

Diagnostic Information



SCHAEFFLER GROUP
AUTOMOTIVE AFTERMARKET

Clutch Function

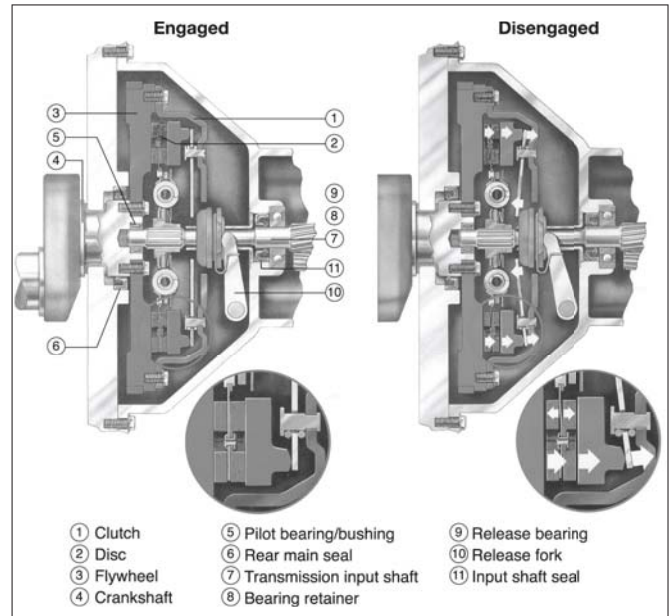
Vehicles equipped with manual transmissions contain clutch systems that connect and disconnect the engine and transmission. The clutch system enables the driver to shift gears.

When the clutch is disengaged, the release mechanism actuates the fork. The fork contacts the release bearing, moving it against the clutch diaphragm spring fingers.

This action allows the clutch pressure plate to lift away from the flywheel, opening a very small space between the disc, flywheel and pressure plate. When the disc moves away from the flywheel, power flow from the engine to the transmission is interrupted. The engine crankshaft and flywheel are rotating at a higher speed than the disc and transmission input shaft that are coasting.

When the clutch is engaged, the disc slips briefly to provide smooth engagement and, once again, the clutch clamps the disc against the flywheel. This causes the input shaft to turn, transmitting engine power to the transmission.

Clutch System



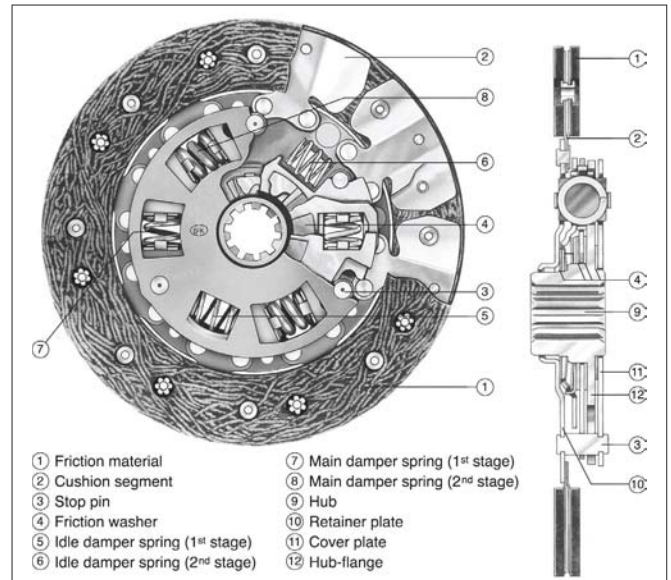
Disc

The disc is a critical component in providing long service life for the clutch system. It provides smooth engagement and dampens engine vibrations.

It is mounted to the input shaft between the flywheel and the clutch. It can slide forward and backward on the shaft, but cannot rotate without rotating the shaft.

Important component parts include the hub-flange and the torsion springs. The hub-flange is located between a cover plate and a retainer plate. The hub is splined to fit the input shaft.

Disc

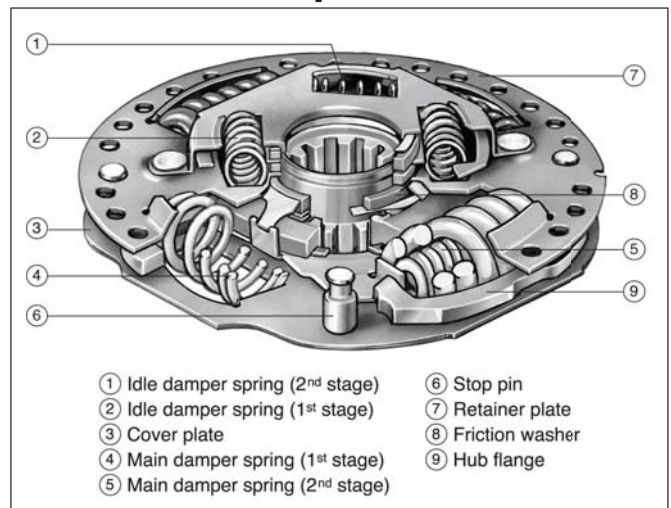


Disc Torsion Damper

Torsion springs in the damper assembly smooth engagement and dampen vibrations. Some discs include idle-stage dampers, either small springs around the hub, or friction washers inside the disc. As pulsations from the engine reach the disc, the springs compress and expand to cushion or dampen vibrations and eliminate gear rattle.

Friction material is riveted to numerous metal components called marcells, or cushion segments. Waves in marcells soften engagement. Some heavy-duty discs do not contain marcells. They are made with cerametallic friction material, characterized by abrupt engagement and some chatter.

Disc Torsion Damper



Clutch

The clutch clamps the disc against the flywheel during engagement. During disengagement it releases pressure on the disc, creating a gap large enough for the disc to move away from the flywheel and enable the driver to shift gears.

A typical diaphragm spring clutch consists of a pressure plate, a diaphragm spring, a pivot ring, drive straps and a cover. When the release bearing contacts the tips of the diaphragm spring fingers, it moves them toward the flywheel. The outside diameter of the diaphragm spring pivots on the cover. This action lifts the pressure ring off the flywheel through the drive straps that connect the cover to the pressure plate.

Lever style clutches produce clamp load by pressure from coil springs. As the friction material of the disc wears, the springs expand, reducing their clamping force. At the same time, pedal effort remains high. As a result of these disadvantages, passenger cars and light trucks are now almost exclusively equipped with diaphragm spring clutches.

Diaphragm spring clutches maintain higher clamp load than lever style clutches throughout the service life of the clutch. As disc friction material wears, clamp load increases during the first half of clutch life before decreasing gradually to its original level. Diaphragm spring clutches require less pedal effort the further the pedal is actuated, reducing stress on release system components.

When replacing a coil spring clutch with a diaphragm spring, always remove over-center or release-assist springs. Designed to reduce the higher pedal effort associated with coil spring clutches, over-center springs may overcompensate when a diaphragm spring clutch is installed. This can result in a very soft pedal and, in some cases, a pedal that will go to the floor and stay there.

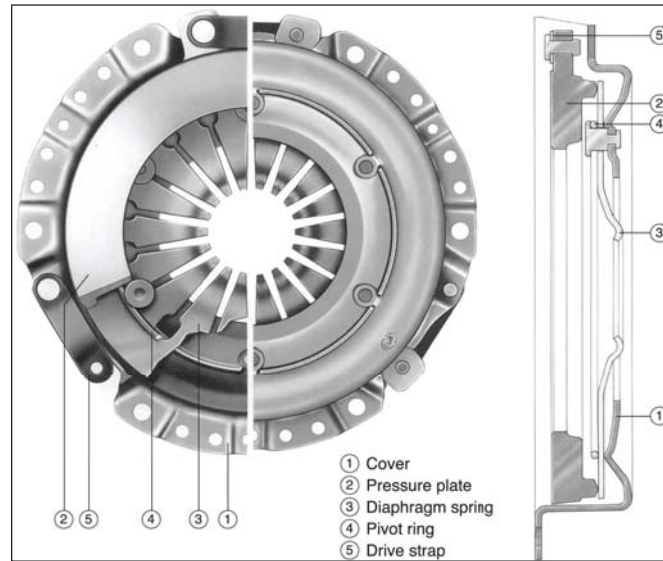
Flywheel

Bolted to the end of the crankshaft, the flywheel provides the mounting surface for the clutch. During engagement, the disc is clamped against the flywheel by the pressure plate.

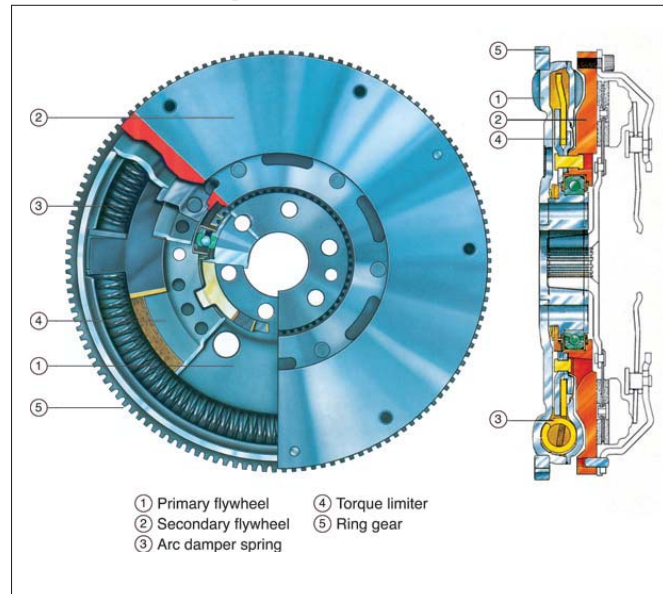
In addition to its other functions, the flywheel acts as a heat sink, dissipating heat and moving it away from the clutch pressure plate and disc friction material. The flywheel must provide a smooth, flat surface in order for the clutch to operate properly.

The Dual-Mass flywheel is designed to absorb engine vibrations before they are transmitted to the driveline where they can create gear rattle. This is achieved by splitting the conventional flywheel into two sections: a primary section that bolts to the crankshaft, and a secondary section, onto which the clutch is bolted. The primary section of the flywheel contains springs to isolate engine vibrations and a torque limiter to

Clutch



Dual-Mass Flywheel



prevent engine torque spikes from exceeding engine and transmission component strength. When torque spikes occur, the torque limiter allows the primary section of the flywheel to turn independently of the secondary section, saving the driveline and transmission from damage.

Diagnosing the cause of a slipping complaint on vehicles equipped with a Dual-Mass flywheel can be difficult because the flywheel, not the clutch, may be the cause. Dual-Mass flywheels are designed to protect the drivetrain by allowing a slight amount of slip to dampen the effects of torque spikes. Torque limiters on some flywheels can weaken over time and allow slipping to occur at lower torque levels.

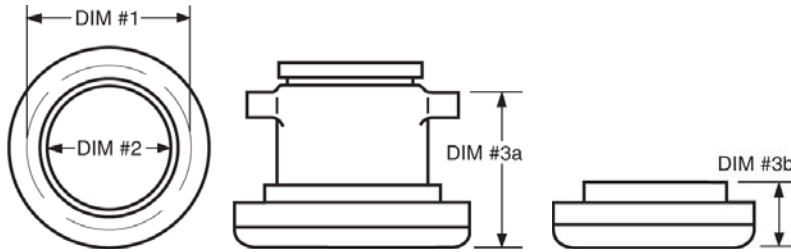
Examine clutch system components to determine the root cause of the slipping. Neither heat marks on the pressure plate nor disintegrated or contaminated friction material indicate a worn Dual-Mass flywheel. If the clutch does not appear to be the cause, a new flywheel is required.

If the LuK RepSet part number is the correct one for the application, you can be sure the components will fit and function properly, despite differences in appearance. In the case of release bearings that appear dissimilar, you can measure three dimensions on each of the bearings and compare the results. The dimensions should be identical, indicating they are fully interchangeable.

Use a caliper to measure the following dimensions on the new bearing and the one you remove from the vehicle.

Bearing Contact Diameter (DIM #1).

The bearing contact surface is the area that contacts the diaphragm spring fingers. It is also called the face. Measure from the center of the face on one side to the center directly across on the other side.



Inside Diameter (DIM #2).

This is the measure of the center of the bearing.

Height.

This dimension is not necessarily the overall height of the bearing. On a bearing assembly, measure from the face of the bearing to the fork contact point at the collar (DIM #3a). In the case of a bearing only, measure from the face of the bearing to the bearing collar contact point (DIM #3b).

Pilot Bearing/Bushing

On many vehicles, a pilot bearing or bushing is located in the end of the crankshaft. The pilot bearing supports the end of the transmission input shaft and centers the disc on the flywheel. Types of pilots include conventional ball bearings, needle bearings and sintered bronze bushings.

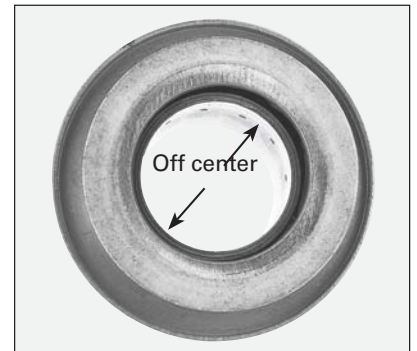


A small and relatively inexpensive component, the pilot bearing or bushing should always be replaced during clutch installation. The variety of problems caused by a worn or defective pilot bearing or bushing are not worth the risk of having to remove the bell housing and transmission to replace this component later.

Release Bearing

The release bearing is attached to the fork and slides on a bearing retainer that is attached to the front of the transmission. The movement of the fork causes the release bearing to slide across the bearing retainer and press against the tips of the diaphragm spring fingers. Ball bearings in the release bearing enable it to turn while applying pressure to the fingers. In order for the clutch to function properly, the bearing retainer must be exactly parallel to the input shaft and provide a smooth surface for the release bearing.

Angular-contact bearings, found in hydraulic release systems and self-adjusting cable systems, are in constant contact with the diaphragm spring fingers. Self-centering bearings are designed to compensate for slight misalignment between the engine and transmission. It is normal for these bearings to be "off center" until they contact the diaphragm spring fingers.



Some vehicle designs utilize a concentric slave cylinder. It eliminates the need for a number of release system components, including the release fork, pivot ball and bearing retainer. Its location inside the bell housing makes it difficult to troubleshoot. To avoid added labor costs later, LuK recommends replacing the concentric slave cylinder when the clutch is replaced.

INSTALLATION TIPS

Attention to detail, thorough examination and replacement of all worn clutch system components can eliminate immediate off-the-lift problems and prevent premature clutch failure. Always follow manufacturers' guidelines for clutch removal and replacement.

Installation

Incorrect installation of the disc will result in interference between the disc and flywheel. Many LuK discs are marked to indicate the side that faces the flywheel.

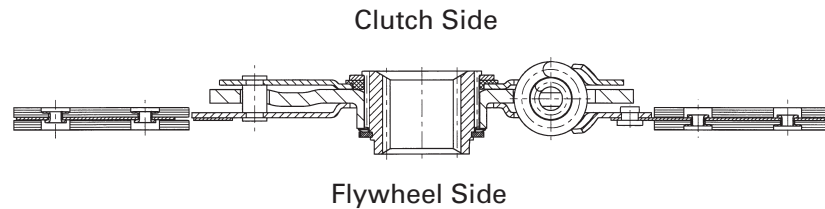
Clean the contact surface of the pressure plate with an alcohol-based cleaner. Use an alignment tool to properly center the disc and install the clutch. Tighten the bolts by hand in a criss-cross, star pattern, drawing them down gradually. This applies stress to the clutch evenly. Never use an air-powered wrench; it will damage the clutch, causing chatter and no release. Torque all bolts to manufacturers' specifications.

Release System and Other Parts

Inspect all release system components and replace any that are worn. This includes the clutch cable, pivot bushings, fork, fork pivot ball, and hydraulic slave and master cylinders. This inspection is especially important if the vehicle has high mileage and the owner experienced release problems.

Always check the condition of halfshaft, carrier bearings, universal joints, driveshaft components and powertrain mounts. Examine other vehicle components that have worn during the service life of the clutch. Drive line components and engine and transmission seals that were new when the original clutch was installed have been subjected to heat and vibration. Worn drive line components are a common cause of vibration. They must be replaced to prevent problems with the new clutch.

Even if inspection does not indicate leaks, replace rear main bearing and transmission input shaft seals on high mileage vehicles. It is not realistic to expect high mileage seals to continue sealing through the service life of several clutches.



Lubrication

Never lubricate conventional ball bearing pilots. A small amount of bearing grease can be used on needle bearing pilots; however, never use grease on sintered bronze bushings. The material in the bushing is designed to gradually release lubrication through small pores. Use a few drops of SAE 30-weight motor oil as an aid to installation.

Lubricate the input shaft splines with a very small amount of high-temperature grease. Then test fit the disc on the splines to distribute a thin film of grease. Make sure it moves freely. Remove the disc and wipe away any excess grease.

Lubricate the bearing retainer with a very light film of high-temperature grease applied to the sliding surface. If the inner diameter of the release bearing is made of nylon, do not lubricate.

Reinstalling the Transmission

Support the transmission with a jack, and keep the input shaft properly aligned with the disc hub as the transmission is reinstalled. If the transmission input shaft will not engage the disc, check the alignment of the transmission and engine. Never force the transmission into the disc or use the bell housing bolts to pull a transmission into place if it won't fully seat against the engine.

Once the shaft is engaged in the disc, keep the transmission jack in place until the bell housing bolts and cross member or cradle bolts are tightened. If the jack is removed before the transmission is properly bolted to the engine, the weight of the transmission on the input shaft will bend the disc, resulting in chatter or no release.

Teardown

Organize teardown procedures to keep track of parts and speed installation. Many of the procedures you use during removal of the old clutch can prevent errors. As you remove the old clutch, note all bolt locations. Bell housing bolts may have different lengths, diameters and thread pitches. If any of the bell housing bolts are used to attach a ground cable to the transmission, mark the bolt and its location. Clean and check all bolts for thread damage.

If the crankshaft flange bolt pattern is symmetrical, mark the relationship of the flywheel to the crankshaft mounting flange to eliminate a balance problem. If the pattern is asymmetrical, the flywheel will only go on one way.

Free Play Adjustment

Replace the clutch cable with every clutch installation. In systems with self-adjusting cables, always check for correct operation of the self-adjusting mechanism. Adjust the cable or mechanical linkage free play to the manufacturer's specifications. Then operate the clutch several times to make sure that the cable housing is firmly seated in its mounts. Test drive the vehicle and make any final free play adjustments.

Examine the master and slave cylinders for leaks. On vehicles equipped with hydraulic release systems, replace the hydraulic fluid with fresh fluid from a sealed container to avoid damage to the seals. Follow manufacturers' recommendations for fluid type.

The degree of difficulty in bleeding a system often depends on the angle at which the hydraulic components are mounted. LuK offers a line of reverse fluid injection bleeder tools. With one tool, one technician can bleed the hydraulic system quickly and efficiently.

Driving Habits and Clutch Wear

Constant engagement and disengagement of the clutch will wear away disc friction material. The rate at which wear occurs, however, depends largely on the driving habits of the operator and vehicle usage.

Driving behaviors and conditions that decrease clutch service life include riding the clutch pedal, high RPM engagement, excessive slipping, harsh downshifting, lugging the engine, excessive vehicle loading, and engine, transmission and suspension modifications.

Begin every clutch diagnosis by discussing the symptoms of the clutch operation with the customer. Collect information about the operating conditions and working environment of the clutch. If possible, road test the vehicle with the customer driving to duplicate the problem. Establish the vehicle mileage and clutch history and mileage.

If the old clutch had relatively low mileage and final diagnosis shows signs of driver abuse, take a ride with the customer to observe their driving habits. Explain how certain behavior you observe reduces clutch service life.

Slipping the clutch during engagement creates excessive heat, damages the clutch and flywheel contact surfaces and accelerates disc friction material wear. Riding the clutch reduces the clamping force of the disc; power transfer from the spinning flywheel is not fully applied to the disc. The result is premature wear of the disc friction material. Waiting in traffic with the vehicle in gear and the clutch disengaged loads the release bearing excessively. Over time, this shortens release bearing life and can eventually cause noise.

Lugging the clutch occurs when the driver selects the wrong gear for the vehicle speed and load. Under low speed/high load conditions, a lower gear should be used to reduce the torque applied to the clutch. Selecting a higher gear causes excessive loading of the disc that can damage the disc hub and torsion springs as well as the clutch drive straps. Over-revving the engine and high-speed downshifting can burst the friction material.

Complete Repair

Complete clutch repair is diagnosing the cause of the damage, fixing the problem and examining and replacing all worn and damaged components.

Component parts incur wear. Some adjust their operating points to compensate for normal wear in disc friction material. The service life of clutch components is not infinite. "As-new" performance cannot be expected in all cases when only LuK RepSet components are installed.

Examination and replacement of all worn clutch system components is critical to ensure the full service life of the clutch and disc. And it is inexpensive insurance against comebacks.

Always examine and replace the following parts if they are worn or damaged: flywheel, slave and master cylinder, cable, fork, linkage, bearing retainer, cross shaft bushings and fork pivot.

Before Removing the Bell Housing

Before teardown, check all components outside the bell housing that could be defective and create the appearance of a problem with the clutch or disc.

Examine all external release system components. On vehicles that provide for external adjustment, always check and adjust the free play. Hydraulic release and self-adjusting cable systems, use constant contact release bearings, this means they have zero free play. Excessive free play causes incomplete release; insufficient free play causes slipping.

As disc friction material wears, the pressure plate moves closer to the flywheel, and the diaphragm spring fingers pivot outward toward the transmission. This causes a gradual decrease in the distance between the release bearing and the diaphragm fingers.

With cable release systems, check for binding, stretching, cracks at the pivot and anchor points, cracks or kinks in the housing and a defective self-adjusting mechanism. With mechanical linkages, check all pivot points to ensure they are clean and properly lubricated.



LuK prototype installations tune clutch products for future production vehicles.

Resurfacing the Flywheel

Increasingly original equipment clutch systems are designed without allowance for flywheel resurfacing. If manufacturers' specifications indicate this, the flywheel cannot be resurfaced and must be replaced during clutch installation to avoid contact between the disc and flywheel, and catastrophic failure.

Proper resurfacing of the flywheel is critical to clutch operation. When resurfacing a stepped or cupped flywheel, be sure to machine the contact surfaces by equal amounts to maintain specified tolerances. Do not assume the existing dimensions are correct, particularly if there were release or engagement problems. If the flywheel shows signs of extreme overheating and deep scoring, it must be replaced.

Clean the mating surface between the crankshaft flange and flywheel mounting surface. In some applications, flywheel bolts require the use of a special thread sealer to prevent oil leaks. Refer to manufacturers' specifications for thread sealer and torque specifications. If the flywheel has been handled by grease- or oil-covered hands, clean it with an alcohol-based cleaner.

Due to their design, LuK does not recommend resurfacing dual-mass flywheels. For some applications LuK offers solid flywheel replacements for dual-mass designs. Engineered as bolt-in replacements, LuK RepSet and solid flywheel replacement options provide increased torque capacity. Many include larger diameter clutches than the original equipment.

DIAGNOSTICS - CHATTER

Chatter is grabbing or jerking during engagement. It is the result of an erratic engagement of the flywheel, disc and pressure plate. Sometimes this can be caused by grease or oil contamination on the friction surfaces. More often it is caused by worn or distorted components preventing the pressure plate from clamping the disc evenly.

CAUSES OF CHATTER

External

- Loose or broken engine or transmission mounts
- Misalignment of chassis and drive line components
- Worn or damaged universal or constant velocity joints
- Missing bell housing dowel pins
- Loose transmission cross member
- Loose rear leaf spring bushings or spring u-bolt nuts
- Worn or bent fork

Internal

- Bent or broken drive straps
- Warped or grooved flywheel
- Missing flywheel dowel pins
- Wear or excessive lubrication of input shaft splines
- Worn pilot bearing/bushing
- Worn bearing retainer
- Worn or damaged disc splines
- Clutch distortion or bent drive straps
- Oil- or grease-contaminated friction material
- Improper bolting of the clutch

PRE-TEARDOWN DIAGNOSTICS

Before removing the bell housing, inspect the area around it and the engine to locate and repair the source of oil leaks. Avoid contamination of disc friction material by touching it with clean hands only. Prior to installation, clean the contact surfaces of the flywheel and the pressure plate with an alcohol-based cleaner. Lubricate input shaft splines with a small amount of high-temperature grease. Slide the disc onto the input shaft splines to distribute a thin film. Remove the disc and wipe away any excess lubricant prior to installation. Check the release system for wear and damage. Worn or distorted components prevent the clutch from clamping the disc evenly, causing chatter. Check the transmission and the engine mounts, and examine the vehicle for damage that could contribute to vibration as the clutch is engaged.

WORN OR BROKEN MOTOR MOUNTS

If motor mounts are worn or broken, shock loads transmit through the vehicle chassis and focus on the clutch package. This vibration can feel like clutch chatter.

MISALIGNMENT

Misalignment between the engine block and transmission can cause premature clutch failure or impair operation. It is often seen on high-mileage vehicles or after a rebuilt engine has been installed. Using a dial indicator, check the runout tolerance between the engine and crank flange, the engine block and flywheel friction face, and the flywheel friction face and bellhousing. If the tolerance exceeds .005 inch, it could impair clutch function. Consult the vehicle maintenance manual for repair procedures.

OIL AND GREASE CONTAMINATION

The presence of oil or grease on the disc friction surface will cause chatter. Inspect the inside of the bellhousing and clutch components for signs of contamination. Replace any leaking or damaged seals and gaskets. Clean the bellhousing and pressure plate and flywheel friction surfaces with a suitable solvent to remove any contaminants. If the disc friction material has been contaminated, ***the disc must be replaced.***

A WORD ABOUT CERAMETALLIC DISCS

Cerametallic friction material has very aggressive engagement characteristics which cause chatter, especially with an uncushioned disc. This condition is normal. LuK strongly recommends that the vehicle owner be made aware of these characteristics before a cerametallic disc is installed.

A WORD ABOUT LUBRICATION

Some components within the clutch package must be lubricated to operate properly. A white lithium-based grease is recommended for bearing retainers and bearing/fork contact surfaces. Apply the grease lightly to these surfaces and wipe away any excess.

Sintered bronze pilot bushings are self-lubricating. Applying grease will block the bushing's lubricating pores and cause the input shaft to seize. To avoid a dry start-up condition, apply a few drops of SAE30 motor oil on the bushing's internal surface.

Use caution when lubricating the transmission input shaft. Excessive grease will contaminate the disc when the clutch is first engaged. Dry graphite can be used as an alternative on the input shaft.

POST-TEARDOWN DIAGNOSTICS

BENT DRIVE STRAPS

Change in drive strap profile

Possible causes:

- Lugging the engine
- Improper handling
- Engine miss

Note: This kind of damage is most likely caused by lugging the engine, which focuses heavy shock loads on the clutch package.

BENT/BROKEN DISC

Excessive run out

Possible causes:

- Shipping damage
- Improper installation

Note: Carefully inspect each disc before installing; return any that are bent, distorted or damaged. To prevent disc damage and distortion:

1. Use an alignment tool,
2. Support the housing with a transmission jack.
3. Rotate the input shaft to align it with the disc spline.

DAMAGED DISC SPLINES

Broken or worn splines

Possible causes:

- Improper installation / misaligned
- Worn input shaft
- Incorrect parts

Note: A worn transmission input shaft allows excessive movement between the shaft and the disc spline. When movement occurs, high shock loads are concentrated on the spline and shaft. Failure to align the disc prior to installing the transmission can result in spline damage.

UNEVEN OR BROKEN FINGERS

Damaged clutch diaphragm fingers

Possible causes:

- Improper installation
- Bent cover housing
- Manufacturing defect

Note: Carefully inspect all components before installing; return any that were damaged during shipping. A deformed or improperly installed cover affects diaphragm finger parallelism, resulting in uneven pressure plate clamping.

CONTAMINATED FRICTION SURFACE

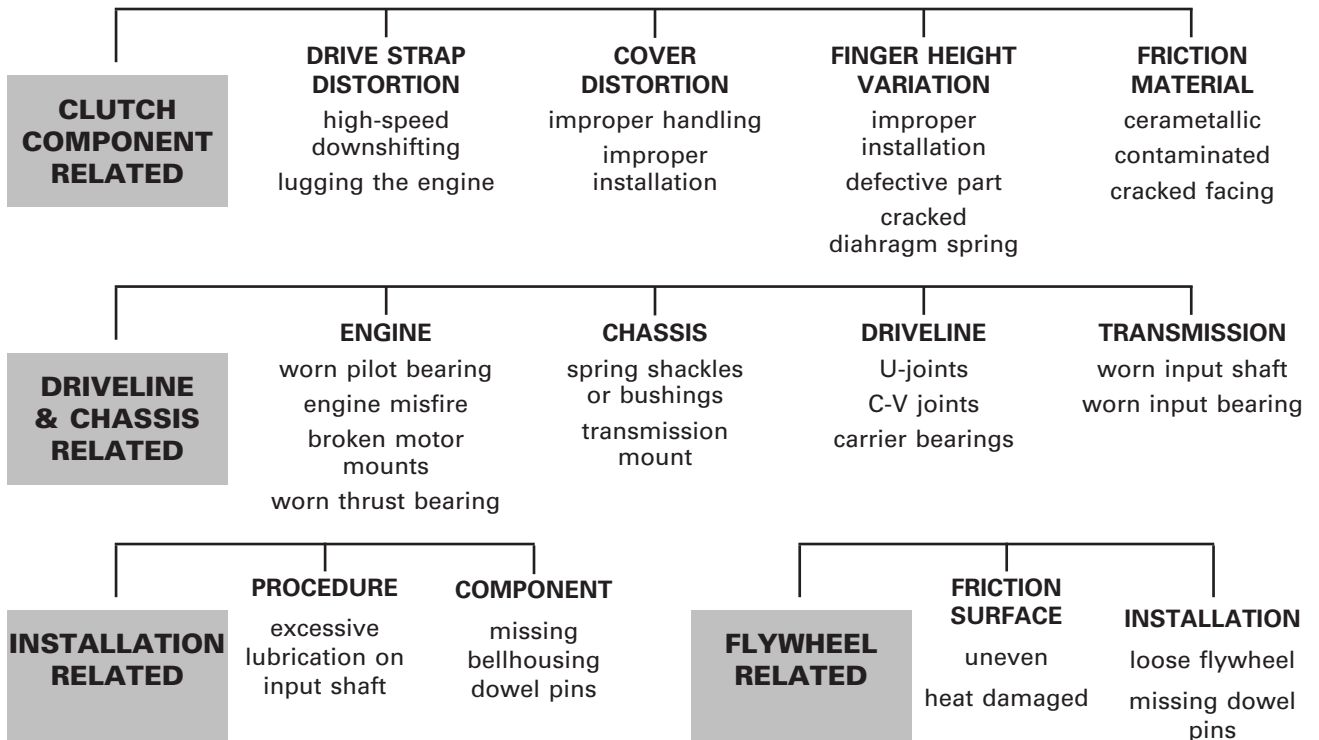
Any foreign substance on friction material, pressure plate or flywheel

Possible causes:

- Leaking rear main engine
- Leaking front transmission
- Excessive lubricant input shaft splines
- Leaking slave cylinder

Note: Any foreign substance allowed to contaminate the friction material can cause problems. If oil, grease, or hydraulic fluid get on the friction material, chatter can result.

FAILURE ANALYSIS FLOW CHART



DIAGNOSTICS - HARD PEDAL

PRE-TEARDOWN DIAGNOSTICS

A hard-pedal condition is normally caused by sticking, binding or improperly lubricated release system components. Something in the release system is restricting movement and increasing the pedal effort needed to release the clutch. Inspect the release system for a binding fork or release bearing. In a mechanical release system, inspect all of the linkages for binding. It may be helpful to disconnect components and test them individually to locate the worn or damaged component.

CAUSES OF HARD PEDAL

External

- Binding or improperly routed cable
- Binding cross shaft due to worn bushings or incorrect lubrication
- Bent fork
- Worn pedal bushings
- Blockage or worn seals in the hydraulic system
- Worn pivot ball

Internal

- Worn, damaged or improperly lubricated bearing retainer
- Worn or damaged fork

POST-TEARDOWN DIAGNOSTICS

Note: There is nothing in the design of the pressure plate that would cause the pedal load to increase significantly.

BENT FORK

Possible causes:

- Bearing installed improperly on fork

WORN OR BINDING CABLE

Possible causes:

- Binding in casing improperly routed

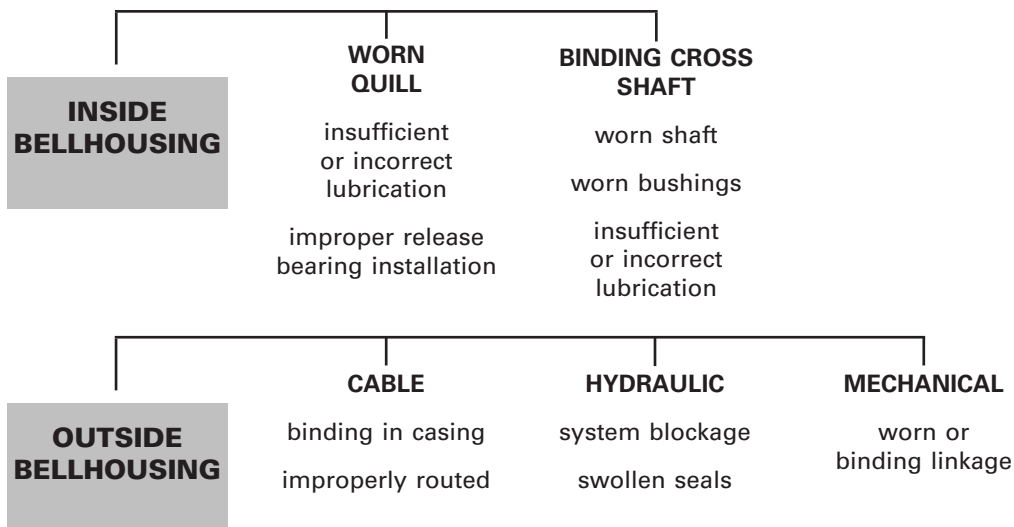
WORN QUILL

Galling on quill shaft

Possible causes:

- Insufficient or incorrect lubrication
- Misalignment

FAILURE ANALYSIS FLOW CHART



CAUSES OF NOISE

External

- Incorrect release system adjustment
- Worn driveshaft or halfshaft components
- Worn engine or transmission mounts
- Broken cable self-adjuster
- Worn or improperly lubricated pedal components

Internal

- Worn or defective input shaft bearing
- Defective or misaligned release bearing
- Worn, misaligned or improperly lubricated pilot bearing/bushing
- Worn, bent or improperly lubricated fork
- Worn input shaft
- Improper disc installation
- Misalignment
- Damaged bearing retainer
- Loose flywheel bolts
- Damaged disc splines, worn stop pins or broken damper

PRE-TEARDOWN DIAGNOSTICS

Proper lubrication during clutch installation can reduce the chances of noise problems down the road. Squeals and growls are usually caused by worn or seized bearings. Chirping noises are usually caused by vibration somewhere in the release system. Determine the source of bearing noise by setting the parking brake, putting the vehicle in neutral and starting the engine.

Use the following test to isolate each of the four possible sources within the clutch package to identify the root cause:

SET THE PARKING BRAKE, PUT THE VEHICLE IN NEUTRAL, START THE ENGINE

1. Transmission bearing

With the vehicle running and in neutral...

Leave the clutch engaged (don't push the clutch pedal). If you hear any growling or grinding sound, the transmission input shaft is the problem.

2. Clutch release bearing

With the vehicle running and in neutral...

If you hear a chirping noise with your foot off the pedal, slowly depress the clutch pedal.

If the noise goes away as soon as the pedal load is applied, the problem is at the fork and pivot stud. Apply lubricant to each surface.

If the noise gets louder as you increase the pedal load, the clutch release bearing is the problem.

3. Pilot bearing

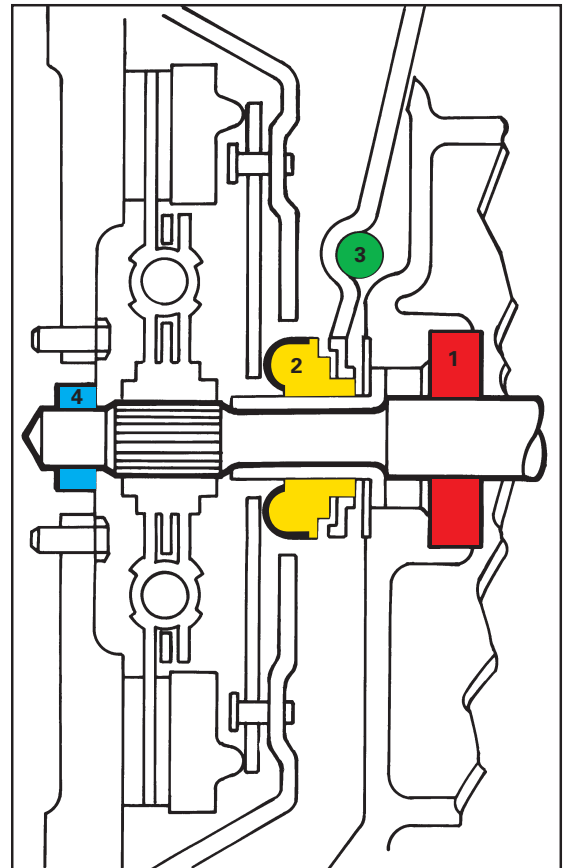
With the vehicle running and in neutral...

Depress and release the clutch pedal. If you hear a squealing noise when the engine speed and the input shaft speed are different, the pilot bearing is the problem.

4. Fork vibration

With the vehicle running and in neutral...

Lightly depress the clutch pedal, if the noise goes away there is a probably a vibration problem.



POST-TEARDOWN DIAGNOSTICS

DAMAGED DISC SPLINES

Broken or worn splines

Possible causes:

- Improper installation / misaligned
- Worn input shaft
- Wrong parts
- Defective pilot bearing

Note: A worn transmission input shaft allows excessive movement between the shaft and the disc splines. When movement occurs, high shock loads are concentrated on the splines and shaft. Failure to align the disc prior to installing the transmission can result in spline damage.

DAMAGED QUILL

Galled or worn bearing contact surface

Possible causes:

- Improper installation
- Misalignment
- Worn fork or pivot ball
- No free-play
- Insufficient lubrication

DAMAGED DISC HUB

Possible causes:

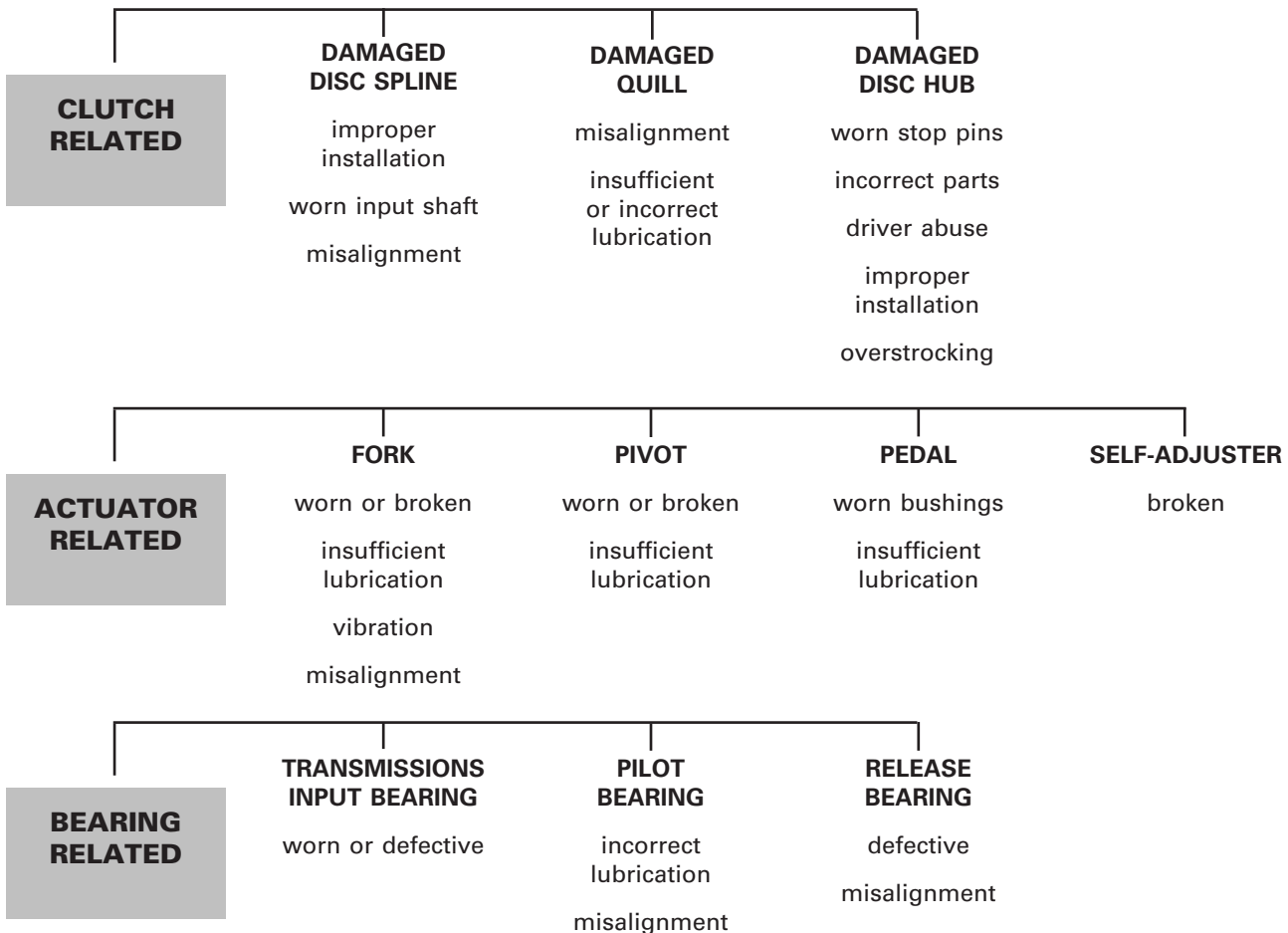
- Worn stop pins
- Driver abuse
- Incorrect parts
- Improper installation

DAMAGED RELEASE BEARING

Possible causes:

- Misalignment
- Manufacturing defect

FAILURE ANALYSIS FLOW CHART



DIAGNOSTICS - RELEASE SYSTEMS**PRE-TEARDOWN DIAGNOSTICS**

When the clutch does not release completely, the disc continues to turn the input shaft and transmission gears. Causes of incomplete release include excessive free play, air in the hydraulic system, binding or wear in release system components and a bent disc.

Movement of the master cylinder will also cause release problems. This is especially noticeable when the master cylinder is mounted to the firewall, and the firewall metal is not rigid enough to hold it in place during actuation. Any movement of the master cylinder reduces the force applied to the hydraulic piston inside, causing incomplete release. Reinforcing of the firewall may be the only solution.

CAUSES OF RELEASE PROBLEMS**External**

- Contaminated hydraulic fluid
- Incorrect release system adjustment
- Air in the hydraulic release system
- Defective or worn release system components
- Defective or worn pedal bushings or brackets
- Flexing of the firewall or any release component attachment point

Internal

- Misalignment of clutch components
- Corroded, damaged or improperly lubricated input shaft splines
- Worn pilot bearing/bushing
- Worn bearing retainer
- Bent or worn release fork or pivot ball
- Worn linkage components
- Stretched release cable
- Excessive or incorrect flywheel machining
- Bent clutch drive straps
- Bent or distorted disc
- Improper transmission lubricant
- Improper bolting of the clutch

TROUBLESHOOTING HYDRAULIC SYSTEMS**1. Check the slave cylinder piston travel for one pedal stroke.**

If it does not meet manufacturer specifications, there may be a leak in the system. Note that a master cylinder leak may be internal or external, so no fluid loss may be visible. If you suspect an internal leak, you should perform the following test: pump the clutch pedal and hold it to the floor. If it slowly begins to engage, you have an internal leak. If you have an internal or external leak, replace the failed cylinder. And always check the clutch facing and pressure plate surfaces for fluid contamination.

2. Check for leaks in the Concentric Slave Cylinder (CSC).

In the case of a leaking CSC, always replace the contaminated disc. Check for cracks at pivot and anchor points. Lubricate all pivot points with a lithium-based grease to prevent premature failure.

TROUBLESHOOTING CABLE SYSTEMS

A precise check of the cable is not possible on the vehicle, therefore, LuK recommends that a new cable be installed with every clutch replacement. Cables must be replaced if worn, stretched, frayed or broken. Check for cracks at pivot and anchor points. Lubricate all pivot points with a lithium-based grease to prevent premature failure.

BLEEDING A HYDRAULIC CLUTCH SYSTEM**REVERSE PRESSURE BLEED:**

1. Use a brake fluid dispenser pump or a pistol-type oil can and a short length of rubber hose.
 - Never use an oil can or hose that has had anything but brake fluid in it.
 - Never mix conventional and silicone brake fluids.
2. Attach the hose to the oil can or brake fluid pump.
3. Place the other end of the hose over the slave cylinder bleeder valve. Be sure to have the hose primed with fluid or more air will get into the system.
4. Finally, pump fluid back through the system until air bubbles no longer appear in the master cylinder and tighten the bleeder valve.

GRAVITY BLEED:

1. Open the slave cylinder bleeder valve.
2. Fill the master cylinder reservoir with fluid.
3. Periodically close the bleeder valve and refill the reservoir so the fluid level remains high.
4. Repeat until all air is removed from the system.
5. Close the slave cylinder bleeder valve, fill the master cylinder reservoir and replace the cap.

POST-TEARDOWN DIAGNOSTICS

BENT DRIVE STRAPS

Change in drive strap profile

Possible causes:

- Lugging the engine
- Improper handling
- Engine miss

Note: This kind of damage is most likely caused by lugging the engine, which focuses heavy shock loads on the clutch package.

BROKEN DRIVE STRAPS

Straps that have completely broken apart

Possible causes:

- Lugging the engine
- High-speed downshifting
- Driver abuse

DISC-TO-FLYWHEEL INTERFERENCE

Contact between damper spring housing and flywheel or flywheel mounting bolts

Possible causes:

- Disc installed backwards
- Flywheel too thin/over-machined
- Incorrect parts

DISC DAMAGED ON OUTER CIRCUMFERENCE

Friction material edges broken or cracked

Possible causes:

- Incorrect parts
- Mounting washers too large

Note: If incorrect washers are used under the clutch mounting bolts, they can damage the disc and may pinch the disc against the flywheel, preventing disc movement and release.

EXCESSIVE FINGER WEAR

Excessive wear on diaphragm fingers

Possible causes:

- Defective release bearing
- Malfunctioning self-adjuster mechanism
- Incorrect clutch adjustment (mechanical systems)

Note: Excessive free-play on a manually-adjusted system can cause a release problem.

DAMAGED DISC SPLINES

Broken or worn splines

Possible causes:

- Improper installation/misaligned
- Worn input shaft
- Incorrect parts

Note: A worn transmission input shaft allows excessive movement between the shaft and the disc spline. When movement occurs, high shock loads are concentrated on the spline and shaft. Failure to align the disc prior to installing the transmission can result in spline damage.

RUSTED DISC SPLINES

Splines that show evidence of corrosion

Possible causes:

- Incorrect/inadequate lubrication
- Bellhousing not sealed properly

Note: Excessive moisture in the bellhousing, combined with inadequate or incorrect lubrication of the input shaft, can cause the disc splines and the input shaft to rust. This restricts the disc from sliding freely on the shaft when the clutch is disengaged.

BENT COVER HOUSING

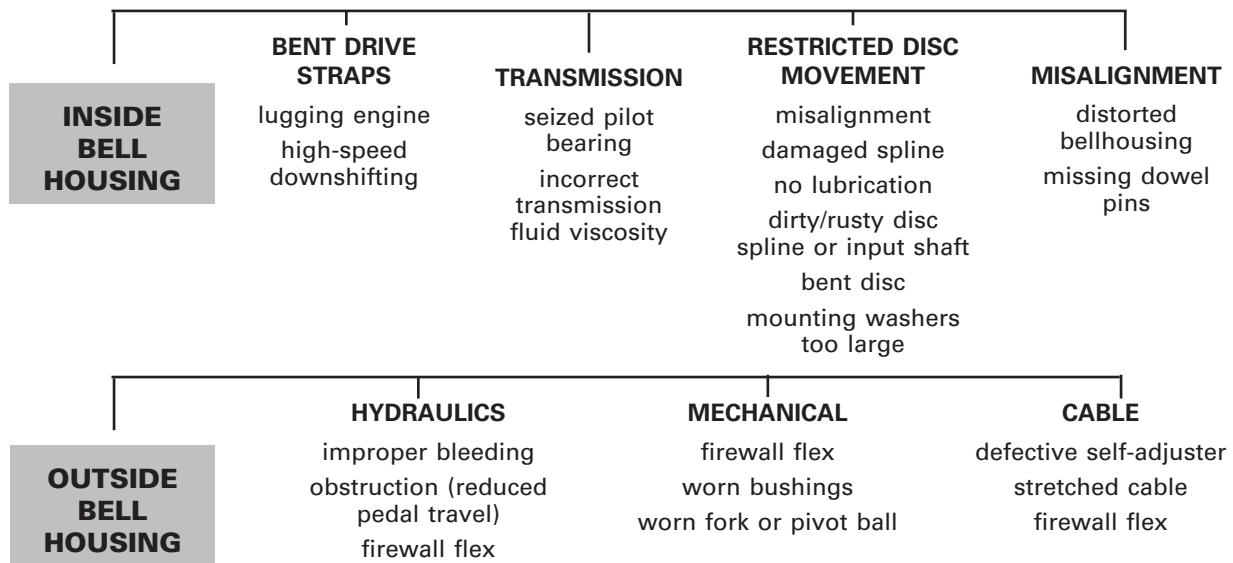
Cover does not sit flat on a flat surface

Possible causes:

- Improper handling
- Not aligned over dowel pin
- Not bolted down evenly

Note: Carefully inspect all components before installing; return any damaged components. When installing the pressure plate cover assembly, carefully align the pilot holes with the flywheel dowel pins. Bolt the cover down evenly in a "star pattern".

FAILURE ANALYSIS FLOW CHART



DIAGNOSTICS - SLIPPING

Normal wear is the most likely cause of slipping if the disc is worn down to the rivets and the clutch has high mileage. If a newly installed clutch is slipping, the most likely causes are oil or grease contamination, incorrect release system adjustment or improper flywheel machining of a stepped or cupped flywheel.

Some slipping of the clutch is normal and necessary for smooth engagement; however, once the clutch is engaged, there should be no slipping. Excessive slipping causes tremendous heat that damages the clutch pressure plate and flywheel.

To determine if the clutch slips too much, start the engine with the emergency brake set, put the transmission in high gear and slowly release the clutch pedal. If the engine stalls immediately, the clutch is not slipping. If the engine continues to run when the clutch is fully engaged, the clutch is slipping excessively. If the engine slows but continues to run, the clutch is slipping partially.

If the vehicle is equipped with a dual-mass flywheel, the flywheel may be the cause of the slipping. Carefully examine the old clutch to rule out the flywheel as the source of the slipping. Indications include heat marks on the pressure plate, disintegrated disc friction material and contamination of the friction material from external leaks. If these symptoms are not evident, install a new flywheel.

CAUSES OF SLIPPING**External**

- Incorrect release system adjustment
- Defective, worn or binding release system components
- Blocked master cylinder port
- Binding slave cylinder
- Defective cable self-adjuster

Internal

- Worn disc
- Oil leaks or excessive lubrication
- Improper flywheel machining
- Misalignment of the release bearing
- Defective dual-mass flywheel

PRE-TEARDOWN DIAGNOSTICS

Clutch slip can be caused by many things inside and outside the bellhousing. Carefully check the clutch assembly and surrounding drivetrain components to identify and repair the root cause of the problem and avoid a comeback. Clutch components aren't the only culprits. The clutch actuator mechanism, or linkage, also plays a critical role in clutch performance. If it does not function properly, slipping will result.

TROUBLESHOOTING HYDRAULIC SYSTEMS

Check the slave cylinder piston travel for one pedal stroke. If it does not meet manufacturer specifications, there may be a leak in the system. Note that a master cylinder leak may be internal or external, so no fluid loss may be visible.

1. Check clutch replacement.

The hydraulic release system must compensate for clutch wear and maintain a light pre-load between the release bearing and diaphragm fingers. If release bearing movement is restricted in any way, the clutch will not fully engage and slipping will result.

2. Check the master cylinder fluid reservoir for blockage.

Debris can settle in the reservoir, blocking the transfer of fluid between the master and slave cylinders. The release system will not be able to compensate for clutch wear.

Lubricate all pivot points with a lithium-based grease to prevent premature failure. Always flush hydraulic system to remove debris and refill with clean fluid.

TROUBLESHOOTING CABLE SYSTEMS

Check the cable for binding. LuK recommends that a new cable be installed with every clutch replacement. Cables must be replaced if worn, stretched, frayed or broken. Lubricate all pivot points with a lithium-based grease to prevent premature failure.

A WORD ABOUT FLYWHEELS

Check the flywheel for grooves, hot spots and thermal cracks; these indicate that the clutch has been slipping excessively and generating tremendous heat. Depending on the extent of the damage, the flywheel should be resurfaced or replaced. Heavily worn flywheels should be replaced. Check the condition of the starter ring gear. Replace if teeth are worn or broken.

When resurfacing stepped or cup-type flywheels, it is very important that the relationship between the friction surface and the mounting surface is maintained during the machining operation. Failure to accurately maintain this dimension will affect clutch performance.

POST-TEARDOWN DIAGNOSTICS

OVERHEATING

Heat discoloration, usually tan, brown or black

Possible causes:

- Inadequate free play
- Defective self-adjuster
- Defective hydraulic components
- Incorrect parts
- Binding linkage or release bearing
- Driver abuse

Note: If the cover and/or disc show exposure to extreme heat, it is likely that the root cause of the problem lies with the actuator mechanism: linkage rods, cable or hydraulic components.

DISINTEGRATED FRICTION MATERIAL (damaged by excessive heat)

Friction material is broken down, fibrous and/or powdery

Possible causes:

- Inadequate free play
- Defective self-adjuster
- Defective hydraulic components
- Incorrect parts
- Binding linkage or release bearing
- Driver abuse

Note: If a clutch is operated partially released for a prolonged period (or under heavy loads), the amount of heat generated will exceed the engineered limits of the friction material. Generally, an overheated pressure plate and disintegrated friction material are seen together.

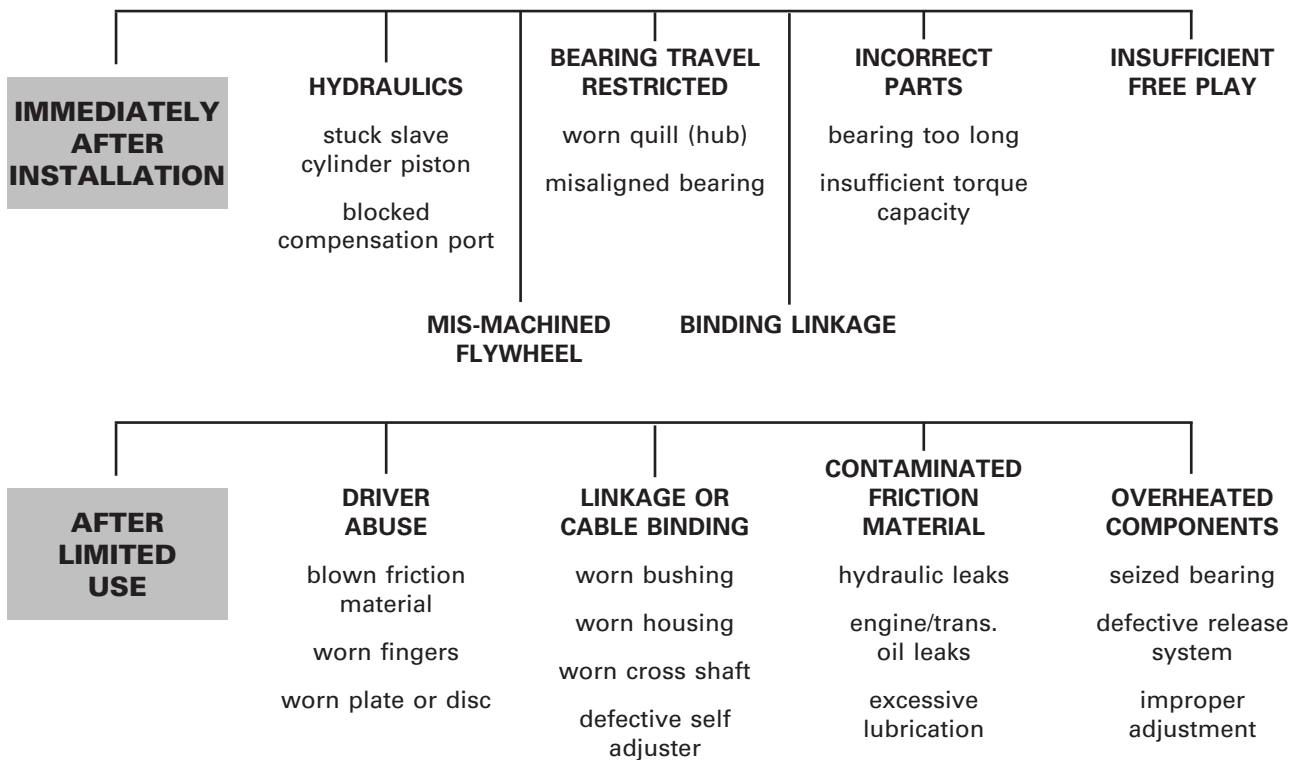
CRACKED OR BROKEN FRICTION MATERIAL

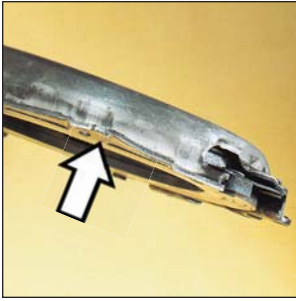
Large chunks of broken friction material - No evidence of excessive heat

Possible causes:

- Improper handling
- Manufacturing defect

FAILURE ANALYSIS FLOW CHART





Bent Clutch Cover

Related Symptom:
Release problems.

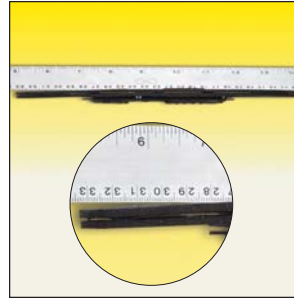
Cause:
Damage prior to installation, misaligned flywheel dowel pins, improper installation of the clutch.



Bent Clutch Drive Strap

Related Symptom:
Chatter, no release.

Cause:
Excessive vehicle load, high-speed downshifting, lugging the engine, improper handling causing damage prior to installation.

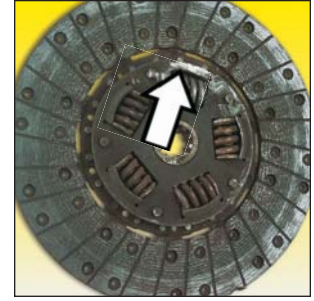


Bent Disc

Related Symptom:
Chatter.

Cause:
Improperly supported transmission during installation, disc installed backwards.

Incorrect installation of the disc will result in interference between the disc and flywheel, causing clutch malfunction.



Broken Cover Plate

Related Symptom:
No release.

Cause:
Driver abuse over-torquing the disc, lugging the engine, high RPM engagement, harsh downshifting, vehicle suspension or engine modifications.

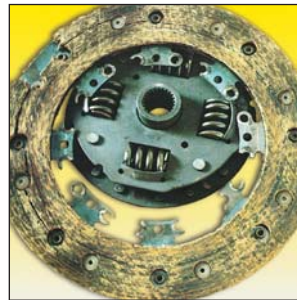


Broken Hub

Related Symptoms:
Noise, engagement problems.

Cause:
Disc was not properly aligned and the transmission input shaft was forced into the hub, shoving the center of the hub out.

The abrasion marks on the leading edge of the disc splines indicate the input shaft was forced onto the hub. Never force the transmission into the disc or use the bell housing bolts to pull a transmission into place.



Broken Segments

Related Symptom:
Noise.

Cause:
High RPM engagement, worn pilot bearing, worn transmission input shaft bearing, misalignment between the engine and transmission, improperly supported transmission during installation.

If the transmission jack is removed before the transmission is properly bolted to the engine, the weight will bend the input shaft, causing uneven engagement and partial release.

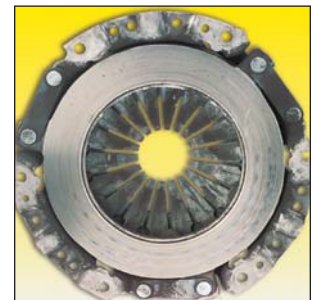


Broken Torsion Damper

Related Symptoms:
Harsh engagement, no release.

Cause:
High RPM engagement abusing the torsion damper and causing the springs to fracture and dislodge from the retainer plate.

A no-release condition will result if the springs lodge in other clutch system components.

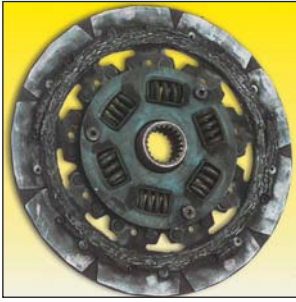


Chatter Marks

Related Symptom:
Release problems.

Cause:
Incorrect installation of the clutch. The clutch was distorted when it was bolted to the flywheel incorrectly.

Chatter marks were caused by the uneven actuation of the diaphragm spring fingers. Heavy finger wear would be evident on the diaphragm spring fingers opposite the chatter marks.



Burnt Friction Material

Related Symptoms:
Chatter, release problems.

Cause:
Riding the clutch, defective release system, improper release system adjustment, clutch components unsuited for the torque of a modified engine, friction material contamination during installation.



Burst Friction Material

Related Symptoms:
Hard pedal, chatter.

Cause:
Harsh downshifting, high RPM engagement, engine over-revving caused by missing a gear, coasting vehicle at a high speed with transmission in gear and clutch disengaged.

The clutch may have friction material embedded between the diaphragm spring and the cover.



Contact Marks

Related Symptoms:
Excessive pedal free play, noise.

Cause:
Incorrect release bearing installation.

The fork was installed with the leaf-spring clip over the top of the release bearing collar, causing uneven force to be applied to the bearing.

The fork must be installed with the clip under the collar.



Contaminated Clutch

Related Symptom:
Slipping.

Cause:
Leaking transmission or engine seal.

On high mileage vehicles, always replace the rear main bearing and the transmission input shaft seals.



Contaminated Friction Material

Related Symptom:
Chatter.

Cause:
Leaking transmission or engine seal, excessive lubrication.

Lubricate input shaft splines with a very small amount of high-temperature grease. Slide the disc on the splines to distribute a thin film. Remove the disc and wipe away any excess.

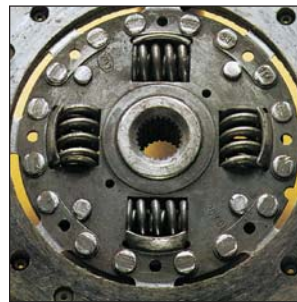


Cracked Cable Housing

Related Symptoms:
Hard pedal, chatter.

Cause:
Incorrectly routed or pinched cable.

A number of problems can occur inside the cable housing, causing the cable to stick or bind. Always replace the cable on vehicles equipped with cable release systems.

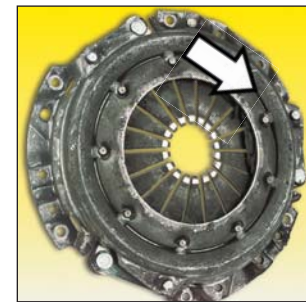


Damaged Volkswagen Disc

Related Symptom:
Noise.

Cause:
Incorrect installation of the wire ring.

The wire ring was not properly seated during installation. After installation, the clutch must be cycled prior to start up to ensure the ring is fully seated under the tabs of the diaphragm spring.



Embedded Friction Material

Related Symptoms:
No release or engagement.

Cause:
Harsh downshifting, high RPM engagement, engine over-revving caused by missing a gear.

The disc friction material burst when the clutch was disengaged, lodging friction material between clutch system component parts.



Excessive Finger Wear

Related Symptoms:
Slipping, noise.

Cause:
Excessive bearing preload caused by riding the clutch, incorrect release bearing installation, defective hydraulic release system or cable self-adjuster, insufficient free play causing the bearing to ride constantly on the diaphragm spring fingers.

The release bearing may seize or make noise before slipping is noticed.

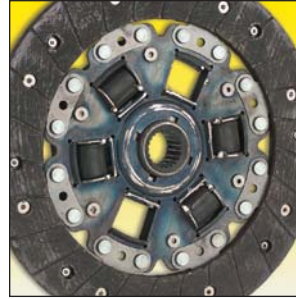


Excessive Lubrication

Related Symptoms:
Slipping, release problems.

Cause:
Excessive lubrication of the input shaft splines.

On startup, the excess lubrication spun off the input shaft onto the pressure plate.

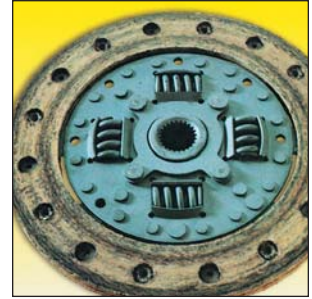


Flywheel Interference

Related Symptoms:
Noise, problems with disengagement.

Cause:
Excessive flywheel machining causing the disc to contact the flywheel mounting bolts, installing the disc backwards, failure to maintain proper flywheel step dimensions.

If the flywheel shows signs of extreme overheating and deep scoring, replace it.



Friction Material Contact

Related Symptom:
Chatter.

Cause:
Flywheel not resurfaced or resurfaced improperly.

The flywheel must have a smooth, flat surface in order for the clutch to actuate properly.



Friction Material Contamination

Related Symptom:
Slipping.

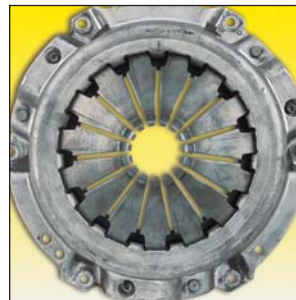
Cause:
Leaking transmission or engine seal, contamination of the friction material during installation.



Grooves and Heat Marks

Related Symptom:
Release problems.

Cause:
Riding the clutch, defective release system, improper release system adjustment, clutch components unsuited for the torque of a modified engine, improper resurfacing of a step/cup flywheel.



Melted Fingers

Related Symptoms:
No release, extreme noise, slipping.

Cause:
Worn bearing retainer, incorrect release bearing installation, worn or bent fork.

The release bearing seized and stopped rotating. The contact marks on the diaphragm fingers were caused by abrasion and heat from constant contact with the bearing. The release bearing would be melted, blue and/or destroyed.



Overheated Pressure Plate

Related Symptom:
Release problems.

Cause:
Riding the clutch, defective release system, improper release system adjustment, clutch components unsuited for the torque of a modified engine.

The disc would have burnt friction material.



Pressure Plate Heat Rings

Related Symptom:
Chatter.

Cause:
Oil contamination, flywheel not resurfaced or resurfaced improperly, failure to maintain flywheel step/cup dimensions.

When resurfacing a stepped or cupped flywheel, be sure to machine the contact surfaces by equal amounts to maintain specified tolerances.

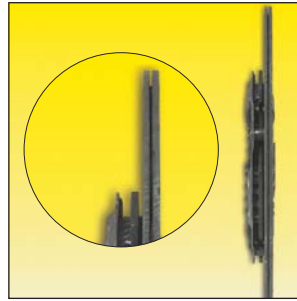


Uneven Finger Wear

Related Symptoms:
Incomplete release, noise.

Cause:
Incorrect installation of the clutch. The clutch was distorted when it was bolted to the flywheel incorrectly.

The pressure plate side would have chatter marks on the side opposite the lighter finger wear.



Uneven Friction Material Wear

Cause:
Riding the clutch, defective release system, improper release system adjustment, use of clutch components unsuited for the torque of a modified engine.



Worn Bearing Retainer

Related Symptoms:
Hard pedal, incomplete release.

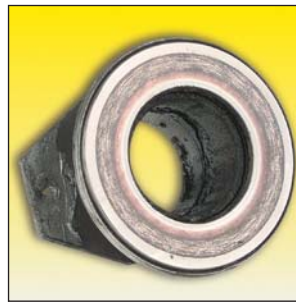
Cause:
Incorrect release system adjustment, worn fork or fork pivot points, insufficient lubrication of the bearing retainer, worn ball stud causing the fork to apply uneven pressure to the release bearing.

For the clutch to function properly, the bearing retainer must have a smooth surface and be exactly parallel to the input shaft.



Worn Friction Material

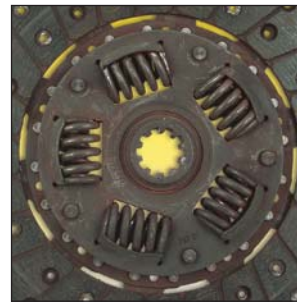
Cause:
If the clutch has high mileage, this wear is normal; however, if mileage is low, possible causes include riding the clutch, excessive vehicle loading, defective release system, improper release system adjustment, improperly machined flywheel, clutch components unsuited for the torque of a modified engine.



Worn Grooves

Related Symptoms:
Slipping, chatter.

Cause:
Excessive bearing preload caused by riding the clutch, incorrect release system adjustment, defective hydraulic release system.

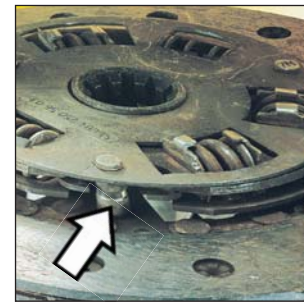


Worn Splines

Related Symptoms:
Harsh engagement, chatter.

Cause:
Worn pilot bearing, worn input shaft, misalignment between the engine and transmission.

Check for misalignment on high-mileage vehicles and those in which the engine or transmission was replaced.



Worn Stop Pins

Related Symptom:
Chatter.

Cause:
Driving in high gear at low RPMs, causing the disc torsion damper to contact the stop pins, high RPM engagement, excessive vehicle loading.