

BRAKE SYSTEM

INDUCTION TO BRAKE SYSTEM	P-2
REGULAR BRAKE SYSTEM	P-3
AIR BLEEDING.....	P-3
INSPECTION OF THE CHECK VALVE OF VACUUM HOSE.....	P-3
ADJUSTMENT AND MAINTENANCE OF BRAKE PEDAL.....	P-4
DISASSEMBLY/ASSEMBLY AND INSPECTION OF FRONT WHEEL DISC BRAKE.....	P-5
DISASSEMBLY/ASSEMBLY AND INSPECTION OF REAR WHEEL DRUM BRAKE.....	P-11
RELATED PARAMETERS OF VACUUM BOOSTER AND MASTER BRAKE CYLINDER.....	P-16
PARKING BRAKE SYSTEM	P-17
ABS (ANTI-LOCK BRAKE SYSTEM) CONTROL SYSTEM	P-19
INTRODUCTION TO ABS CONTROL SYSTEM.....	P-19
DISASSEMBLY/ASSEMBLY AND INSTALLATION OF ABS CONTROLLER.....	P-20
MSABS CONTROL SYSTEM DIAGNOSTIC.....	P-22
OPERATION METHOD AND FUNCTION INTRODUCTION OF DIAGNOSTIC TESTER.....	P-24
TROUBLESHOOTING QUICK INDEXING TABLE.....	P-26
CAUTION WHEN FAILURE DIAGNOSING.....	P-27
DTC FAILURE CHECK SHEET INDEX.....	P-29
ABS SYSTEM CHECK.....	P-41
APPENDIX I.....	P-42
APPENDIX II.....	P-43

INDUCTION TO BRAKE SYSTEM

A15LHD is equipped with a diagonally split dual-circuit vacuum-assisted hydraulic brake system, which consists of service brake and parking brake. A disc brake is used for the front wheels, while a drum brake is for the rear wheels. And the servo system adopts the high-performance vacuum booster and dual-circuit hydraulic master brake cylinder.

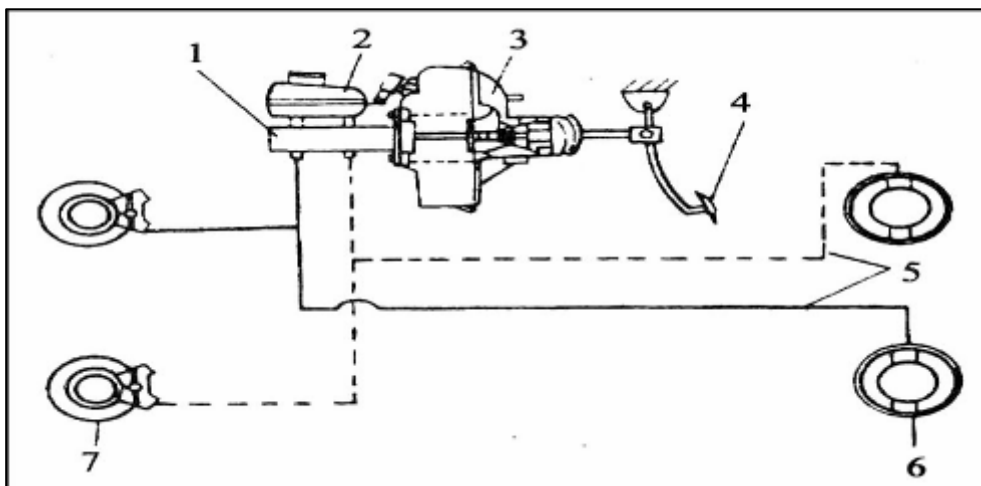
A15LHD is also equipped with an Anti-lock Brake System (ABS) which considerably improves the direction control and brake performance of the whole vehicle when braking. The ABS system is available to prevent the wheels from being locked up; what's more, it can maximize the longitudinal adhesion of tires. That is how the ABS system doesn't only ensure the steer ability of front wheels, but also avoids the sideslip of rear wheels, and therefore can ensure the vehicle to be braked under the condition of maximum adhesion coefficient of road surface.

And the parking brake control mechanism, which applies a cable featuring with the protective cover and low frictional resistance to directly control the drum brake lever of the two rear wheels, is located between the two front seats. The rear wheel brake also serves as a parking brake, which features with the simple structure and high efficiency.

DIAGONALLY-SPLIT DUAL-CIRCUIT BRAKE

A15LHD adopts the diagonally-split dual-circuit brake system, the front chamber of master brake cylinder of which is connected to the left front wheel brake and the rear right brake; and the rear chamber of master cylinder to the front right and rear left wheel brakes. This simple structure ensures 50% of normal brake force maintained in case of the failure of any one of the two circuits, that is, no matter which any circuit fails, the basic brake requirements are still met by the other circuit.

The A15 RHD brake system is shown in the figure below.



Brake System of A15LHD

1 Brake master cylinder	4 Brake pedal	7 Front disc brake
2 Brake fluid reservoir	5 Brake pipeline	
3 Vacuum booster	6 Rear drum brake	

REGULAR BRAKE SYSTEM

AIR BLEEDING

Warning:

• The proper fluid level shall be kept inside the brake fluid reservoir when air bleeding.

Specified fluid type: DOT3 or DOT4

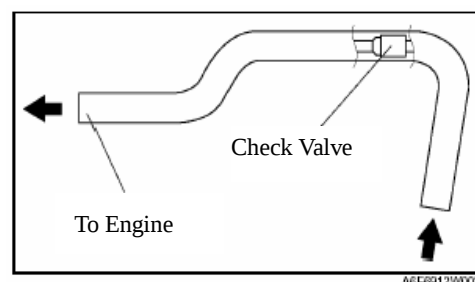
Caution: The brake system shall bleed air once one of brake pipelines disconnects. If one of hydraulic pipes disconnects from the master cylinder, the air bleeding starts from the wheel cylinder most away from the brake master cylinder, and then from the next wheel cylinder till all the four wheel cylinders bleed air. If the disconnection point is a point other than the one at the master cylinder, the air bleeding shall start from the wheel cylinder nearest the disconnection point, and then from the next cylinder till all the four-wheel cylinders bleed air.

- Remove the oil drain plug, and fix a vinyl insulating sleeve on the thread of oil drain plug hole.
- Put the other end of the vinyl insulating sleeve into a clean container available to fill the fluid.
- Step down the brake pedal several times, and then keep it in the position.

INSPECTION OF THE CHECK VALVE OF VACUUM HOSE

Check the following contents after air bleeding:

- Operation of brake
- Oily fluid leakage
- Fluid Level



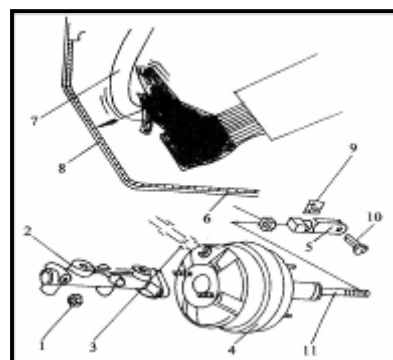
Inspection of the check valve of vacuum hose (power assisted brake unit)

- Detach the clips and vacuum hoses
- Pump the engine-side hoses and apply the pressure force on it, and verify that the air blows only to this side.
- If there are air flow in the both directions or not air flow at all, Replace the vacuum hose.

ADJUSTMENT AND MAINTENANCE OF BRAKE PEDAL

• Adjustment of Clearance between Brake Pedal and Floor

- Operate the brake pedal 7 with a 300 N force as shown in the figure. The clearance between the brake pedal 7 and floor 8 shall not be less than 80 mm.
- If the clearance is less than the limit value, firstly remove the spring locking piece 9 which is used to connect the vacuum booster 4 with the brake pedal 7, then pull out the pin 10, unscrew the lock nut 6 and adjust the push rod fork 5 until the requirement is met.



- | | |
|-------------------------------|-------------------------|
| 1. Nut | 7. Brake pedal |
| 2. Brake master cylinder | 8. Floor |
| 3. Check valve of vacuum hose | 9. Spring locking piece |
| 4. Vacuum booster | 10. Pin |
| 5. Push rod fork | 11. Push rod |

• Adjustment of Brake Pedal Free Travel

- Shut down the engine and step on the brake pedal several times to remove the vacuum kept in the vacuum booster.
- Press down the brake pedal by hand until the resistance is felt, in this case, the pressed distance is the free travel of brake pedal, the required value of which is **3 to 6 mm**.
- In case the free travel is less than the required value, adjust the clearance between the vacuum booster push rod and the master brake cylinder.

Caution: The free travel of brake pedal shall not be shortened due to the carpet laid on the floor, otherwise the brake travel shortened may cause the brake performance decrease, even disable the brake.

- **Maintenance of Brake Pedal**

- Check the smooth operation of brake pedal, and remove it for inspection if its operation is abnormal. Check whether the brake pedal is distorted or deformed, and replace it if any.
- Check whether the brake pedal shaft is worn seriously or deformed, and replace it if any. All shaft pins shall be lubricated when assembling.

DISASSEMBLY/ASSEMBLY AND INSPECTION OF FRONT WHEEL DISC BRAKE

REMOVAL AND INSTALLATION OF FRONT WHEEL DISC BRAKE

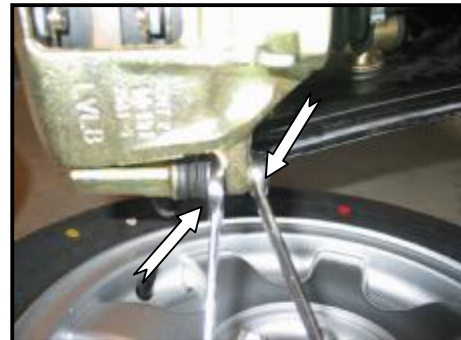
Removal:

- Lift up the vehicle and remove the front wheel.
- Loosen and remove the fixing bolt (where the arrow points).
- Detach the caliper housing and then remove the brake lining.

Install it in the reverse order of removal.

Installation:

- The brake lining with a larger friction surface shall be installed outside when installing the brake block.
- The brake linings on both sides shall be replaced at the same time with the products provided by the same one manufacturer when replacing.
- The tightening torque of securing bolt shall be $25 \pm 2 \text{ N} \cdot \text{m}$ (as shown in the figure).
- The tightening torque of wheel bolt shall be $110 \pm 10 \text{ N} \cdot \text{m}$.
- The brake disc shall be replaced when the wear limit of 10 mm reaches. Remove the caliper housing firstly before replacing the brake disc. Remove the dirt and anti-rust oil on the friction surface of new brake disc before it is installed.



REPLACEMENT OF FRICTION SHOES OF FRONT WHEEL DISC BRAKE

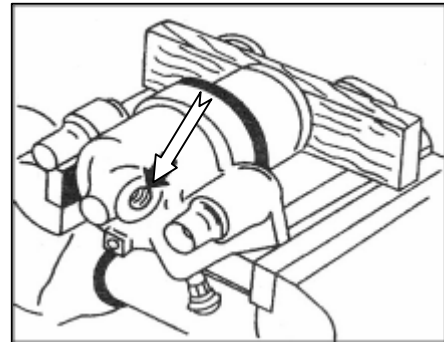
- Lift up the vehicle and remove the front wheel, and then detach the lower fixing bolt of the caliper housing.
- Lift up the brake caliper from the bottom to top, and remove the brake lining (as shown in the figure).
- Press the caliper piston back into the caliper housing. Use a suction hose to pump some fluids out from the brake fluid reservoir if its fluid level is too high before the piston is pressured back, the purpose of which is to prevent the brake fluid from overflowing and damaging the paintwork. Since the brake fluid is corrosive and toxic, it shall be stored in a special plastic bottle or other containers.
- Install the inside brake lining on the brake caliper bracket of the steering knuckle, and then refit the outside brake lining.
- Ensure that the return spring shall be in its proper position when installing the brake caliper; otherwise it may cause the brake noise.
- Tighten the lower fixing bolt of the caliper housing.
- Keep the vehicle in its original position after the completion of installation, and forcefully step on the brake pedal several times so as to make the brake lining in its normal working position.



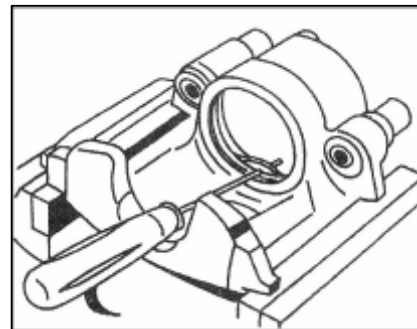
REPLACEMENT OF INTERNAL SEALING RING OF THE WHEEL CYLINDER IN CALIPER HOUSING

- The sealing ring inside the wheel cylinder in caliper housing shall be replaced in case of aging failure to make the sealability bad and brake fluid leakage.
- Loosen and remove the securing bolts from the brake caliper, and remove the brake caliper. The brake caliper removed shall be hung using an iron wire.

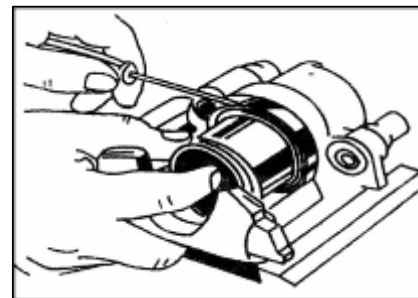
- Use the compressed air to press the piston out of the brake caliper housing. Place a wooden block in the piston indent when pressing so as to avoid the piston damage, as shown in the figure.



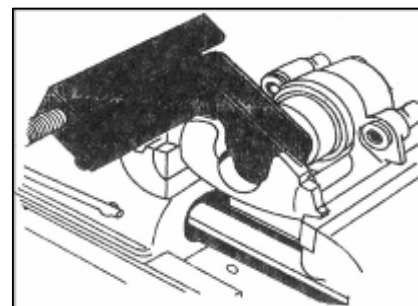
- Apply a tool to carefully pry out the sealing ring, as shown in the figure.



- Install the sealing ring into the piston with a dust boot.
- Use a tool to install the internal seal ring into the seal groove inside the wheel cylinder of brake caliper, as shown in the figure.



- Apply the special piston assembly tool to press the piston of brake caliper into the caliper housing, as shown in the figure. The external sealing lip of dust boot shall be installed into the groove of piston.
- Install the brake caliper body whose sealing ring is already replaced.



INSPECTION OF FRONT WHEEL DISC BRAKE

Maintenance of brake lining

- Check whether there are some oil stains on the surface of brake lining, and use an abrasive cloth to grind off it, if any.
- Check the crack, dropout and other defectives on the brake lining, and replace the brake lining, if any.
- Check the thickness of brake lining, and replace it if worn out.
- Check the wear condition of brake lining, and replace it if the thickness of brake lining is less than the service limit or the lining is worn unevenly. The brake linings on both sides shall be replaced at the same time when replacing them with new linings, and the new ones shall be supplied by the same one manufacturer. The wear limit of brake lining shall be 7 mm, including the backing plate.

Maintenance of brake disc

- Check whether there are some oil stains on the surface of brake disc, and use an abrasive cloth to grind off it, if any.
- Check the crack, corrosion, severe score and other defectives on the brake disc, and replace it if any.
- Check the scratch of brake disc, and machine it again if the scratch is too deep.
- Check the thickness of brake disc, and replace it if the thickness is greater than the limit value. The standard thickness of front wheel brake disc is 13 mm with the service limit of 10 mm.
- Use a dial gauge to measure the face run-out of brake disc, and apply the turning, polishing and other methods to treat its end surface if the run-out exceeds 0.12 mm, and replace the brake disc if the derivation is too large.
- The brake discs on the both sides shall be placed at the same time when replacing.

Maintenance of brake caliper assy.

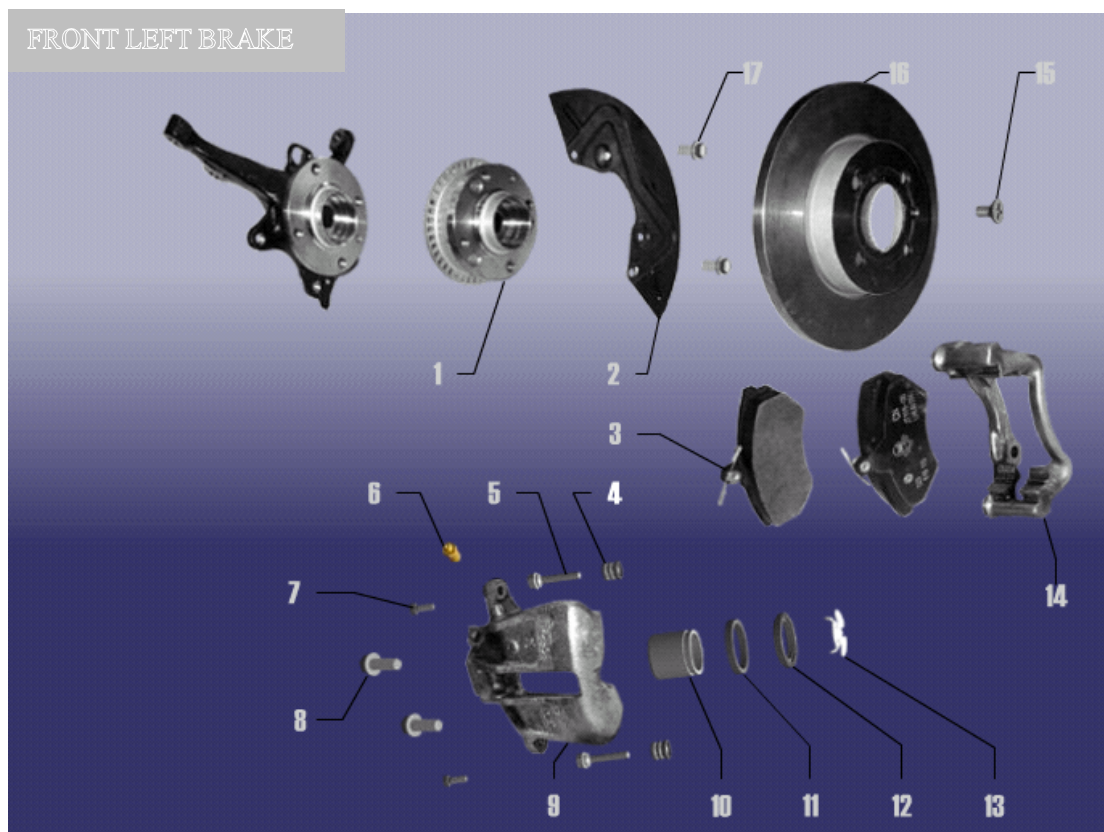
- Check the crack and deformation of the brake caliper, and correct or replace it as appropriate.
- Check the breakage and crack of the dust boot of piston, and replace the boot, if any.
- Check the aging, crack and other defectives of the sealing ring of piston, and replace the ring, if any.
- Check the oil leakage, motion blocked, unsmooth return of the piston, and repair it, if any. Check the damage, corrosion and other defectives of the piston and cylinder wall, and replace the brake caliper assy., if any.

Maintenance of brake caliper assy.

- Check the crack and deformation of the brake caliper, and correct or replace it as appropriate.
- Check the breakage and crack of the dust boot of piston, and replace the boot, if any.
- Check the aging, crack and other defectives of the sealing ring of piston, and replace the ring, if any.
- Check the oil leakage, motion blocked, unsmooth return of the piston, and repair it, if any. Check the damage, corrosion and other defectives of the piston and cylinder wall, and replace the brake caliper assy., if any.

EXPLOSION CHART AND STRUCTURAL CHARACTERISTICS OF FRONT WHEEL DISC BRAKE

The front wheel disc brake adopts the single-cylinder floating caliper structure in where the brake caliper body may slide in the axial direction relatively to the brake disc, the structure of which is shown in the figure below.



Front Wheel Disc Brake

1 Front wheel hub	7 Bolt	13 Piston damping washer
2 Dust cover	8 Bolt	14 Bracket
3 Brake pad assy.	9 Left caliper housing	15 Lock screw
4 Dust boot	10 Piston	16 Brake disc
5 Guide rod	11 Piston gasket	17 Screw
6 Bleeder valve screw	12 Piston dust cover	

Structure of Front Wheel Disc Brake

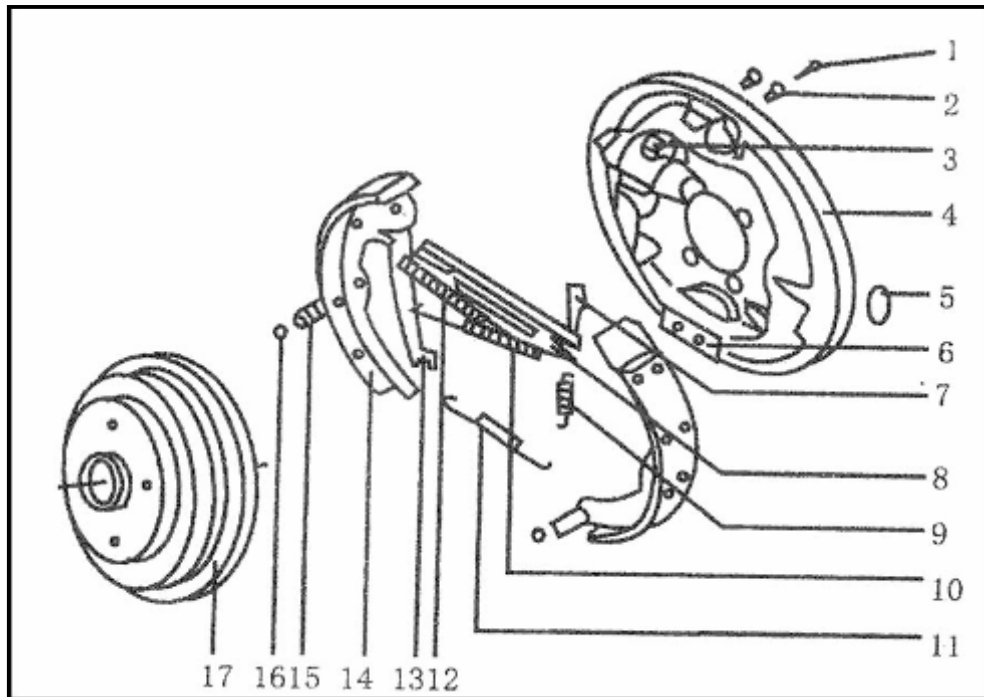
The rotating component of front brake is the brake disc, which is fixed onto the wheel hub and rotates together with the hub. The brake caliper bracket is a fixed component (integrated with the steering knuckle). When braking, the piston pushes the friction pad adjacent to the piston due to the hydraulic pressure, and makes the pad press the brake disc. Since the brake caliper moves relatively on the guide rod of caliper bracket, the counterforce will push the caliper together with friction pad to the other side of brake disc, until the forces applied on both friction pads are equalized.

The piston gasket installed in the caliper housing is elastically deformed when braking, and resumes the original shape, based on the elastic restoring force, and makes the piston return back to its original position when the brake is released. When brake clearance exceeds the set value due to the wear of friction pad, the piston will slide relatively with the gasket so as to achieve the automatic adjustment of clearance.

Characteristics of Front Wheel Disc Brake

- Stable braking performance. The disc brake is generally free of the friction adding effect, so the friction factor makes very limited influence on the braking performance, and the brake stability of whole vehicle is considerably improved.
- Good water stability, i.e., its efficiency decrease is small after being soaked in water. The brake lining of disc brake is with high unit pressure which is easy to squeeze out the water, and, based on the centrifugal force, only the first or twice braking is required to resume the original after water is squeezed out. And, for the drum brake, tenth braking or more is required to resume the original.
- Lower possibility of forming the hot crack or hotspot under the high temperature than that of the brake drum provided that the brake disc is not too thick.
- Smaller dimension and lighter weight than drum brake in case that their output moments of braking force are the same.
- Extremely low thermal expansion in the thickness direction of brake disc, which isn't the same as the thermal expansion of brake drum to make the clearance of brake increase considerably and cause the too larger travel of brake pedal.
- Easy and automatic clearance regulation, and simple maintenance and repair operation.

DISASSEMBLY/ASSEMBLY AND INSPECTION OF REAR WHEEL DRUM BRAKE

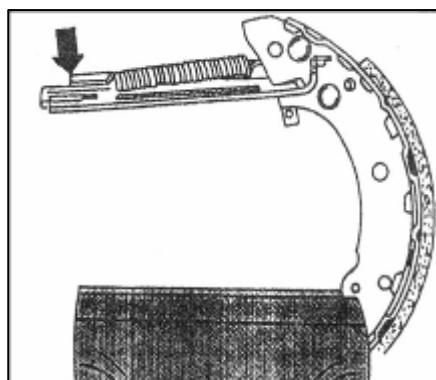
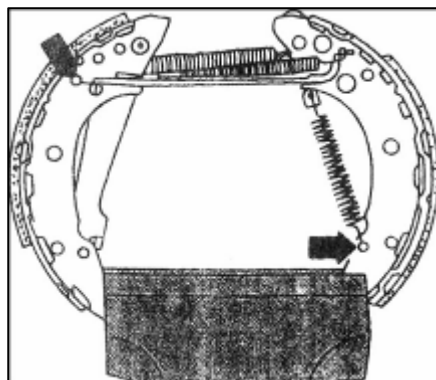


- | | | |
|-------------------------|------------------------------|---------------------------|
| 1. Stop dowel | 7. Regulating plate | 13. Parking braking cable |
| 2. Bolt | 8. Push rod | 14. Brake shoe assy. |
| 3. Brake wheel cylinder | 9. Regulating plate spring | 15. Limit spring |
| 4. Brake back plate | 10. Brake shoe fixing spring | 16. Limit spring seat |
| 5. Rubber stop block | 11. Lower return spring | 17. Brake drum assy. |
| 6. Shoe plate | 12. Return spring | |

DISASSEMBLY/ASSEMBLY OF BRAKE SHOE OF REAR WHEEL DRUM BRAKE

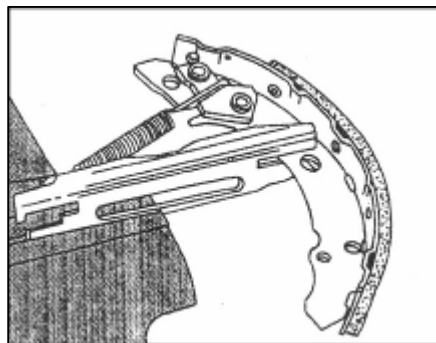
Removal:

- Remove the rear wheel.
- Insert the turning tool into the tire bolt fastening hole on the brake drum, press the shoe clearance regulating wedge-shaped block upwards to make the brake shoe return back to its original position.
- Detach the brake drum.
- Remove the brake shoe fixing spring and parking braking cable.
- Unclip the lower limit spring seat of the shoe, and remove the limit spring.
- Remove the spring of the regulating wedge-shaped block (as shown in the right figure); And take off the return spring, as shown in the figure.
- Remove the brake shoe and friction lining assy.
- It is only allowed to replace the whole brake shoe and friction lining assy. when replacing.

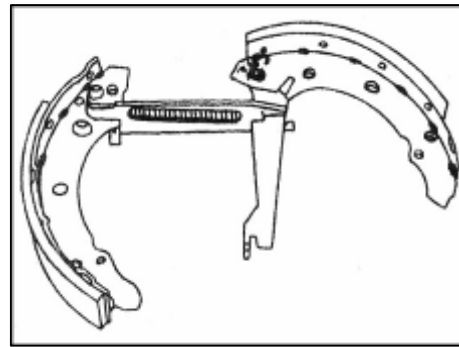


Installation:

- Fix up the fixing spring, as shown in the figure. Install the brake shoe on the push rod, and insert the regulating wedge-shaped block. And the side with the convex positioning faces the brake back plate.



- Install the brake shoe and parking brake lever, and reassemble the return spring, as shown in the figure.
- Fix the parking brake cable on the parking brake lever, and install the brake shoe on the brake wheel cylinder.
- Install the lower return spring, and adjust the return spring and the spring of wedge-shaped block.
- Install the brake drum and rear wheel hub bearing.
- Forcefully step on the brake pedal several times to make the friction lining of brake in place.



REPLACEMENT OF FRICTION LINING OF BRAKE

- Check whether there are some oil stains on the surface of friction lining of brake, and use an abrasive cloth to grind off it, if any. Replace the friction lining of drum brake in case it is worn to its limit, and replace it together with the brake shoe when replacing.

Caution: The friction lining of brake shall be from the same manufacturer and with the same quality when it is replaced with new one.

INSPECTION OF REAR WHEEL DRUM BRAKE

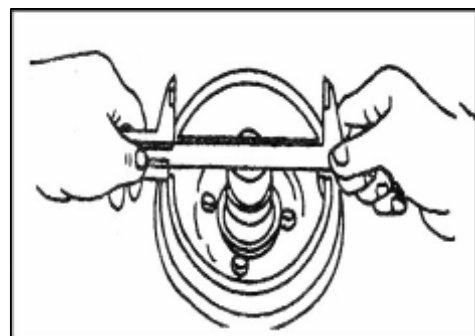
- Measure the inner diameter of brake drum, as shown in the figure.

Standard inner diameter: 200 mm

Service limit: 201 mm

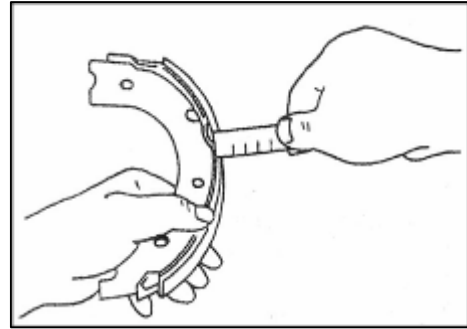
In case there are some scratches and indentions on the inner circle of brake drum after use, reprocess the inner circle on a lathe.

Caution: The inner diameter shall not be greater than the service limit when the inner circle is reprocessed on the lathe.

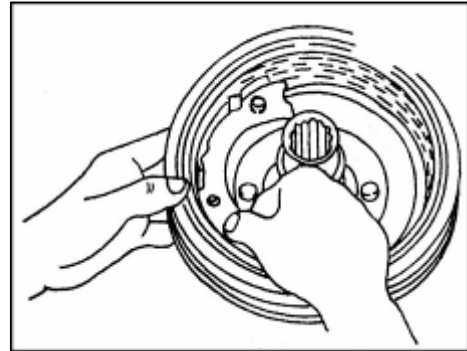


- Measure the thickness of friction lining, as shown in the figure.

Caution: The service limit is 2 mm.



- Check the contact between the friction lining of brake and the brake drum, as shown in the figure.



MAINTENANCE OF BRAKE WHEEL CYLINDER

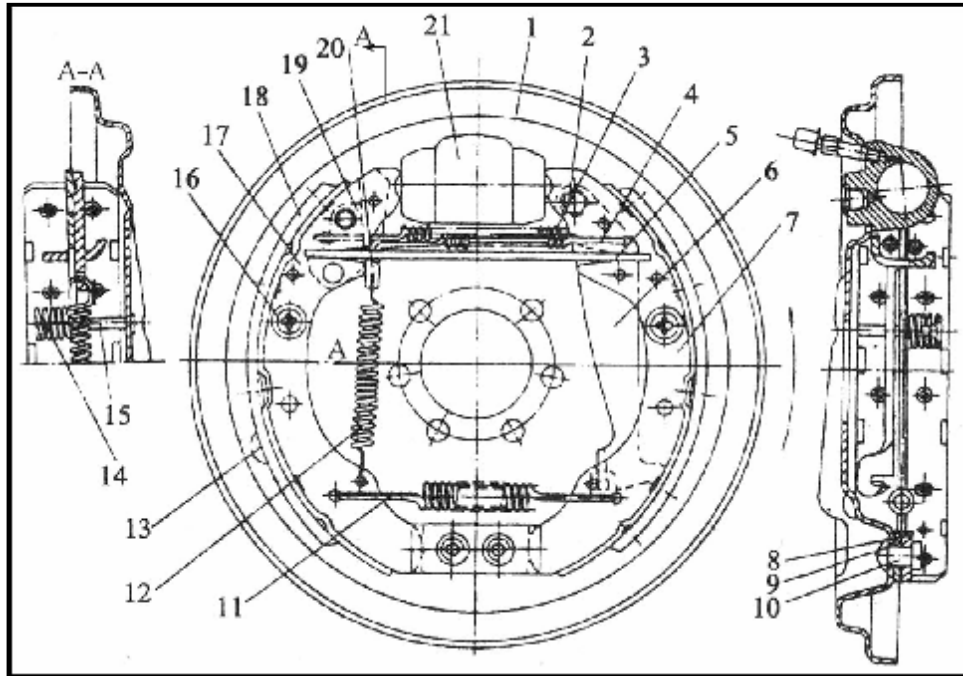
- Check the oil leakage of brake wheel cylinder, and the damage of dust boot.
- Detach the brake wheel cylinder, and check whether there are some scores on piston or cylinder wall, whether the spring is broken, and whether the oil seal is damaged. Replace the brake wheel cylinder if any of the above is found.

MAINTENANCE OF SPRING

- Check the breakage, deformation or elastics weakening of the spring, and replace it, if any.

STRUCTURAL DIAGRAM OF REAR WHEEL DRUM BRAKE

A15LHD adopts the non-balanced drum brake (leading trailing shoe brake) for its rear wheels, as shown in the figure below.



Structural Diagram of Rear Wheel Drum Brake

1 Brake back plate	9 Support plate	17 Brake shoe with wedge-shaped adjusting plate assy.
2 Pin shaft	10 Rivet	18 Friction lining
3 Return spring	11 Lower return spring	19 Wedge-shaped regulating plate
4 Brake shoe fixing spring	12 Tension spring	20 Wedge-shaped regulating block
5 Push rod	13 Inspection hole	21 Brake wheel cylinder
6 Parking brake lever	14 Compression spring	
7 Brake shoe assy.	15 Clamping pin	
8 Support	16 Spring seat	

The piston of brake wheel cylinder pushes out the brake shoe with the force of brake fluid to rotate it outward around the contact point of the brake shoe and the support plate when braking, and thus the friction lining of brake shoe is pressed towards the brake drum, which creates the brake torque to brake the vehicle.

The braking pressure disappears when the braking is released, and the brake shoe returns back to its original position with the help of the return springs 3, 4 and 11.

The braking clearance of rear brake is adjusted automatically. In case the braking clearance exceeds the set value due to the shoe plate wear, the wedge-shaped regulating block 20 located between the lever and brake shoe will move downwards with the help of spring force of tension spring 12 to compensate the clearance increase between the lever and wedge-shaped regulating block so as to make the brake shoe further open toward the brake drum to compensate the friction lining wear.

RELATED PARAMETERS OF VACUUM BOOSTER AND MASTER BRAKE CYLINDER

A15LHD series vehicle's braking equipment adopts the 228.6mm (9in) vacuum booster and tandem type master brake cylinder, which realizes the booster effect using the vacuum produced by the operating engine. The vacuum chamber of the booster connects to the air intake pipe of engine via the vacuum hose and check valve.

The master brake cylinder adopts the tandem type master brake cylinder, which consists of the cylinder body, piston, spring, spring seat, cup and etc. The master brake cylinder connects with the front part of the booster using two bolts. A brake fluid reservoir is installed on the upper part of master brake cylinder. Two working chambers (primary chamber and secondary chamber) at the front and rear are connected serially in the master cylinders.

Main technical parameters of the A15LHD brake system are:

Master brake cylinder: $\phi 22.2$ mm

Vacuum booster: $\Phi 228.6$ mm (9in)

Vacuum booster boost ratio: 3.9:1

Travel of primary chamber: 16 mm

Travel of secondary chamber: 18 mm

Diameter of wheel cylinder of front wheel disc brake: $\Phi 54$ mm

Outer diameter of brake disc: $\Phi 256$ mm

Thickness of brake disc: 13 mm

Thickness of front friction lining: 14 mm

Diameter of brake drum of rear drum brake: $\Phi 200$ mm

Diameter of wheel cylinder of rear drum brake: $\Phi 17.46$ mm

Brake shoe of rear drum brake: $\Phi 200$ mm $\times$ 40 mm $\times$ 5 mm

Front and rear braking power distribution ratio: 65% for front wheel, and 35% for rear wheel

Parking brake: Acting force of parking braking control rod (38mm from terminal) < 400 N when parking on a ramp, with 20% full load

INSPECTION OF VACUUM BOOSTER

Inspection of brake performance

The driver will feel the brake pedal difficult to step down and its resistance force considerably increase compared with normal condition when he step it after the vacuum booster fails. In this case, the booster assy. shall be replaced in time. The condition of vacuum booster is also determined in accordance with the following convenient method:

- Shut down the engine, and forcefully step on the brake pedal several times to remove the vacuum kept inside the vacuum booster.
- Step on the brake pedal with the appropriate force to make the pedal kept in proper position.
- Start up the engine. If you feel the brake pedal fall down automatically and considerably (force increase), it shows that the function of vacuum booster is normal; if the pedal is no reaction, and nor force increase, it exhibits that the booster has failed, and the booster shall be replaced.
- Replace the booster assy., and, at the same time, replace the gasket. The tightening torque of the booster assy. and master brake cylinder retaining nut is 20 ± 2 N·m.

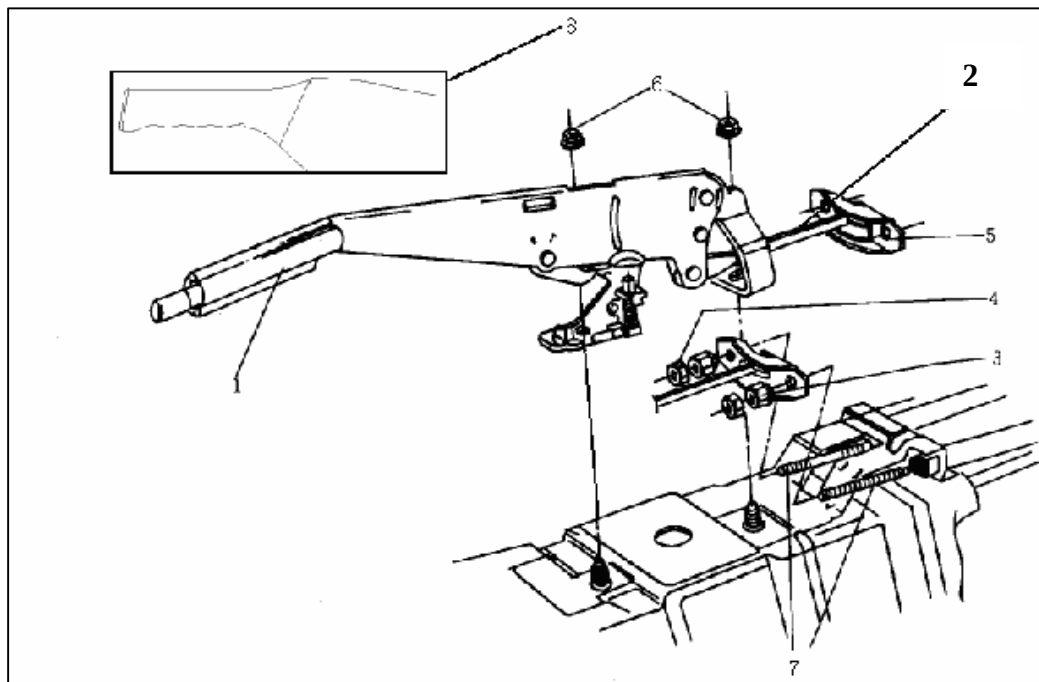
Inspection of the check valve of booster vacuum hose

The check valve of vacuum booster is installed in the vacuum hose. If the check valve failure, the driver will feel the brake pedal difficult to step down, with the feeling of failure to step it down to its limit, and the subsequent braking performance decreases evidently.

Blow the compression air in accordance with the direction of arrow on the check valve body when inspecting the check valve, and the air is available to pass through; and don't pass through if blowing the air in the reverse direction. Its one-way through is also inspected using the mouth suction method. Replace the vacuum hose assy. if the check valve is badly sealed.

PARKING BRAKE SYSTEM

The parking brake is realized by adding a set of manual operating mechanism on the rear wheel brake, as shown in the figure below. Due to the common use of a set of brake with the rear wheel brake, it simplifies the structure and reduces the weight.



- | | |
|----------------------|-----------------------------------|
| 1. Brake control rod | 5. Compensation rod |
| 2. Tie rod | 6. Nut (20Nm) |
| 3. Adjusting nut | 7. Parking brake cable |
| 4. Lock nut (8Nm) | 8. Parking brake dust cover assy. |

Disassembly/Assembly and Installation of Parking Brake System (as shown in the figure above)

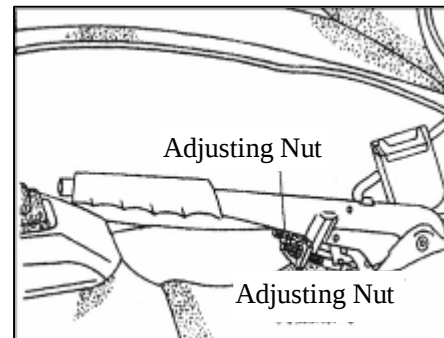
Fit the parking brake dust cover assy. tightly on the parking brake control mechanism, and use the nuts to secure the parking brake control mechanism assy. onto the welding pegs on the vehicle body.

- Remove the tire and rear wheel brake drum, and detach the brake cable clip and parking brake cable suspension clamp, which the tightening clips on the rear axle are available for the bottom of body
- Remove the auxiliary instrument panel (see the Disassembly/Assembly of Auxiliary Instrument Panel)
- Remove the parking brake cable and compensation rod connection adjusting nut and lock nut; And the tightening torque of lock nut is 9 ± 3 Nm.
- Install the hand brake cable and control rod in the reverse order of removal.

Adjustment of Parking Brake (as shown in the figure below)

The rear brake is an automatic adjusting intermittent drum brake, so it is necessary to adjust the parking brake under the normal use, and it is required to adjust the brake only when replacing the parking brake cable, brake shoe assy. or brake wheel cylinder. Adjust it in accordance with the following procedures:

- Loosen the handle of parking brake.
- Forcefully step on the brake pedal once.
- Pull the handle of parking brake upwards 4 ratchets.
- Tighten the adjusting nut until the two wheels isn't available to be turned by hand, as shown in the figure.
- Unclip the parking brake, and check whether the two rear wheels operate freely.

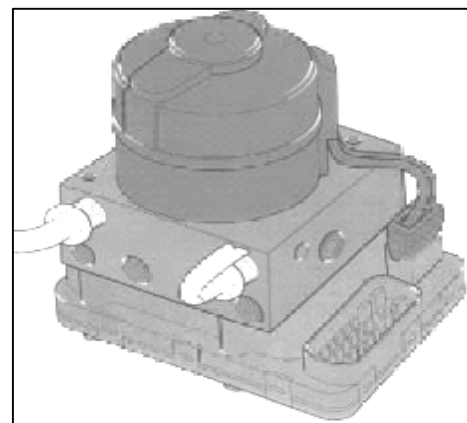


ABS (ANTI-LOCK BRAKE SYSTEM) CONTROL SYSTEM

INTRODUCTION TO ABS CONTROL SYSTEM

Chery's A15LHD series vehicle adopts the MK series ABS system manufactured based on the imported technology. The system is the current newest generation of anti-lock brake system all over the world, which has the EBD (Electronic Brake Distribution) function, and it is unnecessary to prepare for the brake proportion control valve. This system has the following characteristics:

- * Integrated module structure design
- * Small dimension, light weight and low cost
- * Security and reliable, easy to maintenance
- * With the failure information storage and self-diagnostics interfaces



DISASSEMBLY/ASSEMBLY AND INSTALLATION OF ABS CONTROLLER

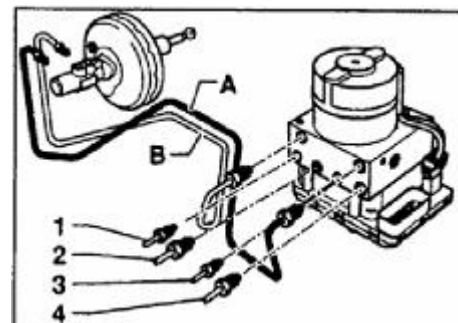
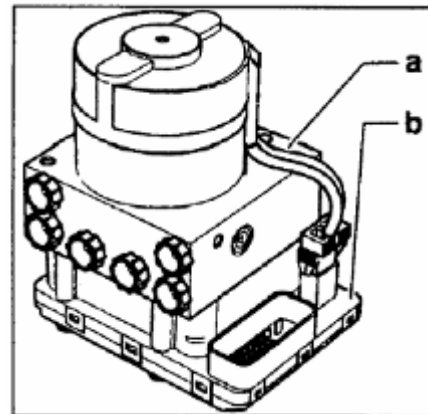
Notices:

- * Use the diagnostic tester to find out the seasons of failures, and then repair it;
- * Unpack the spare part packaging just before the beginning of installation;
- * Only the original parts are available;
- * Pay more attention to the cleanliness during repair, and wipe it only with the non-woolen cloth;
- * Use the cleaning agent without the mineral oil to wipe the outside surface clean before repair;
- * Do not use the compressed air or move the vehicle when the system activates;
- * Remove the ABS assy., and use the proper plugs to block all outlets of hydraulic equipment quickly as possible;
- * Remove other parts which may disturb the repair operation;
- * Please use the brake fluid DOT 4, and do not apply any mineral oil;
- * Use the brake fluid to soak the seals and O-ring, and it is prohibited to use the engine oil or ointment;
- * Check the availability of the regular brake system and ABS brake function after the completion of repair;

1 Check the leakage of all joints of hydraulic pipes.

Removal of MK20-I HECU assy.

- Turn off the ignition switch and disconnect the negative wire of battery;
- Remove the electrical harness from the ABS assy.;
- Step the pedal downwards >60 mm, and use the pedal support to fasten it; It will shut the P-20 central valve of main bump and thus the brake fluid



can't flow out from the outlet when the system activates;

- Remove the brake pipe A and B (connected to the main pump) from the HCU, and then mark them and use the plugs to block the outlet immediately;

- Remove the brake hose 1 to 4 connected to all wheels, and then mark them and use the plugs to block the outlets immediately;

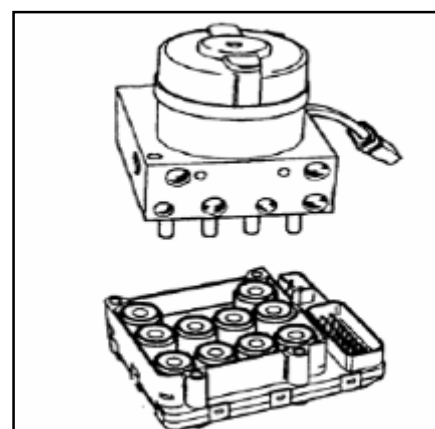
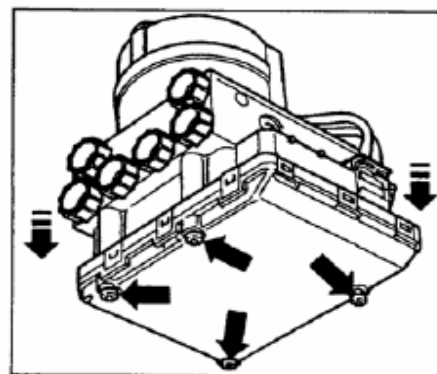
- Remove the nut cap used to secure the HECU on the support;

- Remove the whole HECU from its support.



Replacement of Hydraulic Control Unit/ Electronic Control Unit

- Press down the locking located at the joint side, and remove the electric harness from the pump motor;
- Remove the 4 screws shown in the figure, the removed old screws of which are not available;
- Detach the Hydraulic Control Unit (HCU) from the Electronic Control Unit (ECU);
- Install a new Hydraulic Control Unit (HCU) on the Electronic Control Unit (ECU);
- Use the new screws to tighten the ECU on the HCU with the tightening torque of 3+1Nm;
- Connect the harness of motor, and take care that the locking must be in place.



Caution: The air bleeding operation must be conducted after replacing the hydraulic control unit.

Refit of ABS Assy.

Caution: The plug of hydraulic opening on the ABS assy. can be removed only when installing the brake pipe, the purpose of which is to avoid the foreign material entering into the brake system.

- Install the ABS assy. on its support, with the tightening torque of 20+4Nm;
- Remove the plugs from the hydraulic opening, and install the brake pipe to determine the right connection of the pipe;
- Install the brake pipe connected to the main pump;
- The tightening torques to assemble the brake pipe are 12+4 Nm (M10×1) and 15+3Nm (M12×1);
- Add new brake fluid into the reservoir until the level of fluid reaches the MAX marks, and degas in accordance with the specified method;
- Turn the ignition switch to ON, and ABS warning lamp lights and then switches off after lasting for 1.7 s;
- Clear the DTC (Diagnostic Trouble Code) memory, and then read it and determine whether there are some DTCs;
- Finally, drive the vehicle to determine the function of ABS, and you shall feel the bounce of brake pedal;

MSABS CONTROL SYSTEM DIAGNOSTIC

Check the ABS warning lamp

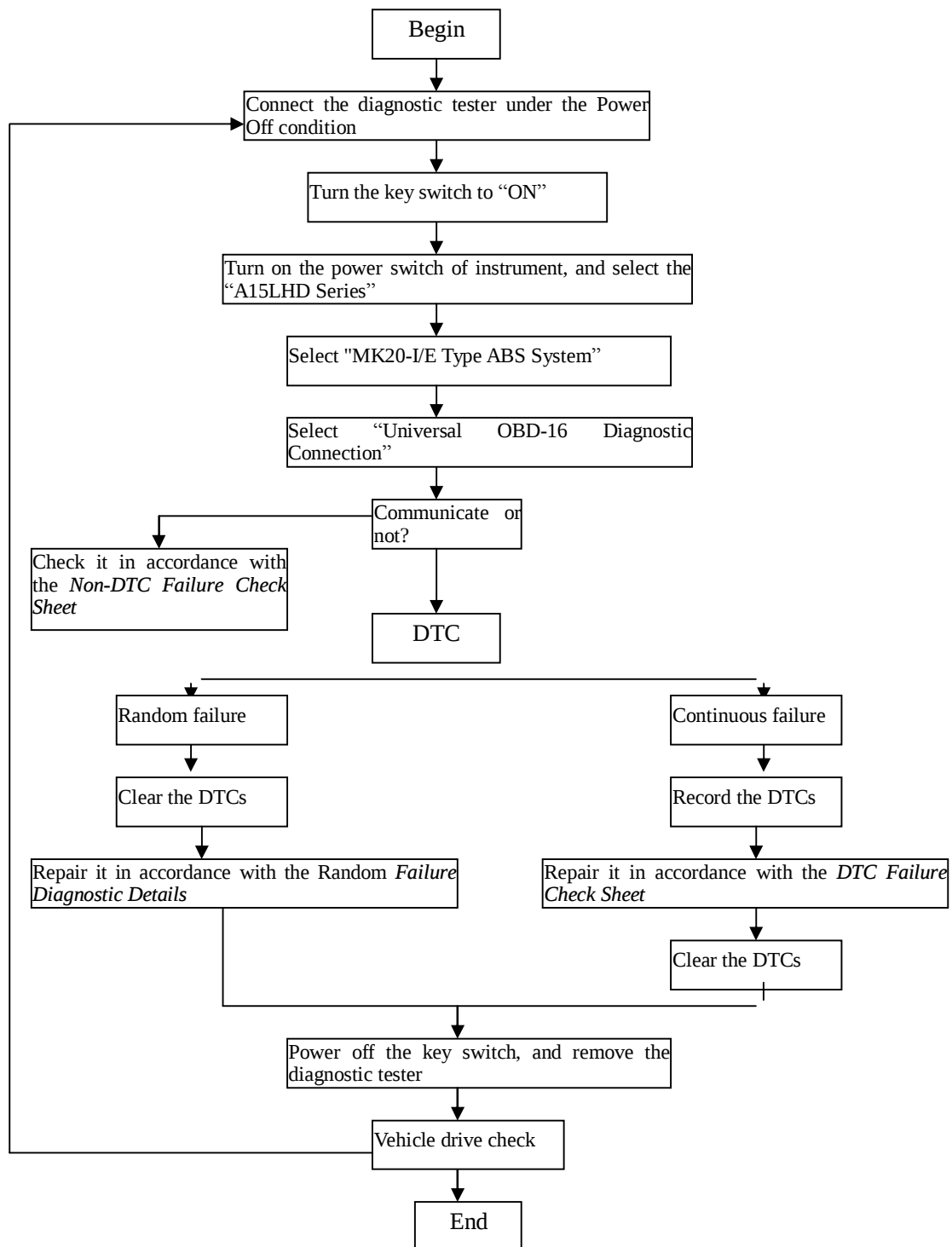
Check whether the ABS warning lamp lights in the following mode.

Turn the ignition switch to “ON”, and ABS warning lamp lights and then switches off after lasting for 1.7 s;

—Not the condition above, it indicates that there are some failures, please check the DTCs.

—The warning lamp fails to light, please refer to the *DTC Failure Check Sheet*.

Readout of status information



OPERATION METHOD AND FUNCTION INTRODUCTION OF DIAGNOSTIC TESTER

- Connect the diagnostic tester with the diagnostic socket (behind the glove box) under the condition of power off, and then turn on the ignition switch.

- Turn on the power supply of the diagnostic instrument, and select the “A15LHD Series”

- Select the “MK20-I/E Type ABS System”

- Select the appropriate function item/channel number

- *CH 01 – Status information display

- *CH 02 – Failure inquiry

- *CH 03 – Hydraulic Control Unit Diagnostic

- *CH 04 – Fluid refilling and air bleeding

- *CH 05 – Clear DTC memory

- *CH 06 – End and Exit

- *CH 07 – Controller coding

- *CH 08 – Measured data display, such as wheel speed signal and etc.

- For example, ABS, ECU’s version or part number.

A15LHD-3550010

Coding: 01901

- Read the DTCs

- Click the “MK20-I/E Type ABS System”, select the “DTC”, and press the “OK” button, in this case, the DTC will display on the screen if there is a DTC.

- Clear the DTC

- 1) Press the “Clear” button on the instrument after the TDC readout.

- 2) In this case, the following will display on the screen

Want to clear the DTC?

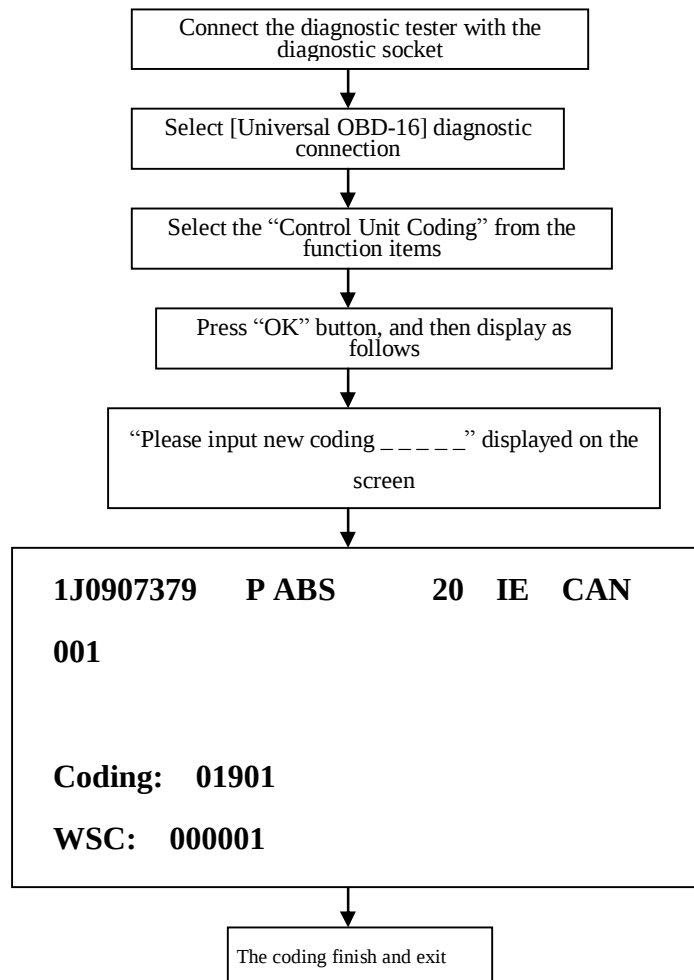
[Yes]: Delete it (key ON, and engine OFF)

If the failure is removed after pressing the “Yes” button, the DTC can be cleared completely.

- ECU coding

The new ECUs shall be coded when replacing the HECUs or ECUs, otherwise the ABS warning lamp will flash and the system fails to operate normally.

The original diagnostic tester is available to code the ECUs, the procedure of which is as follows:



Fluid Refilling and Air Bleeding

- Wet type HCU

If the spare part is a wet type HCU, it is required to only refill the fluid and bleed the air in accordance with the method available to the general brake system after replacing the HCU.

- Dry type HECU

If the spare part is a dry type HCU, apart from refilling the fluid and bleeding the air in accordance with the method available to the general brake system, it is also required to bleed the air of HECU's second circuit after replacing the HCU.

- DTC display mode

System problem display code		Display code
No DTC	Never occur before	No DTC
No problem current (ABS warning lamp NOT light)	Occur before	Random DTC
Problem still exist (ABS warning lamp lights)	Never occur before	Non-random DTC
	Occur before	Random and non-random DTCs

TROUBLESHOOTING QUICK INDEXING TABLE

DTC Failure Check Sheet Index

Diagnostic Code	Description of Failure	Diagnostic Details
65535	Electronic Control Unit (ECU)	Damaged
01276	ABS hydraulic pump	Motor fails to operate
00283	Front left wheel sensor	Electrical and mechanical failures
00285	Front right wheel sensor	
00290	Rear left wheel sensor	
00287	Rear right wheel sensor	
01044	ABS coding error	
00668	Supply terminal 30	
01130	Abnormal ABS operation	Unreasonable signal

CAUTION WHEN FAILURE DIAGNOSING

The ABS adopts the electronic hydraulic control, so it is normal that the phenomena listed in the table below occur under the normal operation of the ABS system, which shows they aren't the failures.

Phenomena Description	
System self-check sound	Sometimes, the sounds like the knock sound come from the engine compartment after the engine starts, which is the sound from the ABS self-check and doesn't indicate it is abnormal.
Sound while the ABS operates	1. Sound from the motor inside the ABS hydraulic unit. 2. Sound generated together with the brake pedal vibration. 3. The suspension knocking sounds created due to braking or the Creak sounds generated due to the contact of tire with the ground when the ABS operates. CAUTION: The tire may still give out the “Creak” sound when the ABS operates normally.
ABS operates but long brake distance	The braking distance of the vehicle with ABS is longer than that of vehicle without ABS when the vehicle travels on a snow or sand-gravel road, and thus a driver shall be reminded to pay more attention to the road condition when driving on the road above.

Repair Details of Random Failure:

In the electronic control system, the instantaneous and poor contact problem may occur in such positions as the electrical circuit and input/output signal passage. Thus it causes the random failure or generates the DTC when ECU self-checking. If the reason of failure still exists, the abnormal parts can be found only in accordance with the *DTC Failure Check Sheet*, but sometimes the reason to cause the failure will disappear automatically, so it is difficult to find out the reason of problem.

In this case, simulate the failure and check whether it reoccurs in accordance with the following methods.

When the major reason may be vibration:

- Slightly swing the connection up and down;
- Slightly swing the harness up and down, left and right;
- Slightly swing the sensor up and down, left and right;
- Slightly swing the other motion parts such as wheel bearing.

Caution: If the harness is twisted off or pulled tightly and then broken, it is necessary to replace it with a new one, especially it may cause the transient open/short circuit of sensor due to the up and down movement of suspension system when the vehicle is traveling. Thus the actual vehicle test must be conducted when checking the signals from the sensor.

When the major reason may be over hot or super-cold:

- Use a blower to heat the parts that you think it may be failed.
- Use the cold spraying agent to check the cold welding phenomenon.

When the major reason may be the over-high contact resistance in the power supply circuit.

- Turn on all electrical switches, including the headlamp and rear defroster switches.

If the failure doesn't reoccur here, it may be diagnosed and repaired only when the failure occurs at next time. The random failure will generally become worse only, and is difficult to get better.

DTC Failure Check Sheet Index

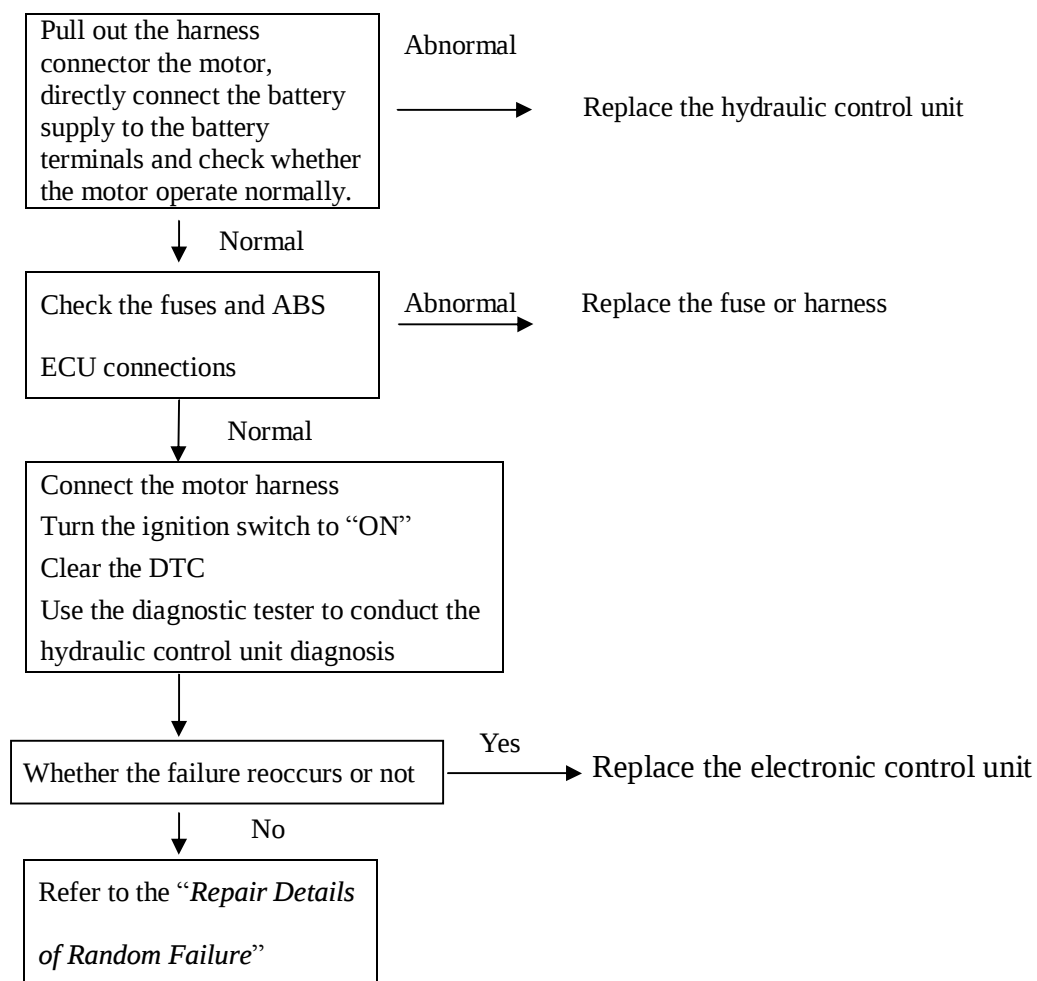
Condition of Failure	
Turn the ignition switch to “ON” (under the engine shut down), and the ABS warning lamp doesn’t light	
The warning lamp doesn't extinguish after the engine starts	
Abnormal ABS operation	Uneven braking force at both sides
	Braking force shortage
	ABS fails to operate when slightly stepping on the brake pedal (the vehicle is in stationary state)
	ABS operates when slightly stepping on the brake pedal (the vehicle is in driving state)
	The brake pedal vibrates seriously when the ABS works
Too long brake pedal travel	
Great force required to step on the brake pedal	
Without DTC output (fail to communicate with the diagnostic tester)	

DTC FAILURE CHECK SHEET

ABS hydraulic pump

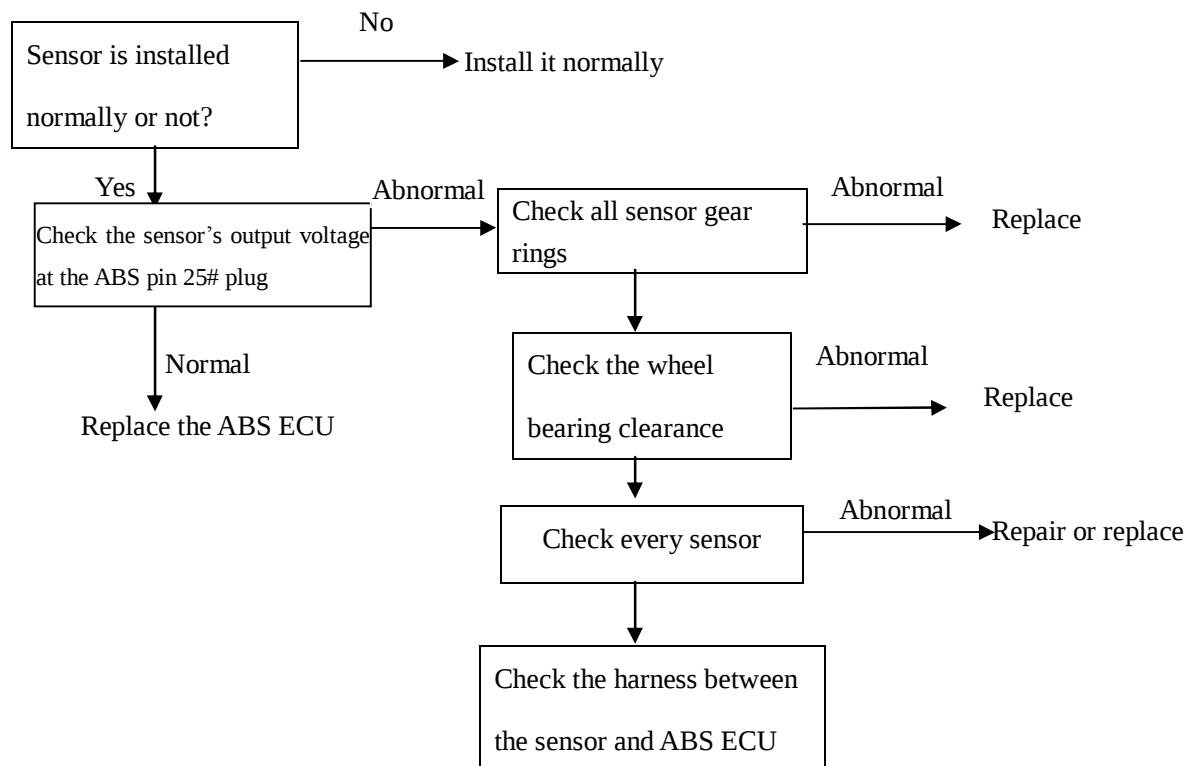
1. The DTC is 01276	Possible Cause
[Description] The ABS ECU will monitor the motor failure to operate normally, and then record this DTC when the vehicle speed exceeds 20 km/h. [Hint] The occurrence of this DTC may be caused due to the disconnection of harness between the motor and ECU. Use the hydraulic unit function of the diagnostic tester to test or drive the motor and take this testing.	• Power supply broken circuit or earth • Motor harness uncoupling • Motor damaged

Caution: If the battery discharges excessively, the motor will fail to be driven, and thus we shall confirm firstly whether the battery voltage is normal before the motor drive testing is conducted, and the vehicle shall be in stationary state when the motor drive testing is conducting.



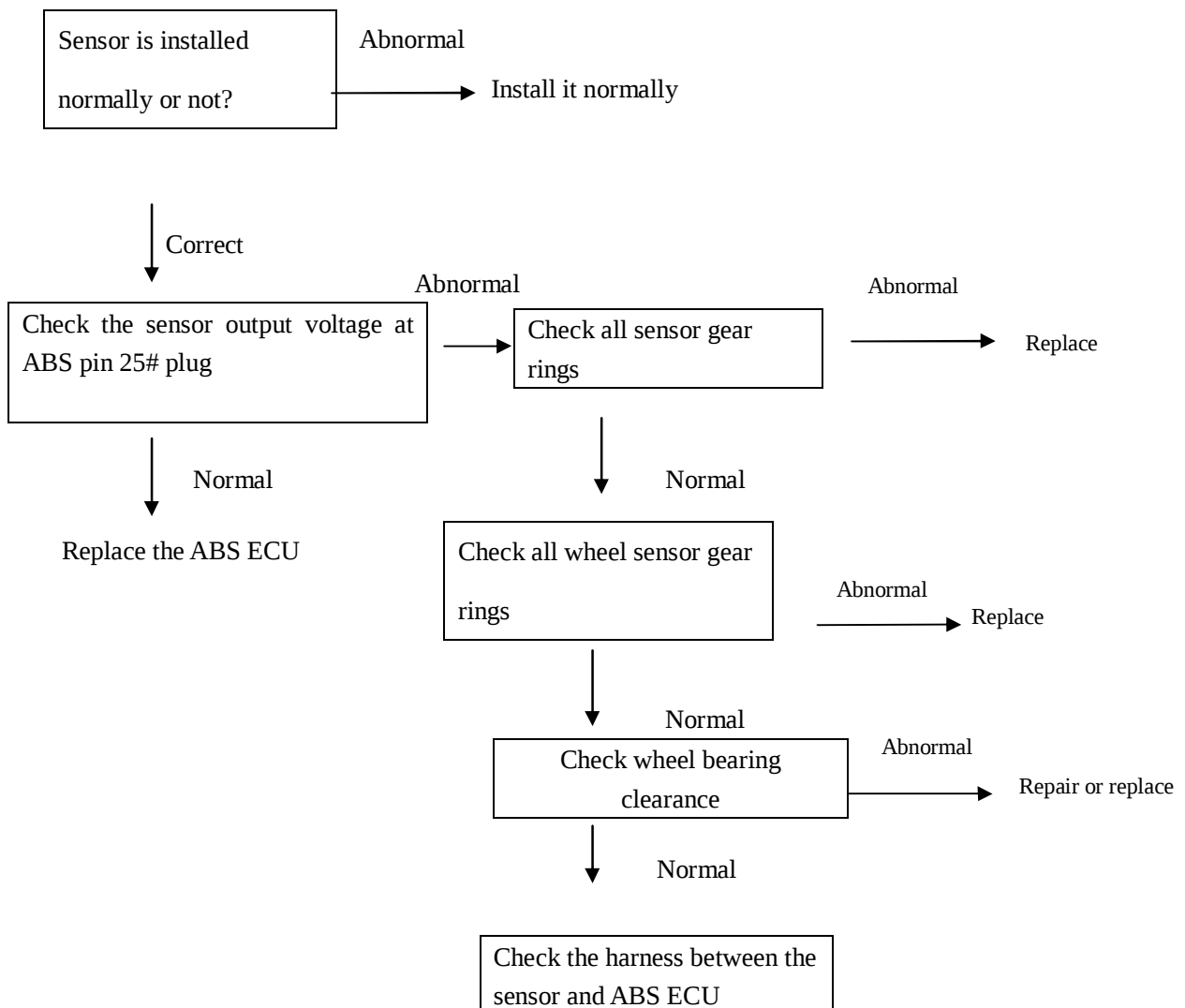
WHEEL SPEED SENSORS: 00283, 00285, 00290, 00287

2. The DTCs are 00283, 00285, 00290, 00287	Possible Cause
[Description] The DTCs will appear when the open circuit can't be detected and there is no signal output yet if the vehicle speed reaches 20 km/h or more. [Hint] It may be caused due to the sensor neglected to be installed, sensor coil or harness short-circuited, excessive clearance between the sensor and gear ring, or the gear damaged. The foreign materials between the wheel speed sensor and gear ring may cause the clearance undersized.	• Sensor neglected to be installed • Sensor coil or harness short circuited • Excessive air clearance between the sensor and gear ring • Gear ring neglected to be installed • ABS ECU failure



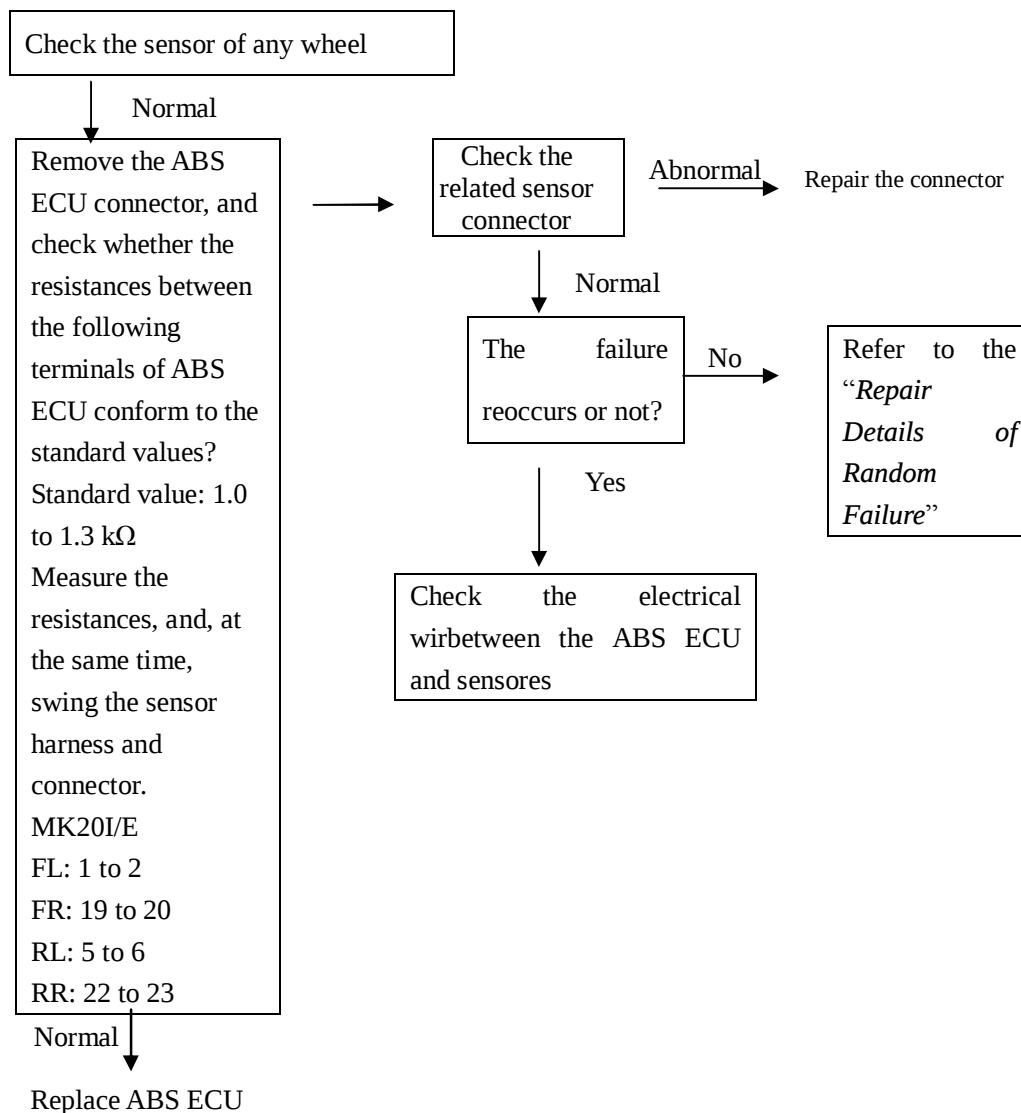
Speed sensor

3. The DTCs are 00283, 00285, 00290, 00287 [Description] When the vehicle speed > 20 km/h, the DTCs will appear if the sensor signal exceeds the tolerance range. [Hint] It is very possible that the too feeble signals from sensor are caused due to the intermittent poor contact or short circuit between sensor coil or harness, the gear ring damaged, or the excessive air clearance between the sensor and gear ring.	Possible Cause • Poor contact or short circuit between the sensor coil or harness • Excessive or undersized air clearance between the sensor and gear ring • Gear ring damaged • ABS ECU failure
--	---



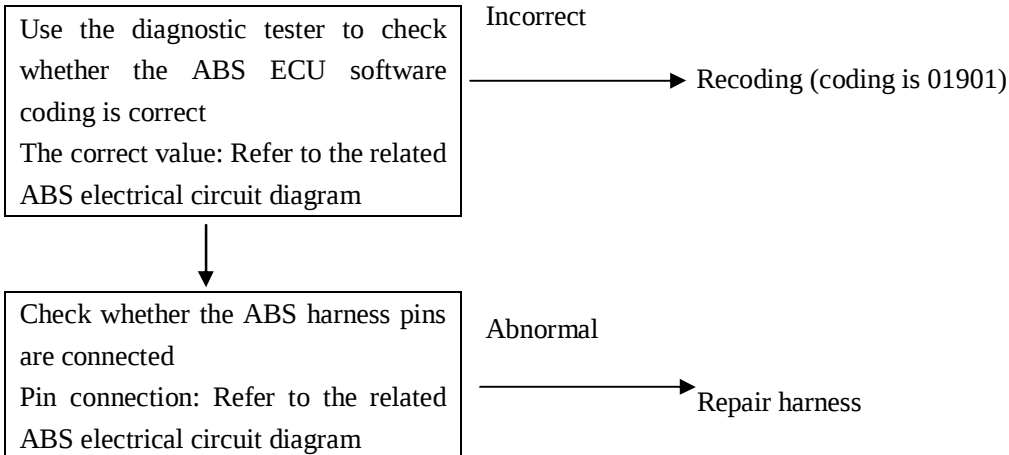
Speed sensor

4. The DTCs are 00283, 00285, 00290, 00287 [Description] The DTCs will appear when the sensor has the recognizable open circuit, short circuit and other failures. [Hint] It may be caused due to the poor contact of sensor, the short circuit of coil or harness, or the failure of sensor signal processing circuit in the ABS ECU.	Possible Cause • Open circuit of sensor connector • Short circuit of sensor • Short circuit between the sensor connection or harness with the counter-earth or power supply • ABS ECU sensor signal processing circuit failure
--	---



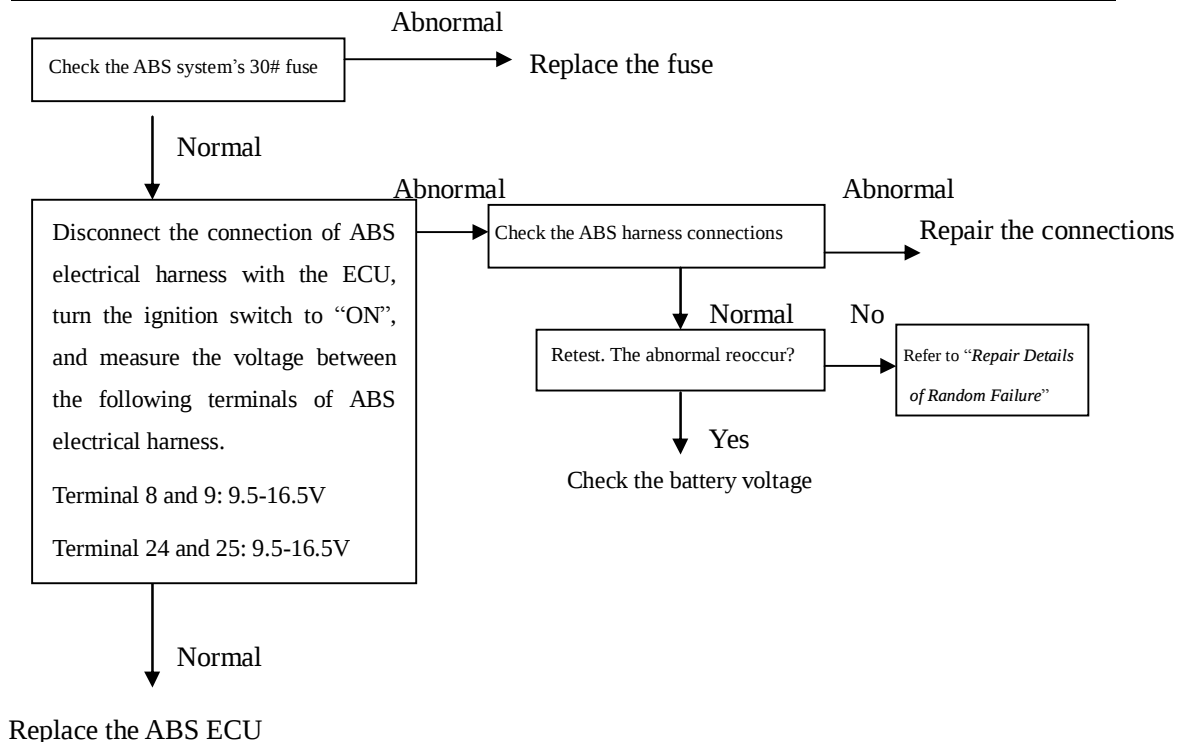
ABS coding error

5. The DTC is 01044 [Description] The DTC will appear when the ECU's software coding is inconsistent with the hardware connection of ABS harness.	Possible Cause • The error connection of pin in ABS harness • ABS coding error
--	--



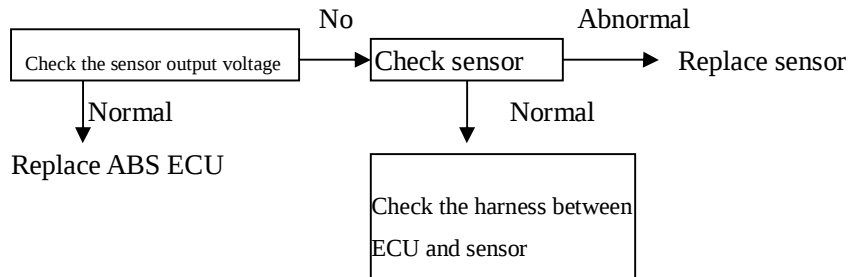
Supply terminal 30

6. The DTC is 00668 [Description] The DTCs will appear when the supply terminal 30# provides the voltage or over-high voltage.	Possible Cause • ABS system's fuse broken • Too low or over-high battery voltage • ABS electrical harness connections damaged • ABS ECU damaged
---	---



ABS operation abnormal

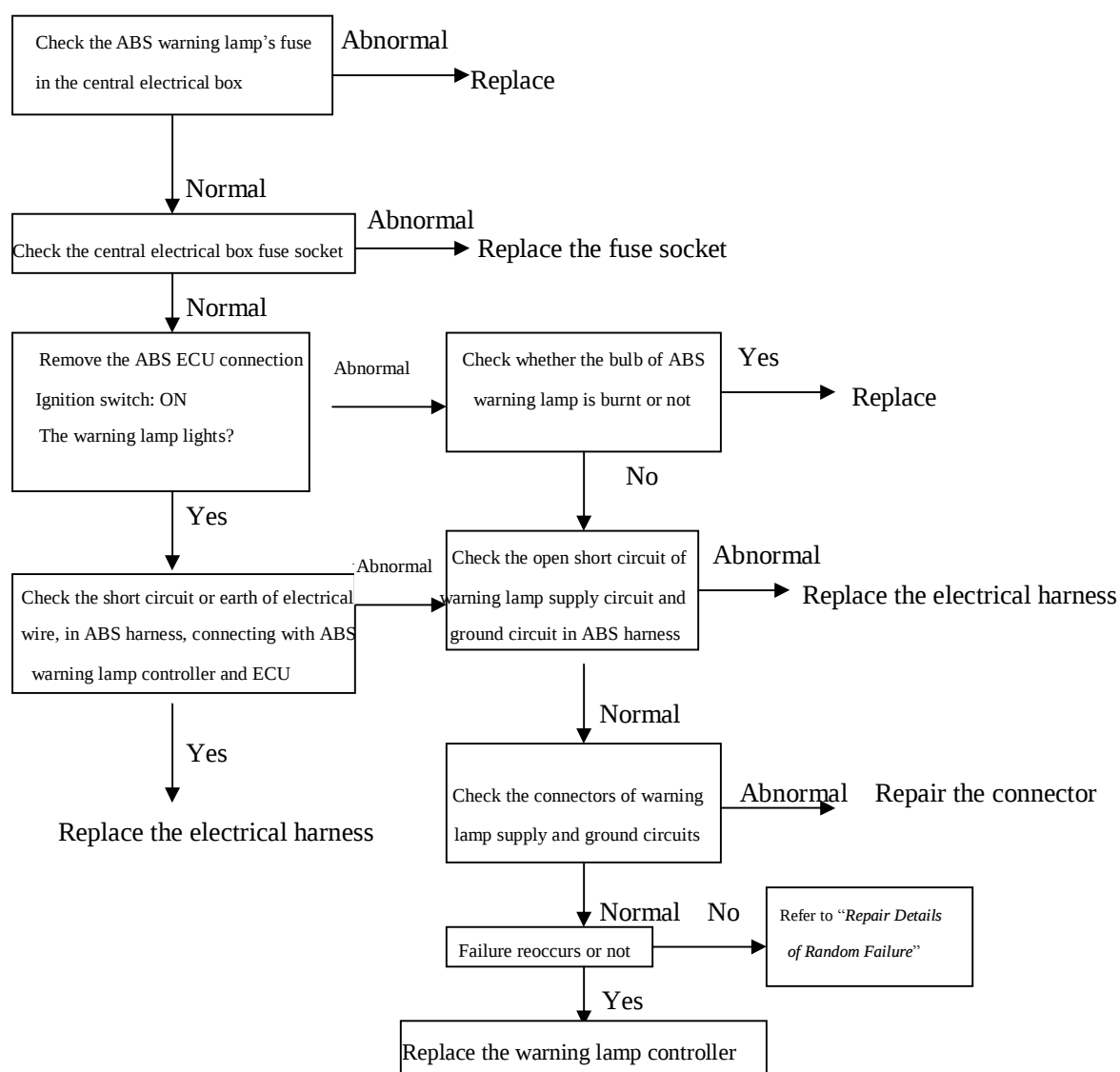
7. The DTC is 01130	Possible Cause
[Description] The DTC will appear when the ABS is interfered by the high-frequency electromagnetic wave or when the microprocessor believes that the input speed signal is incredible.	·High-frequency electromagnetic wave interference ·Sensor damaged or sensor electrical harness damaged · ABS ECU damaged



DTC Failure Check Sheet

※Turn the ignition switch to “ON” position (the engine shuts down), and the ABS warning lamp doesn’t light

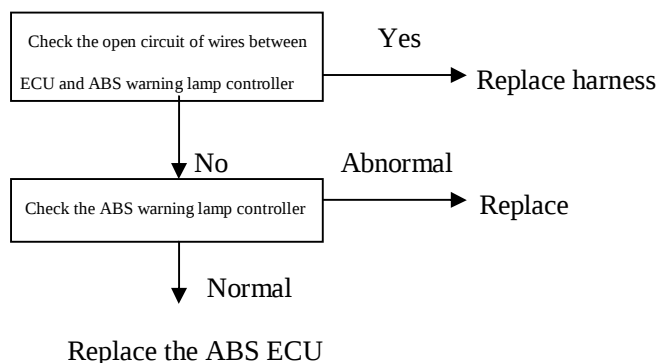
[Description] If the ABS warning lamp fails to light, it is possible that the supply circuit of warning lamp is open circuit, the bulb is burnt, or the warning lamp control is damaged.	Possible Cause
	· The fuse broken · The bulb of ABS warning lamp fuse is broken · The supply circuit broken · The ABS warning lamp controller broken



※The ABS warning lamp lights after the engine starts.

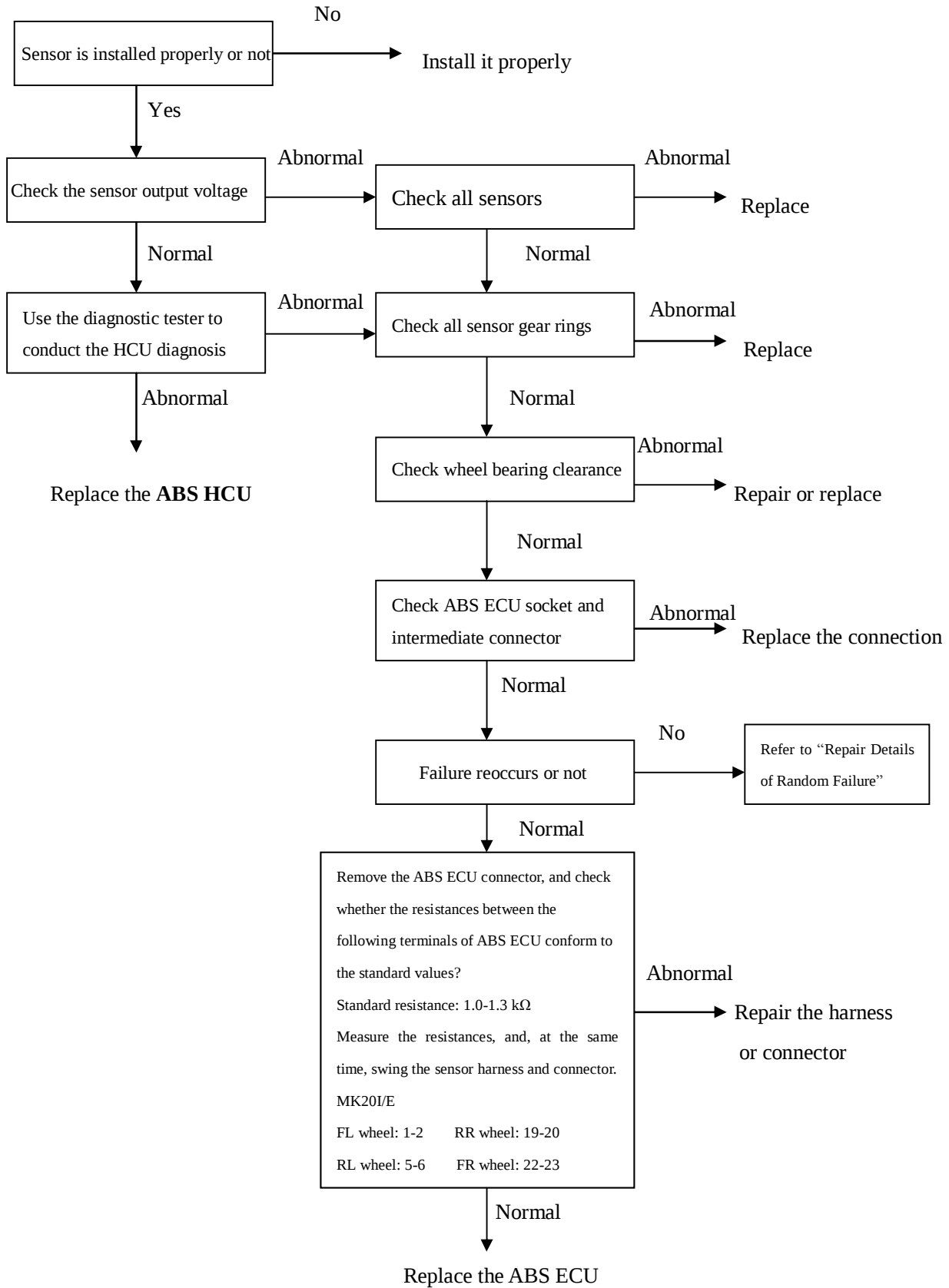
[Description] The possible cause may be the	Possible Cause
ABS warning lamp controller damaged or ABS warning lamp circuit open circuit	• Warning lamp controller damaged • Short circuit of ABS warning lamp controller • ABS ECU damaged

Caution: This failure mode is available only when the system can communicate with the diagnostic instrument (ABS ECU power supply normal) and there is no DTC.



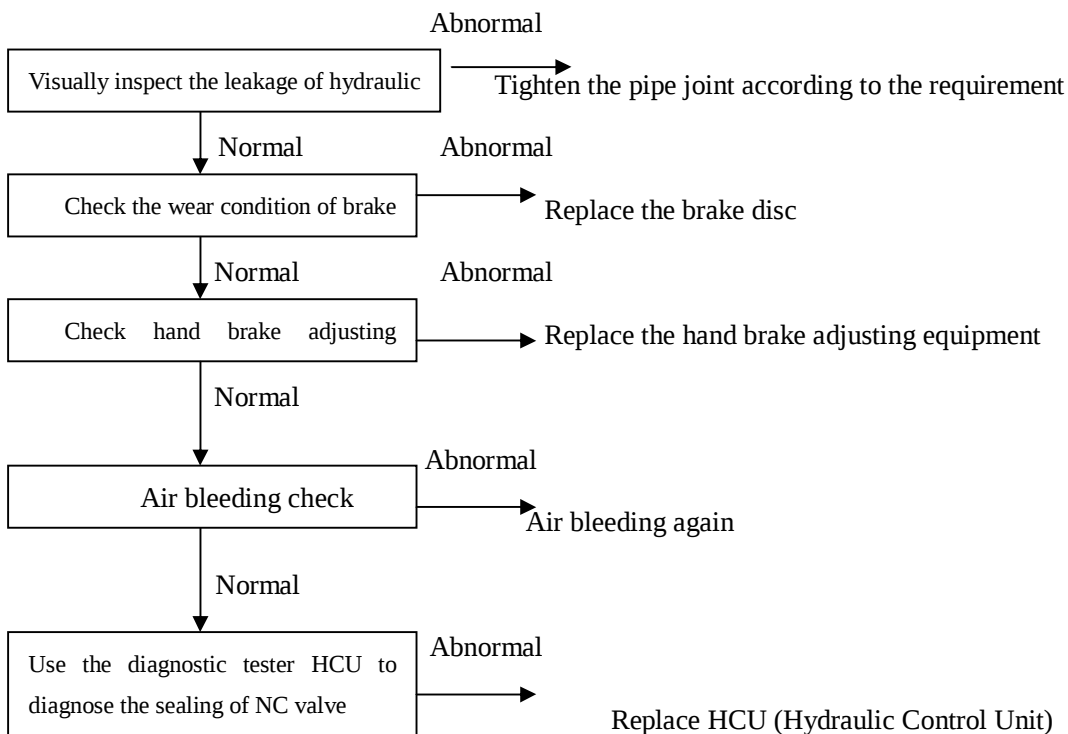
※ABS operation abnormal

[Description]	Possible Cause
This problem is related closely to the driver and road conditions, and thus it is difficult to diagnose this failure. However, if there is no DTC memory, the following checks may be conducted.	• Improper installation of sensor • Sensor harness problem • Sensor damaged • Gear ring damaged • Sensor adhered with foreign material • Wheel bearing damaged • ABS HCU (Hydraulic Control Unit) damaged • ABS ECU (Electronic Control Unit) damaged



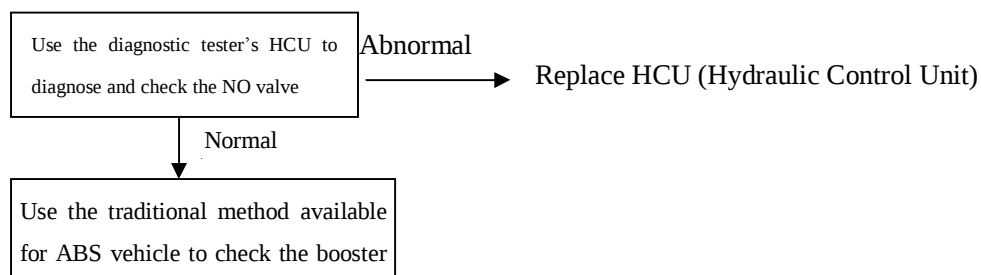
※Too long brake pedal travel

[Description] Firstly take the visual inspection to determine the outside leakage or mechanical failure. Use the air bleeding method to check the air in the system. And use the diagnostic tester and hydraulic testing to check the leakage of normally closed valve (NC valve).	Possible Cause
	• Brake fluid leakage • NC valve leakage • Air kept in the system • Serious brake disc wear • Hand brake adjustment improper



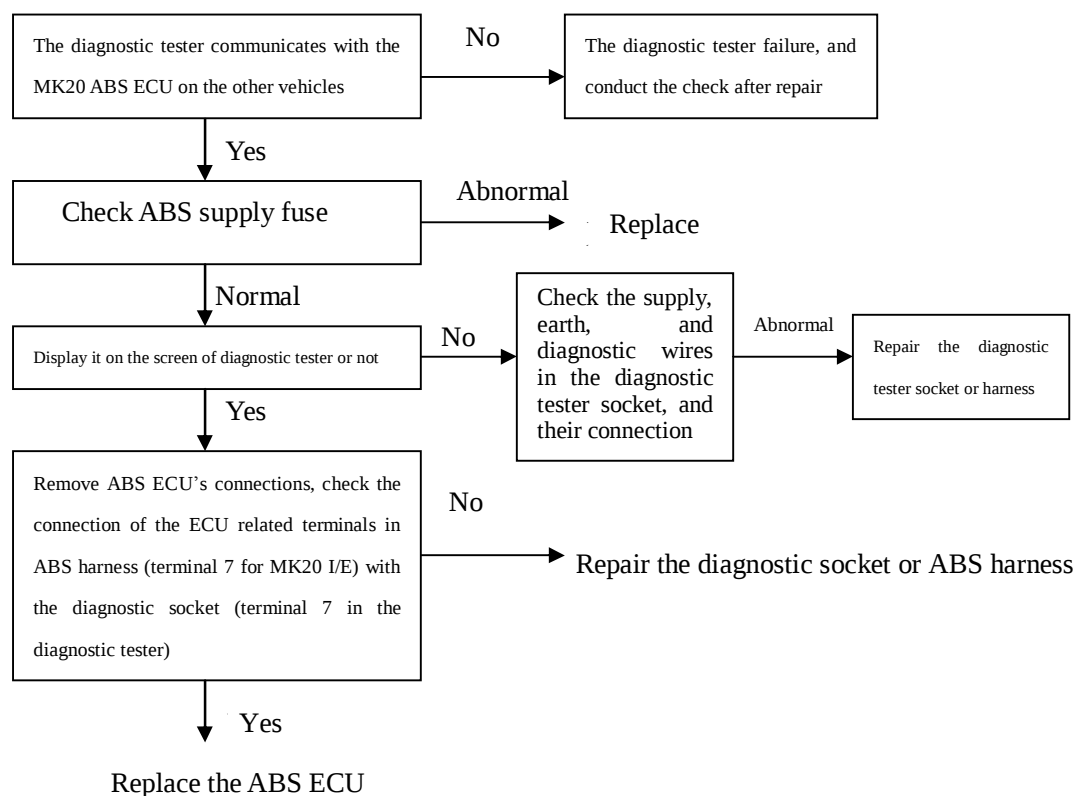
※Forcefully step on the brake pedal

[Description] Use the traditional method to check and control the booster and brake pedal travel. The failure of NO (Normally Open) valve can be checked using the diagnostic tester's hydraulic control unit function.	Possible Cause
	• Booster failure • NO valve failure



※Without DTC output (fail to communicate with the diagnostic tester)

[Description] If it is difficult to communicate with the diagnostic tester, it is possible that the supply circuit of ABS ECU or the diagnostic circuit is open circuit.	Possible Cause
	• The fuse broken • The diagnostic circuit broken or the connection uncoupled • ABS ECU damaged • Diagnostic tester failure



ABS SYSTEM CHECK

Check Item	Ignition Position	Terminal	Standard Value	Unit
		MK20I/E		
Battery voltage (motor)	OFF	25-8	10.1-14.5	V
Battery voltage (solenoid valve)	↑	9-24	↑	V
Supply insulating property	↑	8-4	0.00-0.5	V
Earth insulating property	↑	8-24	↑	V
Supply voltage	ON	8-4	10.0-14.5	V
ABS warning lamp	OFF	ECU not connected	Warning lamp extinguishes	Visual inspection
	ON		Warning lamp lights	Visual inspection
	OFF	Connect the ECU	Warning lamp extinguishes	Visual inspection
	ON		The warning lamp lights and then extinguishes after lasting for 1.7 s	Visual inspection
Braking lamp switch functional pedal not stepped down	ON	8-18	0.0-0.5	V
Braking lamp switch functional pedal stepped down	ON	8-18	10.0-14.5	V
Resistance value of FL wheel speed sensor	OFF	1-2	1.0-1.3	KΩ
Resistance value of FR wheel speed sensor	OFF	19-20	1.0-1.3	KΩ
Resistance value of RL wheel speed sensor	OFF	5-6	1.0-1.3	KΩ
Resistance value of RR wheel speed sensor	OFF	22-23	1.0-1.3	KΩ
FL wheel sensor output voltage	OFF	1-2	3.4-14.8	mV/HZ
FR wheel sensor output voltage	OFF	19-20	3.4-14.8	mV/HZ
RR wheel sensor output voltage	OFF	5-6	>12.2	mV/HZ
RR wheel sensor output voltage	OFF	22-23	>12.2	mV/HZ
Sensor output voltage ratio	$\frac{\text{Maximum peak volt}}{\text{Minimum peak volt}} \leq 2$			

APPENDIX I:

ABS Q&A

1. What's ABS?

ABS, the abbreviation of Anti-lock Brake System, means the function of Anti-lock Brake System (ABS), which is available to ensure that the vehicle traveling on different roads can get the optimal brake distance, and, at the same time, has the better brake stability and steering capacity.

2. Why the ABS is required?

The lock of front wheel will make the vehicle lose the steering capacity when braking, and the lock of rear wheel will cause the disalignment or slide. Through preventing the wheel from being locked, the ABS helps you to keep the operation control on the vehicle when braking. In this case, you can change the direction and wind off the obstacle.

3. How to recognize whether your vehicle is quipped with ABS?

Two methods are recommended: the first one is to observe the instrument panel or switch board when the vehicle starts and determine whether there is a ABS warning lamp which lights at a short time. The second one is simpler, i.e., you consult your provider directly.

4. How the ABS works?

Based on the signals from the wheel speed sensor, the electronic controller in the ABS will adjust the pressure on all wheel brakes via the solenoid valve in accordance with the specified control logic, which looks like an experienced driver applies the repeat braking, but the computer reacts more quickly than brain, and thus its effect is better.

5. How to determine whether the ABS is working?

You will feel the chattering of brake pedal when the ABS is working, and, at the same time, you will also hear the sound from the hydraulic controller working. Here, keep in your mind that you shall not be afraid of them, and shall step on the brake pedal reliably. Is the brake distance of vehicle with ABS shorter than that of vehicle without ABS? In the great majority of cases, the answer is YES, especially on the snow or wet road. But remember not to forget to turn the steering wheel and wind off the obstacle at the critical moment.

6. How to do after ABS fails to operate?

The ABS warning lamp will light continuously once the ABS failure. In this case, the ABS fails to operate, but the regular brake system is good. You just conduct the braking operation in accordance with the regular method.

7. When the ABS warning lamp lights?

The ABS warning lamp will extinguish after it lights for 1.7 s after the vehicle starts. Since then, the ABS warning lamp lights only when the ABS fails to operate. So, do not forget to immediately get to the Service Station once the ABS warning lamp lights. It is recommended that you don't repair the ABS as your pleasure.

m²

“FOUR DOS” and “FOUR DONTs” for the use of **ABS**

“FOUR DOS”

Do step on the brake pedal using your foot at all times, which can ensure sufficient and continuous braking force to make the ABS effectively play its role.

Do maintain the sufficient brake distance. At least 3 s braking duration away from the front vehicle shall be ensured when the vehicle travels on a better road, and the braking duration shall be longer if the vehicle travels on a bad road.

Do learn how to use the ABS to make you prepare for the brake pedal chattering when the ABS works and have the adaptive ability. The parking lot and square is the best site to learn the emergency braking and the use of ABS.

Do read the driver’s manual carefully, and further understand all kinds of operation description provided by the vehicle manufacturer which installs the ABS.

“FOUR DONTs”

Don’t drive the vehicle with ABS at your more pleasure than drive the vehicle without ABS. It is also improper and insecure for the ABS vehicle short-radius turning and quick driveway changing and other rapid steering wheel turning.

Don’t step on the brake pedal repeatedly. When driving the vehicle with ABS, the repeat step on the brake pedal will make the ABS connect and disconnect, which causes the low brake efficiency and larger brake distance. In fact, the ABS itself will automatically increase/decrease the braking force at higher speed, and provide the efficient steering wheel controlled capacity.

Don’t forget to turn the steering wheel. The ABS provide the driver with the steering wheel controlled capacity, but it itself doesn’t automatically implement the vehicle steering operation.

Don’t be afraid of the normal hydraulic working voice and brake pedal chattering when the ABS works, the sound and chattering of which are normal and can make the driver feel hereto that the ABS is playing its role.