MODULE CONTENT

| Unit of Competency | **DIAGNOSE AND REPAIR CLUTCH SYSTEM** |
| --- | --- |
| Module Title | **DIAGNOSING AND REPAIRING CLUTCH SYSTEM** |
| Module Descriptor | This unit identifies the competence required to perform basic diagnose and repair the clutch system. |
| Nominal Duration | **hours** |
| Summary of the Learning Outcomes: | |
| Upon completion of this module the student must be able to: | |
| LO1. Prepare to diagnose and repair clutch system | |
| LO2. Diagnose clutch system | |
| LO3. Repair clutch system | |
| LO4. Complete work processes | |

**LEARNING EXPERIENCES**

**LEARNING OUTCOMES NO. 3**

**REPAIR CLUTCH SYSTEM**

| **Learning Activities** | **Special Instructions** |
| --- | --- |
| Read Information Sheet 3.1-1 Repair clutch system | If you have some problem with the content of the information sheet don’t hesitate to approach your Trainer.  If you feel that you are now knowledgeable on the content of the information sheet, you can now answer the self-check provided in the module. |
| Answer Self-Check 3.1-1 on Repair clutch system | Try to answer the Self-check without looking at the Answer Key  Compare your answer to Answer Key 3.1-1 |
| Observe Trainer’s demonstration on Task Sheet 3.1-1 on Repair clutch system | Listen carefully and attentively so that you may be able to perform a task correctly  Ask questions if are in doubt for clarification |
| Perform the Task Sheet 3.1-1 on Repair clutch system | Remember the step-by-step procedure the Repair clutch system |
| Evaluate the performance using the Performance Criteria Checklist 3.1-1 | Repeat the task in case fail to meet the criteria |

**INFORMATION SHEET 1.1-1**

**REPAIR CLUTCH SYSTEM**

**Learning Objectives:**

After reading this **Information Sheet**, you must be able to:

1. Source and interpreted repair information.
2. Analyze repair options.
3. Select and check repair tools, equipment and materials.
4. Carry out repairs.
5. Carry out post-repair testing.
6. Apply safety practices.

**CLUTCH SYSTEM**

**CLUTCH OVERHAUL**

When adjustment or repair of the linkage fails to remedy  problems  with  the  clutch,  the  clutch  must  be removed  for  inspection.  Any faulty parts should be discarded   and   replaced   with   new   or   rebuilt components.  If replacement parts are not readily available, a decision to use the old components should be based on the manufacturer’s recommendations and the maintenance supervisor.

Transmission or transaxle removal is required to service   the   clutch.   Always   follow   the   detailed directions in the service manual. To remove the clutch in a rear-wheel drive vehicle, remove the drive shaft, the clutch fork, the clutch release mechanism, and the transmission.  With  a  front-wheel  drive  vehicle,  the axle  shafts  (drive  axles),  the  transaxle,  and,  in  some cases, the engine must be removed for clutch repairs.

**WARNING**

When  the  transmission  or  transaxle  is removed,  support  the  weight  of  the  engine. Never let the engine, the transmission, or the transaxle be unsupported.   The   transmission input shaft, clutch fork, engine mounts, and other associated parts could be damaged. After removal of the transmission or transaxle, remove the clutch housing from the rear of the engine. Support the housing as you remove the last bolt.  Be careful  not  to  drop  the  clutch  housing  as  you  pull  it away from the dowel pins. Using  a  hammer  and  a  center  punch,  mark  the pressure  plate  and  flywheel.  These  marks  are  needed when  reinstalling  the  same  pressure  plate  to  assure correct balancing of the clutch.

With the clutch removed, all components are to be cleaned and inspected for wear and damage.  After cleaning, you should inspect the flywheel and pressure plate for signs of unusual wear, such as scoring or cracks.  A straightedge should be used to check for war-page of the pressure plate. Using a dial indicator, measure the runout of the flywheel. The pressure plate release levers should show very limited or no signs of wear   from   contact   with   the   release   bearing.   If excessive wear, cracks, or warpage is noted on the flywheel and/or pressure plate, the assembly should be replaced. This is also a good time to inspect the ring gear teeth on the flywheel. If they are worn or chipped, a new ring gear should be installed.

**NOTE**

Be careful how you clean the parts of the clutch.  Avoid using compressed air to blow clutch dust from the parts. A clutch disc contains asbestos—a cancer-causing substance.

While inspecting the flywheel, you should check the pilot bearing in the end of the crankshaft.

A worn pilot bearing will allow the transmission input shaft and clutch disc to wobble up and down. Using a telescoping gauge and a micrometer, measure the amount of wear in the bushing.  For wear measurements of the pilot bearing, refer to the service manual. If a roller bearing is used, rotate them. They should turn freely and show no signs of rough movement.  If  replacement  of  the pilot  bearing  is  required,  the  use  of  a  slide  hammer puller will drive the bearing out of the crankshaft end. Before installing a new pilot bearing, check the fit by sliding it over the input shaft of the transmission. Then drive the new bearing into the end of the crankshaft. Inspect the disc for wear; inspect the depth of the rivet holes, loose rivets, and worn or broken torsion springs.

Check the splines in the clutch disc hub for a "like   new"   condition.   The   clutch   shaft   splines should be inspected by placing the disc on the clutch shaft and sliding it over the splines. The disk should move  relatively  free  back  and  forth  without  any unusual  tightness  or  binding.  Normally,  the  clutch disc  is  replaced  anytime  the  clutch  is  tom  down  for repairs. Another area to inspect is the release bearing. The release bearing and sleeve is usually sealed and factory packed (lubricated).  A bad release bearing will produce a grinding noise whenever the clutch pedal is pushed   down.   To   check   the   action   of   the   release bearing, insert your fingers into the bearing; then turn the  bearing  while  pushing  on  it.  Try to detect any roughness; it should rotate smoothly. Also, inspect the spring clip on the release bearing or fork. If bent, worn, or fatigued, the bearing or fork must be replaced.

**Clutch Disc and Pressure Plate**

**REMOVAL & INSTALLATION**

The procedures for removal and installation of clutch disc and pressure plate are shown from Figures 1 through 11.



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**Fig. 1: Remove the inspection plug to view the clutch assembly components**



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**Fig. 2: View of the clutch assembly with the transmission removed**



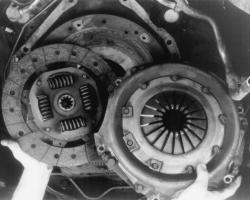
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**Fig. 3: Always use a clutch pilot tool during removal or installation of the clutch assembly**



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**Fig. 4: Using a holding tool, hold the driveplate and remove the clutch pressure plate-to-driveplate bolts**



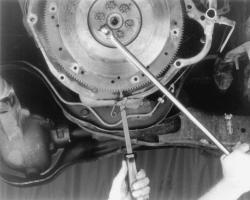
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**Fig. 5: When removing the pressure plate be careful not to allow the fiction disc to drop**



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**Fig. 6: Examine the driveplate for cracks, heat spots and scoring**



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**Fig. 7: Using a holding tool, hold the drive plate and remove the driveplate bolts**



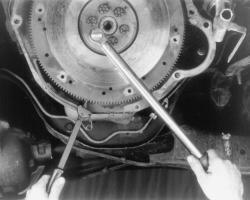
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**Fig. 8: Exercise extreme care when removing the driveplate, it is heavy**



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**Fig. 9: View of the rear engine section with the driveplate removed**



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**Fig. 10: Use a torque wrench to tighten the driveplate bolts and a crisscross pattern**



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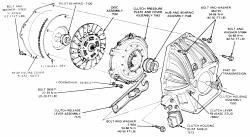
**Fig. 11: With the clutch pilot tool in place, use a torque wrench to tighten the pressure plate-to-driveplate bolts**

**CAUTION**

The clutch driven disc contains asbestos, which has been determined to be a cancer causing agent. Never clean clutch surfaces with compressed air! Avoid inhaling any dust from any clutch surface! When cleaning clutch surfaces, use a commercially available brake cleaning fluid.

**1987 Models**

See Figure 12



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**Fig. 12: Clutch assembly for 1987 F-150, F-250, F-350 and Bronco with the 4.9L, 5.0L and 5.8L engines**

1. Raise and support the truck end on jack stands.

1. Remove the clutch slave cylinder.

1. Remove the transmission.

1. If the clutch housing does not have a dust cover, remove the starter. Remove the flywheel housing attaching bolts and remove the housing.

1. If the flywheel housing does have a dust cover, remove the cover and then remove the release lever and bearing from the clutch housing. To remove the release lever:
   1. Remove the dust boot.
   2. Push the release lever forward to compress the slave cylinder.
   3. On all engines except the diesel and the 7.5L gasoline engines, remove the plastic clip that retains the slave cylinder to the bracket. Remove the slave cylinder.
   4. On the diesel and the 7.5L, the steel retaining clip is permanently attached to the slave cylinder. Remove the slave cylinder by prying on the clip to free the tangs while pulling the cylinder clear.
2. Remove the release lever by pulling it outward.
3. Mark the pressure plate and cover assembly and the flywheel so that they can be reinstalled in the same relative position.
4. Loosen the pressure plate and cover attaching bolts evenly in a staggered sequence a turn at time until the pressure plate springs are relieved of their tension. Remove the attaching bolts.
5. Remove the pressure plate and cover assembly and the clutch disc from the flywheel.

**To install:**

1. Position the clutch disc on the flywheel so that an aligning tool or spare transmission mainshaft can enter the clutch pilot bearing and align the disc.

1. When reinstalling the original pressure plate and cover assembly, align the assembly and flywheel according to the marks made during removal. Position the pressure plate and cover assembly on the flywheel, align the pressure plate and disc, and install the retaining bolts. Tighten the bolts in an alternating sequence a few turns at a time until the proper torque is reached:

10 in. and 12 in. clutch: 15-20 ft. lbs. (20-27 Nm)

11 in. clutch: 20-29 ft. lbs. (27-39 Nm)

1. Remove the tool used to align the clutch disc.

1. With the clutch fully released, apply a light coat of grease on the sides of the driving lugs.

1. Position the clutch release bearing and the bearing hub on the release lever. Install the release lever on the fulcrum in the flywheel housing. Apply a light coating of grease to the release lever fingers and the fulcrum. Fill the groove of the release bearing hub with grease.

1. If the flywheel housing has been removed, position it against the rear engine cover plate and install the attaching bolts and tighten them to 40-50 ft. lbs. (54-68 Nm).

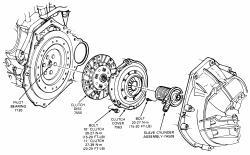
1. Install the starter motor.

1. Install the transmission.

1. Install the salve cylinder and bleed the system.

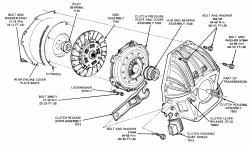
**1988-89 Models**

See Figures 13, 14, 15, 16 and 17



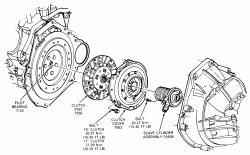
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**Fig. 13: Clutch assembly for 1988 F-150, F-250, and Bronco with the 4.9L, 5.0L and 5.8L engines**



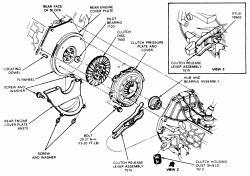
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**Fig. 14: Clutch assembly for 1989 F-150, F-250, and Bronco with the 4.9L, and 5.0L engines with the Borg-Warner T-18 transmission**



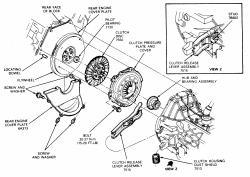
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**Fig. 15: Clutch assembly for 1989 F-150, F-250, and Bronco with the 4.9L, 5.0L and 5.8L engines, except with the Borg-Warner T-18 transmission**



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**Fig. 16: Clutch assembly for 1988 F-250 HD, F-350 and F-Super Duty with the 7.3L diesel and 7.5L engines**



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**Fig. 17: Clutch assembly for 1989 F-250 HD, F-350, F-Super Duty Chassis Cab and Stripped Chassis with the 7.3L diesel and 7.5L engines**

1. Raise and support the truck end on jackstands.

1. On trucks with the externally mounted slave cylinder, remove the clutch slave cylinder. On trucks with an internally mounted slave cylinder, disconnect the quick-disconnect coupling with a spring coupling tool such as T88T-70522-A.

1. Remove the transmission.

1. On gasoline engine models, except the 7.5L engine, remove the starter. Remove the flywheel housing attaching bolts and remove the housing. On diesel engine models and the 7.5L gasoline engine, remove the cover and then remove the release lever and bearing from the clutch housing. To remove the release lever:
   1. Remove the dust boot.

* 1. Push the release lever forward to compress the slave cylinder.

* 1. Remove the slave cylinder by prying on the steel clip to free the tangs while pulling the cylinder clear.

* 1. Remove the release lever by pulling it outward.

1. Mark the pressure plate and cover assembly and the flywheel so that they can be reinstalled in the same relative position.

1. Loosen the pressure plate and cover attaching bolts evenly in a staggered sequence a turn at time until the pressure plate springs are relieved of their tension. Remove the attaching bolts.

1. Remove the pressure plate and cover assembly and the clutch disc from the flywheel.

**To install:**

1. Position the clutch disc on the flywheel so that an aligning tool or spare transmission mainshaft can enter the clutch pilot bearing and align the disc.

1. When reinstalling the original pressure plate and cover assembly, align the assembly and flywheel according to the marks made during removal. Position the pressure plate and cover assembly on the flywheel, align the pressure plate and disc, and install the retaining bolts. Tighten the bolts in an alternating sequence a few turns at a time until the proper torque is reached:

10 in. and 12 in. clutch: 15-20 ft. lbs. (20-27 Nm)

11 in. clutch: 20-29 ft. lbs. (27-39 Nm)

1. Remove the tool used to align the clutch disc.

1. With the clutch fully released, apply a light coat of grease on the sides of the driving lugs.

1. Position the clutch release bearing and the bearing hub on the release lever. Install the release lever on the fulcrum in the flywheel housing. Apply a light coating of grease to the release lever fingers and the fulcrum. Fill the groove of the release bearing hub with grease.

1. If the flywheel housing has been removed, position it against the rear engine cover plate and install the attaching bolts and tighten them to 40-50 ft. lbs. (54-68 Nm).

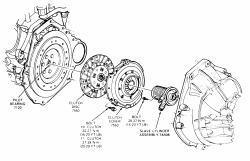
1. Install the starter motor, if removed.

1. Install the transmission.

1. Install the salve cylinder and bleed the system.

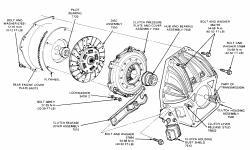
**1990-96**

See Figures 18, 19 and 20



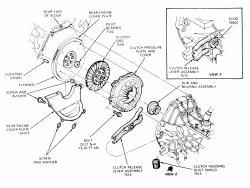
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**Fig. 18: Clutch assembly for 1990-96 F-150, F-250, and Bronco with the 4.9L, 5.0L and 5.8L engines, except with the Borg-Warner T-18 transmission**



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**Fig. 19: Clutch assembly for 1990-93 F-150, F-250, and Bronco with 4.9L, and 5.0L engines, with the Borg-Warner T-18 transmission**



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**Fig. 20: Clutch assembly for 1990-96 F-250 HD, F-350, F-Super Duty Chassis Cab and Stripped Chassis with the 7.4L diesel and 7.5L engines**

1. Raise and support the truck end on jackstands.

1. On trucks with the externally mounted slave cylinder, remove the clutch slave cylinder. On trucks with an internally mounted slave cylinder, disconnect the quick-disconnect coupling with a spring coupling tool such as T88T-70522-A.

1. Remove the transmission.

1. On models with the internally mounted slave cylinder, remove the starter. Remove the flywheel housing attaching bolts and remove the housing. On models with the externally mounted slave cylinder, remove the cover and then remove the release lever and bearing from the clutch housing. To remove the release lever:
   1. Remove the dust boot.

* 1. Push the release lever forward to compress the slave cylinder.

* 1. Remove the slave cylinder by prying on the steel clip to free the tangs while pulling the cylinder clear.

* 1. Remove the release lever by pulling it outward.

1. Mark the pressure plate and cover assembly and the flywheel so that they can be reinstalled in the same relative position.

1. Loosen the pressure plate and cover attaching bolts evenly in a staggered sequence a turn at time until the pressure plate springs are relieved of their tension. Remove the attaching bolts.

1. Remove the pressure plate and cover assembly and the clutch disc from the flywheel.

**To install:**

1. Position the clutch disc on the flywheel so that an aligning tool or spare transmission mainshaft can enter the clutch pilot bearing and align the disc.

**WARNING**

New pressure plate/cover bolts have been issued for use on the diesel and the 7.5L gasoline engine. The bolts for the diesel are5/16in. x 18 x3 / 4 in. The bolts for the 7.5L are 5 / 16 in. x 18 x5 /9 64 in. The 5 /9 64 in. bolts cannot be used with the dual mass flywheel used on the diesel, since they would interfere with the operation of the primary flywheel.

1. When reinstalling the original pressure plate and cover assembly, align the assembly and flywheel according to the marks made during removal. Position the pressure plate and cover assembly on the flywheel, align the pressure plate and disc, and install the retaining bolts. Tighten the bolts in an alternating sequence a few turns at a time until the proper torque is reached:

10 in. and 12 in. clutch: 15-20 ft. lbs. (20-27 Nm)

11 in. clutch: 20-29 ft. lbs. (27-39 Nm)

1. Remove the tool used to align the clutch disc.

1. With the clutch fully released, apply a light coat of grease on the sides of the driving lugs.

1. Position the clutch release bearing and the bearing hub on the release lever. On the diesel and the 7.5L engine, clean and lubricate the transmission bearing retainer. Install the release lever on the fulcrum in the flywheel housing. Apply a light coating of grease to the release lever fingers and the fulcrum. Fill the groove of the release bearing hub with grease.

1. If the flywheel housing has been removed, position it against the rear engine cover plate and install the attaching bolts and tighten them to 40-50 ft. lbs. (54-68 Nm).

1. Install the starter motor, if removed.

1. Install the transmission.

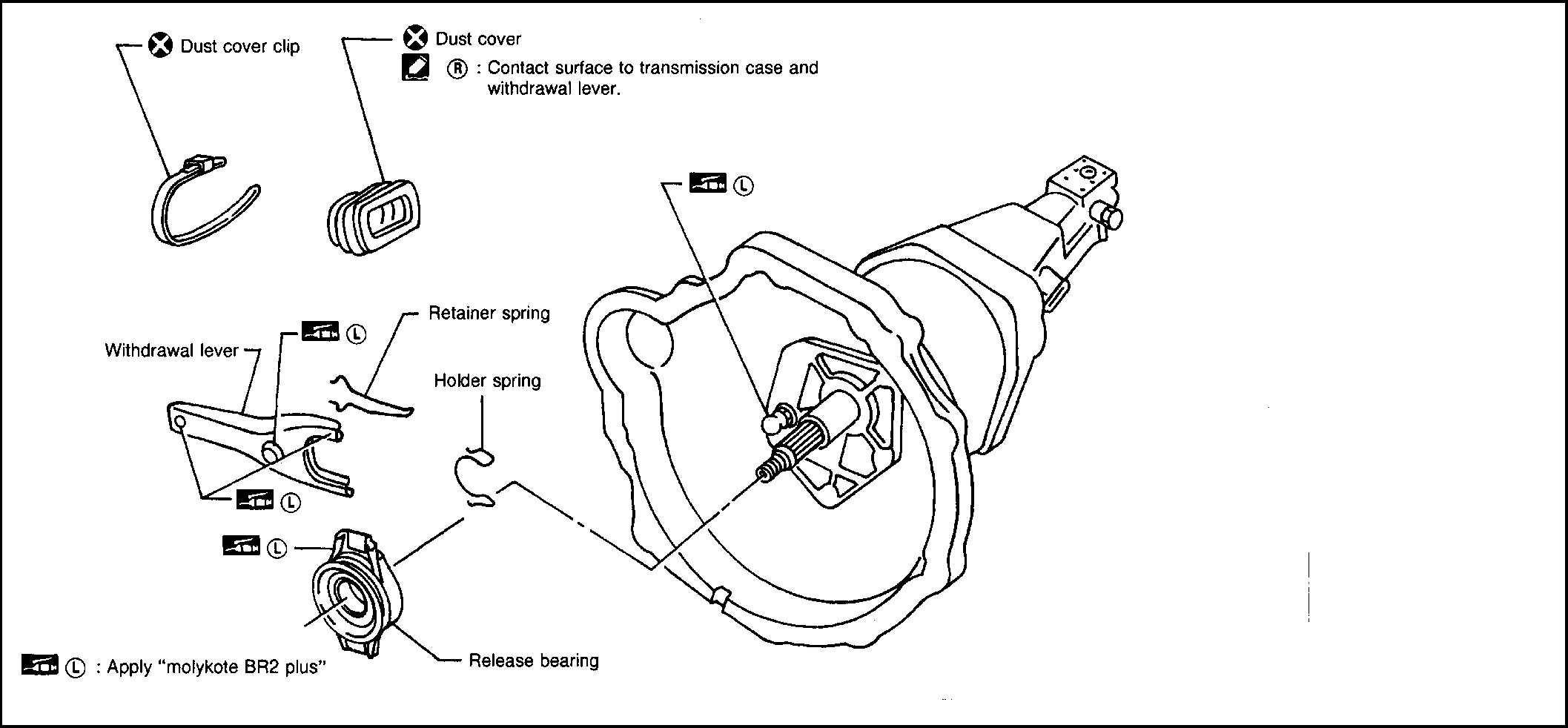
1. Install the salve cylinder and bleed the system.

**INFORMATION SHEET 2**

**Replacing Damage Parts of Clutch System**

***Replacement of parts to be done if goes beyond the tolerance limits***

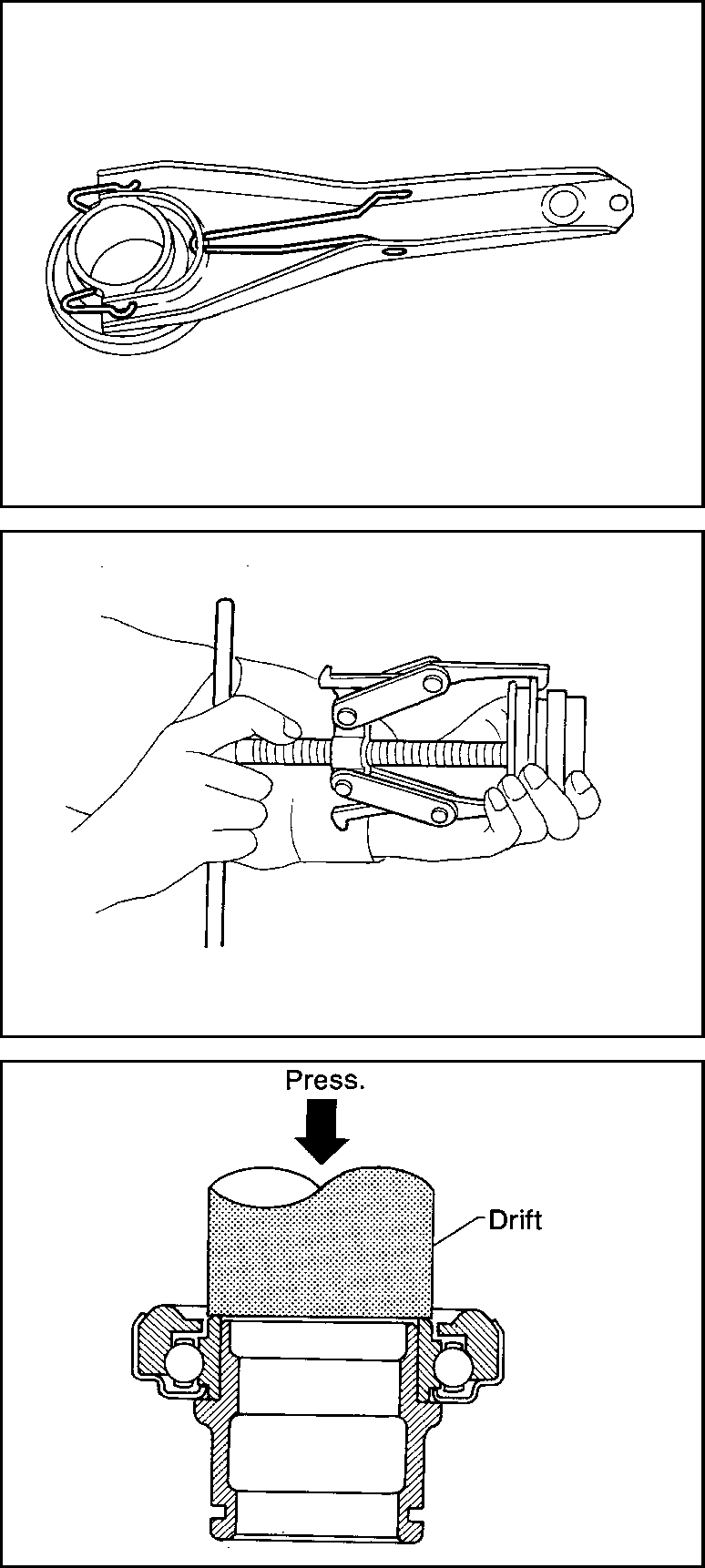
**CLUTCH RELEASE MECHANISM**



**REMOVAL AND INSTALLATION**

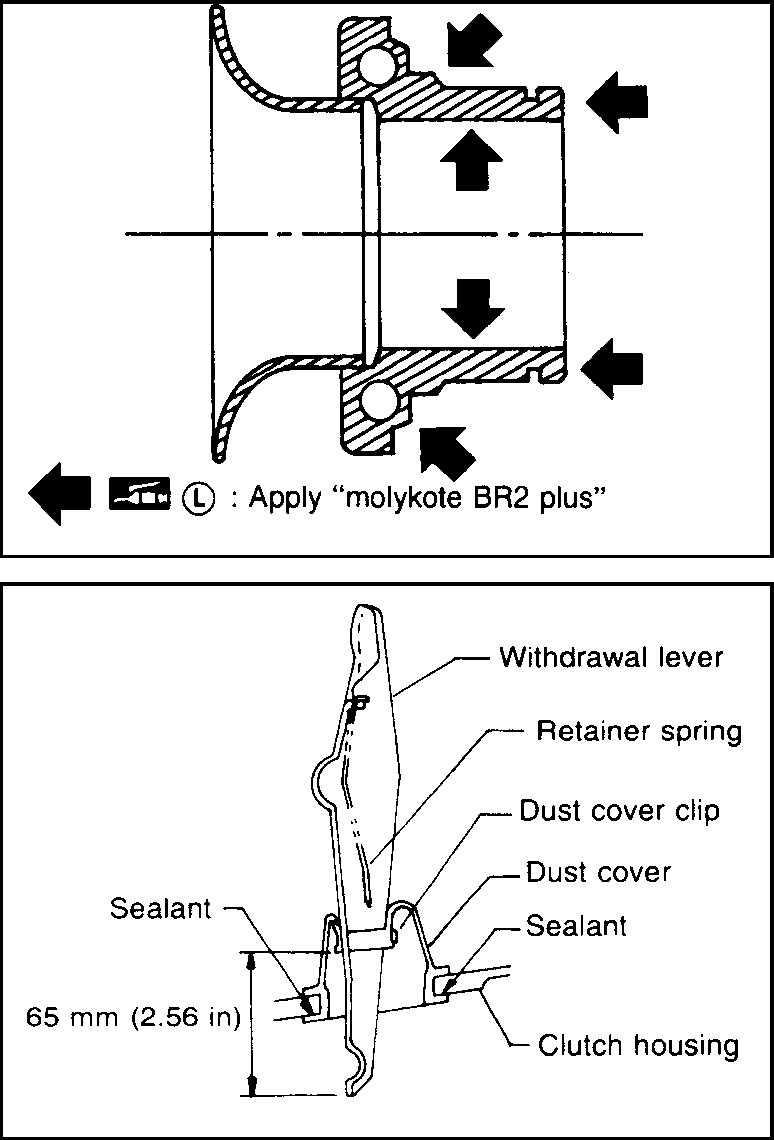
1, Install retainer spring and holder spring

2, Remove release bearing

3, Install release bearing with suitable drift.

**INSPECTION**

* Check release bearing to see that it rolls freely and is free from noise, cracks, pitting or wear. Replace if necessary.
* Check release sleeve and withdrawal lever rubbing surface for wear, rust or damage. Replace if necessary.



**LUBRICATION**

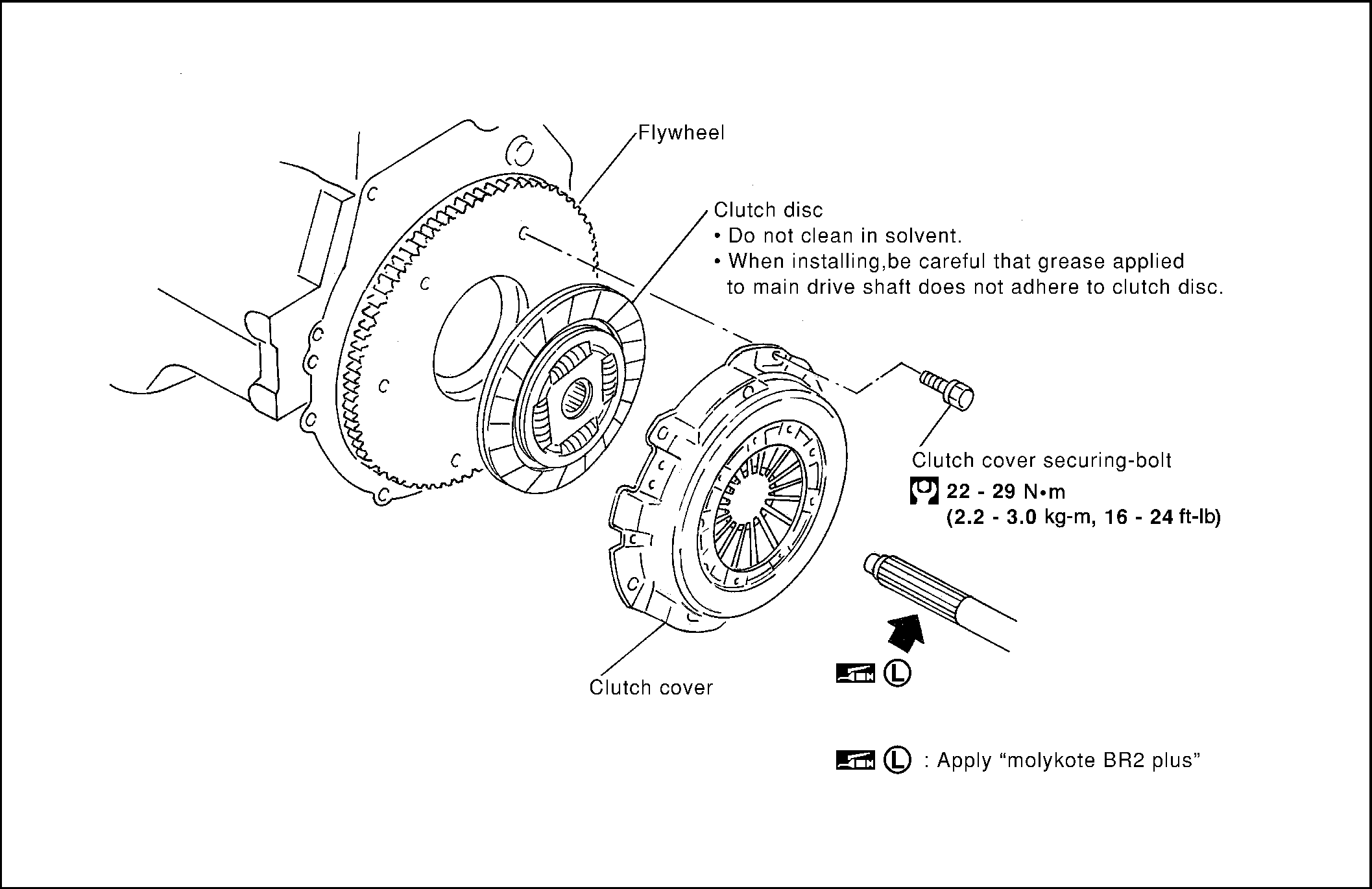
* Apply recommended grease to contact surface and rubbing surface.

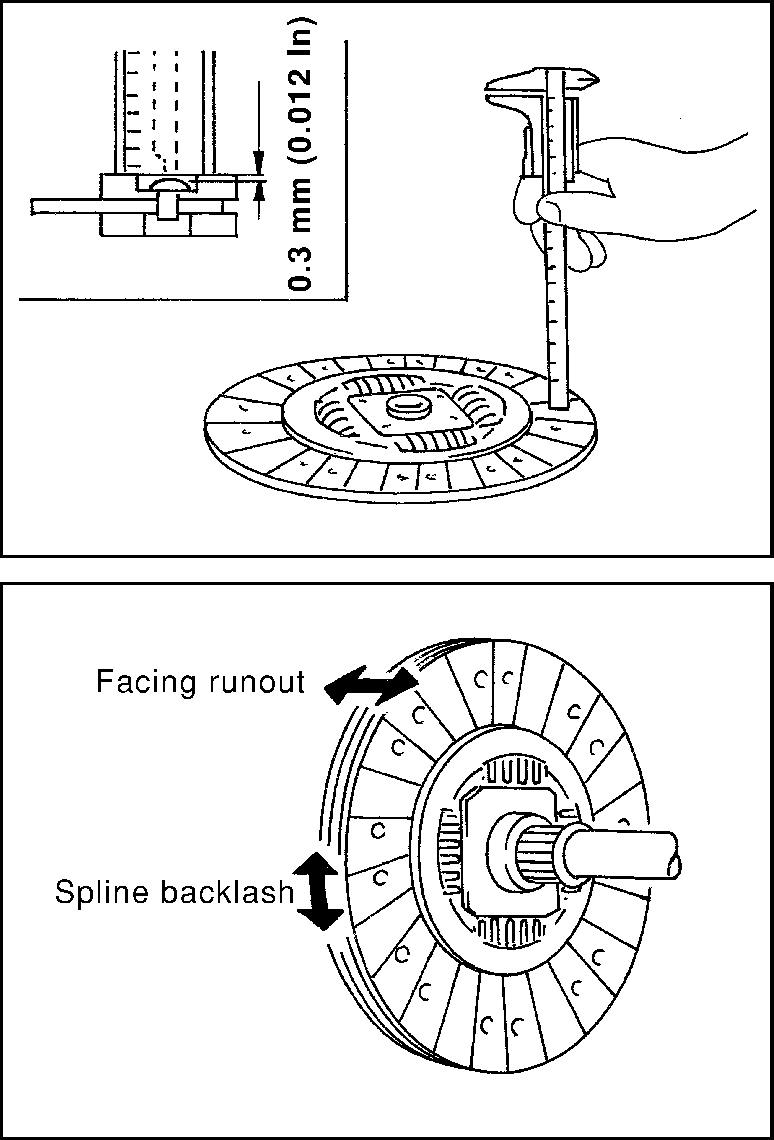
**Too much lubricant might cause clutch disc facing damage.**

**DUST COVER SEALING**

* Apply recommended sealant to contact surface of dust cover to transmission case and withdrawal lever and then install dust cover clip.

**CLUTCH DUISC AND CLUTCH COVER**



**Clutch Disc**

**INSPECTION**

* Check clutch disc for wear of facing.

**Wear limit of facing surface to rivet head: 0.3 mm (0.012 in)**

**\* Check clutch disc for spline backlash and facing run out. Maximum spline backlash (at outer edge of disc):**

**1.0 mm (0.039 in) Run out limit:**

**1.0 mm (0.039 in)**

**Distance of run out check point (from hub center):**

1. **(4.72 in)**

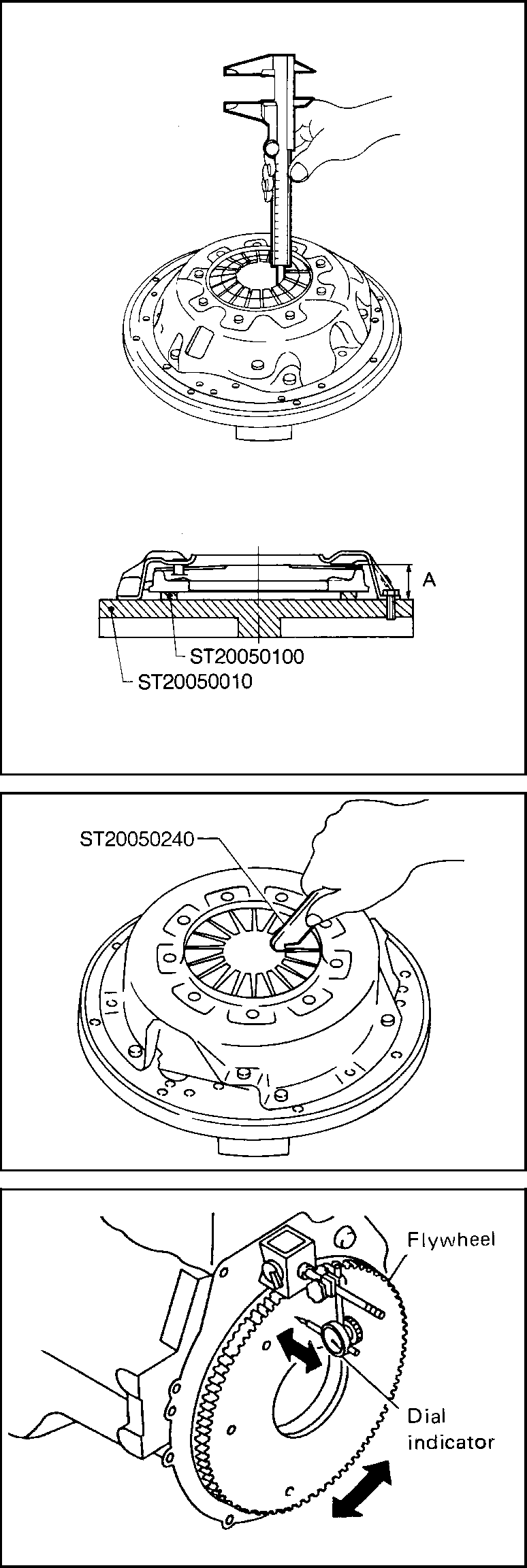
* Check clutch disc for burns, discoloration or oil or grease leakage. Replace if necessary.

**CLUTCH DISC AND CLUTCH COVER**

**INSTALLATION**

* Apply “molykote BR2 plus” grease to contact surface of splines to clutch disc hub.

**Too much lubricant might damage clutch disc facing.**

**Clutch Cover and Flywheel**

**INSPECTION AND ADJUSTMENT**

* Set Tools and check height and unevenness of diaphragm spring.

**Diaphragm spring height “A”:**

**36.5 - 38.5 mm (1.437 - 1.516 in)**

* Check thrust rings for wear or damage by shaking cover assembly and listening for chattering noise, or lightly hammering on rivets for a slight cracking noise. Replace clutch cover assembly if necessary.
* Check pressure plate and clutch disc contact surface for slight burns or discoloration. Repair pressure plate with emery paper.
* Check pressure plate and clutch disc contact surface for deformation or damage. Replace if necessary.
* Adjust unevenness of diaphragm spring with Tool. **Uneven limit:**

**0.7 mm (0.028 in)**

**FLYWHEEL INSPECTION**

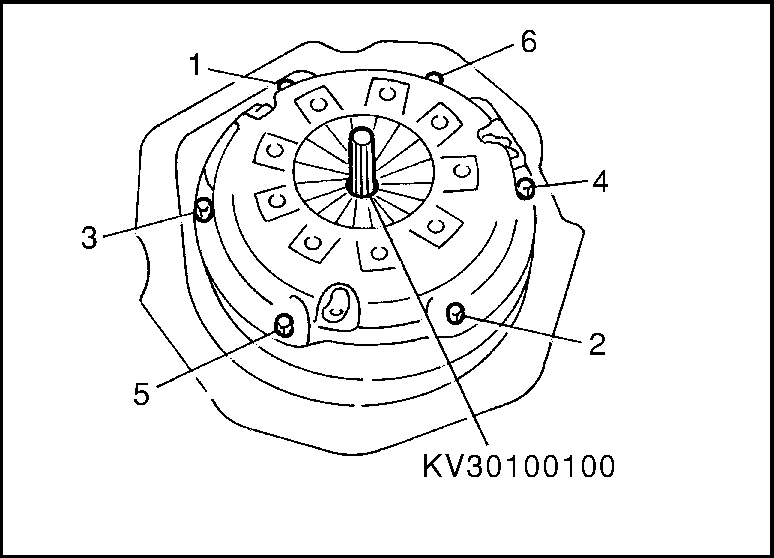
1, Check contact surface of flywheel for slight burns or discoloration. Repair flywheel with emery paper.

2, Check flywheel runout.

**Runout (Total indicator reading):**

**Refer to EM section. (Inspection — CYLINDER BLOCK)**

**Clutch Cover and Flywheel (Cont’d)**

**INSTALLATION**

* Insert Tool into clutch disc hub when installing clutch cover and disc.
* Tighten bolts in numerical order.
* **Be careful not to allow grease to contaminate clutch facing.**

**SERVICE DATA AND SPECIFICATIONS (SDS)**

**General Specifications**

**CLUTCH CONTROL SYSTEM CLUTCH DISC**

Type of clutch control Hydraulic

**CLUTCH MASTER CYLINDER**

Inner diameter mm (in) 15.87(5/8)

**CLUTCH OPERATING CYLINDER**

Unit: mm (in)

| Engine | TD27Ti | ZD30DDTi |
| --- | --- | --- |
| Model | 250 | 260 |
| Facing size  (Outer dia. x inner dia. x thickness) | 250 x 160 x 3.7 (9.84 x 6.30 x 0.1457) | |
| Thickness of disc assembly under load | 7.9 - 8.3 (0.311 - 0.327) Under a load of 5,884 N (600 kg, 1,323 lb) | |

**CLUTCH COVER**

Engine TD27Ti ZD30DDTi

| Model | 250 | 260 |
| --- | --- | --- |
| Full load N (kg, lb) | 5,884 (600, 1,323) | 6,760 (689, 1,520) |

**Inspection and Adjustment**

**CLUTCH PEDAL**

Unit: mm (in)

| Handle | LHD | RHD |
| --- | --- | --- |
| Pedal height\* | 227-237 (8.94 - 9.33) | 210-220 (8.27 - 8.66) |
| Pedal stroke | 155 - 160 (6.10 - 6.30) | |
| Pedal free play (Backlash at clevis) | 1.0 - 3.0 (0.039 - 0.118) | |

\*: Measured from surface of melt sheet to surface of pedal pad

**CLUTCH DISC**

Unit: mm (in)

| Engine | TD27Ti | ZD30DDTi |
| --- | --- | --- |
| Disc model | 250 | 260 |
| Rear limit of facing surface to rivet head | 0.3 (0.012) | |
| Runout limit of facing | 1 (0.04) | |
| Distance of runout check point (from the hub center) | 120 (4.72) | |
| Maximum of spline backlash of spline (at outer edge of disc) | 1.0 (0.039) | |

**INFORMATION SHEET 3**

**SET/ADJUST CLUTCH SYSTEM COMPONENTS**

| This Information deals with e46's Self Adjusting Clutch which uses Special Tools for dismounting as according to Bentley Manual.  The SAC works by having a [rotary plate](http://viglink.pgpartner.com/rd.php?r=16894&m=825277901&q=n&rdgt=1410192680&it=1410624680&et=1410797480&priceret=79.99&pg=~~3&k=e170dbebf35c8685096094c547a3a86d&source=feed&url=http%3A%2F%2Fwww%2Eautogeek%2Enet%2Fbfpk400cir%2Ehtml%3Fproductid%3Dbfpk400cir%26channelid%3DPGRAB%26utm%5Fsource%3DCSEs%26utm%5Fmedium%3DPriceGrabber%26utm%5Fcampaign%3DCSE&st=feed&mt=~~~~~~~~n~~~) inside the cover plate assembly that is pushed clockwise by springs. As the clutch wears, this [rotary plate](http://viglink.pgpartner.com/rd.php?r=16894&m=825277901&q=n&rdgt=1410192680&it=1410624680&et=1410797480&priceret=79.99&pg=~~3&k=e170dbebf35c8685096094c547a3a86d&source=feed&url=http%3A%2F%2Fwww%2Eautogeek%2Enet%2Fbfpk400cir%2Ehtml%3Fproductid%3Dbfpk400cir%26channelid%3DPGRAB%26utm%5Fsource%3DCSEs%26utm%5Fmedium%3DPriceGrabber%26utm%5Fcampaign%3DCSE&st=feed&mt=~~~~~~~~n~~~) slowly moves clockwise to take up the wear.  NB. The new clutches come with this SAC pre-reset in the anti-clockwise position with a shipping plate. But if you want to refit an existing clutch you need to reset it.  To reset the SAC you will need a large 3 legged bearing puller as in the picture.  Before the SAC can be reset the diaphram spring must be compressed. Make a cylindrical oblock on a lathe which just sits inside the spring fingers. If you do not have a lathe, some improvisation could be done.  1. Insert the puller as shown & compress the spring. Note that the silver SAC plate underneath can be freely moved now. Click image for larger version  Name: 006.jpg Views: 4557 Size: 137.3 KB ID: 293765 Click image for larger version  Name: 007.jpg Views: 4015 Size: 118.5 KB ID: 293766 2. Fit the [clutch disc](http://viglink.pgpartner.com/mrdr.php?url=http%3A%2F%2Fviglink.pgpartner.com%2Fsearch.php%2Fform_keyword%3Dclutch%2Bdisc&mode=) on to the flywheel with the normal centering tool.  3. With the spring still compressed (puller attached) fit the cover plate to the flywheel & tighten all the [cover bolts](http://motors.shop.ebay.com/i.html?_nkw=cover+bolts). Click image for larger version  Name: 009.jpg Views: 3870 Size: 140.7 KB ID: 293768 4. Using a screwdriver or similar, rotate the silver SAC plate fully anti-clockwise. Note there are alignment marks near the small springs to show this. Click image for larger version  Name: 008.jpg Views: 2982 Size: 102.3 KB ID: 293767 5. Keep the SAC plate in the anti-clockwise position with the screwdriver while removing the pressure on the diaphram spring, and remove the puller.  6. Remove the centering tool. |
| --- |

**Precaution in Handling Hydraulic Fluid and Special Tools**

**Objective:**

After reading this information sheet, you must be able to practice precaution in handling hydraulic fluid and special tools.

**PRECAUTIONS AND PREPARATION**



| _Pic5 | **Precautions**   * **Recommended fluid is brake fluid “DOT 4”.** * **Do not reuse drained brake fluid.** * **Be careful not to splash brake fluid on painted areas.** * **When removing and installing clutch piping, use Tool.** * **To clean or wash all parts of master cylinder, operating cylinder and clutch damper, use clean brake fluid.** * **Never use mineral oils such as gasoline or kerosene. It will ruin the rubber parts of the hydraulic system.**   **WARNING:**  **Remove all dust from clutch disc with a dust collector after cleaning with waste cloth.** |
| --- | --- |
| SBR820B |
|  |

**Preparation**

**SPECIAL SERVICE TOOLS**

\*: Special tool or commercial equivalent

| Tool number Tool name | Description |
| --- | --- |
| ST20050010 Base plate | Inspecting diaphragm spring of clutch cover |
|  |
|  |
| ST20050100 Distance piece | Inspecting diaphragm spring of clutch cover |
|  |
| GG94310000  Flare nut torque wrench | Removing and installing each clutch piping |
| KV30100100\* Clutch aligning bar | Installing clutch cover and clutch disc |
| ST20050240\* Diaphragm spring adjusting wrench | Adjusting unevenness of diaphragm spring of clutch cover |

**Apply Personal Safety Procedures**

**Introduction**

Auto mechanic safety should not be neglected in any mechanic shop or even at home in the garage. Many injuries related to working on cars from tools or general accidents can be avoided if the right precautions are taken. Within this article, a few of the best tips will be given with regards to safety for auto mechanics. This will help to avoid any personal injury.

**Safety around the Car**

As far as the car is concerned, safe practices to do are as follows;

1. It should always have the handbrake on as well as the gearshift in the park position. It is easy for a car to roll and may roll with your underneath it.
2. It is always a good idea to have chock blocks in front of the wheels to prevent movement as well. If you have to have the car running while you work, then ensure that the parking brake is on since you can't have the gearshift in park.
3. Do not smoke while you are working on a car, the smoke may go into your eyes blinding you for a short time or it may ignite flammable substances such as gas.
4. Take off any jewelry such as rings and watches before starting any work on the car to avoid damage to the jewelry or arcing off the battery.

**Working With Electronics on a Vehicle**

As most tools are metallic and electricity will travel along conductive materials such as steel, you need to use insulated or rubber coated tools when you work on any electrical components of a car. The electric shock that you can experience from the car can be enough to cause damage to the body.

**Must Have Auto Repair Safety Gear**



When it comes to working on cars there are many opportunities to be injured. Luckily for do-it-yourself and professional mechanics inexpensive auto repair safety protection devices are readily available. We are going to focus on the three types of protection auto mechanic use most. These are cost-effective solutions providing a lot of value.

**Latex Mechanics Gloves**

There's a big difference between latex and regular mechanics gloves. The regular varieties are not disposable and made of a fabric or leather material. These are most often used when grinding, working around hot exhaust or welding. The latex gloves are stretchy tight fitting gloves that become like a second skin.

The nice thing about these types of gloves is they can be purchased in a variety of thickness and in nitrile for those with allergies. You can get medical grade, often referred to as exam gloves, which are very thin for situations where less protection and more fingertip feel is required. Specialized mechanics grade [**nitrile disposable gloves**](http://www.galeton.com/gloves/disposable-gloves/nitrile/#_blank)are much thicker and hold up to heavy duty operations without tearing. Although they can be chemical resistant they are easily destroyed by harsher things like brake fluid or carburetor cleaner.  
  
The protection they provide can outweigh any comfort or cost issues. One of the major benefits is they prevent chemicals and oils from being absorbed through the skin. The other benefit is since they act like a second epidermis they reduce the severity of knuckle busting incidents. Although you still might be injured in this situation it would be far worse without the additional layer. The important thing to remember is you don't have to wear them all the time. If you're performing diagnosis, taking voltage readings or pulling [check engine light codes](http://autorepair.answers.com/indicator-lights/what-is-a-check-engine-light) you don't need them. Put them on when you're in the engine compartment replacing alternators, water pumps and operations where injuries are more likely.

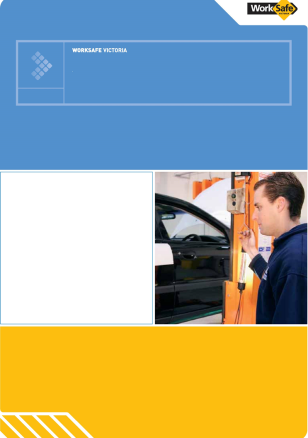
**Eye Protection for Auto Repairs**

It's hard to find a more important area to protect then your eyes. This is often a hard sell to younger mechanics for some reason. Although I resisted wearing these on a regular basis I became a believer when a coworker got an aluminum shaving in his eye. My supervisor at the time had me take him to the emergency room for treatment so that I could see what was involved. Long story made short, I have been [wearing eye protection](http://www.aoa.org/patients-and-public/caring-for-your-vision/protecting-your-vision#_blank) ever since. Often the main objection to wearing these is comfort or the ability to see properly.   
  
Safety glasses can fog up and hamper vision. This is because of the temperature differential between the mechanic working hard and the outside environment. The better vented the glasses are the less fogging is experienced. They also make [anti-fog spray](http://www.amazon.com/Glasses-Anti-Fog-Lens-Cleaner-Spray/dp/B0019QXA8S#_blank) for glasses that works quite well. There are different levels of protection for different automotive repair operations. The three most common would be a face shield, safety goggles and lightweight glasses. Owning all three and wearing them at the proper time is a necessity. If you obtain eye protection that is comfortable you'll be more likely to wear it.

**Ear Protection Devices**

This is one of the overlooked safety devices that is not only inexpensive but can also make a huge impact on the quality of life in an auto mechanics golden years. Ear protection devices can range from simple earplugs to noise canceling earmuffs. Both professional and do-it-yourself auto mechanics are often exposed to damaging noise. Striking something with a hammer or using air tools can produce extremely slow, almost unnoticeable degradation in hearing abilities. These auto repair safety devices are inexpensive. Earplugs start in the two dollar range and noise canceling headphones at around twenty dollars.

The three safety protection devices for mechanics discussed in this article are the ones I utilized the most. The only other safety precaution that's more important is common sense. If you stop and think about the operation you're about to perform and identify the dangerous areas, you can put together a repair plan that minimizes this risk. Therefore professional mechanics often say the most important protection device you have is your brain. Logical thinking goes a long way to preventing injuries while working on cars.



**INFORMATION SHEET 3**

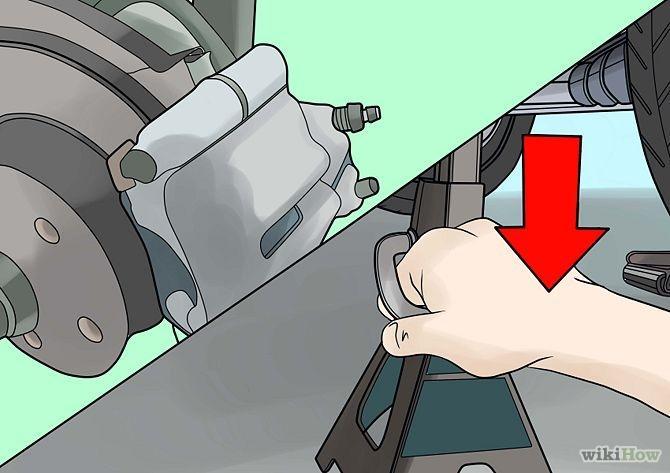
**BLEED CLUTCH HYDRAULIC SYSTEM**

[**How to Bleed a Slave Cylinder**](http://www.wikihow.com/Bleed-a-Slave-Cylinder)

**Three Methods:**

1. [**Bleed a Slave Cylinder Manually**](http://www.wikihow.com/Bleed-a-Slave-Cylinder#Bleed_a_Slave_Cylinder_Manually_sub)
2. [**Bleed a Slave Cylinder With a Vacuum Pump**](http://www.wikihow.com/Bleed-a-Slave-Cylinder#Bleed_a_Slave_Cylinder_With_a_Vacuum_Pump_sub)
3. [**Bleed a Slave Cylinder With a Hose**](http://www.wikihow.com/Bleed-a-Slave-Cylinder#Bleed_a_Slave_Cylinder_With_a_Hose_sub)

The slave cylinder is part of the hydraulic clutch system in vehicles with manual transmissions. When the master cylinder or the slave cylinder starts leaking fluid, it must be replaced along with the brake fluid. Adding the new parts introduces air into the system, which creates a soft or non-existent clutch action when you press the pedal. To bleed air from the hydraulic clutch system, you must release air from the slave cylinder. The following article describes the 3 ways to bleed a slave cylinder.

**Method 1 of 3: Bleed a Slave Cylinder Manually**

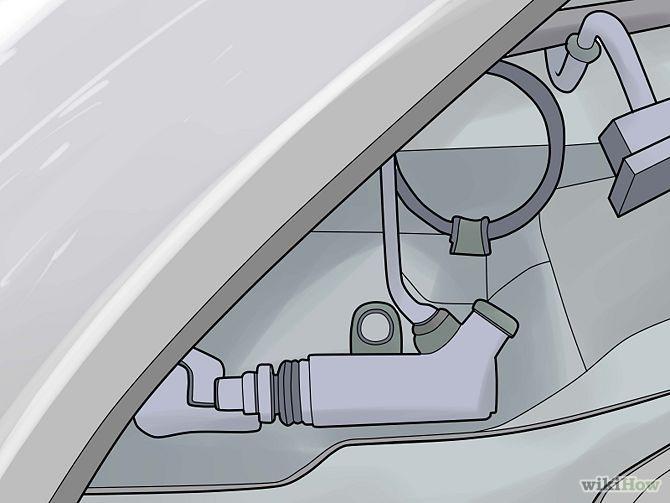
**1**

**Raise the engine end of the vehicle off the ground, securing it by using jack stands; then access the bleeder valve, also called the pitcock or bleed nipple.**



**2**

**Ask an assistant to sit in the vehicle to press and hold the clutch pedal to the floorboard and not let or pull it up, until you say to do so.**



**3**

**Slide under the vehicle and locate the slave cylinder.** If it is not visible, it may be mounted inside the transmission on a few vehicles (as part of the release/throwout bearing) and outside the transmission on most. Look at the owner’s or repair manual for your vehicle make and model, for help locating the slave cylinder.



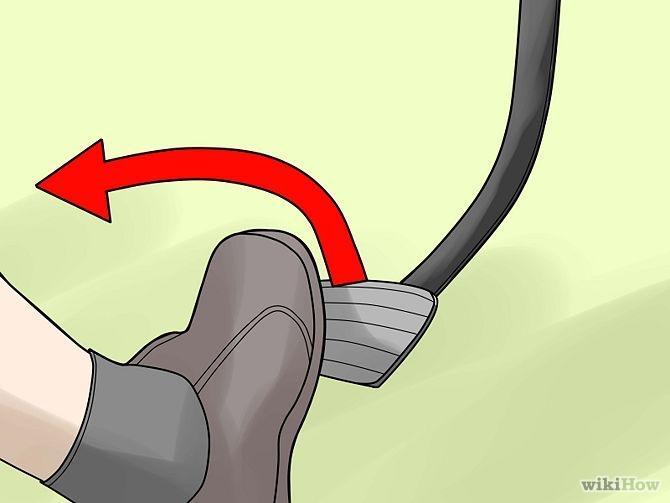
**4**

**Loosen the bleeder valve with a wrench and have a pan or such and a rag ready to catch any brake fluid that leaks out.** Let it stay open to see whether a little fluid will flow out by gravity flow. This flow can push air out.



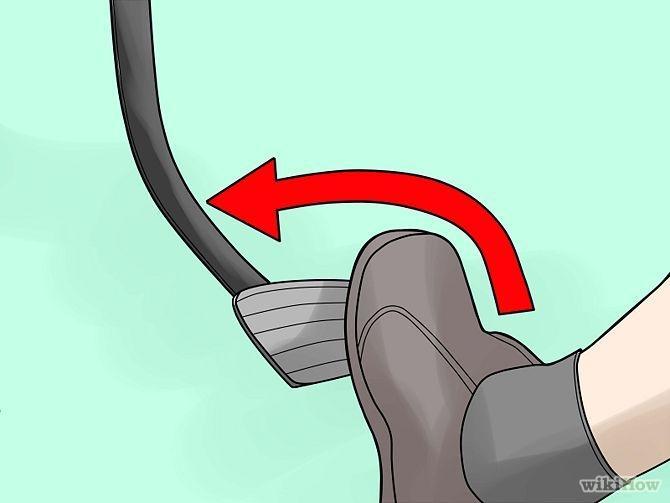
**5**

**Tighten the valve once it seems that all the air sputter and "burping" has come out, if any is noticed.**



**6**

**Release the clutch pedal (only after the valve is closed).** It likely will stay on the floor and will have to be pulled up.



**7**

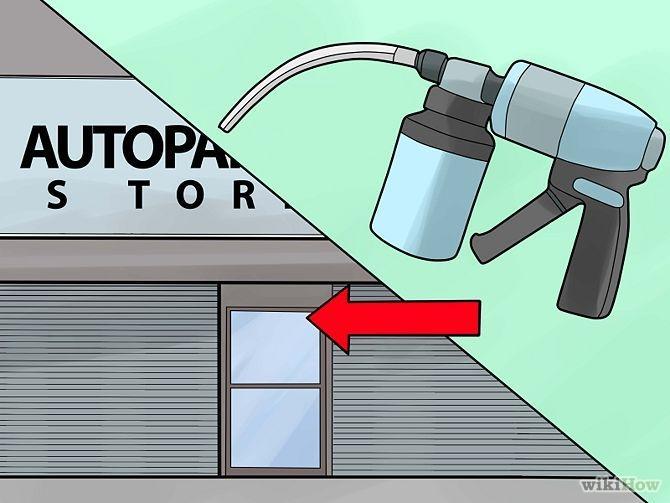
**Repeat pressing the clutch down, opening the bleeder valve to bleed air out, closing the valve, and lifting the pedal until the clutch develops pressure, and the pedal feels normal again.**



**8**

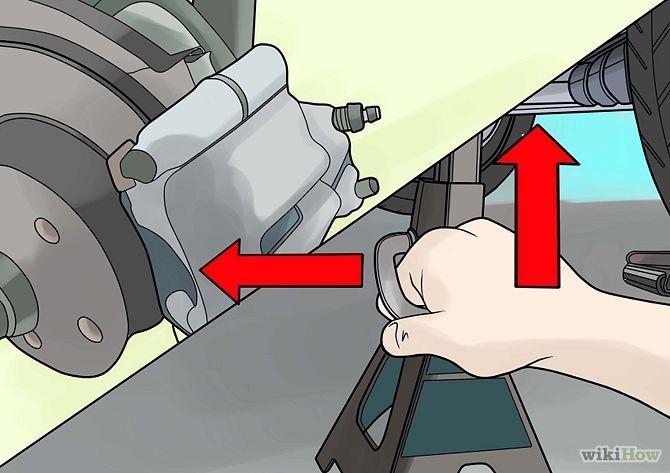
**Check the brake fluid level in the reservoir for the proper level and add more, if necessary.**

**Method 2 of 3: Bleed a Slave Cylinder With a Vacuum Pump**



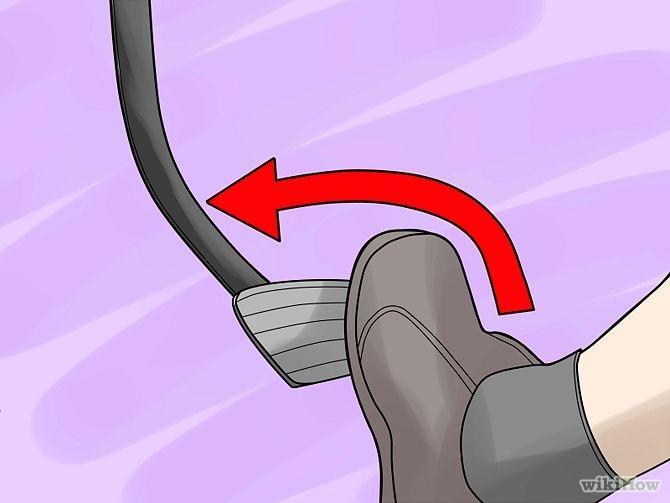
**1**

**Obtain a hand vacuum bleeder pump at your local auto parts store.**



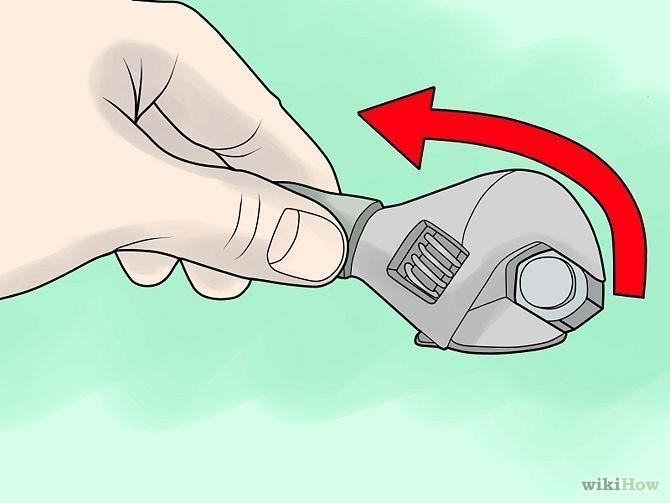
**2**

**Jack up the vehicle to access the bleeder valve.**



**3**

**Ask an assistant in the vehicle to press the clutch pedal to the floorboard.**



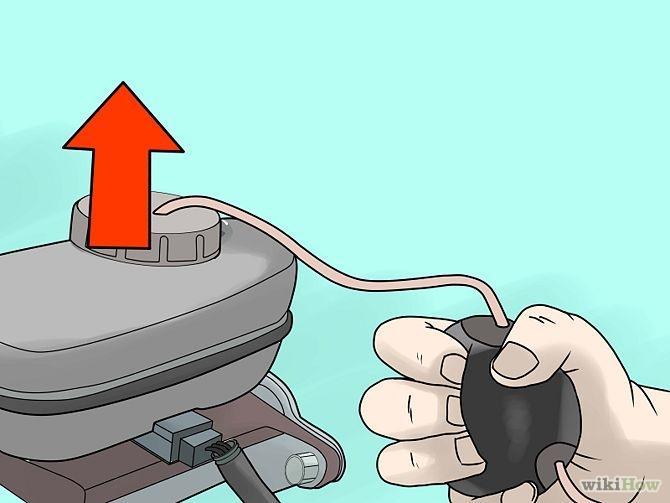
**4**

**Loosen the bleeder valve and attach the vacuum pump.**

1. **5**

**Pump brake fluid into a transparent container**

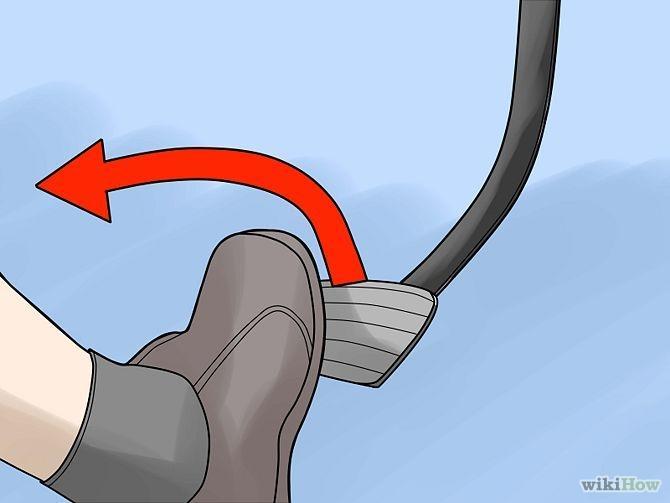
until it has no air bubbles coming out of the hose.





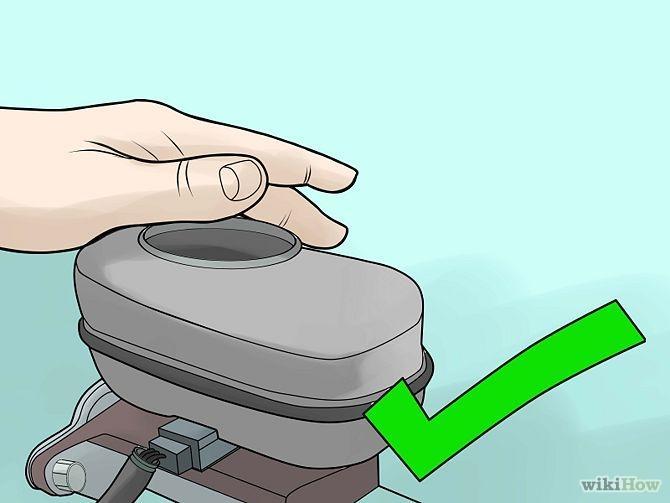
**1**

**Close the bleeder valve.**



**2**

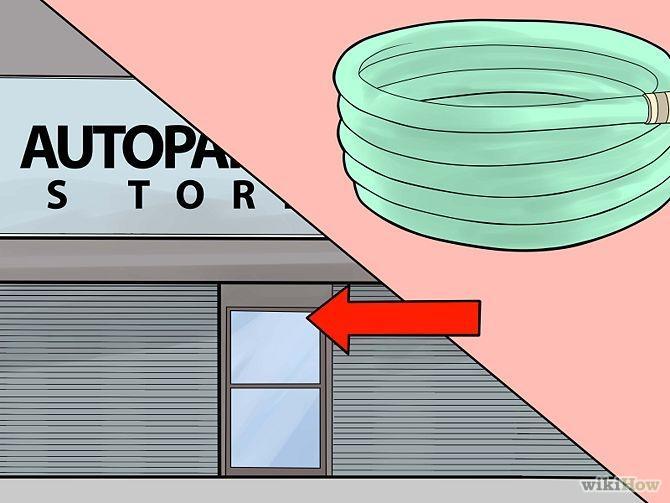
**Pull the clutch pedal off the floor, drawing brake fluid into the master cylinder, and test for play in the pedal.** If it feels soft, bleed more air out.



**3**

**Check the fluid level in the reservoir for the proper level; add more, if necessary.**

**Method 3 of 3: Bleed a Slave Cylinder With a Hose**



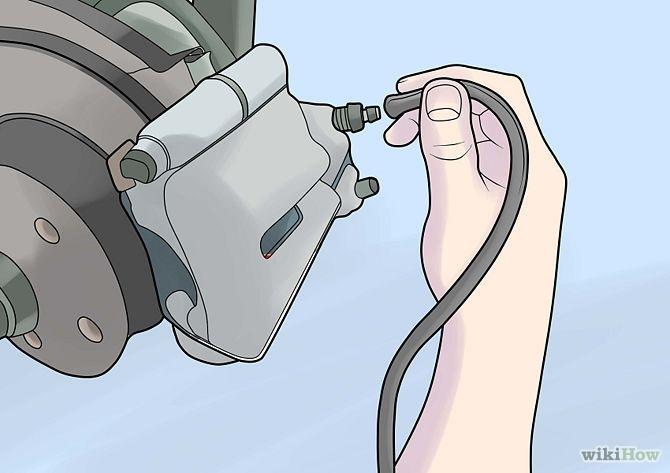
**1**

**Get a small hose or plastic tubing from your local auto parts or fish supplies store.**



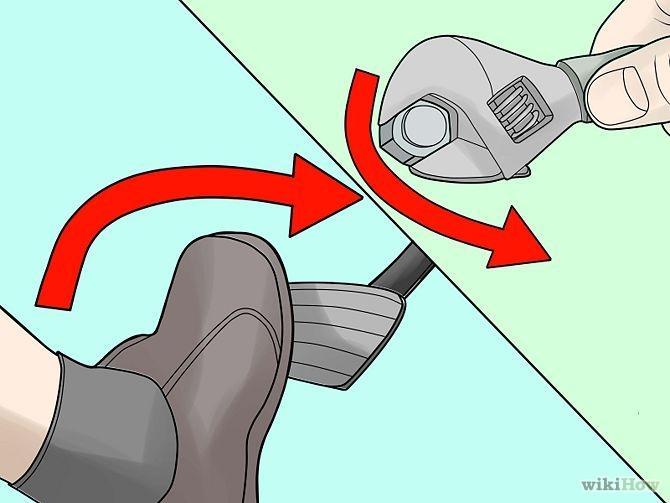
**2**

**Jack up the vehicle.**



**3**

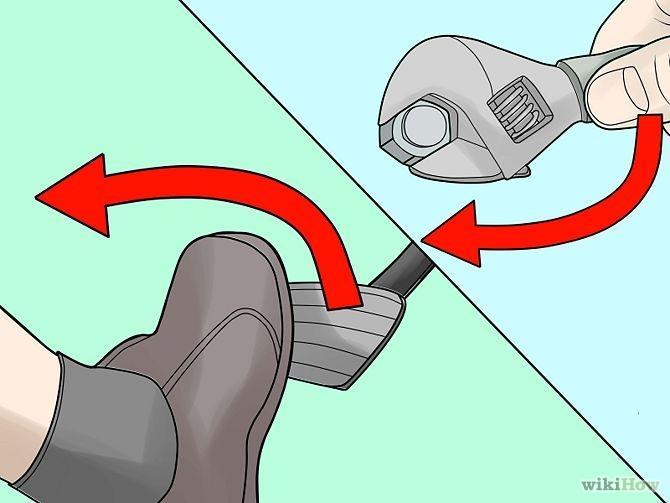
**Press one end of the hose onto the bleeder valve and insert the other into a transparent bottle half-filled with new brake fluid.**



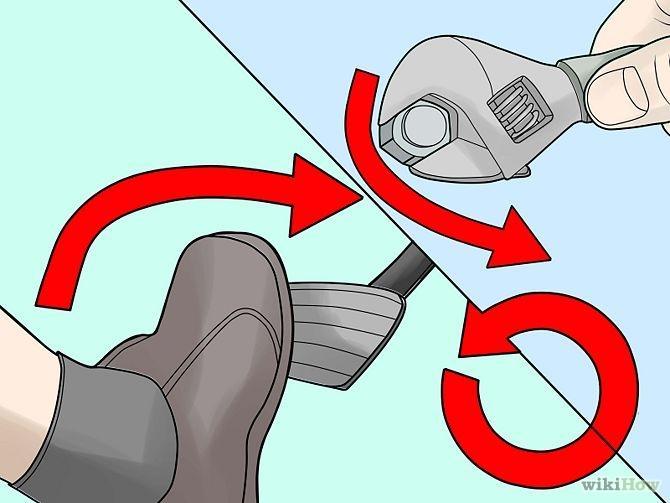
**4**

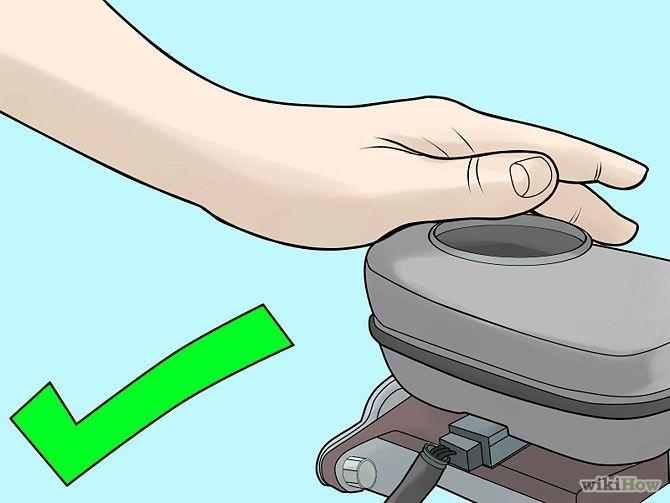
**Bleeding process:** Have an assistant press the clutch pedal to the floor, while you loosen the bleed screw on the slave cylinder. The air will flow into the container and bubble out into the brake fluid, where air can’t seep back into the slave cylinder.

* + Tighten the bleed screw and then ask your assistant to let up on the clutch pedal.



* + Repeat the process until no more air bubbles bleed into the container.





**5**

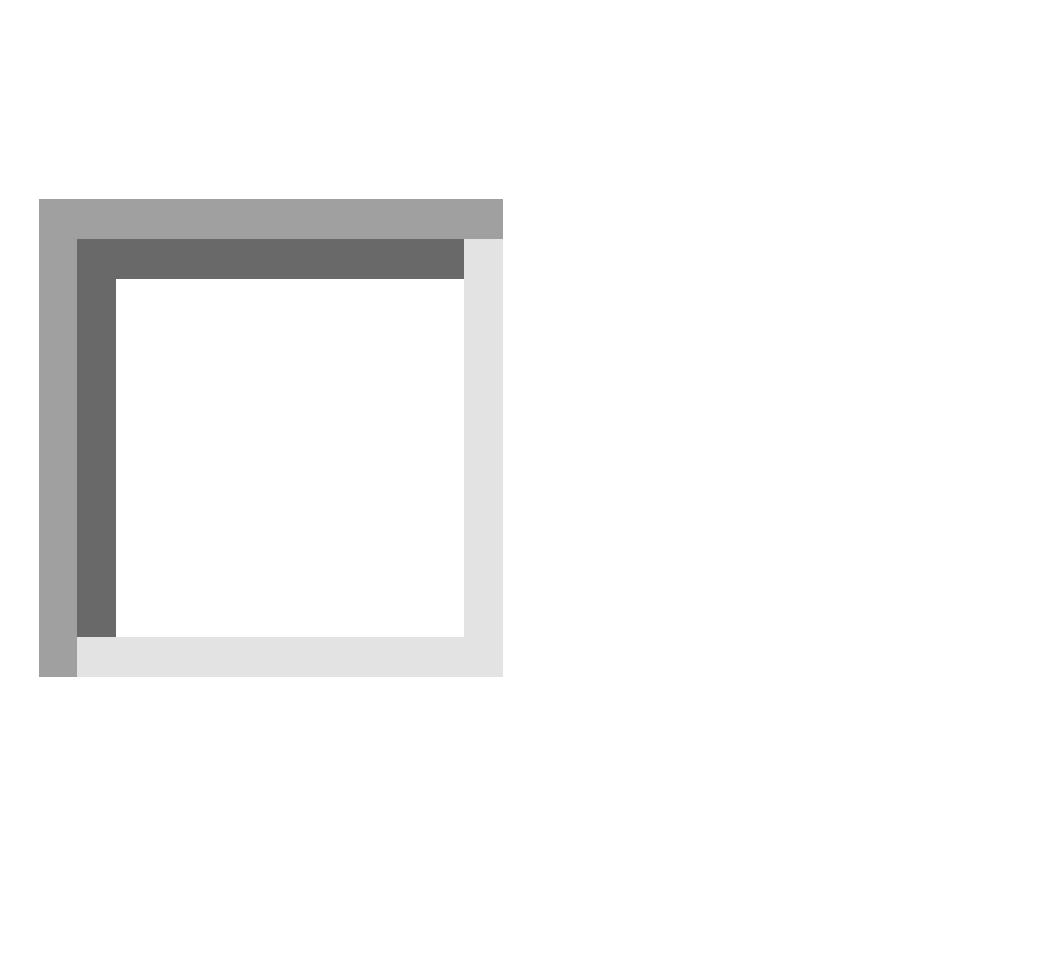
**Look at the fluid reservoir to ensure the level is correct and add more, if needed.**

2 jack stands

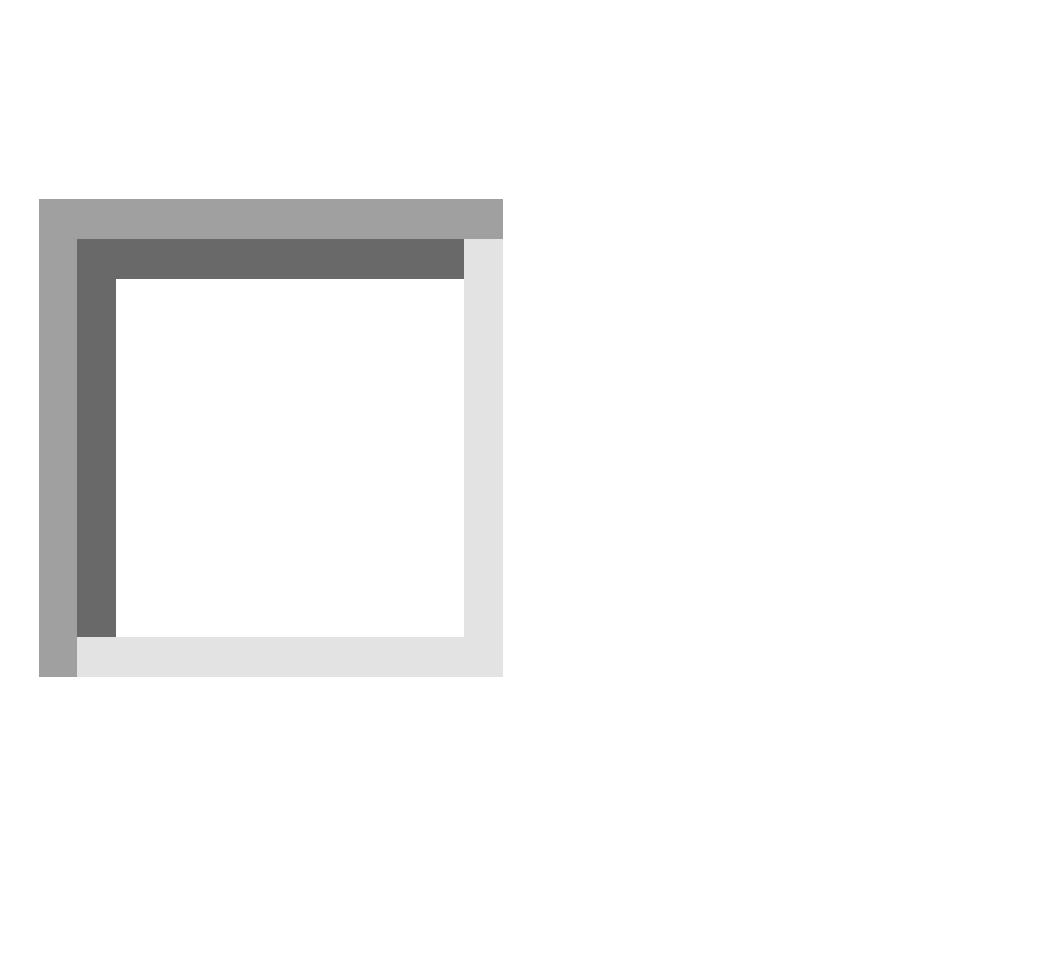
Wrench

New brake fluid

Rags

* 

Method 2: Hand vacuum pump

* + Transparent container
* 

Method 3: Hose about 1/4 inch (approx 6 or 7 mm) -- with clear vinyl hose, seeing what is happening will be easier.

* + A small, transparent bottle

**HYDRAULIC SYSTEM BLEEDING**

**Externally Mounted Slave Cylinder**

1. Clean the reservoir cap and the slave cylinder connection.
2. Remove the slave cylinder from the housing.
3. Using a 3 / 32 in. punch, drive out the pin that holds the tube in place.
4. Remove the tube from the slave cylinder and place the end of the tube in a container.
5. Hold the slave cylinder so that the connector port is at the highest point, by tipping it about 30° from horizontal. Fill the cylinder with DOT 3 brake fluid through the port. It may be necessary to rock the cylinder or slightly depress the pushrod to expel all the air.

**WARNING**

Pushing too hard on the pushrod will spurt fluid from the port!

1. When all air is expelled (no more bubble are seen), install the slave cylinder.

*Some fluid will be expelled during installation as the pushrod is depressed.*

1. Remove the reservoir cap. Some fluid will run out of the tube end into the container. Pour fluid into the reservoir until a steady stream of fluid runs out of the tube and the reservoir is filled. Quickly install the diaphragm and cap. The flow should stop.
2. Connect the tube and install the pin. Check the fluid level.
3. Check the clutch operation.

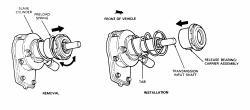
**Internally Mounted Slave Cylinder**

See Figure 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19

*With the quick-disconnect coupling, no air should enter the system when the coupling is disconnected. However, if air should somehow enter the system, it must be bled.*

1. Remove the reservoir cap and diaphragm. Fill the reservoir with DOT 3 brake fluid.
2. Connect a piece of rubber tubing to the slave cylinder bleed screw. Place the other end in a container.
3. Loosen the bleed screw. Gravity will force fluid from the master cylinder to flow down to the slave cylinder, forcing air out of the bleed screw. When a steady stream with no bubbles flows out, the system is bled. Close the bleed screw.

*Check periodically to make sure the master cylinder reservoir doesn't run dry.*



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**Fig. 9: Clutch release bearing removal with the concentric slave cylinder**



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**Fig. 10: View of the concentric slave cylinder and throwout bearing assembly**



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**Fig. 11: Removing the throwout bearing from the slave cylinder**



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**Fig. 12: Removing the concentric slave cylinder attaching bolts**



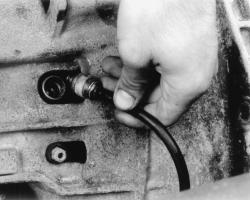
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**Fig. 13: Removing the concentric slave cylinder from the bell housing**



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**Fig. 14: If the special coupling tool is not available, the fluid coupling can be uncoupled with a flat-bladed tool**



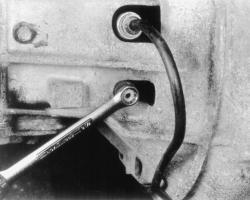
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**Fig. 15: Gently pull fluid hose from the fitting**



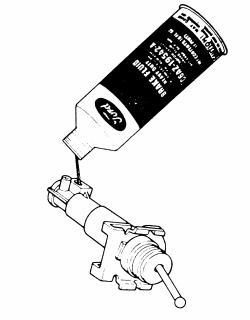
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**Fig. 16: Always replace the O-ring seal**



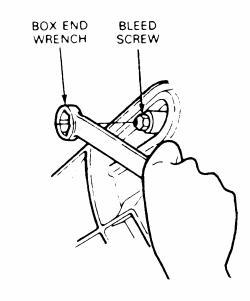
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**Fig. 17: Use a box wrench to bleed the concentric slave cylinder at bleeder valve**



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**Fig. 18: Bleeding the external slave cylinder**

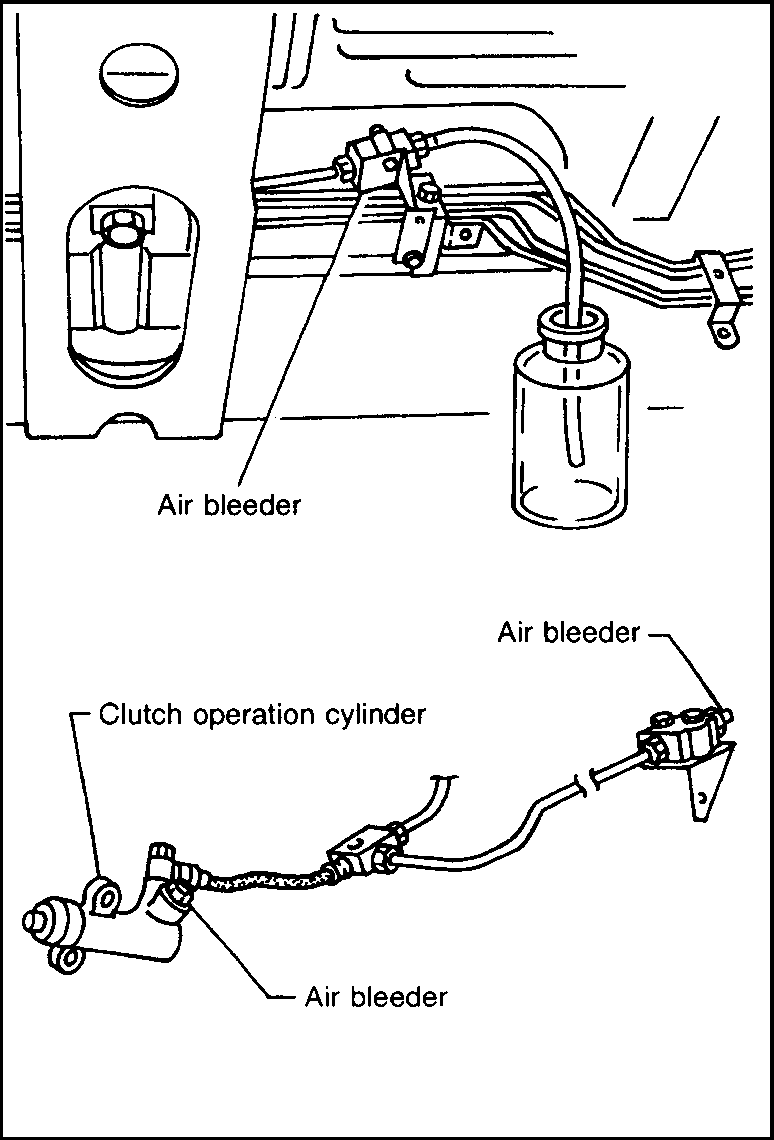


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**Fig. 19: Bleeding the concentric slave cylinder**

1. Add fluid to fill the master cylinder reservoir.
2. Fully depress the clutch pedal. Release it as quickly as possible. Pause for 2 seconds. Repeat this procedure 10 times.
3. Check the fluid level. Refill it if necessary. It should be kept full.
4. Repeat Steps 5 and 6 five more times.
5. Install the diaphragm and cap.
6. Have an assistant hold the pedal to the floor while you crack the bleed screw (not too far-just far enough to expel any trapped air). Close the bleed screw, then release the pedal.
7. Check, and if necessary, fill the reservoir.

CLUTCH FLUID BLEEDING PROCEDURE FOR NISSAN TERRANO TS27

**Bleeding Procedure**

1. Bleed air from clutch operating cylinder according to the following procedure.

**Carefully monitor fluid level at master cylinder during bleeding operation.**

1. Top up reservoir with recommended brake fluid.
2. Connect a transparent vinyl tube to air bleeder valve of clutch damper.
3. Fully depress clutch pedal several times.
4. With clutch pedal depressed, open bleeder valve to release air.
5. Close bleeder valve.
6. Repeat steps (c) through (e) above until brake fluid flows from air bleeder valve without air bubbles.

2. Bleed air from clutch operating cylinder according to the above procedure.

3. Repeat the above bleeding procedures 1 and 2 several times.