THE ROVER SD1 BRAKING SYSTEM

This essay was inspired by two short articles prepared for "ROVER" magazine by Robbie Bath, erstwhile Technical Coordinator of the Rover SD1 Club.

WARNING! BRAKE DUST IS HAZARDOUS! USE LIQUID BRAKE CLEANER; WEAR A MASK, NEVER USE AN AIRLINE. BRAKE FLUID REMOVES PAINT! AVOID SPILLAGE, KEEP SOILED HANDS AWAY FROM PAINT!

BRAKING SYSTEM DESCRIPTION

- The Rover SD1 braking system is hydraulically actuated and vacuum servo assisted.
- It has a split circuit master cylinder, front disc brakes and rear self-adjusting drum brakes.
- Under braking, weight transfer takes place so a pressure limiting valve prevents the rear brakes locking first.
- More braking effort goes to the front, with rear brakes just steadying the car.

Brake Fluid

- Brake fluid is classed by DOT number. A higher number indicates a higher boiling point.
- It is hygroscopic so absorbs moisture that progressively lowers the boiling point.
- The Rover SD1 requires minimum DOT 3 fluid. If using DOT 4 or higher, there are some points to note: -
- Can top up a DOT 3 system with DOT 4 fluid.
- Cannot top up a DOT 4 system with DOT 3 fluid.
- Never top up a DOT 3 or DOT 4 system with DOT 5 silicone fluid.
- DOT 5 silicone can be used only to top up a system already filled with same.
- To use silicone fluid requires draining the old fluid, refill with silicone and drain again, then finally refill with DOT 5 silicone, an expensive process and not wholly satisfactory.
- Better to wait until the brake system is rebuilt, all seals renewed and re-assembled using DOT 5 silicone fluid and then use it in a clean system.

Servo

- The brake servo uses vacuum from the engine to reduce the effort required on the brake pedal. It multiplies the braking effort by a ratio of approximately 3.5 to 1.

Master Cylinder and Reservoir

- This stores and distributes the brake fluid to the front calipers and rear cylinders.

Pressure Limiting Valve

- A pressure limiting valve fitted to the inner wing below the master cylinder divides the brake pressure in a set ratio to prevent the rear brakes locking before the fronts.

- It is not ABS so wont prevent all wheels locking under severe braking pressure.

Pipes

- There are two types of brake pipe. Metal tubing and flexible hoses.

- Tubes run from master cylinder to pressure limiting valve, to front inner wings and from the front struts to calipers.

- From pressure limiting valve under the car to the axle extension.

- Along the axle to the LH wheel cylinder, then across the axle to the RH cylinder.

- Hoses run from inner wings to front struts and from underbody to axle extension.

Calipers

- At the front there are four different types of caliper that may be attached to the suspension strut with two bolts: -

- Twin piston, solid disc

- Four piston, solid disc, single circuit (recognised by 1 bleed nipple per caliper)

- Four piston, vented disc, single circuit

- Four piston, vented disc, dual circuit.(recognised by 3 bleed nipples per caliper)

Wheel Cylinders

- At the rear there is one double acting wheel cylinder for each drum.

Friction Material

- Disc pads fitted to the calipers at the front, and brake shoes for the rear drums may be of two types of friction material.
- Asbestos based and non-asbestos.
- The latter type are generally more expensive.
- The minimum thickness of the friction material for both types is 3mm or 1/8 in.
- Older type shoes have riveted linings and newer types are bonded.

Friction Surfaces

- At the front 10.5 inch dia solid or vented discs.
- At the rear 9 inch dia drums.

OPERATION

- When depressed, the brake pedal acts with the servo to move the primary and secondary pistons in the master cylinder forward, blocking the holes to the reservoir.
- This creates pressure in the fluid down through the pipes to the pressure limiting valve, which distributes the pressure in a preset ratio to the front calipers and rear wheel cylinders.
- At the front, increased pressure in the calipers forces pistons to press the pads on to the discs.
- At the rear, it pushes the wheel cylinder pistons apart, pressing the brake shoes against the drum.
- As by-products, heat is generated and dust is created from pads/shoes.

PROBLEMS

- Excess free travel at the brake pedal can be due automatic adjusters malfunction.
- Fluid pressure has to push the rear shoes up to the drum surfaces before any braking takes place, front or rear.
- A spongy pedal indicates either air in the system or the flexible brake hoses are old or worn.

- The pedal rubber must be in good condition and securely fitted.

Brake Fluid

- Being hygroscopic, brake fluid absorbs moisture over time, lowering its boiling point and efficiency.
- It causes internal corrosion and a condition sometimes known as vapor lock.
- The system works on minimal travel of the master cylinder primary and secondary pistons.
- Excess heat vaporizes moisture and can push some of the fluid back into the reservoir.
- There may then be insufficient travel of the pistons to compress the vapor so the pedal goes to the floor with no braking effect.
- Repeated pushing can generate some braking effect.
- To avoid future problems brake fluid should be changed biannually or as recommended.

Servo

- If servo is not working properly, up to 3.5 times greater effort than normal is required and the car will not slow as desired.
- To check, depress the brake pedal and start the engine.
- If OK the pedal should sink a little further.
- If not, reduced or nil vacuum is getting to the servo due to blocked vacuum feed from inlet manifold/efi plenum, a blocked or damaged valve or a damaged hose.
- If it be the hose, use only proper vacuum hose as a replacement.

Master Cylinder

- Damaged seals can allow brake fluid to leak down the servo, stripping off paint as it goes.
- Seals between reservoir and master cylinder can leak and leakage across the seals means fluid is not forced down the pipes but goes back to the reservoir resulting in no brakes.

Pressure Limiting Valve

- Generally reliable and unless leaking from a connection, replace if it fails.

Brake Pipes

- Metal pipes can corrode and get damaged externally.
- Check especially underneath the car where they are vulnerable to careless jacking or by objects in the road hitting the underside of the car.
- Moisture in the brake fluid can also cause internal corrosion.
- Flexible hoses can split/fail catastrophically or more likely soften with age and swell under pressure, reducing the effort reaching the calipers/cylinders.
- Ideally they should be changed every three years but often fail an MOT first.
- An improvement is to use "Goodridge" type braided hose that is not prone to swelling and gives better "feel" to the pedal.
- Flexible hoses can also fail so that fluid passes in one direction only, effectively becoming a non return valve, allowing fluid under pressure to (say) the rear wheel cylinders and apply the brake, but not allowing the fluid to return and release it.

Calipers

- Main problem is leaking and/or sticking pistons.
- If pistons stick IN; then the car may steer to the stuck side when not braking and to the opposite side under braking due to less effective braking on the stuck side.
- If the pistons stick OUT; then the car may steer to the opposite side under braking.
- These conditions cause pads and discs to overheat and make lots of noise!
- When fitting new pads, the exposed areas of pistons should be thoroughly cleaned before they are pushed in, as dirt and damage on the pistons will hasten seal damage.
- It may be possible to free stuck pistons and get them working smoothly again but as with leaking around the pistons, more than likely it necessitates removal of calipers and replacement of seals and/or pistons following thorough cleaning/inspection.

Wheel Cylinders

- Same problem as above but with cylinders hidden inside brake drums it is harder to diagnose unless fluid comes through/drips from the back plate, or the rear brakes are ineffective due to fluid contaminating the shoes.

- Cylinder reseal kits are available, but repeated leaking will necessitate replacement of the wheel cylinder.

Friction Material

- Grinding noises from any wheel means lost friction material and metal to metal contact between pads/shoes and disc/drums.

- If a car is driven enthusiastically, normal pads/shoes can glaze over reducing efficiency. Consider replacement with high performance items.

- Changing pads/shoes require a period of sensible use in order to bed in and can alter the feel of the brake pedal. They should only be replaced in axle sets, not just the one that has worn.

- Friction material has been known to come away from the back plates of cheap pads. If choosing bargain items, be careful, lives are at stake!

Friction Surfaces

- Depending on model/year, an SD1 will have either solid, early vented or late vented discs at the front, and drums at the rear.

- Early vented discs have alternating full and half webs and are prone to warping under heavy use.

- Later discs have full webs thus being stronger items and can be retro-fitted.

- Solid discs can be reground down to 13.1 mm. thickness. It is not advisable to regrind vented discs, as the process is liable to subsequent warping.

- Drums can be re-ground to a maximum diameter of 9.040", i.e. 40 thou oversize.

BLEEDING

- Spongy brake pedal indicates air in the fluid, so it is necessary to bleed the system but also to change fluid if required.

- A vacuum device can be used to remove old fluid before re-filling the reservoir prior to bleeding.

- A length of tubing is used between each bleed nipple in turn and a jar containing enough fresh fluid to keep the end of the tube covered.

- An assistant is required to operate the pedal while opening the bleed nipple, allowing air bubbles and fluid to escape.

- Release the pedal only after closing the nipple or air may re-enter the system as it can if reservoir level is allowed to drop too far.

- When using a proprietary bleeding kit, follow the manufacturers' instructions.

Order of Bleeding

Twin piston and Four piston single circuit

- Start at rear RH cylinder. Bleed until fresh fluid with no air comes from the nipple. It helps the air to escape if the rear of the car is jacked as high as possible.

- Next, bleed the LH front caliper, likewise.

- Finally, bleed the RH front caliper.

Four piston dual circuit

- Start at rear RH cylinder, as in 1a above.

- Next, bleed likewise from the two lower nipples (together with a twin bleed tube) on the LH front caliper followed by the upper bleed nipple on this caliper.

- Finally, bleed likewise from the RH front caliper.

- The result is a solid brake pedal with little free play.

HANDBRAKE SYSTEM DESCRIPTION

- The cable consists of an outer sheath, an inner cable and a second cable joined to a pivot on the end of the sheath.

- The pivot is fixed to the rear axle via a compensating lever (compensator).

- The inner cable goes to the RH drum and the second cable, with an adjuster on the end, goes to the LH drum via a cable guide on the differential.

- Operating levers protrude from the back plates.

- Inside the drums are shoes, springs and an automatic adjuster, whose purpose is to push the brake shoes up close to the drum to take up wear.

OPERATION

- The hand brake lever pulls the inner cable to apply the RH hand brake and by effectively shortening the inner cable, the outer sheath simultaneously pushes the compensator to the right (towards vertical) thereby pulling the LH hand brake on with its attached cable.

- System efficiency relies on cleanliness, good lubrication and low friction throughout.

PROBLEMS

Automatic adjusters

- The automatic adjusters, fixed by a pin and spring to the upper shoe, may wear out or seize up due to lack of maintenance.

- If the component parts or the ratchet teeth are worn the adjuster can be replaced.

- If seized, it can probably be dismantled, cleaned and re-assembled with high temperature grease, applied sparingly, to restore normal function.

Hand Brake Levers

- The hand brake levers (operated by the cables) can seize at their pivot point rendering the handbrake useless on that drum.

- Also the cable-end pins can seize in the lever.

- It is necessary to dismantle the shoes to remove the lever for maintenance.

- Operate on one side only and refer to other side for re-assembly, as the springs and levers can easily be mis-assembled.

- Free a seized pivot-point with WD40 and work the levers by hand until they are completely free.

- The pivot-point pin is effectively a large rivet that can be dressed on an anvil with a ball-peen hammer to eliminate any unwanted looseness.

- Excessive play or complete seizure will require a replacement lever

- Ensure the rubber boots are sound.

Compensator

- The compensator can become stiff on its pivot bolt or the cable attachment can seize in the compensator yoke.

- If this happens, the LH brake lever travel is restricted and the handbrake effort is applied unevenly.

- Dismantle the compensator arm and its rubber bushes from the axle bolt and remove the cable attachment from the yoke for thorough cleaning, inspection and re-assembly using only rubber friendly lubricant.

Cable

- The cable can wear through its protective sheath especially over the centre of the axle or the cable guides or it can become stiff due to water entry.

- Mostly, the only cure is to fit a new item, but it may be possible to revive a stiff cable, forcing cleaning fluid through the sheath and restore its function with machine oil.

INSPECTION AND TESTING

- Raise the car on axle stands so both rear wheels are off the ground. With handbrake lever off, check both wheels rotate freely.

- Check the cable, its attachments, compensator and its yoke for free movement.

- Check that each operating lever moves freely up and down, and when pulled up, it operates the brake on that wheel.

- Pull the handbrake on by one notch and check the brakes do not bind by rotating each wheel.

- At two notches on the lever the brakes should start to bind and at three notches the brake should fully resist rotating the wheel by hand.

- The braking effect must be the same on both sides.

- A further one or two notches on the handbrake lever must lock the rear brakes sufficiently to resist rolling

ADJUSTMENT

- If the above inspection and testing is unsatisfactory then adjustment is necessary.

- Underneath the car at the handbrake lever, slacken both cable adjusting nuts.
- Disconnect both cables from their handbrake operating levers.
- If the drums have been previously removed start the engine and apply the brake pedal hard (at least 3 times) to set the automatic adjusters.
- The ratchets will click as they take up the slack but the wheels should be free to rotate when the brake pedal is released.
- Attach the LH cable to its lever and adjust its length so the compensator makes an angle of 30° to the vertical towards the left (Very important, to ensure correct operation).
- Connect the RH brake cable to its lever and fit the split pins to both sides.
- At the hand brake lever cable adjuster, pull the sheath rearwards until the RH cable end and operating lever just start to move.
- Tighten the rearward adjusting nut up to its bracket then one more complete turn and secure the adjustment with the lock nut.
- Finally re-check the operation of the handbrake as described earlier.

Footnote

- The Hydraulic and Mechanical Braking Systems on the SD1 are exposed to the severest possible working environment; as such they rely totally on regular, competent maintenance and cleanliness to ensure continued efficient operation. Lives are at stake.
- This essay is intended only to explain and clarify the essential elements of the SD1 Braking Systems, how they work, how they can fail and the nature of the recommended maintenance. It is not a service manual.
- If owners are unsure about undertaking such work, better to employ service professionals rather than perform substandard work on the braking systems. Please advise of any Errors and Omissions.

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