housings on pedals, pin and spacer for wear and seizure, replacing as necessary.
2. Check return springs of clutch pedal for weakness, replacing as necessary.

ASSEMBLY
Assemble pedals in reverse order of removal, adhering to the instructions given below.
• Apply a film of the recommended grease (ISECO Molykote Longterm n. 2) to sliding parts.

INSTALLATION
Install in reverse order of removal, adhering to the following instructions.
• Replace seal between pedal support and body if necessary.
• Observe the following tightening torque.

ELECTROPUMP UNIT

1: Tightening torque
Brake and clutch hydraulic system pipe fittings
10 thru 12 N·m
(1 thru 1.2 kg·m)
(7.4 thru 8.9 ft·lb)

• To install hydraulic assy to pedal assy follow stops 1 and 2 - Hydraulic Assy - Installation.
• Fill tank with recommended fluid (ATE Blau S; AGIP Brake Fluid Super; IP Auto Fluid FR).
• Bleed the brake system (see: ABS) MARK II Braking System with Wheel Antilock - Brake System Bleeding) and clutch system (see: Group 12 - Clutch - Hydraulic System Bleeding).

1 Electropump unit - support securing screw
2 Washer
3 Spring bushing
4 O-Rings
5 Screw
6 Label
7 Accumulator
8 O-Ring
9 Spring bushing
10 Pressurized fluid feed hose
11 O-Ring
12 Pressure switch
13 Electric motor
14 Pump
15 Spring bushing

N·m
1 (Kg·m)
(ft·lb)

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REMOVAL

CAUTION:
Prior to removing the electropump unit it is necessary to discharge the braking system pressure; remove the ignition key and press the brake pedal right down repeatedly (at least 20 times) until it sticks.

1. Disconnect the battery.
2. Drain the brake and clutch fluid by operating as follows.
   a. Remove plug 1 from tank 2.

3. Disconnect connector 1 from the electric motor 2 and connector 5 from the pressure switch 4.
   Remove clip 3.

4. Disconnect the pipe 1 from the electropump unit; keep spring 2.

5. Back off screw 1 securing the electropump unit to the support 2.

WARNING:
Clutch and brake fluid is corrosive; protect paintwork adequately.

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1. Plug
2. Clutch and brake fluid tank
3. Electropump feed hose

1. Connect for electric motor
2. Electric motor
3. Clip
4. Pressure switch
5. Connector for pressure switch

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6. Remove the electropump unit from the support ①, by sliding it off the pin ②.

**DISASSEMBLY**

1. Get hold of spring bushings ①.

2. Un screw screw ① and remove hose ②, retrieving the O-Rings.

3. With a suitable tool, unscrew the accumulator ① from the electropump unit and retrieve the O-Ring.

4. Unscrew the pressure switch ① and remove it from the electropump unit, retrieving the O-Ring.

**Having clamped the electropump unit in a vice provided with jaw lines, disassemble as follows.**

1. Support
2. Pin

1. Support
2. Nut
3. Screws

1. Accumulator

1 Screw securing hose - electropump unit
2 Hose
FRONT AND REAR BRAKES

Accumulator - electropump unit connection
40 thru 46 N·m
(4.1 thru 4.7 kg·m)
(29.5 thru 33.9 ft·lb)

Screw connecting hose on electropump unit
16 thru 20 N·m
(1.6 thru 2 kg·m)
(11.8 thru 14.8 ft·lb)

T: Tightening torques
Screws and nuts securing support - body
9 thru 10 N·m
(0.9 thru 1 kg·m)
(6.6 thru 7.4 ft·lb)

Screw securing electropump unit - support
8 thru 10 N·m
(0.9 thru 1 kg·m)
(6.6 thru 7.4 ft·lb)

Hose - pressurized fluid delivery pipe connection
16 thru 20 N·m
(1.6 thru 2 kg·m)
(11.8 thru 14.8 ft·lb)

- Fill tank with recommended fluid (see:
Inspection Specifications) then bleed
(see: (ABS) MARK II Braking System
with Wheel Antilock - Brake System
Bleeding).

INSTALATION
Re-install by operating in reverse order of
removal, adhering to the following instruc-
tions.
- Replace the spring bushings if
damaged or worn.
- Observe the following tightening tor-
ques.

WARNING:
Do not separate the pump from the elec-
tric motor.

REASSEMBLY
Reassemble the electropump unit by
operating in reverse order of removal, tak-
ing care to lock the various connections to
the specified torques.

CAUTION:
The circuit is a high pressure one and
correct reassembly is extremely impor-
tant for the safety of the vehicle dur-
ing braking: adhere strictly to instruc-
tions.
- Replace the O-Rings.
- Observe the following tightening tor-
ques.

T: Tightening torques
Pressure switch - electropump unit connection
20 thru 26 N·m
(2 thru 2.7 kg·m)
(14.8 thru 19.2 ft·lb)

HYDRAULIC ASSEMBLY

1 Clutch and brake fluid tank
2 Bracket
3 Screw
4 Cotter pin
5 Pin
6 Electropump feed hose
7 Braking pressure modulating electro-
valve unit
8 Brake pressure adjusting valve
9 O-Rings
10 Main electrovalve (cannot be
separated from 11)
11 Brake master cylinder and hydraulic
servo cylinder
12 Washer

N·m
(Kg·m)
(ft·lb)

1 35±40
(3.6±4.1)
(25.8±29.5)

21.4±29.4
(2.2±3)
(15.8±21.7)

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REMOVAL

WARNING:
Prior to removing the hydraulic assembly it is necessary to discharge the braking system pressure; remove the ignition key and press the brake pedal right down repeatedly (at least 20 times) until it sticks.

1. Disconnect the battery.
2. Remove the windscreen washing liquid container 3 to create greater working space.
3. Drain the clutch and brake fluid from the tank by operating thus.
   a. Remove plug 1 from tank 2.

4. Unscrew the union 2 and disconnect the pipe 1 from the hydraulic assembly.

b. Disconnect the feed hose 2 from the electropump 3 and collect the fluid draining directly from the tank 1.

WARNING:
Clutch and brake fluid is corrosive; protect paintwork adequately.

5. Back off the screw 1 tying the ground wires 8 to the hydraulic assy. Disconnect connector 7 from the main electrovalve 2, connector 4 from the electrovalve unit 5 and connector 6 from the tank 3.

6. Back off the screw 1 securing the square 4 for connection 3 of the front wheel impulse pick-up to the hydraulic assy. Disconnect the clutch master cylinder supply duct 2.

7. Unscrew unions 1, 2 and 3 then disconnect corresponding pipes from the hydraulic assy.
8. Working from within the passenger compartment, disconnect the brake pedal 1 from the piston of the master cylinder 3 by acting on the cotter pin 2.

9. Back off the four units 1 connecting the hydraulic assy 2 to the pedal assy and remove the former by extracting it from the four studs.

1. Nuts connecting the hydraulic pedal assy
2. Hydraulic assy
FRONT AND REAR BRAKES

DISASSEMBLY
1. Unscrew screw ① and with the aid of a lever, free the brake fluid tank ③ from the two unions ②.

2. Back off the three nuts ①, separate the electrovalve unit ② from the hydraulic assy and retrieve the O-Rings.

3. If necessary unscrew the brake pressure adjusting valve ① and remove it from the electrovalve unit ②.

1 Screw connecting the brake fluid tank - hydraulic assy
2 Unions
3 Brake fluid tank

1 Brake pressure adjusting valve
2 Electrovalve unit

WARNING:
Do not disassemble the electrovalve unit and brake pressure adjusting valve components; do not separate the brake master cylinder from the hydraulic servocylinder.

REASSEMBLY
Reassemble the hydraulic assembly in reverse order of removal, making sure to tighten the various connections to the specified torques.

CAUTION:
The circuit is a high pressure one and correct reassembly is extremely important for the safety of the vehicle during braking; adhere strictly to instructions.

- Replace the O-Rings.
- Observe the following tightening torques.

1: Tightening torques
Brake pressure adjusting valve-electrovalve unit connection
36 thru 40 N·m
(3.6 thru 4.1 kg·m)
(26.8 thru 29.5 ft·lb)

Nuts securing the electrovalve unit - hydraulic assy
21.4 thru 29.4 N·m
(2.2 thru 3 kg·m)
(15.8 thru 21.7 ft·lb)

INSTALLATION
Install in reverse order of removal, adhering to these instructions.
1. Apply Lowac Perfect Seal to the hydraulic assy - pedal assy joining surfaces.
2. Observe the following tightening torques.

1: Tightening torques
Nuts connecting the hydraulic assembly - pedal assy
11.3 thru 14 N·m
(1.1 thru 1.4 kg·m)
(8.3 thru 10.3 ft·lb)

Unions connecting the hydraulic assy - pipes carrying pressurized fluid to the brake calipers
12 thru 16 N·m
(1.2 thru 1.6 kg·m)
(8.9 thru 11.8 ft·lb)

Screw securing the square connecting the front left hand wheel impulse pick-up to the hydraulic assy
9 thru 10 N·m
(0.9 thru 1 kg·m)
(6.6 thru 7.4 ft·lb)

Union connecting pipe ("from" electropump) - hydraulic assy
16 thru 20 N·m
(1.6 thru 2 kg·m)
(11.8 thru 14.8 ft·lb)

3. Fill the tank with recommended fluid (see: Inspection Specifications) then bleed (see: (ABS) MARK II Braking System with Wheel Antilock - Brake System Bleeding).

Screw locking union on hydraulic assy
16 thru 20 N·m
(1.6 thru 2 kg·m)
(11.8 thru 14.8 ft·lb)
IMPULSE PICK-UPS
AND IMPULSE EMITTING WHEELS

FRONT IMPULSE PICK-UPS

Installation
Re-install by operating in reverse order of removal and adhering to the following instructions.

CAUTION:
The impulse pick-ups are not interchangeable (neither front with rear nor left with right).
When re-installing take great pains to ensure that the impulse pick-ups, new or used, are installed in the correct position.

- Observe the following tightening torques.

\[ \text{T} \text{ : Tightening torques} \]
Screw securing cable plate - suspension upper link
9 thru 10 N-m
(0.9 thru 1 kg-m)
(6.6 thru 7.4 ft-lb)

Screw securing impulse pick-up - support
9 thru 10 N-m
(0.9 thru 1 kg-m)
(6.6 thru 7.4 ft-lb)

Nuts securing support - steering knuckle
9 thru 10 N-m
(0.9 thru 1 kg-m)
(6.6 thru 7.4 ft-lb)

- Ensure that the impulse pick-up cables are secure in their anchor points on the body and secured to the suspension assemblies to prevent damage when the vehicle is running.
- Adjust the air gap between the impulse pick-up and the impulse emitting wheel by operating as follows.

Adjustment of the air gap between the front impulse pick-up and impulse emitting wheel.

- If installing a new impulse pick-up
  a. Loosen the air gap adjusting screw \( \text{T} \).
  b. Drive the impulse pick-up home against the impulse emitting wheel (there is a plastic spacer on the impulse pick-up head of the same thickness as the air gap required).
- Keeping the impulse pick-up against the impulse emitting wheel, tighten the air gap adjusting screw \( \text{T} \) to the specified torque.

\[ \begin{align*}
\text{T} & : \text{Tightening torque} \\
& \text{Screw adjusting the air gap between the impulse pick-up and impulse emitting wheel} \\
& 2.4 \text{ thru } 3 \text{ N-m} \\
& (0.24 \text{ thru } 0.3 \text{ kg-m}) \\
& (1.77 \text{ thru } 2.21 \text{ ft-lb})
\end{align*} \]

1 Screw adjusting air gap between the impulse pick-up and impulse emitting wheel

- If the impulse pick-up is re-used.
  a. Using a thickness gauge, check that the air gap between the impulse pick-up and impulse emitting wheel is as specified. Make the same test in two or three other positions of the impulse emitting wheel.

Air gap between front impulse pick-up and impulse emitting wheel:
\[ t = 0.7 \text{ mm} \]
\[ (0.03 \text{ in}) \]

FRONT AND REAR BRAKES

Removal
1. Disconnect the battery.
2. Working in the engine compartment, disconnect the electrical connection of the cable of the front impulse pick-up in question.
3. Place the car on a lift, put on the hand brake and raise the car.
4. Back off the screw 2 securing the cable plate 3 to the suspension upper link.
Back off the screw 1 securing the impulse pick-up to the support 4; retrieve the impulse pick-up.

5. If necessary, remove the support of the impulse pick-up by unscrewing the two nuts securing it to the steering knuckle.

1 Screw securing impulse pick-up - support
2 Screw
3 Cable plate
4 Impulse pick-up support
5 Impulse pick-up cable
FRONT AND REAR BRAKES

d. Check that the air gap remains as specified in two or three further positions of the impulse emitting wheel.

REAR IMPULSE PICK-UPS

Removal
1. Disconnect the battery.
2. Working in the passenger compartment, remove the rear seat, raise the sound proof upholstery then disconnect the electrical connection ① of the rear impulse pick-up cable concerned, sliding it off from outside the car.

3. Place the vehicle on the lift, activate the hand brake and raise the car.

4. Free the impulse pick-up cable ① from the three clips ② securing it to the De Dion axle.

b. Failing to find such a value, loosen the air gap adjusting screw ①.

c. Put a spacer equivalent to the specified air gap between the impulse pick-up and the impulse emitting wheel (0.7 mm; 0.03 in).
Keeping the impulse pick-up in contact with the spacer and impulse emitting wheel, tighten the adjusting screw to the specified torque.

①: Tightening torque
Screw adjusting the air gap between the impulse pick-up - impulse emitting wheel
2.4 thru 3 N·m
(0.24 thru 0.3 kg·m)
(1.77 thru 2.21 ft·lb)
5. Unscrew the screw securing the impulse pick-up to the support and get hold of the impulse pick-up.

- Ensure that the impulse pick-up cables are secure in their anchor points on the body and secured to the suspension assemblies to prevent damage when the vehicle is running.
- Adjust the air gap between the impulse pick-up and the impulse emitting wheel by operating as follows.

Adjustment of the air gap between the rear impulse pick-up and impulse emitting wheel:

- If installing a new impulse pick-up
  a. Loosen the air gap adjusting screw ①.
  b. Drive the impulse pick-up home against the impulse emitting wheel (there is a plastic spacer on the impulse pick-up head of the same thickness as the air gap required).
  c. Keeping the impulse pick-up against the impulse emitting wheel, tighten the air gap adjusting screw ① to the specified torque.

① : Tightening torque
Screw adjusting the air gap between the impulse pick-up and impulse emitting wheel
2.4 thru 3 N·m
(0.24 thru 0.3 kg·m)
(1.77 thru 2.21 ft·lb)

- If the impulse pick-up is re-used.
  a. Using a thickness gauge, check that the air gap between the impulse pick-up and impulse emitting wheel is as specified. Make the same test in two or three other positions of the impulse emitting wheel.

Air gap between rear impulse pick-up and impulse emitting wheel:
\[ t = 1.1 \text{ mm} \]
\[ (0.04 \text{ in}) \]

Installation
Install in reverse order of removal, adhering to the following instructions.

CAUTION:
The impulse pick-ups are not interchangeable (neither front with rear nor left with right).
When re-installing take great pains to ensure that the impulse pick-ups, new or used, are installed in the correct position.

- Observe the following tightening torques.

① : Tightening torques
Screw securing impulse pick-up support
9 thru 10 N·m
(0.9 thru 1 kg·m)
(6.6 thru 7.4 ft·lb)

Nuts securing support - wheel hub
9 thru 10 N·m
(0.9 thru 1 kg·m)
(6.6 thru 7.4 ft·lb)

b. Failing to find such a value, loosen the air gap adjusting screw ①.
c. Put a spacer equivalent to the specified air gap between the impulse pick-up and the impulse emitting wheel (1.1 mm; 0.04 in).
Keeping the impulse pick-up in contact with the spacer and impulse emitting wheel, tighten the adjusting screw to the specified torque.

1: Tightening torque
Screw adjusting the air gap between the impulse pick-up - impulse emitting wheel
2.4 thru 3 N-m
(0.24 thru 0.3 kg-m)
(1.77 thru 2.21 ft-lb)

d. Check that the air gap remains as specified in two or three further positions of the impulse emitting wheel.

FRONT IMPULSE EMITTING WHEELS

Removal
1. Place car on lift, activate the hand brake, raise the car at the front using a column type jack, secure with stands and remove the wheel.
2. Remove the pads (see: Traditional Braking System - Front Brakes - Pad Replacement - steps 3 and 5).
3. Unlock and back off the two screws, securing the brake caliper to the steering knuckle, without disconnecting it from the brake hose.
4. Remove the brake caliper unit; secure the brake caliper on one of the suspension links.
5. Extract the hub cover 4 and cotter pin 1.
6. Back off nut 2 and extract together with washer 3.

7. Remove the hub complete with brake disc and place on bench.

8. Using pliers, remove the retainer ring 1 and separate the impulse emitting wheel 2 from hub.

Installation
Re-install by operating in reverse order of removal, adhering to the following instructions.

• Clean the impulse emitting wheel thoroughly, checking that there are no signs of damage.
• Put the impulse emitting wheel into place and secure it to the hub with the retainer ring.
• Re-install the hub on the steering knuckle but do not insert the cotter pin.
• Check the clearance of the front hub bearings by operating as follows.
Front hub bearing clearance check

a. Install a comparator on a magnetic base (or suitable tool) so that it touches the steering knuckle axis (pre load the comparator to 1 mm (0.04 in)).

- Check the air gap between the impulse pick-up and the impulse emitting wheel (see: Impulse Pick-ups and Impulse Emitting Wheels - Front Impulse Pick-ups - Adjustment of the Air Gap between the Front Impulse Pick-up and the Impulse Emitting Wheel).

REAR IMPULSE EMITTING WHEELS

Removal

1. Place car on lift, chock front wheels, raise rear using a column type jack secure on stands and remove the wheel.
2. Back off screws ①, get hold of washers and plates then uncouple the outer axle shaft ②.

CAUTION:
During operations take care to avoid damage to the bellows ③ protecting the joints.

1. Cotter pin
2. Lock nut

b. Move the wheel hub axially (back and forth) and read the clearance indicated on the comparator. This clearance should come within specified values.

Front hub bearing clearance:

\[ G = 0.02 \text{ thru } 0.12 \text{ mm} \]

(0.0008 thru 0.005 in)

c. Re-position the cotter pin thus:
   - If the clearance value is 0.02 thru 0.06 mm (0.0008 thru 0.002 in), back off nut until cotter pin is inserted.
   - If the clearance value is 0.06 thru 0.12 mm (0.002 thru 0.005 in), screw on the nut until cotter pin is inserted.

d. Bend the cotter pin back and re-assemble the hub cover.

- Observe the following tightening torque.

① : Tightening torque
Screw securing the brake caliper to the steering knuckle
74 thru 83 N-m
(7.5 thru 8.5 kg-m)
(54.6 thru 61.2 ft-lb)

3. Extract the cotter pin ① from the wheel shaft and slide off the lock nut ②.

4. Having installed a suitable tool to prevent wheel shaft from turning, back off the nut securing the hub to the wheel shaft and slide off the associated washer.

5. Assemble percussion tool A.3.0617 on tool A.3.0327, then, operating as illustrated hereafter, extract the wheel hub ① and retrieve equipment.
6. Using two suitable half-plates and with the aid of a press, divide the impulse emitting wheel and hub.

- Using a press, slip the impulse emitting wheel onto the hub and check correct installation (see: Inspection Specifications - Checks and Adjustments).
- Lock the wheel hub securing nut to the following tightening torque.

\[ T : \text{Tightening torque} \]
Nut securing wheel hub
265 thru 324 N·m
(27 thru 33 kg·m)
(195.5 thru 239 ft·lb)

**ANTILOCK SYSTEM CONTROL UNIT**

**NOTE:**
The electronic unit is situated in the passenger compartment, to the left of the pedal Assy.

**REMOVAL AND INSTALLATION**
1. Disconnect the battery.
2. Remove protective casing by acting on associated nails.
Back off screws and remove the control unit from the support.

**WARNING:**
Avoid knocks to the electronic unit.

4. Re-install in reverse order of removal.
FRONT AND REAR BRAKES

FRONT BRAKES

PAD REPLACEMENT
See: Traditional Braking System - Front Brakes.

BRAKE CALIPER
See: Traditional Braking System - Front Brakes.

BRAKE DISC

Removal
1. Remove pads as per “Pad Replacement”, applying suitable reference marks to facilitate subsequent installation.
2. Back off two brake caliper/steering knuckle screws without disconnecting from system. Secure brake caliper to a suspension link.
3. Carry out the operations described in steps 5., 6., 7. and 8. - Impulse Pick-ups and Impulse Emitting Wheels - Front Impulse Emitting Wheels.
4. Back off two screws securing the wheel hub to the brake disc and separate the two parts.

Inspection
1. Clean brake discs and check that working surfaces are free from score marks and porosity. Replace or grind as necessary.
2. Should working surfaces need grinding, adhere to the following instructions.
a. Always grind off the same amount of material on both surfaces.
b. Dimensions and tolerances as per “Inspection Specifications”, “Checks and Adjustments” are mandatory.

Installation
Install in reverse order of removal, adhering to these instructions.
- Lubricate wheel hub nut thread using recommended grease (AGIP Grease 33 FD; IP Autogrease FD).
- Check front wheel hub bearing clearance (see: Impulse Pick-ups and Impulse Emitting Wheels - Front Impulse Emitting Wheels - Installation).
- Observe the following tightening torque:

- Tightening torque
  Screw securing brake caliper to steering knuckle
  74 thru 83 N·m
  (7.5 thru 8.5 kg·m)
  (54.6 thru 61.2 ft·lb)

- Check the air gap between the impulse pick-up and the impulse emitting wheel (see: Impulse Pick-ups and Impulse Emitting Wheels - Front Impulse Pick-ups - Adjustment of the Air Gap between the Front Impulse Pick-up and the Impulse Emitting Wheel).

REAR BRAKES

PAD REPLACEMENT

BRAKE CALIPERS

BRAKE DISC

See: Traditional Braking System - Rear Brakes.

1 Screw
2 Wheel hub
3 Brake disc
FRONT AND REAR BRAKES

HAND BRAKE

CONTROL LEVER Super 90

Alfa 90 AND Alfa 75

1 Upper grip
2 Control bar
3 Control lever body
4 Support/body retaining screw
5 Hand brake on indicator sending unit
6 Lever support
7 Cotter
8 Washer
9 Actuating fork
10 Pin
11 Guide
12 Push rod
13 Bracket
14 Spring
15 Screw
16 Screw
17 Lower grip
18 Backset pin

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FRONT AND REAR BRAKES

REMOVAL
1. Raise car on a platform lift.
2. Back off locknut ③ and nut ②, and disconnect cable ①.

3. Back off screw ① from car interior, disconnect rear cigar lighter wiring and remove console ②.

4. Back off four screws ① and disconnect sending unit lead ②.

5. Move front seats fully forward; remove plugs ①.

6. Move lever to gain access to lever/control cable conn. rod connection.
7. Remove cotter and lever/conn. rod pin; remove control lever.
8. If necessary, back off 2 control lever grip screws ①, disassemble lever and take off indicator sending unit.

INSPECTION
1. Visually check that components are not excessively worn or damaged. In particular, check ratchet and pawl are not worn or damaged; if necessary replace lever assembly.
2. Check that hand brake on indicator sending unit is working properly.

INSTALLATION
If previously disassembled, assemble lever and install adopting a reversal of the removal sequence, and adhering to the instructions given below.

- Coat cable sliding surfaces with the recommended grease (AGIP Grease 15; SHELL RETINAX G11).
- Adjust hand brake (see Hand Brake Lever Travel Adjustment).
FRONT AND REAR BRAKES

CONTROL LEVER

1. Handle
2. Control lever
3. Washer
4. Spacer
5. Spacer
6. Hand brake on indicator sending unit
7. Cotter
8. Washer
9. Fork

10. Pin
11. Screw
12. Washer
13. Bushing
14. Pin
15. Gasket
16. Lever support
17. Nut
18. Pin
19. Pawl
20. Spacer
21. Ratchet
22. Inner washer
23. Spring
24. Outer washer
25. Control rod
26. Push button

REMOVAL
1. Place car on platform lift, raise and acting on control lever relay assy, remove cotter ②, fork connecting pin ④ and control cable ③.

2. Remove control lever handle ① from car interior, back off screws retaining center console ③ to body and remove console with bellows ④.

1. Fork
2. Cotter
3. Control cable
4. Pin

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FRONT AND REAR BRAKES

DISASSEMBLY
1. Take off cotter 1 from pin 2 connecting lever 3 to relay fork 4, remove pin, retrieve associated washer and detach fork from lever.

2. Back off bolt retaining lever to support and pull out associated bushing.

3. Disconnect hand brake on indicator sending unit lead 1.

4. Back off and remove four lever support screws 2.

5. Remove lever with support.

3. Back off push button 1 and take off push rod 2 with spring 3 and associated washers 4.

4. If necessary, take off indicator sending unit 1 and detach lever 2 from support 3, and disassemble ratchet and pawl mechanism removing rivets 4.

INSPECTION
1. Visually check components for excessive wear or damage. In particular, check lever/support bushing surface conditions and ratchet mechanism teeth for wear.

---

1. Handle
2. Control lever
3. Center console
4. Bellows

1 Cotter
2 Pin
3 Lever
4 Fork

1 Push button
2 Push rod
3 Spring
4 Washers

1 Cable
2 Support/body retaining screws
3 Lever support

1 Hand brake on indicator sending unit
2 Lever
3 Lever support
4 Rivets

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2. Check that hand brake on indicator sending unit is working properly.
3. Replace worn or defective parts.

**ASSEMBLY**

Assemble support and lever adopting a reversal of the disassembly sequence and positioning control components as indicated in figure.

**CONTROL CABLE**

**REMOVAL**

1. Raise car on platform lift.
2. Remove exhaust pipe center section and front end (see: Group 04 - Exhaust System - Removal).
3. Disconnect remote control rod from gear lever and move out of the way to gain access to hand brake control lever/cable connection.
4. Remove cotter ① and take out pin ②, thereby releasing cable ③.

**INSTALLATION**

Install by adopting a reversal of the removal sequence and adhering to the instructions given below.

- Adjust hand brake cable as per “Hand Brake Lever Travel Adjustment”.

5. Back off locknut ③ and nut ④, remove cable ① from levers ② and take off together with sheath.

**INSTALLATION**

1. Install control lever with support on car adopting a reversal of the removal sequence.
2. Adjust hand brake as per “Hand Brake Lever Travel Adjustment”.

6. Release sheath ① from retaining brackets ②.
FRONT AND REAR BRAKES

HAND BRAKE LEVER TRAVEL ADJUSTMENT

1. Check that hand brake lever is in rest position.
2. Adjust pad clearance as indicated in "Rear Brakes - Clearance Adjustment".
3. Tighten nut ① on threaded terminal ③ until cable end float is nil.
4. Tighten locknut ②.
5. Operate hand brake lever and check that rear wheels are locked after 4 to 6 clicks.

WARNING:
Tighten nut without moving levers ④ from rest position (levers abutting limit travel pin) to avoid a reduction in clearance between inner pads and brake disc, as this would cause binding, even with hand brake released.

1 Hand brake adjusting nut
2 Locknut
3 Cable threaded terminal
4 Brake pad actuating lever

---

INSPECTION SPECIFICATIONS

SPECIFICATION

BRAKE CALIPERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Front</th>
<th>Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfa 90 2.5(later)</td>
<td>BREMBO</td>
<td>ATE</td>
</tr>
<tr>
<td>Alfa 75(later)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6V models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfa 75 Turbo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GTV 6.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other models</td>
<td>ATE</td>
<td>ATE</td>
</tr>
</tbody>
</table>

Cylinder dia.
Front  48 mm (1.89 in)
Rear   38 mm (1.50 in)
# FRONT AND REAR BRAKES

## TRADITIONAL BRAKING SYSTEM

### BRAKE-SERVO

<table>
<thead>
<tr>
<th>Car type</th>
<th>Vacuum cylinder diam.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6V engine cars</td>
<td>6 in</td>
</tr>
<tr>
<td>Other models</td>
<td>8 in</td>
</tr>
</tbody>
</table>

### BRAKE MASTER CYLINDER

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Stroke (front/rear)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.2 mm (0.87 in)</td>
<td>16.5/10</td>
</tr>
</tbody>
</table>

## BRAKING SYSTEM WITH (ABS) MARK II ANTILOCK

### ANTILOCK SYSTEM

### SERVO BRAKE

- **Operating pressure**
  - 140 thru 180 bar
  - (13970 thru 17960 KPa)
  - (142.5 thru 183.2 Kg/cm²)
  - (2026.67 thru 2604.42 p.s.i.)
- **Maximum pressure (prior to safety valve activation)**
  - 210 bar
  - (20954 KPa)
  - (213.7 Kg/cm²)
  - (3038.5 p.s.i.)

### ATE ABS MARK II

- High pressure hydraulic
  - 140 thru 180 bar
  - (13970 thru 17960 KPa)
  - (142.5 thru 183.2 Kg/cm²)
  - (2026.67 thru 2604.42 p.s.i.)
# FRONT AND REAR BRAKES

## GENERAL REQUIREMENTS

### FLUIDS AND LUBRICANTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Recommended product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic brake system</td>
<td>FLUID</td>
<td>ATE: Blau S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AGIP: Brake Fluid Super HD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IP: Auto Fluid FR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part no.: 3681-69903</td>
</tr>
<tr>
<td>Brake caliper bellows</td>
<td>GREASE</td>
<td>ATE: Bremszylinger Pasta</td>
</tr>
<tr>
<td>Pedal pivot</td>
<td>GREASE</td>
<td>ISECO: Molykote Longterm n. 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part no.: 3671-69831</td>
</tr>
<tr>
<td>Parking brake cable sliding surfaces</td>
<td>GREASE</td>
<td>AGIP Grease 15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part no.: 3671-69810</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SHELL RETINAX G 11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part no.: 3671-69811</td>
</tr>
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</table>

## SEALANTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Recommended product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake servo-shim and pedal support contact surfaces</td>
<td>JOINTING</td>
<td>LOWAC: Perfect Seal</td>
</tr>
<tr>
<td>(1)</td>
<td>COMPOUND</td>
<td>Part no. 3522.00011</td>
</tr>
<tr>
<td>Hydraulic assy - pedal assy adjoining surfaces (2)</td>
<td>JOINTING</td>
<td>LOWAC: Perfect Seal</td>
</tr>
<tr>
<td></td>
<td>COMPOUND</td>
<td>Part no. 3522.00011</td>
</tr>
</tbody>
</table>

(1) Vehicles equipped with traditional braking system
(2) Vehicles equipped with (ABS) MARK II antilock braking system
CHECKS AND ADJUSTMENTS

DISC REGRINDING DATA

Front disc
Cars with self-ventilated front discs

<table>
<thead>
<tr>
<th></th>
<th>New</th>
<th>Min. thickness after grinding</th>
<th>Max. wear thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake disc thickness C (mm) (in)</td>
<td>22 (0.866)</td>
<td>21 (0.827)</td>
<td>20 (0.787)</td>
</tr>
</tbody>
</table>

Other models

<table>
<thead>
<tr>
<th></th>
<th>New</th>
<th>Min. thickness after grinding</th>
<th>Max. wear thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake disc thickness E (mm) (in)</td>
<td>12.7 (0.5)</td>
<td>10 (0.39)</td>
<td>9 (0.35)</td>
</tr>
</tbody>
</table>

Rear disc

<table>
<thead>
<tr>
<th></th>
<th>New</th>
<th>Min. thickness after grinding</th>
<th>Max. wear thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake disc thickness G (mm) (in)</td>
<td>10 (0.39)</td>
<td>9 (0.35)</td>
<td>8 (0.315)</td>
</tr>
</tbody>
</table>

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**Symbols**

- ✓ Roughness [µm]
- // Parallelism [mm]
- ○ Flatness [mm]
- ⊥ Squareness [mm]

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FRONT AND REAR BRAKES

REAR BRAKE PAD CLEARANCE

On assembly (0.1 to 0.15 mm) (0.004 to 0.006 in)

BRAKE PAD THICKNESS [mm] (in)

<table>
<thead>
<tr>
<th></th>
<th>FRONT</th>
<th></th>
<th>REAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td></td>
<td>Max. wear thickness</td>
<td>New</td>
</tr>
<tr>
<td>16.5 (0.65)</td>
<td>(1)</td>
<td>15 (0.59)</td>
<td>(1)</td>
</tr>
</tbody>
</table>

(1) On cars provided with brake pad wear indicator, replace pads when indicator lights up

HAND BRAKE LEVER TRAVEL ADJUSTMENT

Number of free notches on ratchet before wheel locking: 4 to 6

ADJUSTMENT OF THE AIR GAP BETWEEN THE IMPULSE PICK-UPS AND THE IMPULSE EMITTING WHEELS (*)

\[ t = \text{air gap} \]

1 Screw adjusting air gap \( t \) between the impulse pick-up and impulse emitting wheel
2 Impulse emitting wheel
3 Impulse pick-up
4 Impulse pick-up support

CAUTION:
The impulse pick-ups are not interchangeable (neither front with rear nor left with right).
When re-installing make sure that the impulse pick-ups, new or re-used, are installed in their correct position.

(*) Vehicles equipped with (ABS) MARK II antilock braking system
## FRONT AND REAR BRAKES

### NEW IMPULSE PICK-UP
(The impulse pick-up head bears a plastic spacer equivalent to the air gap required.)

- a. Loosen adjusting screw ①.
- b. Drive the impulse pick-up ③ home against the impulse emitting wheel ②.
- c. Keeping the impulse pick-up against the impulse emitting wheel, tighten the adjusting screw ① to the specified torque:
  - 2.4 thru 3 N·m
  - (0.24 thru 0.3 kg·m)
  - (1.77 thru 2.21 ft-lb)

### USED IMPULSE PICK-UP

#### Front impulse pick-ups
- a. Using a thickness gauge, check that the air gap (t) between the impulse pick-up ③ and the impulse emitting wheel ② is as specified. Also check same in two or three further positions of the impulse emitting wheel.
  - **Air gap between front impulse pick-up and impulse emitting wheel:**  
    \[ t = 0.7 \text{ mm (0.03 in)} \]
- b. Failing to find this value, loosen the air gap adjusting screw ①.
- c. Place a spacer equivalent to the specified air gap (0.7 mm; 0.03 in) between the impulse pick-up and impulse emitting wheel. Keeping the impulse pick-up, spacer and impulse emitting wheel in contact, tighten the adjusting screw ① to the specified torque:
  - 2.4 thru 3 N·m
  - (0.24 thru 0.3 kg·m)
  - (1.77 thru 2.21 ft-lb)
- d. Check that the air gap (t) is as specified in two or three further positions of the impulse emitting wheel.

#### Rear impulse pick-ups
- a. Using a thickness gauge, check that the air gap (t) between the impulse pick-up ③ and the impulse emitting wheel ② is as specified. Also check same in two or three further positions of the impulse emitting wheel.
  - **Air gap between front impulse pick-up and impulse emitting wheel:**  
    \[ t = 1.1 \text{ mm (0.04 in)} \]
- b. Failing to find this value, loosen the air gap adjusting screw ①.
- c. Place a spacer equivalent to the specified air gap (1.1 mm; 0.04 in) between the impulse pick-up and impulse emitting wheel. Keeping the impulse pick-up, spacer and impulse emitting wheel in contact, tighten the adjusting screw ① to the specified torque:
  - 2.4 thru 3 N·m
  - (0.24 thru 0.3 kg·m)
  - (1.77 thru 2.21 ft-lb)
- d. Check that the air gap (t) is as specified in two or three further positions of the impulse emitting wheel.
FRONT AND REAR BRAKES

REAR IMPULSE EMITTING WHEELS (*)

Assembly tolerance

Parallelism error between the impulse emitting wheel 1 and impulse pick-up support 2:
0.3 mm
(0.01 in)

1 Rear impulse emitting wheel
2 Impulse pick-up support

(*) Vehicles equipped with (ABS) MARK II antilock braking system

TIGHTENING TORQUES [N·m (kg·m; ft·lb)]

<table>
<thead>
<tr>
<th>Description</th>
<th>[N·m (kg·m; ft·lb)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screws front brake caliper to steering knuckle</td>
<td>74 to 83 (7.5 to 8.5)</td>
</tr>
<tr>
<td></td>
<td>(54.6 to 61.2)</td>
</tr>
<tr>
<td>Nuts, rear brake caliper to gearbox/differential housing</td>
<td>46 to 52 (4.7 to 5.3)</td>
</tr>
<tr>
<td></td>
<td>(33.9 to 38.4)</td>
</tr>
<tr>
<td>Screws, spacer and rear brake disc to inner axle shaft (1)</td>
<td>40 to 54 (5 to 5.5)</td>
</tr>
<tr>
<td></td>
<td>(36.1 to 39.8)</td>
</tr>
<tr>
<td>Screws, spacer to outer axle shaft (1)</td>
<td>44 to 54 (4.5 to 5.5)</td>
</tr>
<tr>
<td></td>
<td>(32.5 to 39.8)</td>
</tr>
<tr>
<td>Screws, rear brake disc to axle shaft (2)</td>
<td>28 to 35 (3 to 3.6)</td>
</tr>
<tr>
<td></td>
<td>(21.4 to 25.8)</td>
</tr>
<tr>
<td>Locknut, rear brake disc clearance adjusting screw (torque for guidance only, to be obtained by means of a wrench)</td>
<td>7 to 10 (0.7 to 1)</td>
</tr>
<tr>
<td></td>
<td>(5.2 to 7.4)</td>
</tr>
</tbody>
</table>

(1) Cars with axle shafts equipped with spacer (refer to Group 00 - Use of Units in Car)
(2) Cars with axle shafts not equipped with spacer (refer to Group 00 - Use of Units in Car)
### TRADITIONAL BRAKING SYSTEM data

<table>
<thead>
<tr>
<th>Part</th>
<th>[N·m (kg·m; ft·lb)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fittings, hydraulic brake system piping</td>
<td>10 thru 12 (1 thru 1.2)</td>
</tr>
<tr>
<td></td>
<td>(7.4 thru 8.9)</td>
</tr>
<tr>
<td>Fittings, hydraulic brake system hoses</td>
<td>10 thru 15 (1 thru 1.5)</td>
</tr>
<tr>
<td></td>
<td>(7.4 thru 11.1)</td>
</tr>
<tr>
<td>Nuts, brake servo to pedal support</td>
<td>12 thru 15 (1.2 thru 1.5)</td>
</tr>
<tr>
<td></td>
<td>(8.9 thru 11.1)</td>
</tr>
<tr>
<td>Nuts, brake master cylinder to brake servo</td>
<td>12 thru 15 (1.2 thru 1.5)</td>
</tr>
<tr>
<td></td>
<td>(8.9 thru 11.1)</td>
</tr>
</tbody>
</table>

### (ABS) MARK II WHEEL ANTILOCK BRAKING SYSTEM data

<table>
<thead>
<tr>
<th>Part</th>
<th>[N·m (kg·m; ft·lb)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure switch - electropump unit connection</td>
<td>20 thru 26 (2 thru 2.7)</td>
</tr>
<tr>
<td></td>
<td>(14.8 thru 19.2)</td>
</tr>
<tr>
<td>Accumulator - electropump unit connection</td>
<td>40 thru 46 (4.1 thru 4.7)</td>
</tr>
<tr>
<td></td>
<td>(29.5 thru 33.9)</td>
</tr>
<tr>
<td>Screw connecting hose - electropump unit (union)</td>
<td>18 thru 20 (1.6 thru 2)</td>
</tr>
<tr>
<td></td>
<td>(11.8 thru 14.8)</td>
</tr>
<tr>
<td>Screw securing electropump unit - support</td>
<td>9 thru 10 (0.9 thru 1)</td>
</tr>
<tr>
<td></td>
<td>(6.6 thru 7.4)</td>
</tr>
<tr>
<td>Hose (on electropump unit) - pressurized fluid delivery pipe connection</td>
<td>16 thru 20 (1.6 thru 2)</td>
</tr>
<tr>
<td></td>
<td>(11.8 thru 14.8)</td>
</tr>
<tr>
<td>Screws securing electropump unit support - body</td>
<td>9 thru 10 (0.9 thru 1)</td>
</tr>
<tr>
<td></td>
<td>(6.6 thru 7.4)</td>
</tr>
<tr>
<td>Nuts securing coil and electropump unit support - body</td>
<td>9 thru 10 (0.9 thru 1)</td>
</tr>
<tr>
<td></td>
<td>(6.6 thru 7.4)</td>
</tr>
<tr>
<td>Brake adjusting valve - braking pressure modulation electrovalve unit connection</td>
<td>35 thru 40 (3.6 thru 4.1)</td>
</tr>
<tr>
<td></td>
<td>(25.8 thru 29.5)</td>
</tr>
<tr>
<td>Nuts securing electrovalve unit - hydraulic assy</td>
<td>21.4 thru 29.4 (2.2 thru 3)</td>
</tr>
<tr>
<td></td>
<td>(15.8 thru 21.7)</td>
</tr>
<tr>
<td>Screw tightening union on hydraulic assy</td>
<td>16 thru 20 (1.6 thru 2)</td>
</tr>
<tr>
<td></td>
<td>(11.8 thru 14.8)</td>
</tr>
<tr>
<td>Nuts connecting hydraulic - pedal assies</td>
<td>11.3 thru 14 (1.1 thru 1.4)</td>
</tr>
<tr>
<td></td>
<td>(8.3 thru 10.3)</td>
</tr>
<tr>
<td>Unions connecting hydraulic assy - pipes carrying pressurized fluid to brake calipers</td>
<td>12 thru 16 (1.2 thru 1.6)</td>
</tr>
<tr>
<td></td>
<td>(8.9 thru 11.8)</td>
</tr>
<tr>
<td>Screw securing hydraulic assy - square for connection of front left hand wheel impulse pick-up</td>
<td>9 thru 10 (0.9 thru 1)</td>
</tr>
<tr>
<td></td>
<td>(6.6 thru 7.4)</td>
</tr>
<tr>
<td>Union connecting pipe (&quot;from&quot; electropump unit) - hydraulic assy</td>
<td>16 thru 20 (1.6 thru 2)</td>
</tr>
<tr>
<td></td>
<td>(11.8 thru 14.8)</td>
</tr>
<tr>
<td>Screw securing front impulse pick-up cable plate - suspension upper link</td>
<td>9 thru 10 (0.9 thru 1)</td>
</tr>
<tr>
<td></td>
<td>(6.6 thru 7.4)</td>
</tr>
<tr>
<td>Screw securing impulse pick-up (front and rear) - support</td>
<td>9 thru 10 (0.9 thru 1)</td>
</tr>
<tr>
<td></td>
<td>(6.6 thru 7.4)</td>
</tr>
<tr>
<td>Nuts securing front impulse pick-up - steering knuckle</td>
<td>9 thru 10 (0.9 thru 1)</td>
</tr>
<tr>
<td></td>
<td>(6.6 thru 7.4)</td>
</tr>
<tr>
<td>Nuts securing rear impulse pick-up - wheel hub</td>
<td>9 thru 10 (0.9 thru 1)</td>
</tr>
<tr>
<td></td>
<td>(6.6 thru 7.4)</td>
</tr>
<tr>
<td>Screw adjusting air gap, impulse pick-up impulse emitting wheel (front and rear)</td>
<td>2.4 thru 3 (0.24 thru 0.3)</td>
</tr>
<tr>
<td></td>
<td>(1.77 thru 2.21)</td>
</tr>
</tbody>
</table>
## TROUBLESHOOTING FOR TRADITIONAL BRAKING SYSTEM

For correct brake system troubleshooting check:
- Tyres for wear
- Tyre inflation pressure
- Brake fluid and compliance with programmed maintenance instructions.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive pedal travel</td>
<td>• Brake master cylinder leakage</td>
<td>Overhaul brake master cylinder</td>
</tr>
<tr>
<td></td>
<td>• Defective vacuum system non return valve</td>
<td>Replace valve</td>
</tr>
<tr>
<td></td>
<td>• Load proportioning valve leakage</td>
<td>Overhaul or replace</td>
</tr>
<tr>
<td></td>
<td>• Brake system fittings leakage</td>
<td>Tighten fittings</td>
</tr>
<tr>
<td></td>
<td>• Air in brake system</td>
<td>Bleed</td>
</tr>
<tr>
<td>Pedal sponginess</td>
<td>• Air in brake system</td>
<td>Bleed</td>
</tr>
<tr>
<td></td>
<td>• Clogged air vent on reservoir</td>
<td>Clean and bleed system</td>
</tr>
<tr>
<td></td>
<td>• Hose swelling caused by deterioration</td>
<td>Replace hoses and bleed system</td>
</tr>
<tr>
<td></td>
<td>or use of poor quality hose</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Worn caliper seals</td>
<td>Drain hydraulic system, wash using spirit</td>
</tr>
<tr>
<td></td>
<td>• Low boiling point brake fluid</td>
<td>and replace seals</td>
</tr>
<tr>
<td>Insufficient braking power</td>
<td>• Brake line leakage</td>
<td>Change to recommended brake fluid and</td>
</tr>
<tr>
<td></td>
<td>• Air in brake system</td>
<td>bleed system</td>
</tr>
<tr>
<td></td>
<td>• Grease, oil, mud or water on pad surfaces</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Excessive pad wear or deterioration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Improper contact between pad and disc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Brake master cylinder malfunction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Worn or seized pad actuating pistons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Obstruction to pedal travel and pad movement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Insufficient braking power</td>
<td></td>
</tr>
</tbody>
</table>

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# FRONT AND REAR BRAKES

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uneven braking</td>
<td>• Incorrect tyre pressure</td>
<td>Inflate to the correct pressure</td>
</tr>
<tr>
<td></td>
<td>• Grease, mud or water on pad surfaces</td>
<td>Clean components and detect cause of trouble</td>
</tr>
<tr>
<td></td>
<td>• Pad surfaces excessively worn or deteriorated</td>
<td>Replace pads</td>
</tr>
<tr>
<td></td>
<td>• Load proportioning valve not properly adjusted or inefficient</td>
<td>Adjust or overhaul or replace as necessary</td>
</tr>
<tr>
<td></td>
<td>• Incorrect wheel bearing adjustment</td>
<td>Adjust bearings</td>
</tr>
<tr>
<td></td>
<td>• Incorrect wheel alignment</td>
<td>Adjust alignment</td>
</tr>
<tr>
<td>Fade</td>
<td>Unsuitable or inefficient friction materials</td>
<td>Replace pads</td>
</tr>
<tr>
<td>Vibration on brake application</td>
<td>• Scored discs</td>
<td>Grind or replace as necessary</td>
</tr>
<tr>
<td></td>
<td>• Distorted pads</td>
<td>Replace as necessary</td>
</tr>
<tr>
<td></td>
<td>• Grease or brake fluid on braking surfaces</td>
<td>Replace pads</td>
</tr>
<tr>
<td>Brake squeal</td>
<td>• Return springs weakened or failed</td>
<td>Replace defective parts</td>
</tr>
<tr>
<td></td>
<td>• Glazed pads</td>
<td>Dress or replace pads</td>
</tr>
<tr>
<td>Brakes binding</td>
<td>• Pedal articulation binding or excessive brake servo output rod length</td>
<td>Lubricate connection, check pedal return spring</td>
</tr>
<tr>
<td></td>
<td>• Brake master cylinder by-pass clogged</td>
<td>and adjust rod as necessary</td>
</tr>
<tr>
<td></td>
<td>• Brake master cylinder pistons seized</td>
<td>Remove foreign matter by blowing compressed air</td>
</tr>
<tr>
<td></td>
<td>• Piston protectors distorted</td>
<td>Overhaul brake master cylinder and bleed system</td>
</tr>
<tr>
<td></td>
<td>• Defective brake calipers spring-back because of defective piston seals</td>
<td>Replace piston seals</td>
</tr>
<tr>
<td></td>
<td>• Excessive disc distortion</td>
<td>Grind or replace disc</td>
</tr>
<tr>
<td></td>
<td>• Hand brake stuck</td>
<td>Check and repair</td>
</tr>
<tr>
<td></td>
<td>• Brake master cylinder clogged</td>
<td>Overhaul master cylinder and bleed system</td>
</tr>
<tr>
<td></td>
<td>• System lines clogged</td>
<td>Check and clean</td>
</tr>
<tr>
<td></td>
<td>• No pedal free travel</td>
<td>Adjust pedal travel</td>
</tr>
</tbody>
</table>
## FRONT AND REAR BRAKES

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedal rattle</td>
<td>• Excessive disc runout</td>
<td>Check using a gauge, manually rotating disc. If runout exceeds requirements, repair or replace disc.</td>
</tr>
<tr>
<td></td>
<td>• Excessive disc thickness variation</td>
<td>Measure using a suitable gauge. Replace disc if necessary</td>
</tr>
<tr>
<td>Rear wheel locking</td>
<td>Defective load proportioning valve</td>
<td>Replace</td>
</tr>
<tr>
<td>(on light braking)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rear wheel locking (on hard braking)</td>
<td>• Low front brake effectiveness</td>
<td>Overhaul front brakes</td>
</tr>
<tr>
<td></td>
<td>• Grease, oil, mud or water on braking surfaces</td>
<td>Clean or replace and detect causes of trouble</td>
</tr>
<tr>
<td></td>
<td>• Excessive front pad wear</td>
<td>Replace pads</td>
</tr>
<tr>
<td></td>
<td>• Brake master cylinder in pad condition</td>
<td>Repair or replace</td>
</tr>
<tr>
<td>Brake servo</td>
<td>• Non-return valve leakage</td>
<td>Check valve</td>
</tr>
<tr>
<td>Lack of assistance</td>
<td>• Seal leakage between vacuum housing and control unit</td>
<td>Replace brake servo assembly</td>
</tr>
<tr>
<td></td>
<td>• Disc valve leakage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Actuating piston gland leakage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Master cylinder/brake servo sealing ring leakage</td>
<td>Replace sealing ring</td>
</tr>
<tr>
<td></td>
<td>• Damaged hose or fittings</td>
<td>Repair or replace</td>
</tr>
<tr>
<td>Idle adjustment impossible (all connections tight)</td>
<td>Engine draws air from brake servo</td>
<td>Replace non-return valve or brake servo</td>
</tr>
<tr>
<td>Hand brake inoperative</td>
<td>• Incorrect adjustment</td>
<td>Adjust</td>
</tr>
<tr>
<td></td>
<td>• Control cable damaged or broken</td>
<td>Replace cable</td>
</tr>
<tr>
<td></td>
<td>• Defective brake control cable connec- tion</td>
<td>Check connection</td>
</tr>
<tr>
<td>Hand brake stuck after application</td>
<td>• Binding in cable return travel</td>
<td>Remove obstacles or replace cable</td>
</tr>
<tr>
<td></td>
<td>• Lever push button stuck</td>
<td>Disassemble and unlock or replace lever</td>
</tr>
</tbody>
</table>
## FRONT AND REAR BRAKES

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand brake on indicator fails to light up</td>
<td>• Open circuit</td>
<td>Restore circuit continuity</td>
</tr>
<tr>
<td></td>
<td>• Defective sending unit</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>• Defective indicator</td>
<td>Replace</td>
</tr>
</tbody>
</table>

## TROUBLESHOOTING FOR THE (ABS) MARK II ANTILOCK BRAKING SYSTEM

For correct brake system troubleshooting check:
- Tyres for wear
- Tyre inflation pressure
- Brake fluid and compliance with scheduled maintenance instructions.

**NOTE:**
The correct operation of the "brake fluid min. level and pad wear" warning light on the A.R. CONTROL and of the "ABS MARK II system" warning light (5) on the instrument panel is the following:
- On turning the key to IGNITION, both lights illuminate and extinguish (not at the same time) after approximately two seconds.
- On starting the engine, the (5) light only will illuminate again, to extinguish about two seconds after the key has returned from the START position to IGNITION.
- In motion, both lights are off.

**WARNING:**
If ABS control is disconnected, indicated by the illumination of the (5) light on the instrument panel, the servo assisted braking system still continues to operate; the simultaneous illumination of the (5) light on the instrument panel and the "brake fluid minimum level and pad wear" warning light on the A.R. CONTROL, on the other hand indicates an effectively hazardous situation on account of an excessive reduction in hydraulic circuit pressure and the lack of servo assistance.

**NOTE:**
Reference should be made to the wiring diagram and cabling shown at the end of this paragraph for electrical testing and component location.
# FRONT AND REAR BRAKES

<table>
<thead>
<tr>
<th>Fault Description</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S) light fails to illuminate with key to IGNITION</td>
<td>• Blown bulb</td>
<td>Replace bulb or check wiring</td>
</tr>
<tr>
<td></td>
<td>• Diode N29a (see Wiring Diagram) is cut off and ABS unit not supplied at same time</td>
<td>Carry out diagnosis procedure of the (ABS) MARK II antilock system</td>
</tr>
<tr>
<td>(S) lights but remains so with key to IGNITION</td>
<td>• ABS unit not supplied or inefficient</td>
<td>Carry out diagnosis procedure of the (ABS) MARK II antilock system</td>
</tr>
<tr>
<td></td>
<td>• Brake fluid tank switch H34 or N28 pressure switch (see Wiring Diagram) inefficient</td>
<td></td>
</tr>
<tr>
<td>With key to IGNITION, the (S) light and the “brake fluid minimum level and pad wear” light on A.R. CONTROL light up but both remain so</td>
<td>• Insufficient brake fluid</td>
<td>Top up</td>
</tr>
<tr>
<td></td>
<td>• The pressure in the high pressure circuit has not overtaken the minimum safety value (105 bar)</td>
<td>Wait 30 seconds</td>
</tr>
<tr>
<td></td>
<td>• N28 pressure switch (see Wiring Diagram) inefficient</td>
<td>Carry out diagnosis procedure of the (ABS) MARK II antilock system</td>
</tr>
<tr>
<td>With key to IGNITION, the “brake fluid minimum level and pad wear” light on A.R. CONTROL lights up but remains so</td>
<td>• Worn pads</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>• Insufficient brake fluid</td>
<td>Top up</td>
</tr>
<tr>
<td></td>
<td>• Brake fluid tank switch H34 (see Wiring Diagram) inefficient</td>
<td>Carry out electrical diagnosis of the brake fluid tank for the (ABS) MARK II antilock braking system</td>
</tr>
<tr>
<td></td>
<td>• N28 pressure switch (see Wiring Diagram) inefficient</td>
<td>Carry out diagnosis procedure of the (ABS) MARK II antilock system</td>
</tr>
<tr>
<td>With key to IGNITION, (S) light illuminates and extinguishes duly after 2 seconds but fails to light up again on starting</td>
<td>• Relay L38 (see Wiring Diagram) inefficient</td>
<td>Carry out diagnosis procedure of the (ABS) MARK II antilock system</td>
</tr>
<tr>
<td>With the key to IGNITION, the (S) light illuminates and duly extinguishes after 2 seconds, but on starting lights up again and remains so</td>
<td>• ABS unit inefficient</td>
<td>Replace</td>
</tr>
<tr>
<td>When running, the (S) light illuminates or both the (S) light and the “brake fluid minimum level and pad wear” light on A.R. CONTROL light up</td>
<td>• Multiple causes</td>
<td>Carry out diagnosis procedure of the (ABS) MARK II antilock system</td>
</tr>
</tbody>
</table>
# FRONT AND REAR BRAKES

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| When running the light illuminates now and again due to causes unknown (and not shown by the diagnosis of the (ABS) MARK II anti-lock system) | - Badly connected or rusty connections  
- Clearance of the front wheel hub bearings not within specified tolerance limits  
- Diode N29b (see Wiring Diagram) cut off  
- Relay 140 (see Wiring Diagram) inefficient  
- ABS control unit occasionally inefficient | Verify and rectify  
- Return clearance to within specified values (see: Group 21 - Front Suspension Inspection Specifications - Checks and Adjustment)  
- Replace  
- Replace  
- Replace |
| Insufficient braking power | - Brake line leakage  
- Air in brake system  
- Grease, oil, mud or water on pad surfaces  
- Pad deterioration  
- Worn or seized pad actuating pistons  
- Brake master cylinder/hydraulic servo cylinder inefficient due to internal leakage | Repair or replace faulty parts  
- Bleed system  
- Clean and detect cause of trouble.  
- Replace pads  
- Replace pads and grind discs as necessary  
- Replace calipers  
- Verify presumed cause thus:  
  - Connect two 100 bar pressure gauges (A.2.0440) to the front caliper bleed screws  
  - Turn the key to IGNITION and wait for the electropump to come to a halt  
  - Remove key  
  - Press brake pedal with suitable tool (A.2.0442) until 100 bar is reached on front caliper pressure gauges  
  - Wait about 3 minutes for the pressure to settle then check that the loss of pressure is no greater than 5 bar in 5 minutes. If pressure loss is greater, replace master cylinder with hydraulic servo cylinder |
| Excessive pedal travel | - Brake master cylinder and/or hydraulic servo cylinder leakage  
- Fluid leakage from brake pressure adjusting valve  
- Brake system union leakage  
- Air in brake system  
- Gaskets inside master cylinder and/or hydraulic servo cylinder inefficient | Replace brake master cylinder with hydraulic servo cylinder  
- Replace  
- Tighten unions to specified torque.  
- Replace  
- Bleed  
- Replace brake master cylinder with hydraulic servo cylinder |
# FRONT AND REAR BRAKES

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedal sponginess</td>
<td>Air in brake system</td>
<td>Bleed</td>
</tr>
<tr>
<td></td>
<td>Clogged air vent on brake fluid tank</td>
<td>Clean and possibly replace</td>
</tr>
<tr>
<td></td>
<td>Use of unsuitable brake fluid</td>
<td>Change to recommended brake fluid and bleed system</td>
</tr>
<tr>
<td>Uneven braking</td>
<td>Incorrect tyre pressure</td>
<td>Inflate to correct pressure</td>
</tr>
<tr>
<td></td>
<td>Grease, oil, mud or water on pad surfaces</td>
<td>Clean components and detect cause of trouble. Replace pads</td>
</tr>
<tr>
<td></td>
<td>Pad surfaces unevenly worn or deteriorated</td>
<td>Detect cause of trouble and replace pads</td>
</tr>
<tr>
<td></td>
<td>Inefficient brake pressure adjusting valve</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Incorrect wheel trim</td>
<td>Adjust</td>
</tr>
<tr>
<td>Vibration on brake application</td>
<td>Unevenly worn pads</td>
<td>Detect cause and replace pads</td>
</tr>
<tr>
<td></td>
<td>Grease or brake fluid on braking surfaces</td>
<td>Detect cause and replace pads</td>
</tr>
<tr>
<td></td>
<td>Distorted discs</td>
<td>Grind or replace</td>
</tr>
<tr>
<td>Brakes squeal</td>
<td>Unsuitable pads</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>Rusty discs</td>
<td>Grind or replace</td>
</tr>
<tr>
<td>Brakes binding</td>
<td>Pedal fails to return to rest position</td>
<td>Check pedal motion and repair fault. Replace master cylinder with hydraulic servo cylinder</td>
</tr>
<tr>
<td></td>
<td>Calipers stay partially closed</td>
<td>Check and possibly replace</td>
</tr>
<tr>
<td></td>
<td>Hand brake stuck</td>
<td>Check and repair</td>
</tr>
<tr>
<td>Rear wheels tend to brake more than front ones</td>
<td>Inefficient brake pressure adjusting valve</td>
<td>Replace</td>
</tr>
<tr>
<td>Hand brake inoperative</td>
<td>Pads not adjusted</td>
<td>Adjust</td>
</tr>
<tr>
<td></td>
<td>Hand brake travel adjustment incorrect</td>
<td>Adjust</td>
</tr>
<tr>
<td></td>
<td>Control cable damaged or broken</td>
<td>Replace cable</td>
</tr>
<tr>
<td></td>
<td>Hand brake control on calipers defective</td>
<td>Replace calipers</td>
</tr>
<tr>
<td>Car still braking with hand brake off</td>
<td>Binding in cable return travel</td>
<td>Remove obstacles or replace cable</td>
</tr>
</tbody>
</table>
FRONT AND REAR BRAKES

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand brake stuck</td>
<td>Lever pushbutton stuck</td>
<td>Disassemble and release or replace lever</td>
</tr>
<tr>
<td>Hand brake on indicator fails</td>
<td>• Open circuit</td>
<td>Restore circuit continuity</td>
</tr>
<tr>
<td></td>
<td>• Defective switch</td>
<td>Replace</td>
</tr>
<tr>
<td></td>
<td>• Defective A.R. CONTROL</td>
<td>Check and possibly replace</td>
</tr>
</tbody>
</table>

DIAGNOSIS PROCEDURE OF THE (ABS) MARK II ANTILOCK SYSTEM

DIAGNOSTIC INSTRUMENTATION

1. Universal diagnoser for electronic systems (C.1.0132)
2. Selector (1)
3. Selector (2)
4. Jacks
5. Connecting cable (C.0.0032)
6. Interface for ABS MARK II (C.1.0133)
7. Connection to wiring connector
8. Tie cables
9. Multimeter
10. Switch (2)
11. Switch (1)
12. Pushbuttons

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FRONT AND REAR BRAKES

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**CAUTION:**
Prior to working on the hydraulic circuit, the brake fluid pressure should be completely discharged by pressing the brake pedal at least 20 times until it sticks, with the ignition key removed. The circuit is at 180 bar.

---

Hydraulic circuit pressure gauge (A.2.0441)
1 Washers
2 Screw

---

**PRELIMINARY OPERATIONS**
- Remove the ignition key.
- Fully discharge the hydraulic circuit pressure (**press brake pedal at least 20 times until it sticks**).
- Connect the pressure gauge (A.2.0441) to the pump unit outlet.

---

---
Test No. 1

Ensure that the pressure in the hydraulic circuit is below 80 bar.

Insert the ignition key and check the "brake fluid min, level and pad wear" light illumination on A.R. CONTROL and (3) illumination on instrument panel.

NO

Carry out "ELECTRICAL TESTS WITH DIAGNOSER" (with particular reference to test No. 5).

YES

Check that the pressure in the hydraulic circuit starts to increase.

NO

Is pump motor working?

YES

YES

NO

Check that electric motor supply is 12V.

a) If supply is 12V: replace electropump.
b) If supply is not 12V: find fault by testing these points with a multimeter, referring to ground:

<table>
<thead>
<tr>
<th>Pressure switch connector pin 1</th>
<th>~ 0V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure switch connector pin 4</td>
<td>~ 0V</td>
</tr>
<tr>
<td>Terminal 85 relay 140</td>
<td>~ 0V</td>
</tr>
<tr>
<td>Terminal 86 relay 140</td>
<td>12V</td>
</tr>
<tr>
<td>Fuse relay 140</td>
<td>12V</td>
</tr>
<tr>
<td>Terminal 87 relay 140</td>
<td>12V</td>
</tr>
<tr>
<td>Electropump connector, pin 2</td>
<td>12V</td>
</tr>
<tr>
<td>Electropump connector, pin 1</td>
<td>~ 0V</td>
</tr>
</tbody>
</table>

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YES

- Check brake fluid supply circuit.
- Replace electropump.

NO

Check that at approx. 145 bar the warning light extinguishes and the alarm on the A.T. CONTROL ceases

YES

A) Warning light fails to extinguish:
Carry out: ELECTRICAL TESTS WITH DIAGNOSER.
B) The "brake fluid min. level and pad wear" on A.R. CONTROL fails to extinguish:
- Check pads for wear and level of brake fluid in tank.
- Test terminal 85 of relay 139 with a multimeter referred to ground.
  1) If value read is 12V: replace relay 139 (should alarm fail to cease, test entire pad circuit as per A.R. CONTROL Troubleshooting).
  2) If value read is ~0V:
     a) disconnect brake fluid tank connector; if alarm ceases, replace tank;
     b) disconnect pressure switch connector; if alarm ceases, replace pressure switch.
- Eliminate the short circuit between terminal 85 of relay 139 and ground.
Check that the pressure does not exceed 180 bar.

- If the pressure settles at a pressure above 180 bar, the pressure switch is incorrectly calibrated and should therefore be replaced.
- If electropump however keeps running, disconnect the pressure switch connector:
  a) if the electropump stops, replace the pressure switch;
  b) if the electropump does not stop, look for the fault by testing these points with a multimeter referred to ground.

<table>
<thead>
<tr>
<th>Pressure switch connector pin 4</th>
<th>12V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 87 of relay 140</td>
<td>~0V</td>
</tr>
</tbody>
</table>

Check that the time elapsed on reaching 180 bar is no more than 60 seconds.

- Check that electric motor supply is 12V.
- Replace electropump.

Test N° 2

With a pressurized hydraulic circuit (pump at a halt) and the key inserted, press the brake pedal several times.
FRONT AND REAR BRAKES

Check that when the pressure reaches 140 ± 4 bar the pump is activated thus restoring the pressure to 180 bar.

NO

Replace the pressure switch.

YES

Test № 3

Turn the key to the IGNITION position.
Wait until maximum pressure (180 bar) is attained.
Remove the key.
Wait 3 minutes to allow pressure to stabilize perfectly.

NO

After 5 minutes check that the pressure leak is less than 10 bar.

NO

Confirm back-up of brake fluid in tank.
Choke electropump feed hose accordingly.
Does back-up stop?

YES

Replace electropump.

NO

Replace master cylinder with hydraulic servo cylinder.

YES

Replace master cylinder with hydraulic servo cylinder.
ELECTRICAL TESTS WITH DIAGNOSER

NOTE:
Subsequent to a repair it is advisable to resume the diagnosis from the start.

Ohmmetric measurement set-up
- Disconnect the connector from the ABS unit.
- Insert the diagnostic equipment interface (C.1.0133) in the cable connector.

1 Cable connector

- Ensure that the interface (C.1.0133) is connected to the diagnoser (C.1.0132) by means of the cable supplied (C.9.0032).
FRONT AND REAR BRAKES

- Set rotating selectors (1) and (2) to position 1.
- Set switches (1) and (2) to position 1.
- Verify that the pressure in the hydraulic circuit is 140 thru 180 bar.
- Remove the key.
- Set-up the multimeter for OHM measurement and insert the prods of the tie cables into the blue and black jacks of the diagnoser marked OHM.
- Selectors (1) and (2) to position 1.

Test N° 4

Impulse pick-ups test

Selector (1) to position 1.
Set multimeter to position 20 KΩ F.S..

Read 2100 ± 300  Ω on the multimeter.
Turn selector (1) to positions 2 - 3 - 4 and check that the value obtained remains between 2100 ± 300  Ω.

<table>
<thead>
<tr>
<th>Selector</th>
<th>Impulse pick-up tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>position 1</td>
<td>RH rear</td>
</tr>
<tr>
<td>position 2</td>
<td>LH front</td>
</tr>
<tr>
<td>position 3</td>
<td>LH rear</td>
</tr>
<tr>
<td>position 4</td>
<td>RH front</td>
</tr>
</tbody>
</table>

Operate on defective impulse pick-up only.
A) If the value read on the diagnoser is approx. 1000  Ω, one of the two connecting cables between the impulse pick-up and control unit connector is short circuiting on the body: eliminate the problem.
B) For other values (and therefore for other types of failure) the resistance should be measured directly on the impulse pick-up involved and also on the control unit connector.

NOTE: Measuring directly on the multimeter (without the diagnoser) the impulse pick-up resistance should be 1100 ± 300  Ω.

<table>
<thead>
<tr>
<th>Impulse pick-up</th>
<th>Control unit connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH rear (L30)</td>
<td>4 - 22</td>
</tr>
<tr>
<td>LH front (L29)</td>
<td>5 - 23</td>
</tr>
<tr>
<td>LH rear (L31)</td>
<td>6 - 24</td>
</tr>
<tr>
<td>RH front (L28)</td>
<td>7 - 25</td>
</tr>
</tbody>
</table>

A Impulse pick-up electrical connection

Control unit connector

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PA360900000004
Test N° 5

Warning light alarm SW test (tank and pressure switch)

Selector (1) to position 5.
Set up multimeter to position 200 Ω F.S.

Read ~ 0 Ω on the multimeter.

Check brake fluid tank level.
If level is normal, use the previously set up multimeter directly on the tank connector, pins 1 and 2 to check that the resistance value is ~ 0 Ω.

Is the value read ~ 0 Ω?

Replace tank.

A Tank connector

1 2 3 4 5
FRONT AND REAR BRAKES

- Reconnect connector to tank.
- Turn key to IGNITION position.
- Wait for electropump to stop.
- Remove key.
- Disconnect pressure switch connector.
- Using previously set up multimeter, check directly on the pressure switch connector, pins 3 and 5 that the resistance value is \( \sim 0 \, \Omega \).

Is the value read \( \sim 0 \, \Omega \)?

YES

- Reconnect the connectors and check continuity between pins 9 and 10 of the control unit connector (disconnecting interface C.1.0133). Otherwise look for opening on cable between:
  - Pin 2 tank connector and pin 3 pressure switch connector.
  - Pin 1 tank connector and pin 9 control unit connector.
  - Pin 5 tank connector and pin 10 control unit connector.

NO

Replace pressure switch.

Remove brake fluid tank connector.

Read infinite resistance on the multimeter.

YES

Verify that there is no continuity to ground on one of the two pins 9 and 10 of the control unit connector (with interface C.1.0133 disconnected). Otherwise look for the short circuit in the connections of pins 1 and 2 of the tank connector.

A Control unit connector
FRONT AND REAR BRAKES

Replace tank connector.
Read ~ 0 Ω on the multimeter.
Press the brake pedal several times.

Read infinite resistance on the multimeter when the pressure goes below 105 bar.

Disconnect the pressure switch connector.
Is infinite resistance read on the multimeter?

Eliminate the short circuit on the pressure switch cable:
- from pin 10, control unit, connector to pin 5, pressure switch connector;
- from pin 3, pressure switch connector, to pin 2, brake fluid tank connector;
- from pin 1, brake fluid tank to pin 9, control unit connector.

Replace pressure switch.

Test N°6

Electrovalve test
Multimeter to position 200 Ω F.S.,

Check the resistances indicated below for the various selector positions (1):

<table>
<thead>
<tr>
<th>Position</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>5 thru 8 Ω (FRONT RH load)</td>
</tr>
<tr>
<td>7</td>
<td>3 thru 5 Ω (rear drain)</td>
</tr>
<tr>
<td>8</td>
<td>3 thru 5 Ω (FRONT LH drain)</td>
</tr>
<tr>
<td>9</td>
<td>3 thru 5 Ω (FRONT RH drain)</td>
</tr>
<tr>
<td>10</td>
<td>5 thru 8 Ω (rear load)</td>
</tr>
<tr>
<td>11</td>
<td>5 thru 8 Ω (FRONT LH load)</td>
</tr>
</tbody>
</table>

Using previously set up multimeter, check the following values directly on the electrovalve unit connector.

<table>
<thead>
<tr>
<th>Prod position</th>
<th>Correct value [Ω]</th>
<th>Corresponding electrovalve</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 - 1</td>
<td>5 thru 8</td>
<td>Front LH Load</td>
</tr>
<tr>
<td>7 - 2</td>
<td>3 thru 5</td>
<td>Front LH Drain</td>
</tr>
<tr>
<td>7 - 3</td>
<td>5 thru 8</td>
<td>Rear Load</td>
</tr>
<tr>
<td>7 - 4</td>
<td>3 thru 5</td>
<td>Rear Drain</td>
</tr>
<tr>
<td>7 - 5</td>
<td>3 thru 5</td>
<td>Front RH Drain</td>
</tr>
<tr>
<td>7 - 6</td>
<td>5 thru 8</td>
<td>Front RH Load</td>
</tr>
</tbody>
</table>

Replace electrovalve unit.
FRONT AND REAR BRAKES

Check cable continuity between electrovalve unit connector and control unit connector.

<table>
<thead>
<tr>
<th>Electrovalve unit connector pin</th>
<th>Control unit connector pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>11</td>
</tr>
</tbody>
</table>

Selector (1) to position 12. Read 2 thru 5 Ω on the multimeter (MAIN ELECTROVALVE).

With a previously set up multimeter, check that the resistance value is 2 thru 5 Ω directly on the main electrovalve connector.

Check continuity of the cable corresponding to the main electrovalve.

<table>
<thead>
<tr>
<th>Main electrovalve connector pin</th>
<th>Control unit connector pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>Directly to ground</td>
</tr>
</tbody>
</table>

Replace master cylinder with hydraulic servo cylinder.
Voltmetric measurement set-up

- Remove the key.
- Selector (1) to position 1.
- Selector (2) to position 1.
- Switches (1) and (2) to position 1.
- Turn the key and wait until maximum pressure (180 bar) is reached in the hydraulic circuit.
- Remove the key.
- Set the multimeter up for VOLT measurement and insert the cable tie black prod into the black jack marked VOLT and the red prod of the other cable tie into the red jack marked VOLT.

Test N° 7

Control unit inhibit test during start-up phase

Selector (2) to position 1.
Set multimeter to 20 V F.S. position.
Turn the key to the IGNITION position.

Read 12V on the multimeter.

Is the fuse of relay 139 open?

YES
Replace.

NO

Attempt to start and verify that the voltage goes down to ~0V in this phase.

Replace relay 139, Should trouble persist, look for the failure by testing these points with a multimeter referred to ground.

Without starting the engine:

<table>
<thead>
<tr>
<th>Terminal 30 relay 138</th>
<th>12V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 87 relay 138</td>
<td>12V</td>
</tr>
<tr>
<td>Terminal 85 relay 138</td>
<td>~0V</td>
</tr>
<tr>
<td>Control unit connector pin 2</td>
<td>12V</td>
</tr>
</tbody>
</table>

During start-up:

<table>
<thead>
<tr>
<th>Terminal 89 relay 138</th>
<th>12V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 85 relay 138</td>
<td>~0V</td>
</tr>
<tr>
<td>Terminal 87 relay 138</td>
<td>~0V</td>
</tr>
<tr>
<td>Control unit connector pin 2</td>
<td>~0V</td>
</tr>
</tbody>
</table>

A Control unit connector

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Test No 8

ABS control unit main supply test

Selector (2) to position 2,
Multimeter to position 20V F.S.,
Turn the key to the IGNITION position.

Read ~0V on the multimeter.

Using a multimeter test B7a of relay 137 (referring to ground); a voltage of ~0V should be read.

Replace relay 137.

Check continuity between terminal 30 of relay 137 and pin 20 of the control unit connector.

Put switch (1) to position 2.
FRONT AND REAR BRAKES

Read 12V on the multimeter.

YES

NO

Replace relay 137 or associated fuse.
If the trouble persists, look for the cause by testing these points with a multimeter, referring to ground.

<table>
<thead>
<tr>
<th>Component</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuse of relay 137</td>
<td>12V</td>
</tr>
<tr>
<td>Terminal 85 relay 137</td>
<td>0V</td>
</tr>
<tr>
<td>Terminal 86 relay 137</td>
<td>12V</td>
</tr>
<tr>
<td>Terminal 30 relay 137</td>
<td>12V</td>
</tr>
<tr>
<td>Control unit connector pin 20</td>
<td>12V</td>
</tr>
</tbody>
</table>

Turn selector (2) to position 3.

Carry out the same procedure as described for selector (2) in position 2.
- With switch (1) to position 1, read 0V on the multimeter.
- With switch (1) to position 2, read 12V on the multimeter.

YES

Check continuity of the cable between terminal 30 of relay 137 and control unit connector on pin 3.

NO
Diode N29a diminished voltage test (see Wiring Diagram)

Selector (2) to position 4.
Switch (1) to position 1.
Multimeter to position 20V F.S..
Turn the key to the IGNITION position.

Read 0.6 thru 0.8V on the multimeter.

Replace diode N29a, if failure persists, continue with diagnosis.

Check that warning light is illuminated.

- Check fuse box fuse.
- Check bulb efficiency.
- Check cable of diode N29a both at pin 2 of connector G124 and terminal 30 of relay I37.
- Check connection between instrument panel, warning light and pin 2, connector G124.

Switch (1) to position 2.
FRONT AND REAR BRAKES

Read 12V on the multimeter. NO
YES

Check cable between pin 2 of connector G124 and pin 27 of the control unit connector.

Check that the warning light is extinguished.

Test N° 10

Electrovalve ground efficiency test

Selector (2) to position 5.
Switch (1) to position 2.
Set multimeter to 200 mV F.S.
Turn the key to the IGNITION position.
Read ~ 0V on multimeter.

Briefly press pushbuttons 1 - 2 - 3 - 4 individually, verifying that the voltage read on the multimeter never exceeds 10 mV.

NO

Check efficiency of electrovalve ground.

YES

1 Electrovalve unit ground.
FRONT AND REAR BRAKES

Test N° 11

Impulse pick-up dynamic test

- Set multimeter to position 2V F.S. in ALTERNATED CURRENT.
- Switch (1) in position 1.
- Raise the vehicle so that the wheels turn freely.

- Selector (2) to position 6. Turn the rear RH wheel at approx. 1 rev. per sec. and read 0.15 thru 0.7V on the multimeter.
- Selector (2) to position 7. Turn the front LH wheel at approx. 1 rev. per sec. and read 0.15 thru 0.7V on the multimeter.
- Selector (2) to position 8. Turn the rear LH wheel at approx. 1 rev. per sec. and read 0.15 thru 0.7V on the multimeter.
- Selector (2) to position 9. Turn the front RH wheel at approx. 1 rev. per sec. and read 0.15 thru 0.7V on the multimeter.

• Complete the four tests so as to establish that there is no inversion between the cables of the individual impulse pick-ups, bearing in mind that when a rear wheel is turned it may pull the other one into motion.
• Check good condition of the impulse emitting wheel.
• Check the air gap between the impulse pick-up and impulse emitting wheel.
[See: Inspection Specifications].

Electrovalve dynamic test set-up

- Remove the key.
- Ascertained that all previous tests proved positive otherwise refrain from carrying out the following.
- Selector (1) to position 1.
- Selector (2) to position 1.
- Switch (1) to position 2.
- Switch (2) to position 1.
- Raise the car enough to allow the wheels to turn freely.
- Insert the key and wait until the pressure in the hydraulic circuit reaches the maximum pressure of 180 bar.
Test N° 12

Front LH load and drain electrovalve test

Press the brake pedal quite hard.
Check that front LH wheel is locked.

Press pushbutton 1 and check that the front LH wheel unlocks within 1-2 seconds.
WARNING: The pushbutton should never be pressed for more than 30 seconds; in the event of test repetition, allow at least the time for which the button was pressed to elapse between one test and the next in order to avoid overheating of the electrovalves.

NO

Replace the electrovalve unit.

YES

Release pushbutton 1.

NO

Replace the electrovalve unit.

YES

Verify a slight sinking of the brake pedal with a consequent wheel lock.

NO

Replace the electrovalve unit.

YES

Release the brake pedal.
FRONT AND REAR BRAKES

Test N° 13

Front RH load and drain electrovalve test

Proceed as per the previous test by pressing pushbutton 2 and check the effect on the front RH wheel.

YES

NO

As per previous test, if hypothesized conditions fail to be met, proceed with electrovalve unit replacement.

Test N° 14

Rear load and drain electrovalve test

Proceed as per the previous test by pressing pushbutton 3 and check the effect on both rear wheels.

WARNING: Brake pedal sinking on release of the pushbutton will be less than in previous tests.

YES

NO

As per previous test, if hypothesized conditions fail to be met, proceed with electrovalve unit replacement.

Test N° 15

Main electrovalve test

Press the pedal quite hard until test completion.

Press pushbutton 1 several times until the brake pedal sinks completely.

Press pushbutton 4.
FRONT AND REAR BRAKES

Check that the brake pedal returns to its initial position. NO Replace the brake master cylinder with the hydraulic servo cylinder.

YES

Release pushbutton 4 and the brake pedal.

OBSERVATIONS
Should the problem persist on completion of the diagnostic procedure, proceed thus:
- Check that all the connections are well connected and rust free.
- Check that the clearance of the front wheel hub bearings come within the tolerance limits (see: Group 21 - Front Suspensions - Inspection Specifications).
- Check that diode N29b (see Wiring Diagram) is not open.
- Check that relay I40 (see Wiring Diagram) is efficient.
- Replace ABS control unit.

ELECTRICAL DIAGNOSIS OF THE BRAKE FLUID TANK FOR THE (ABS) MARK II ANTILOCK BRAKING SYSTEM

a. Resistance (< 10 Ω)
b. Microswitch FLS1; it sends a tank minimum oil level alarm to the A.R. CONTROL
c. Microswitch FLS2; it signals an excessive decrease in the tank brake fluid level to the ABS control unit.
Disconnect the brake fluid tank connector.
- Remove the plug.
- Check that the level of the brake fluid in the tank reaches the MAX mark otherwise top up.

Using a multimeter set up for OHM measurement, check the resistance values summed up in the following table.

<table>
<thead>
<tr>
<th>Points to test</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pins 1 and 2</td>
<td>~ 0 Ω</td>
</tr>
<tr>
<td>Pins 3 and 4</td>
<td>Infinite</td>
</tr>
</tbody>
</table>

Replace brake fluid tank.

Keeping the prods of the multimeter on pins 3 and 4, gradually syringe the brake fluid out from the tank.
Check that at a certain level (between MIN and MAX) microswitch FLS1 closes and read a resistance value lower than 10 Ω on the multimeter.

Replace brake fluid tank.

Now put the multimeter prods on pins 1 and 2.
Syringe the fluid up further and check that microswitch FLS2 opens, reading a value of infinite resistance on the multimeter.

Replace brake fluid tank.

Gradually fill up the brake fluid tank, verifying first the closure of microswitch FLS2 (read a value of ~ 0 Ω on pins 1 and 2) and subsequently the opening of microswitch FLS1 (read a value of infinite resistance on pins 3 and 4).
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Battery</td>
</tr>
<tr>
<td>B1</td>
<td>Ignition switch</td>
</tr>
<tr>
<td>C11</td>
<td>ALFA ROMEO Control display</td>
</tr>
<tr>
<td>C13</td>
<td>Optoelectronic cluster</td>
</tr>
<tr>
<td>D27</td>
<td>ABS system warning lamp</td>
</tr>
<tr>
<td>G4</td>
<td>Free fusebox</td>
</tr>
<tr>
<td>G52</td>
<td>Fusebox ground</td>
</tr>
<tr>
<td>G53</td>
<td>Engine compartment ground</td>
</tr>
<tr>
<td>G53a</td>
<td>Engine compartment ground - right side</td>
</tr>
<tr>
<td>G53b</td>
<td>Engine compartment ground - left side</td>
</tr>
<tr>
<td>G55</td>
<td>Hood ledge panel ground</td>
</tr>
<tr>
<td>G56</td>
<td>Branch terminal board</td>
</tr>
<tr>
<td>G73a</td>
<td>Connector for right rear services</td>
</tr>
<tr>
<td>G94b</td>
<td>8-way connector for engine compartment</td>
</tr>
<tr>
<td>G95</td>
<td>Central fusebox</td>
</tr>
<tr>
<td>G95D</td>
<td>Connector for ALFA ROMEO Control</td>
</tr>
<tr>
<td>G96E</td>
<td>Connector for console</td>
</tr>
<tr>
<td>G96N</td>
<td>Connector for battery</td>
</tr>
<tr>
<td>G98O</td>
<td>Connector for ignition switch</td>
</tr>
<tr>
<td>G98P</td>
<td>Connector for door services</td>
</tr>
<tr>
<td>G96Q</td>
<td>Connector for performance gauge</td>
</tr>
<tr>
<td>G96S</td>
<td>Connector for cluster</td>
</tr>
<tr>
<td>G96V</td>
<td>Fuses</td>
</tr>
<tr>
<td>G96C</td>
<td>Single connector for ALFA ROMEO Control - cluster</td>
</tr>
<tr>
<td>G99c</td>
<td>Connector for engine dashboard (C)</td>
</tr>
<tr>
<td>G103</td>
<td>Connector for grounds and brakes fluid tank</td>
</tr>
<tr>
<td>G123</td>
<td>Pedal assembly ground</td>
</tr>
<tr>
<td>G124</td>
<td>ABS system connector</td>
</tr>
<tr>
<td>G125</td>
<td>ABS system free fusebox</td>
</tr>
<tr>
<td>G126</td>
<td>ABS system relay safety fuse</td>
</tr>
<tr>
<td>H10</td>
<td>Left front brake pad switch</td>
</tr>
<tr>
<td>H11</td>
<td>Right rear brake pad switch</td>
</tr>
<tr>
<td>H34</td>
<td>ABS system brake fluid tank switch</td>
</tr>
<tr>
<td>I2</td>
<td>Heated rear window relay</td>
</tr>
<tr>
<td>I17</td>
<td>Fog light relay</td>
</tr>
<tr>
<td>I27</td>
<td>Seat height adjustment relay</td>
</tr>
<tr>
<td>I31</td>
<td>Front power windows - heater relay</td>
</tr>
<tr>
<td>I37</td>
<td>ABS system control unit relay</td>
</tr>
<tr>
<td>I38</td>
<td>ABS system auxiliary relay</td>
</tr>
<tr>
<td>I39</td>
<td>Brake fluid level warning lamp relay</td>
</tr>
<tr>
<td>I40</td>
<td>ABS system brake fluid electropump relay</td>
</tr>
<tr>
<td>L28</td>
<td>Front RH pick-up</td>
</tr>
<tr>
<td>L29</td>
<td>Front LH pick-up</td>
</tr>
<tr>
<td>L30</td>
<td>Rear RH pick-up</td>
</tr>
<tr>
<td>L31</td>
<td>Rear LH pick-up</td>
</tr>
<tr>
<td>M10</td>
<td>Brake fluid adjusting valves</td>
</tr>
<tr>
<td>M11</td>
<td>ABS system main valve</td>
</tr>
<tr>
<td>N22</td>
<td>ALFA ROMEO Control unit</td>
</tr>
<tr>
<td>N27</td>
<td>ABS system control unit</td>
</tr>
<tr>
<td>N28</td>
<td>Brake fluid electropump apparatus</td>
</tr>
<tr>
<td>N29a</td>
<td>Connection for free diode (A)</td>
</tr>
<tr>
<td>N99b</td>
<td>Connection for free diode (B)</td>
</tr>
</tbody>
</table>
### SPECIAL TOOLS

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.5.0194</td>
<td>Wrench, wheel cylinder, 17</td>
<td>22-12</td>
</tr>
<tr>
<td>A.3.0327</td>
<td>Hub puller (to be used, without screw, with tool A.3.0617)</td>
<td>22-36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22-37</td>
</tr>
<tr>
<td>A.3.0617</td>
<td>Percussion tool for rear wheel hub pulling (to be used with tool A.3.0327 without screw)</td>
<td>22-36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22-37</td>
</tr>
<tr>
<td>C.1.0132</td>
<td>Universal diagnoser for electronic system</td>
<td>22-59</td>
</tr>
<tr>
<td>C.9.0032</td>
<td>Cable connecting C.1.0132 and C.1.0133</td>
<td>22-59</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22-65</td>
</tr>
<tr>
<td>C.1.0133</td>
<td>Interface for ABS MARK II</td>
<td>22-59</td>
</tr>
<tr>
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<td>A.2.0440</td>
<td>Front and rear brake calipers 100 bar pressure gauges</td>
<td>22-57</td>
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<td>A.2.0441</td>
<td>Hydraulic circuit 200 bar pressure gauge (ABS MARK II system)</td>
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<tr>
<td>A.2.0442</td>
<td>Brake pedal operating tool</td>
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