

## REVERSE BLEEDING IN HYDRAULIC CLUTCH

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### ABSTRACT

Reverse Bleeding injects fluid at the lowest point of the system, the slave bleeder valve. Working with the law of physics – air rises in fluid – the injectors using Reverse Bleeding forces the air through the fluid and out the master cylinder using less than 10 psi. Reverse Bleeding utilizes fluid paths in which enhanced braking mechanisms offer almost no resistance, which makes it ideal for ABS systems. Metering valves, proportioning valves, and anti-lock valving are designed to manipulate clutch pressure, while providing minimal resistance to fluid as it returns to the master cylinder following the release of braking pressure. During vacuum bleeding negative pressure is exerted on the system from each of the bleeder valves. This negative pressure or vacuum draws the fluid from the reservoir, through the system and out the bleeder valves. This goal of bench bleeding is to remove all of the air from the component prior to its installation. The master cylinder is usually placed in a vice and a combination of Reverse Bleeding and Pressure bleeding is usually used. During pressure bleeding the fluid in the reservoir is pressurized. The pressurized fluid is allowed to pass through the master cylinder to the bleeder valves. When the bleeder valves are opened, the pressurized fluid and air will be forced out the bleeder valves.

### INTRODUCTION

Reverse Bleeding injects fluid at the low points, the slave bleeder valves. Reverse Bleeding takes advantage of the “laws of Physics” air rises in fluid. The complete system is bled by forcing the air up and out the master cylinder reservoir. The clutch/brake fluid then fills the reservoir.

Reverse bleeding is the absolute best single clutch and brake bleeding method to use. It is the most effective at removing trapped air. It works well with ABS equipped vehicles as well as any vehicle with a bleed screw. It is very quick, the fastest of any bleeding method.

The clutch hydraulic system on Spridgets (and some other British cars) is hard to bleed. The internal diameter of the clutch lines is larger than that found in the brake system. This makes it easier for air bubbles to move back up the line and means that any time you try bleeding the system in the usual way (pushing fluid out the bleeder screw) you will be fighting against the buoyancy of the air bubbles. It can work but you will need to move a LOT of fluid to get all the air out (especially if the system is dry). This is why pressure bleeding or vacuum bleeding is more effective than simply pumping the pedal. Its much easier to push the air in the direction it wants to go already. By putting fluid IN the bleeder, instead of taking fluid OUT of the bleeder you will force the air into the master cylinder where it will be vented out through the cap. There are a few ways to do this. If you have a pressure bleeder, you can connect the bleeder to the bleeder screw. If you have a squeeze action oil can with a trigger pull, you can fill this with brake fluid and pump fluid in through the bleeder (connect the two with a length of acrylic tubing). Or you can try the following method (suggested by MGA guru Barney Gaylord).

### LITERATURE REVIEW

#### NEED AND IMPORTANCE

If we have replaced the clutch slave or master cylinder, the lines or simply changed the fluid, we need to do adequate job removing the air from the system before our clutch we work properly. This procedure is called “BLEEDING” the clutch system. By most mechanics and is important because air in a hydraulic system will cause it to malfunction.

According to 2007 Hummer H3, If there is an air in this system, that air bubble can compress. This compressing air bubble will observe much of the fluid being send from the master cylinder to the slave cylinder keeping the slave cylinder from activating as for as it should or even at all. If the slave cylinder doesn't travel as fare as it should, our clutch will not fully disengage making it difficult to shift our transmission, especially into first gear from a stop.

According to Wagner Matos Santos, Alvaro Costa Neto (2012),The clutch actuation system is directly linked to vehicle easy of operation and ergonomics. For passenger cars, a comfortable pedal force is considered light when it is under 100 N and hard if over 130 N.

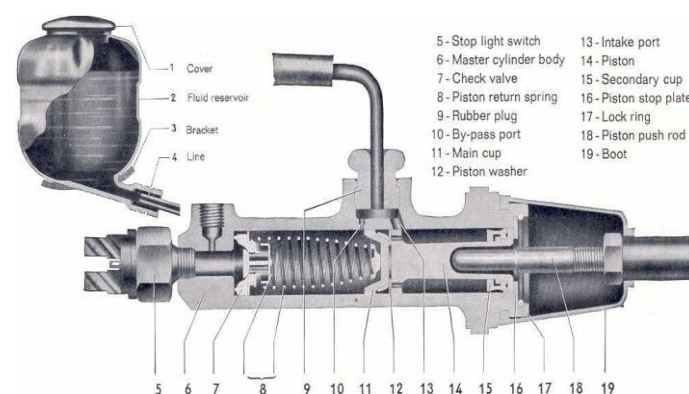
According to Venkatesh Gore, Ritesh Gujar, Pratik Kale, Arbaj Tamboli, Parag Bute, Volume: 04 Issue: 01 | Jan -2017 - In general the hydraulic clutch is used in four wheelers for smooth and light weight functioning. But now days in super bikes this clutch is used for faster transmission and less effort.

## CONCLUSION FROM LITERATURE REVIEW

- The easiest way to bleed the clutch is to use a vacuum pump to pull the fluid and air out of the system while keeping the clutch fluid reservoir topped off.
- Continue pumping fluid from the bleeder valve until we know longer see air bubbles in the fluid.
- With the bleeder valve closed, have one person depress the clutch pedal as for as they can. Open the bleeder valve and allow the fluid to runover until its close down, while one person maintains pressure on the clutch pedal. When the fluid flows slowly, while one person still has a pressure on the clutch pedal, close the bleeder valve.
- Thus the air bubbles are removed from hydraulic fluid by using reverse bleeding method. The complete system is bled by forcing the air up and out the master cylinder reservoir
- To remove the air from our clutch system we need to bush or pull the air down through the fluid line to the bleeder valve on the slave cylinder. To keep things clean, we should attach a tube to the nipple on the bleeder valve.

## COMPONENTS OF HYDRAULIC SYSTEM

### Clutch Master Cylinder



**FIG 1 CLUTCH MASTER CYLINDER**

The master cylinder is bolted to firewall in the back of the engine bay. It is connected by a short hose to the clutch fluid reservoir. Its name suggests a simple cylinder with a steel line coming out of the end. The internal piston is connected to the clutch adjustment rod. Thus as the clutch pedal is pressed, the fluid in the master cylinder is forced out of the cylinder into the steel clutch fluid line that runs to the slave cylinder.

Clutch Slave Cylinder



**FIG 2 CLUTCH SLAVE CYLINDER**

The concentric slave cylinder housings are made of die cast or forged aluminium, which requires costly processing and subsequent anodizing treatment.

The slave cylinder is bolted to the actual transmission itself. One end of the cylinder is open to the clutch fluid line. On the other side a steel rod connects the piston of the cylinder to the clutch fork on the bell housing of the tranny.

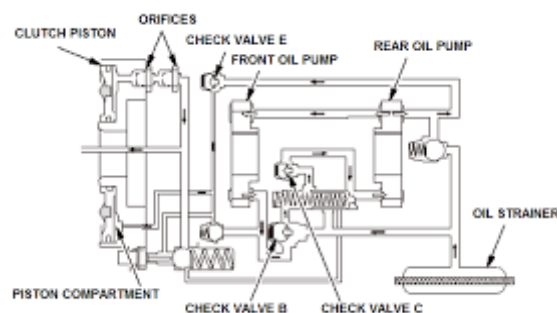
### **FUNCTION OF HYDRAULIC SYSTEM**

Achieving proper geometry when installing the master cylinder is critical to a Properly functioning hydraulic clutch system. It is important to make sure that master is mounted securely to the firewall and at the correct angle. Proper placement of the master cylinder push rod on the clutch pedal is also critical. If positioned too high on the pedal, there will not be enough push rod travel which will not allow the clutch disc to disengage when the pedal is depressed. If positioned too low on the pedal, the pedal will become hard to depress.

The hydraulics with the master cylinder and the slave cylinder take the place of the Bowden cable. The brake fluid is taken from the reservoir of the brake system or from a separate container. This pipe leads to the master cylinder. The amount of fluid sinks as the brake-pads wear down, therefore, in this situation the container should not be filled to the brim.

The pressure is distributed from the master cylinder and stays the same for the respective pedal pressure everywhere. By using various piston diameters, a manufacturer can set a transformation ratio, e.g., by using a smaller master cylinder diameter, the pedal force can be reduced.

The spring in the slave cylinder presses the piston through the linkage, even when no activity is taking place, against the release bearing, which then lies on the tongue of the membrane spring and always rotates with it. Earlier, only the hydraulic clutch operation was self-adjusting, nowadays it is also the standard in cable operated systems.



**FIG 3 HYDRAULIC CYLINDER SYSTEM**

## **FINDING A PROBLEM ON HYDRAULIC CLUTCH SYSTEM CAVITATION**

Cavitations occur when the volume of fluid demanded by any part of a hydraulic circuit exceeds the volume of fluid being supplied. This causes the absolute pressure in that part of the circuit to fall below the vapor pressure of the hydraulic fluid. This result in the formation of vapor cavities within the fluid, which implode when compressed, causes a characteristic knocking noise. The consequences of cavitations in a hydraulic system can be serious. Cavitations cause metal erosion, which damages hydraulic components and contaminates the fluid. In extreme cases, cavitations can cause mechanical failure of system components. While cavitations can occur just about anywhere within a hydraulic circuit, it commonly occurs at the pump.

## **AERATION**

Aeration occurs when air contaminates the hydraulic fluid. Air in the hydraulic fluid makes an alarming banging or knocking noise when it compresses and decompresses, as it circulates through the system. Other symptoms include foaming of the fluid and erratic actuator movement. Aeration accelerates degradation of the fluid and causes damage to system components through loss of lubrication, overheating and burning of seals. Air usually enters the hydraulic system through the pump's inlet.

## **CAUSES ON CLUTCH SYSTEM**

The following is a list of causes induced in clutch system

- a. Bad clutch disc
- b. Pressure plate or flywheel warped
- c. Clutch disc overheated
- d. Bad pressure plate
- e. Unable to engage transmission into gear
- f. Noise or vibration coming from the area of the clutch
- g. Clutch grabs or shutters as it is engaged

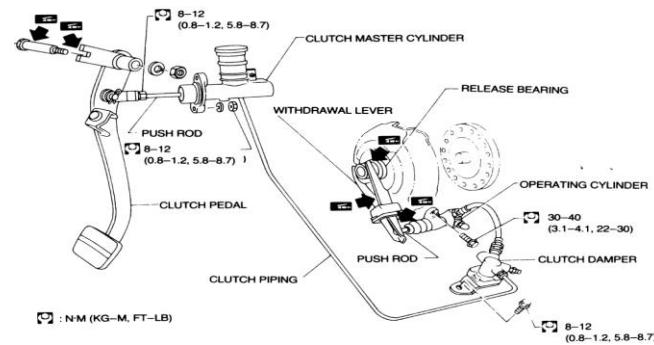
## **WORKING PRINCIPLE OF REVERSE BLEEDING**

Procedure for manual Reverse Bleeding

- a. Open the bleeder
- b. Press the clutch slowly
- c. Keep clutch pedal pressed
- d. Close bleeder valve
- e. Slowly release clutch pedal

Reverse bleeding injects fluid at the lowest point of the system, the slave bleeder valve. Working with the law of physics air rises in fluid and the injectors using reverse bleeding forces, the air through the fluid and out the master cylinder using less than 10psi. Reverse bleeding utilizes fluid paths in which enhanced clutch mechanisms offer almost no resistance, which makes the air bubbles completely out from the system.

Reverse Bleeding utilizes fluid paths in which enhanced clutch mechanisms offer almost no resistance. While proving minimal resistance to fluid as it returns to the master cylinder following the release of clutch pressure. During pressure bleeding the fluid in the reservoir is pressurized. The pressurized fluid is allowed to pass through the master cylinder to the bleeder valves.



**FIG 4 REVERSES BLEEDING ON HYDRAULIC SYSTEM**

When the bleeder valves are opened, the pressurized fluid and air will be forced out the bleeder valves. During vacuum bleeding negative pressure is exerted on the system from each of the bleeder valves. This negative pressure or vacuum draws the fluid from the reservoir, through the system and out the bleeder valves. This goal of bench bleeding is to remove all of the air from the component prior to its installation. The master cylinder is usually placed in a vice and a combination of Reverse Bleeding and Pressure bleeding is usually used.

A technique developed by Phoenix Systems uses the Injector to create pulsations which generate a force within the system which acts to overcome the surface tension of the trapped air. This Pulse Generation helps to force trapped air out of a system. It's like tapping on a caliper, slave, master or line, at the same time. This will bleed and flush that portion of the hydraulic circuit. A clutch pedal depressor is used to prevent the return of trapped air.

### PROCESS OF REVERSE BLEEDING

In reverse bleeding process following procedure needs to be followed to ensure smooth operation of clutch.

### MASTER CYLINDER



**FIG 5 MASTER CYLINDER**

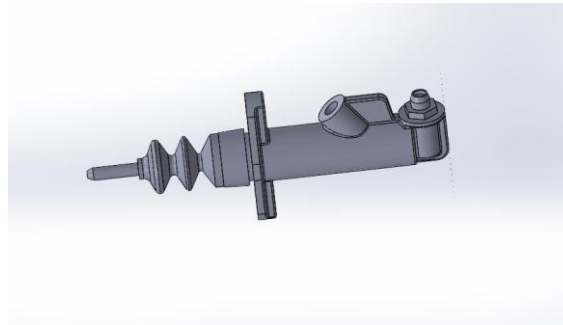
In automotive engineering, the master cylinder is a control device that converts non-hydraulic pressure (commonly from a driver's foot) into hydraulic pressure. This device controls slave cylinders located at the other end of the hydraulic system.

A clutch master cylinder is a component found on vehicles equipped with manual transmission, and serves as the pump for the hydraulically operated clutch system. When the clutch pedal is pressed, the clutch master cylinder pushes fluid through the system down to the clutch slave cylinder so that it may disengage the clutch.

As they are hydraulic in nature, clutch master cylinders are often prone to issues with leaks that will interfere with its ability to displace fluid. When the clutch master cylinder has problems, it can lead to issues with the clutch pedal and shifting gears.

### SLAVE CYLINDER

The clutch slave cylinder is a component found on vehicles equipped with manual transmissions. It works together with the clutch master cylinder to disengage the clutch when the pedal is pressed so that the transmission can be safely shifted. The clutch slave cylinder receives pressure from the master cylinder and extends a rod, which will push against a fork or lever to disengage the clutch. When the clutch master cylinder has any problems, it can cause issues with shifting gears, which will take away from the overall drivability of the vehicle and can even damage to the transmission.



**FIG 6 SLAVE CYLINDER**

Usually a clutch slave cylinder will produce a few symptoms that alert the driver that a problem has occurred and needs to be serviced. A reservoir above each master cylinder supplies the master cylinder with enough brake fluid to avoid air from entering the master cylinder (even the typical clutch uses brake fluid, but it may also be referred to as "clutch fluid" in a clutch applr). Each piston in a master cylinder operates a brake circuit, and for modern light trucks and passenger cars, usually a brake circuit leads to a brake caliper or shoe on only two of the vehicle's wheels, and the other brake circuit provides brake-pressure to slow down and stop the other two wheels.

### ANOTHER METHOD

- 1) Connect the clutch Bundy pipe to the reservoir end with help of banjo bolt at an angle of 25degrees.
- 2) Ensure that banjo bolt is properly torque tightened before doing the reverse bleeding
- 3) Hose routing has to be done such as to avoid kinking of hose and fouling with stiffener plate of cabin
- 4).Loose the clutch booster nipple using open end spanner and after loosening the nipple fix the filling nozzle properly.
- 5) Connect the two pin connector of the equipment to the switch box and switch ON the power.
- 6) Ensure the oil level in the reservoir of the equipment, if the level of oil is found to be low fill the reservoir by opening the cap. Oil specification: Clutch hydraulic fluid DOT 3
- 7) Switch "ON" the equipment by pressing the switch on the top.
- 8) Ensure that the green light on the switch glows brightly after switching on the machine.
- 9) Clutch hydraulic fluid DOT 3 should be used and filling should be done at a pressure of 2bar maximum. If not increase the filling by adjusting the regulator provided at the side of the equipment.
- 10) Filling quantity should be more than 300ml. Once complete circuit is filled, oil will reach the max mark reservoir in the front side.
- 11) Immediately stop filling by pressing the "Stop" button on the equipment. After removing filling nozzle ensure that the nipple of clutch booster is properly tightened.

12) After doing reverse bleeding check for a smooth operation of clutch pedal and check for clutch release travel of 21mm.

## RESULT AND ANALYSIS

If there is air in the system, that air bubble can compress. This compressing air bubble will absorb much of the fluid being sent from the master cylinder to the slave cylinder keeping the slave cylinder from actuating as far as it should, or even at all. If the slave cylinder does not travel as far as it should, your clutch will not fully disengage making it difficult to shift your transmission, especially into 1st gear from a stop.

To remove the air from your clutch system you need to push or pull the air down through the fluid line to the bleeder valve on the slave cylinder. To keep things clean you should attach a tube to the nipple on the bleeder valve. If you use a clear tube it can be easy to see when all the air has exited the system. The easiest way to bleed the clutch is to use a vacuum pump to pull the fluid and air out of the system while keeping the clutch fluid reservoir topped off. Continue pumping fluid from the bleeder valve until you no longer see air bubbles in the fluid.

Used a large syringe to remove some of the existing air out of the reservoir.

In Ashok Leyland ennore Chennai unit, the buses and trucks are manufactured .the cost saving by reverse bleeding is:

Monthly target=3200 vehicle

Oil waste per vehicle=50-100ml

Lets us assume the oil waste per vehicle will be 75ml, then

Total oil waste per month=2,40,000ml

Oil waste in litres per month=240 L

Cost of oil per litre =Rs.500

Profit for company=Rs.1,20,000

This is the profit for only one company's single plant let us assume Ashok Leyland have more than 8 plants in India , and also other company also manufactures vehicle so profit would be more by using the reverse bleeding technique.

## CONCLUSION

Clutch is a mechanism used for connecting and disconnecting an engine and the transmission system in a vehicle whenever the driver needs and during gear shifting.

To remove the air from clutch system we should push or pull the air down through the fluid line to the bleeder valve on the slave cylinder.

Thus the air bubbles are removed from hydraulic fluid by using reverse bleeding method. The complete system is bled by forcing the air up and out the master cylinder reservoir. The clutch fluid then fills the reservoir.

By using plastic materials and more intelligent designs, cost savings can be attained for clutch actuation products, which seemed to have reached their products. At the same time, the functionality has been expanded, thus increasing actuation and driving comfort.

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