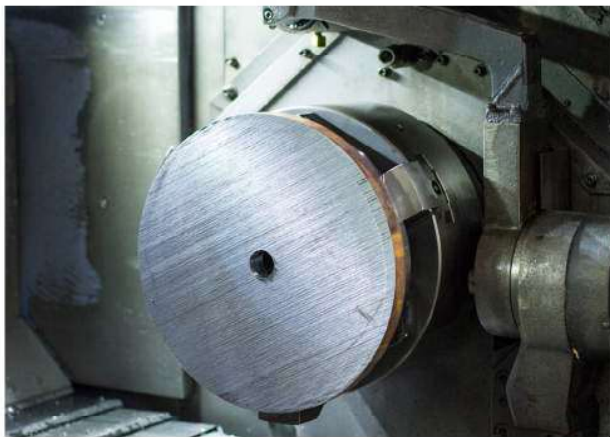
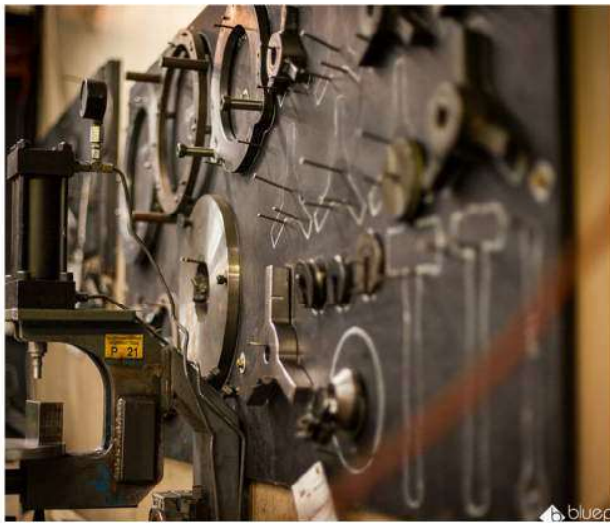


UNDERSTANDING
CLUTCH
SYSTEMS



69 YEARS OF AUSTRALIAN MANUFACTURING



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Australia's world-class clutch manufacturer

Clutch Industries (CI) is a full-service clutch manufacturer, manufacturing clutch kits, clutch cover assemblies, clutch plates and flywheels. Clutch Industries manufacturing and test facility is world class, having been an original equipment supplier for Ford, Holden, Nissan, Mitsubishi and Toyota. With more than 68 years of local design, development and manufacturing experience, we have become the largest and most experienced clutch manufacturer in Australia. We are uniquely placed in terms of both experience and capabilities to provide the widest range of professionally engineered products in the market today.

CI is known for its bold innovation, through identifying our core competencies, we have been able to leverage our strengths and compete successfully in both Australia and overseas markets. An extensive Research and Development (R&D) department with highly experienced engineering and innovation capabilities enabling us to differentiate ourselves from competitors in both product and services.

In particular, is our capability to provide the widest range of professionally engineered products in the category, all supported by an outstanding after sales support and service network. With our head office located in Thomastown, Victoria. In addition to their head office location, Clutch Industries has distribution centres in Melbourne, Sydney, Perth, Tasmania, Brisbane, New Zealand, United Kingdom and the United States.

RepcO start their Clutch Manufacturing Division in Melbourne

RepcO Brakes (PBR) and **RepcO Clutch** manufacturing division bought by **BBA Group**

Clutch manufacturing department (known as **PBR Clutch**) of **BBA Group** is sold off forming **Clutch Industries Pty Ltd**

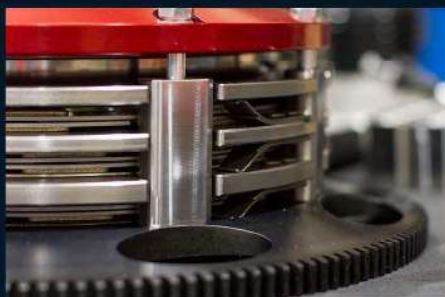
Clutch Industries celebrates their 65th anniversary of manufacturing clutch system in Australia

1951

1986

2002

2016



INTERNAL COMBUSTION ENGINE.

A common theme in most things automotive is the internal combustion engine. Pistons move up and down and work together to spin the crankshaft.

The spinning of the crank shaft delivers the **torque** to the driving wheels. Torque originally meant “to twist” and is now defined as a force that tends to cause rotation.

There’s no surprise that the engine torque (the rotation or spinning of the crank) is the force that rotates the wheels, but if an engine were connected directly to the wheels, they would turn all the time. Drivers couldn’t sit at idle, wait at lights or change gears comfortably.

Drivers need to be able to connect and disconnect the spinning motion of the crankshaft without turning off the engine, and that’s where the clutch comes in.

WHAT IS A CLUTCH?

The clutch is a coupling that sits between the engine and gearbox. Its purpose is to **connect and disconnect** the engine’s torque to the gearbox and driving wheels.

WHY IS IT CALLED A CLUTCH?

To clutch something is to grasp something tightly - **grab hold of it**.

A good way to look at it is that a clutch is a way of grabbing hold of the torque of the engine (and letting go of it as well).

WHAT’S THE PRINCIPLE?

A clutch is just like a vice. You have two sides to the vice that are designed to clamp down onto something, in this case a clutch plate. When the vice is tightened the disc is held, when the vice is loosened, the clutch plate is not held.



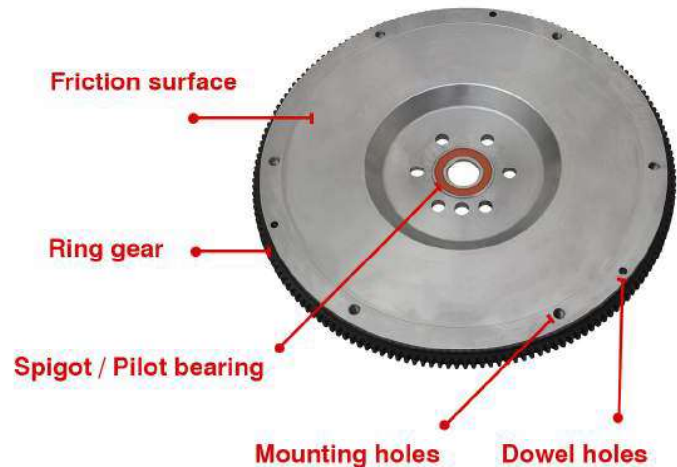
COMPONENTS OF A CLUTCH

1. FLYWHEEL

The flywheel is one side of the vice. It is a big metal disc that bolts directly to the crankshaft. Its role is to:

- Provide a flat clamping surface for the clutch plate to match up to.
- Keep momentum, it's a heavy mass that keeps turning the crank.
- Take heat away from the clutch plate.

Because the flywheel is bolted directly to the crank, the flywheel will always spin at the same rate as the crank shaft of the engine. (Around the outside of the flywheel you will find a ring gear. Although it is part of the flywheel, ring gears have nothing to do with the clutch itself. They work with the starter motor).



2. GEARBOX INPUT SHAFT

A small but very strong shaft. At one end is a locating pin that sits in the centre of the flywheel/crank. A spigot bearing sits in the centre of the flywheel, on the locating pin of the shaft. Because the input shaft is not bolted to the crank, it does not turn with the crank, it just uses it as a locating point.

The opposite end of the shaft is connected to the gearbox. Along the shaft you'll find gear teeth, called the spline, these match the centre hole of the clutch plate.

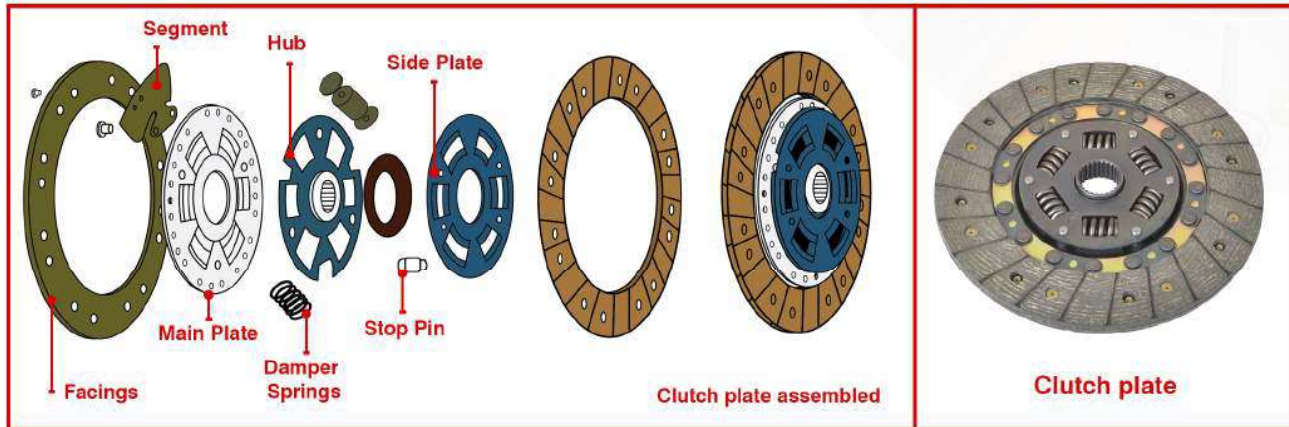
The gearbox input shaft's purpose is to:

- Line up the gearbox with the centre of the crank shaft, keeping the rest of the drive train straight and true to the crank.
- Give the clutch plate something to locate onto and position itself.



3. CLUTCH PLATE

The clutch plate is a disc that slides over the gearbox input shaft. The spline or teeth at the centre of the clutch plate match the teeth of the gearbox input shaft. When the clutch plate slides over the shaft, the matching spline teeth mean the clutch plate is keyed or locked into the gearbox input shaft, and is positioned flat to the flywheel.

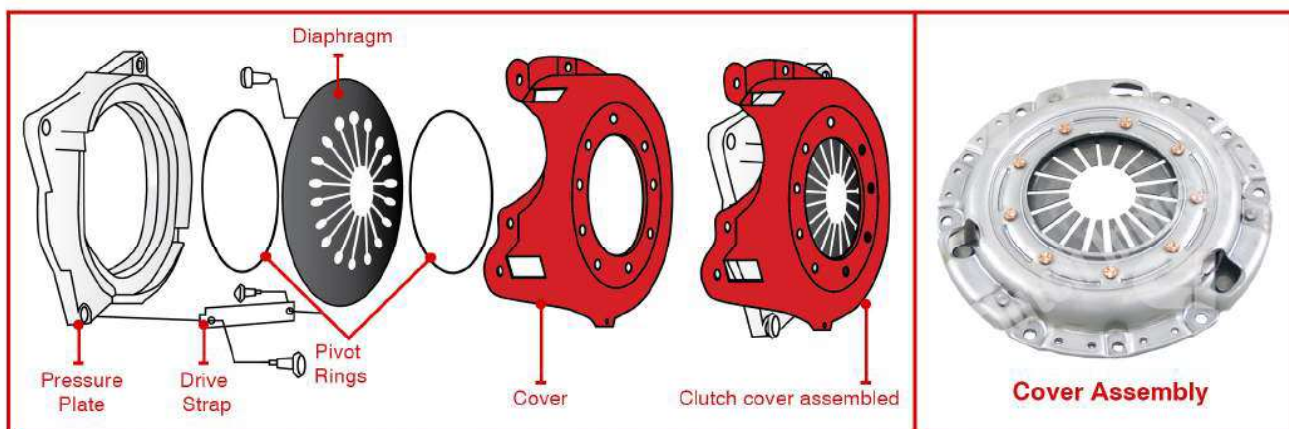


Around the outside of the clutch plate, on both sides, there is a hoop of friction material. The friction material riveted to the disc is designed to grip the flywheel. Because of the interlocking spline, the clutch plate and gearbox input shaft will then turn together.

'When things rub together friction comes into play. In some cases you don't want friction, so a lubricant is used. In other cases you want the friction and use materials to maximise it to achieve grip. Examples of friction material include brake pads, tyres and the material on clutch plates.'

4. COVER ASSEMBLY

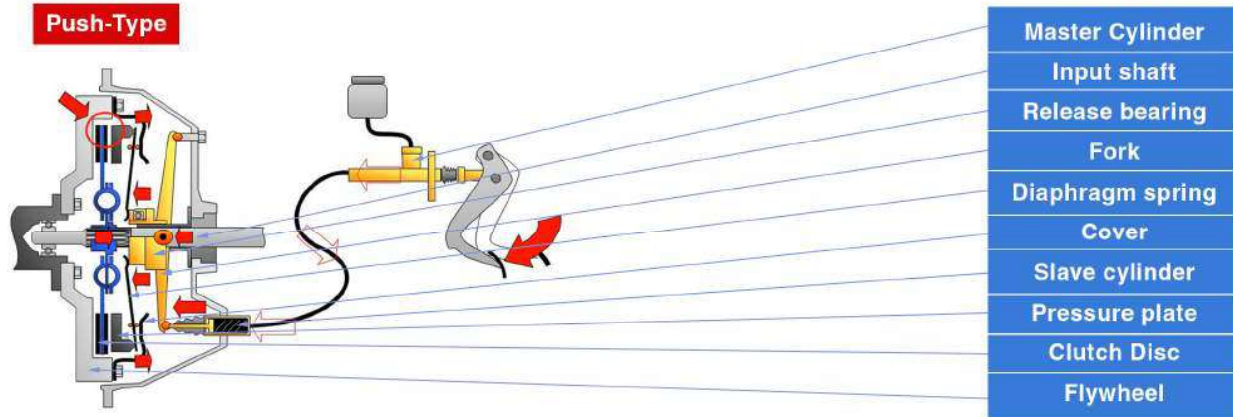
The cover assembly bolts to the flywheel and over the clutch plate. The purpose of the cover assembly is to carry the matching surface (a heavy metal casting) for the flywheel, and a spring loaded system that pushes the casting towards the flywheel. Together the cover assembly and flywheel work just like a vice and work together to clamp down onto the friction material of the clutch plate. When the cover is bolted to the flywheel, its default position is clamped. The vice is tightly clamped onto the clutch plate.



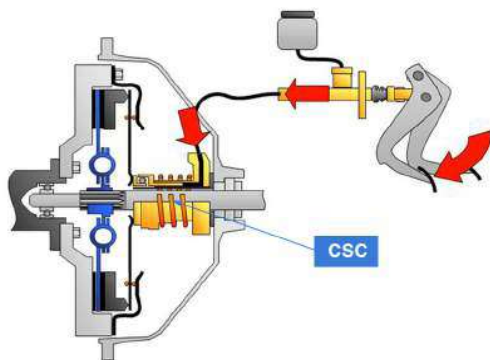
COMPONENTS OF A CLUTCH

5. ACTUATION SYSTEM

To disconnect the clutch, or let go of the torque, you have an actuation system which starts at the pedal and ends at the clutch cover assembly. The Thrust Bearing in a 3 piece clutch kit is one component of the actuation system.

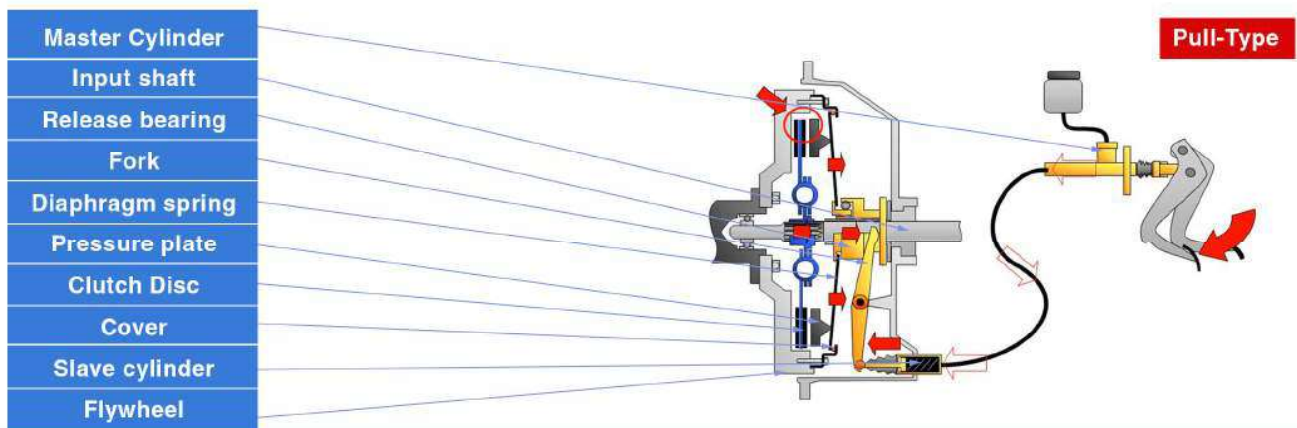


Concentric Slave Cylinder (CSC)



Putting your foot on to the clutch pedal is the same as winding back one side of the vice. When you push onto the pedal, it works a series of connected parts which end with a push onto the spring loaded part of the cover assembly. The spring load is taken off and because the clutch plate is no longer clamped to the flywheel, it stops spinning at the same rate as the crank. It means you have disconnected drive.

Remember the locating pin of the gearbox input shaft is just a locating pin. It will sit in the flywheel, but is not bolted to it so it won't spin at the same rate.

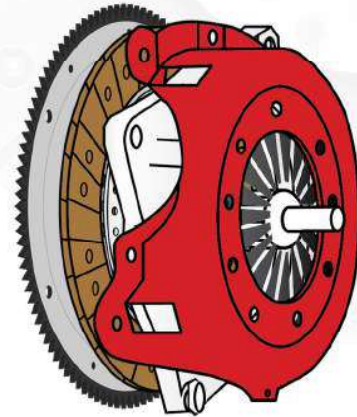


The simplest way is to think of two sides.

One side is the vice that is the flywheel and cover assembly. They are both connected to the crank shaft. They turn together, carrying the engine torque, and work together to clamp onto the clutch plate.

The other side is the assembly that is the clutch plate and gearbox input shaft. Being keyed together, the clutch plate and gearbox input shaft will always turn together.

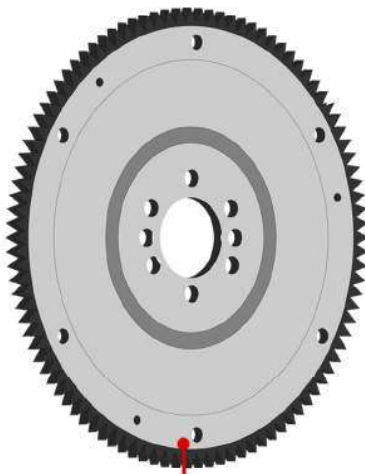
When the flywheel and cover assembly clamp onto the clutch plate:



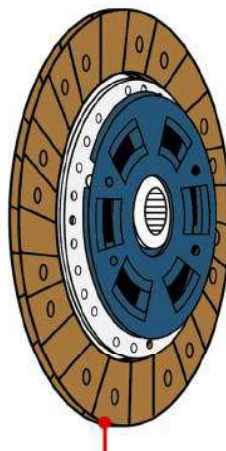
Complete Clutch Assembly

- *The friction material grabs.*
- *The clutch plate and gearbox input shaft start spinning at the same speed as the flywheel.*
- *The torque (turning motion of the engine crank) is now being delivered to the gearbox via the clutch plate and input shaft, therefore the wheels are turning.*

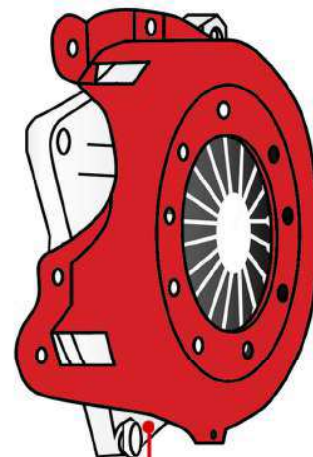
When the clutch pedal is pushed, the actuation system works on the spring loaded part of the cover assembly. It winds back the vice and there is no clamp on the clutch plate, it stops turning and torque is disconnected.



Flywheel



Clutch Plate



Clutch Cover

UPGRADES

An factory vehicle comes fitted with a standard clutch. The largest category of clutch sold is standard replacement kits but we're not all standard drivers. If an engine is modified from standard to improve performance or if the vehicle is under a higher strain than normal (carrying or towing heavy weight) an upgraded clutch might be needed.

There are three methods of upgrading a clutch;

1) CLAMP LOAD

Increasing the clamp load on the cover assembly is a common way to get more torque capacity from your clutch system. It involves increasing the load exerted by the diaphragm to clamp the clutch disc between the pressure plate and the flywheel. The amount of clamp increase is limited as this can make the clutch pedal feel heavy and put strain on the clutch actuation system (hydraulics or cable ect.).



2) FRICTION MATERIAL

Changing the friction material on a clutch disc can increase the torque capacity and can improve the thermal properties. Common clutch disc materials are;

Organic – Most commonly used on OE applications this material is great for drivability but is not suited for high performance applications due to poor torque capacity when hot.

Aramid – Generally a mixture of organic and aramid this compound has the drivability of standard organic material with much higher torque capacity and better heat resistance. Found in 4Terrain Ultimate this material is perfectly suited to 4WD applications where higher performance is needed without any compromise to drivability.

Cerametallic/Ceramic - Suited to high performance or race applications this material can handle a high level of heat while also giving a massive increase in torque capacity. Unfortunately, the drivability is significantly decreased as the material gives a more aggressive engagement than organic material. This material can be found in the Mantic performance range.



Increasing the size or the surface area of a clutch increases the torque capacity of the system, however unlike brakes you're generally not able to simply install a larger clutch. There are two methods that are used by performance clutch manufactures to increase the surface area;

Multiple Plates

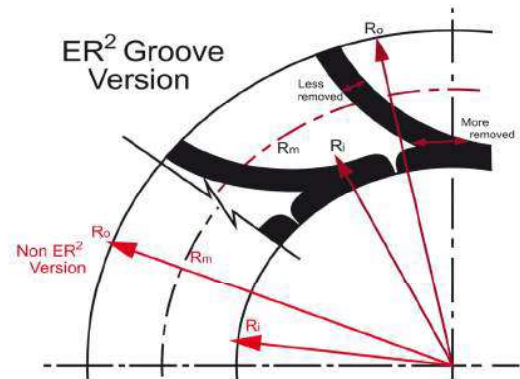
Installing twin or triple plates in most cases can be done without modifying the bellhousing and can double or triple the torque capacity without having a detriment to the drivability. The Mantic Track series has a range of twin and triple plate kits which feature several different plate options to suit various applications from street to track.



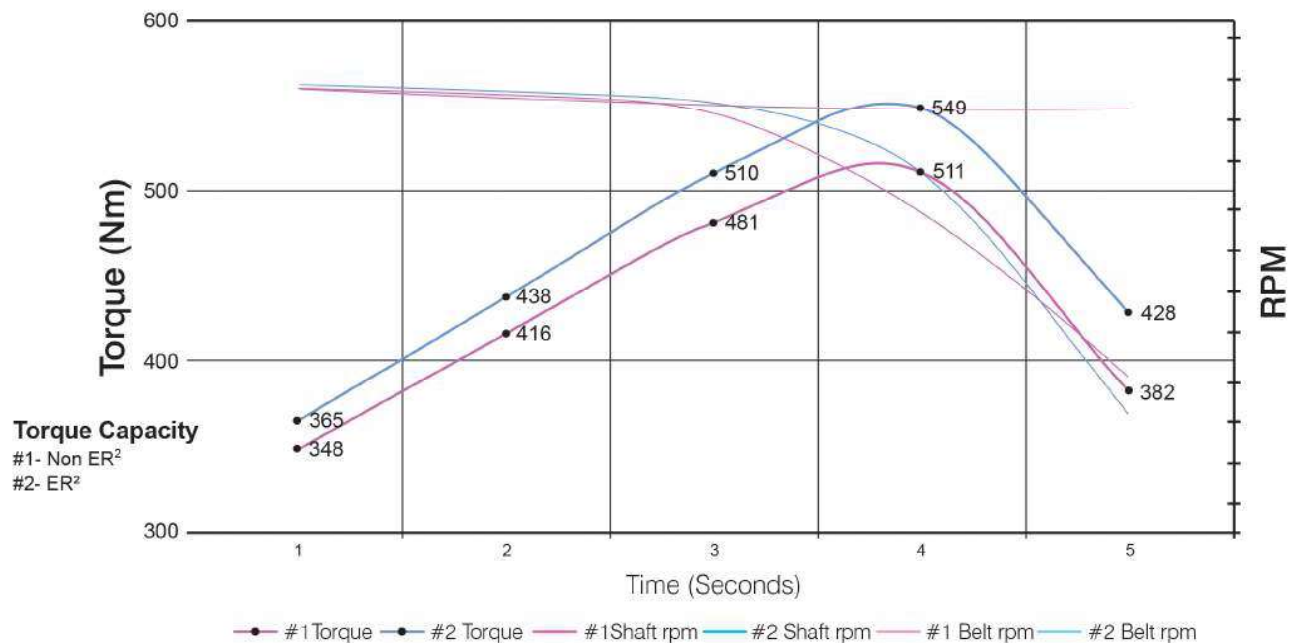
ER² Groove

This groove is a patented system that has been specifically designed to increase the Mean Effective Radius of the pressure plate and assist in heat removal. The increase in the Mean Effective Radius of the cover assembly gives a significant increase in torque capacity.

By adding the groove to the pressure plate, the inside radius of the friction face has effectively been increased. The first 5/16 inches (7.9375mm) of the pressure plate has all but been removed and added to this, there is progressively less material removed as the radius increases. The net effect of this is to move the effective inside radius further out.



The Mean Effective Radius of the clutch is directly proportional to the torque capacity of the system. Therefore as the Mean Effective radius increases so does the Torque Capacity of the clutch. This system can be found in both the Mantic and 4Terrain performance clutch range.



POPULAR BRANDS



2 Year Warranty
or
40,000 kms
*Conditions apply

PREMIUM CLUTCH KIT

- Widest range of passenger, light commercial and commercial clutch kits.
- Made to meet or exceed O.E specifications.

OE SPEC

HEAVY DUTY CLUTCH

- Suits popular hardworking vehicles.
- 20% increased torque capacity
- Value upgrade over standard clutch.

3 Year Warranty
or
50,000 kms
*Conditions apply



BASIC UPGRADE



3 Year Warranty
or
50,000 kms
*Conditions apply

Terrain OFF-ROAD ENGINEERING

- Designed for off-road vehicles.
- SG Iron ER² grooved unbreakable pressure plate.
- Improved clutch disc

4X4 PERFORMANCE

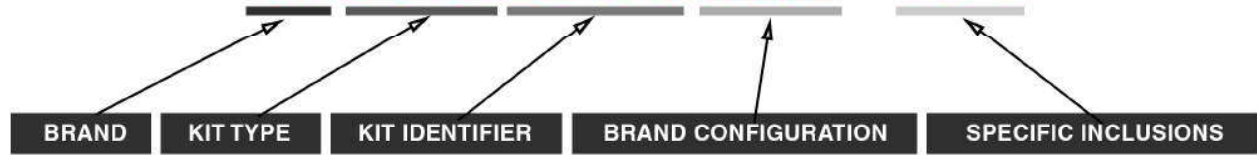
mantic CLUTCH

- Designed for performance street & track vehicles
- Various clutch disc options
- Multiple plate kits available



PASSENGER PERFORMANCE

4TDMR2780NHD-CSC



COMMON BRAND PREFIX

4T = 4Terrain

4TU = 4Terrain Ultimate

MS = Mantic Stage (1-5)

M9 = Mantic 9000 Series

COMMON KIT TYPE PREFIX

DMF = Dual Mass Flywheel; kit inc. dual mass flywheel

DMR = Dual Mass Replacement; conversion kit to replace dual mass flywheel

MR = Multi Rate clutch disc; kit inc. a multi rate clutch disc

R = Standard clutch kit

SK = Service Kit; suits CI DMR solid flywheel

SRF = Steel Replace Flywheel; kit inc. flywheel

COMMON BRAND POSTFIX

N = New kit

HD = Heavy Duty; used in both the 4Terrain and CI range

COMMON KIT INCLUSION POSTFIX

CSC = Concentric Slave Cylinder

SA = Self Adjusting Customer

SSCC = Sprung, Segment, Cushioned Ceramic Disc

SSC = Sprung, Segment Ceramic Disc

SC = Segment Ceramic Disc

Designed and manufactured to replace the clutch system installed as Original Equipment, reliable is the term which best describes the CI standard replacement kits. This range provides a Quality Assured replacement part that will meet or exceed the requirements of an original vehicle.



CI KITS FEATURE:

- > Chrome Vanadium Diaphragm for maximum durability
- > Forged clutch disc hubs for maximum strength
- > Clutch disc run out specification <0.5mm for smooth engagement
- > Flywheels are balanced to <70gcm (gram centimeters)
- > Release bearings dynamically tested to 1,500,000 cycles at 180°C
- > Premium friction materials for maximum torque capacity

COMPONENTS DESIGNED TO MEET THE FOLLOWING SPECIFICATIONS:

- > AS 1830 T2220
- > UNI 8893h
- > SAE 6150
- > AISI 1045

CI HEAVY DUTY

CI Heavy Duty (HD) clutch system is a tough, no-nonsense clutch upgrade. Engineered to handle loads of torque, it leaves standard specification clutches behind. The HD clutch is built to endure the rugged demands of workhorse vehicles. A logical choice for those who demand relentless reliability. The HD clutch system is ideal for vehicles involved in activities that subject standard clutches to higher than usual loads. It is equally comfortable navigating congested city streets.



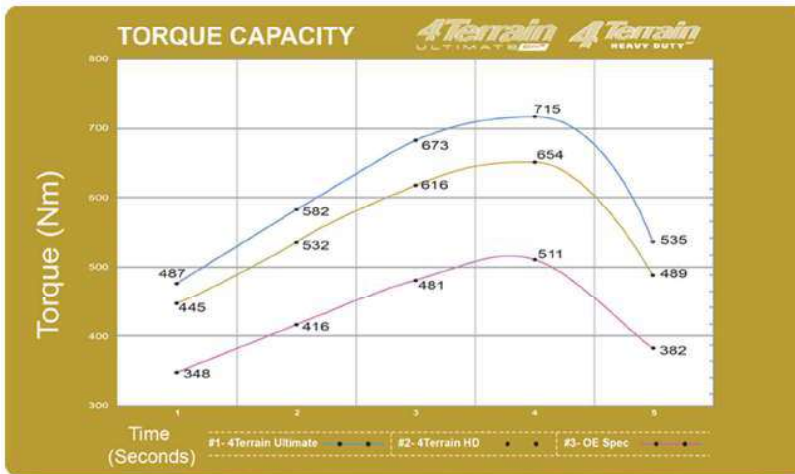
- > Towing
- > Engine modification
- > Delivery driving
- > Trade use

HD clutches have minimum of 20% increase in torque capacity, that provides a reduction in 'slip' while simultaneously increasing the delivery of power over a wider horsepower range. They provide drivers with a powerful next level upgrade to standard kits.

4Terrain Heavy Duty is a tough, no-nonsense clutch upgrade designed for hardworking vehicles. Engineered to handle high torque loads it leaves standard specification clutches behind.

The system has been engineered for the following uses that need higher than original torque capacity:

- > Towing
- > High weight loads
- > Trade/commercial use

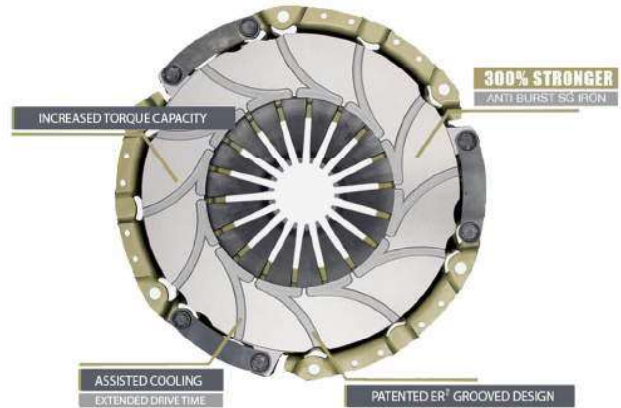


4Terrain Heavy Duty delivers an increase in torque capacity through the patented ER2 heavy duty cover assembly. This system features an increased clamp load of on average 20% higher than OE. The system also gains torque capacity from the Spheroidal Graphite Iron (SG Iron) ER2 grooved pressure plate. This groove has been specifically designed to increase the Mean Effective Radius of the pressure plate and assist in heat removal. The increase in the Mean Effective Radius of the cover assembly gives a significant increase in torque capacity.

The 4Terrain Heavy Duty Clutch system is built to endure the rugged demands of workhorse vehicles. It's a logical choice for anyone who demands relentless reliability.

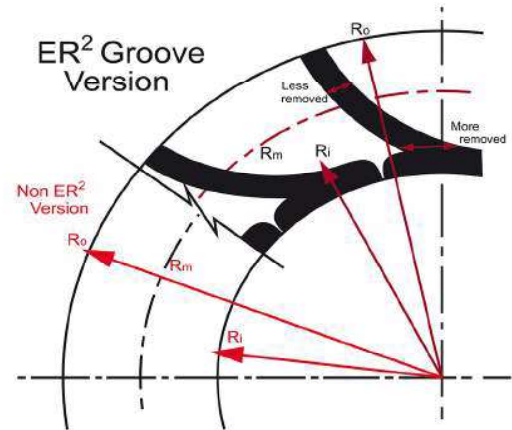


4T Ultimate with Patented* ER² Groove Design has many features which make the product unique. It is comprised of a cover assembly, clutch disc and release bearing (Some kits also include a solid replacement flywheel or DMR). The cover assembly incorporates a premium corrosion resistant surface finish, which exhibits excellent resistance to oxidation over a prolonged period. In addition, the clutch pressure plate incorporates 4T Ultimate's exclusive ER² design technology.



The cover assembly's pressure plate is manufactured from Spheroidal Graphite casting material and has a yield strength some 300% higher than standard castings. The material's microstructure also improves heat dispersion. The cover assembly incorporates greater clamp load than a standard cover assembly. This translates to more torque capacity.

The Patented* pressure plate with ER² grooves are precision machined with CAD/CAM technology. The design enhances the performance in 2 ways. Firstly, it increases the torque capacity of the cover assembly and secondly it assists with cooling which in-turn enables the friction material to operate at lower temperatures and therefore at a higher coefficient of friction. Again, this enhances the torque capacity of the clutch.



The kit's clutch disc has a unique flywheel side friction material. The Aramid friction material exhibits 50% less wear than a conventional clutch disc's friction material. This material also reduces the effects of clutch fade. Fade is the decline in the clutch system's ability to transmit torque as operating temperatures increase.

It also means that the clutch system is capable of transmitting up to 60% more torque than a standard Clutch Kit making it suitable for demanding conditions. This overall Torque Capacity increase has been achieved by higher Clamp Loads, increased Mean Effective Radius of the pressure plate, better cooling and higher coefficient of friction materials on the clutch disc.

PASSENGER PERFORMANCE UPGRADE

STAGE STREET



Mantic Stage 1 and Stage 2 clutch kit Cover Assemblies feature the Patented* ER² Groove Design, which is a unique groove pattern CNC machined on the friction face of the pressure plate. This groove has been specifically designed to increase the Mean Effective Radius of the pressure plate and assist in heat removal. The increase in the Mean Effective Radius of the cover assembly gives a significant increase in torque capacity.

STAGE 1 / ER² ORGANIC

Features an upgraded cover assembly with organic disc and ER² grooved Spheroidal Graphite (SG) iron pressure plate. Providing up to a 40% torque capacity increase over OE while not compromising drivability.

STAGE 2 / ER² DUAL FRICTION OC

Features an upgraded cover assembly with OC (combined organic / cerametallic) disc and ER² grooved SG iron pressure plate. This system gives up to an 80% increase in torque capacity while still having excellent drivability.

STAGE SPORT

STAGE 3 / SPRUNG CENTRE CUSHIONED CERAMETALLIC

Features an upgraded cover assembly with sprung cushioned cerametallic disc and SG iron pressure plate. Giving up to a 100% torque capacity increase, this system is designed for track as well as street use.



STAGE 4 / SPRUNG CENTRE UNDAMPENED CERAMETALLIC

Features an upgraded cover assembly with sprung undampened cerametallic disc and SG iron pressure plate. Giving up to a 100% torque capacity increase, this system is designed for track use.

STAGE 5 / RIGID CENTRE UNDAMPENED CERAMETALLIC

Features an upgraded cover assembly with rigid centre undampened cerametallic disc and SG iron pressure plate. Giving up to a 100% torque capacity increase, this system is aggressive and is only for track use.



* Torque capacity increase is only a guide based on a peak torque capacity figure which is dependent on your vehicle.

STREET TWIN / TRIPLE DISC KIT

The Mantic Street 9000 series is a 9" (230mm) diameter multiple application clutch system.

Available in twin and triple disc configurations with various disc options to suit street and track use.

STREET / ORGANIC

The organic plate option provides outstanding levels of torque capacity, with low pedal effort (light pedal) which is designed to be driven everyday. The twin configuration holds up to 1,230Nm of peak torque while the triple holds up to 1,845Nm of peak torque.

STREET / SPRUNG CENTRE CUSHIONED CERAMETALLIC

The sprung centre cushioned segmented cerametallic clutch disc offers a level of performance above organic discs, while still being able to be used for street as well as track applications.

The twin configuration holds up to 2,050Nm of peak torque while the triple holds up to 3,075Nm of peak torque.



SPORT TWIN / TRIPLE DISC KIT

SPORT / RIGID CENTRE CUSHIONED CERAMETALLIC

The rigid centre cushioned cerametallic disc allows for a harder driving style while also providing some dampening. Designed for track applications that still require some compromise for driveability.

The twin configuration holds up to 2,050Nm of peak torque while the triple holds up to 3,075Nm of peak torque.

SPORT / RIGID CENTRE UNDAMPENED CERAMETALLIC

The rigid centre undampened cerametallic disc is the most aggressive level in the Mantic 9000 range. Designed for pure performance, the engagement is sudden, limiting the chance of slippage. It is recommended for track use only.

The twin configuration holds up to 2,050Nm of peak torque while the triple holds up to 3,075Nm of peak torque.



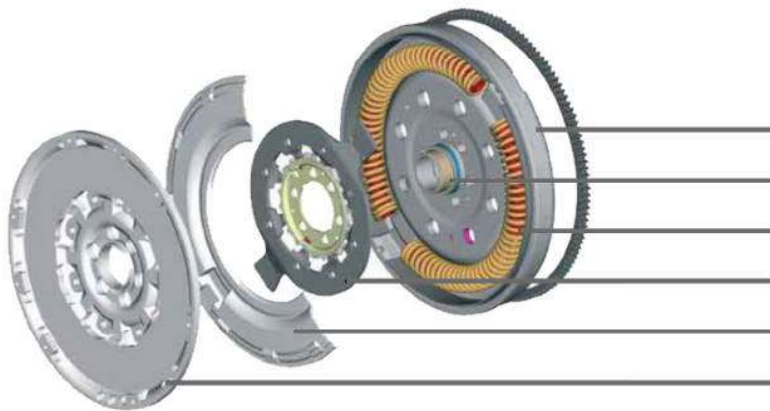
* Torque figure quoted is a peak torque capacity, we recommend applying a 1.5 safety factor when selecting the correct system for your application.

DUAL MASS FLYWHEELS

A Dual Mass Flywheel (DMF) is comprised of two flywheels that work together with dampening springs to reduce vibrations.

ADVANTAGES

- > Isolates engine vibrations
- > Reduces noise
- > Helps to prevent transmission damage
- > Improves shifting comfort



STANDARD DUAL MASS FLYWHEEL

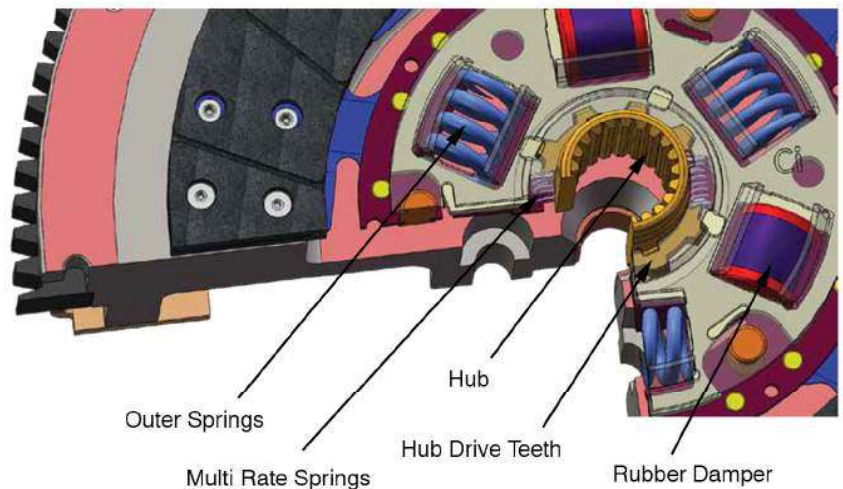
- > Primary flywheel
- > Plain bearing
- > Arc springs
- > Flange
- > Primary cover (cross section)
- > Secondary flywheel

DUAL MASS FLYWHEEL REPLACEMENTS

Dual Mass Flywheel Replacements (DMR) move the damping system from the flywheel to the clutch plate. This returns the flywheel back to a conventional solid mass flywheel.

ADVANTAGES (OVER DMF)

- > Increased ability to handle higher torque
- > Greater reliability
- > Better thermal dynamics
- > Cost efficient: Both on the initial purchase and ongoing with the ability to machine the flywheel



Note: When a DMR system is fitted it is common to have an increase in drive train noise.

CLUTCH DISC DESIGNS

RIGID CLUTCH DISCS

FEATURES

- > Specially tuned cushion deflection
- > Suited to vehicles with a Dual Mass Flywheel (DMF) as dampening occurs in the flywheel

ADVANTAGES

- > Simple design
- > Smooth build up of torque when used with a DMF



Note: When not used in conjunction with a DMF engagement is sudden and NVH could be an issue as the clutch system has no dampening.

SINGLE-STAGE TORSIONAL DAMPER CLUTCH DISCS



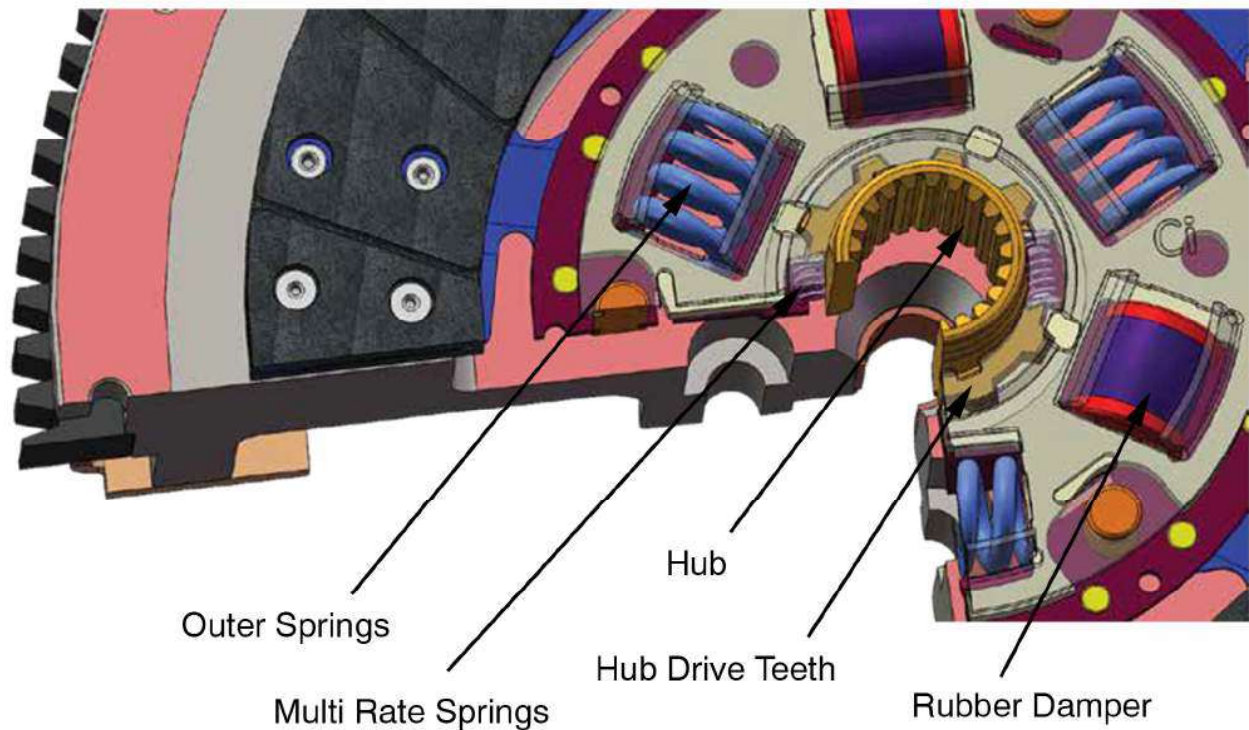
FEATURES

- > Single-stage torsional damper with custom spring tension
- > Suited to vehicles with either a single or dual mass flywheel

ADVANTAGES

- > Reduction of vibration and noise in the powertrain

MULTI-RATE TORSIONAL DAMPER CLUTCH DISC



FEATURES

- > Multi-stage torsional damper with separated first and second stage dampers
- > Tuned for low torque low angularity dampening as well as high torque high angularity dampening
- > Suited for vehicles with a solid mass flywheel or vehicles that have been converted from a dual mass flywheel to a solid mass flywheel

ADVANTAGES

- > Reduction of vibration and noise in the powertrain
- > Smooth build up of torque when accelerating
- > Low vibrations at idle

CLUTCH DISCS AND DUAL MASS FLYWHEELS

A DMF is designed to reduce the torsional vibrations in the powertrain therefore generally a clutch disc used in a DMF has no torsional dampeners. If a vehicle is converted from a DMF to a solid mass flywheel the clutch disc is now required to dampen noise and vibrations. This is done by using a multi-rate clutch disc which reduces most of the noise and vibration however in some vehicles higher vibration and noise can be experienced compared to the standard DMF.

SEMI-AUTO TRANSMISSION

Semi-Auto Transmission also known as clutch-less manual, automated manual or auto-shift gearbox (ASG) can be found in many different modern vehicles. Similar to a traditional torque converter automatic transmission the select lever has a neutral, reverse, automatic and manual gearshift position.

The movement of the clutch is done electric motors controlled by the transmission control unit. The clutch itself works off the same principles as a traditional clutch the difference being the control and movement is handled electronically.



ADVANTAGES

- > Option of either auto or manual operation
- > Highly efficient with low energy consumption
- > Low cost

CLUTCH REPLACEMENT

Replacing a clutch in a semi-auto transmission does not take significantly more time than a traditional manual clutch. The workshop manual should be referred to ensure the correct procedure is followed when disconnecting and reconnecting the automatic shifting mechanisms which may require specific diagnostic kits.

DOUBLE CLUTCH TRANSMISSION (DCT)

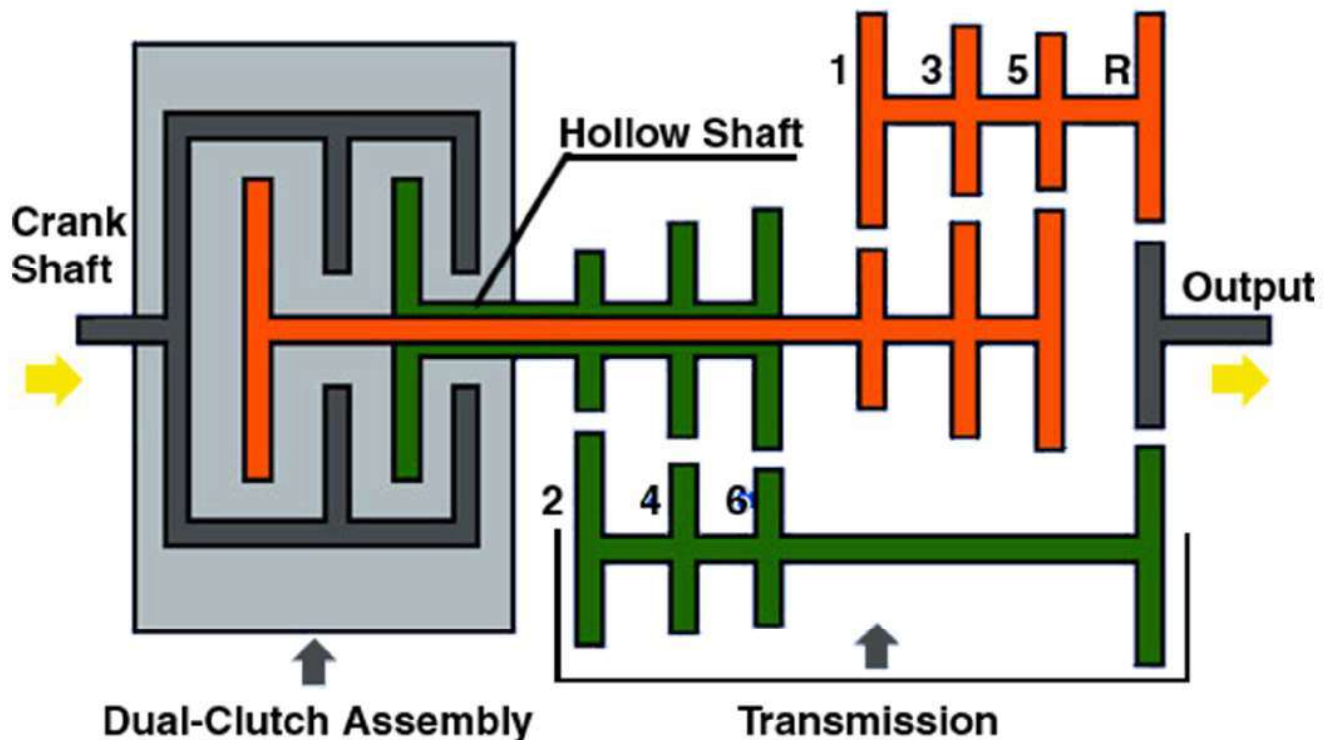
DCT consists of two sub-transmissions located in one transmission housing. Each sub-transmission is designed like a manual transmission with its clutch assigned to it. Depending on the engine's torque and space, the clutches can be either a wet for high torque applications or dry design which is more economical.

When driving all gear shifts and clutch movements are electrohydraulic or electromechanically actuated. A sub-transmission is always connected with the engine through the clutch, with the other sub-transmission preselected a gear ready to be actuated. This makes the gear shifts extremely quick with no delays in selecting gears.

ADVANTAGES

- > More efficient than a torque converter
- > Fast shifting
- > Comfort of an automatic with the response characteristics and of manual transmission

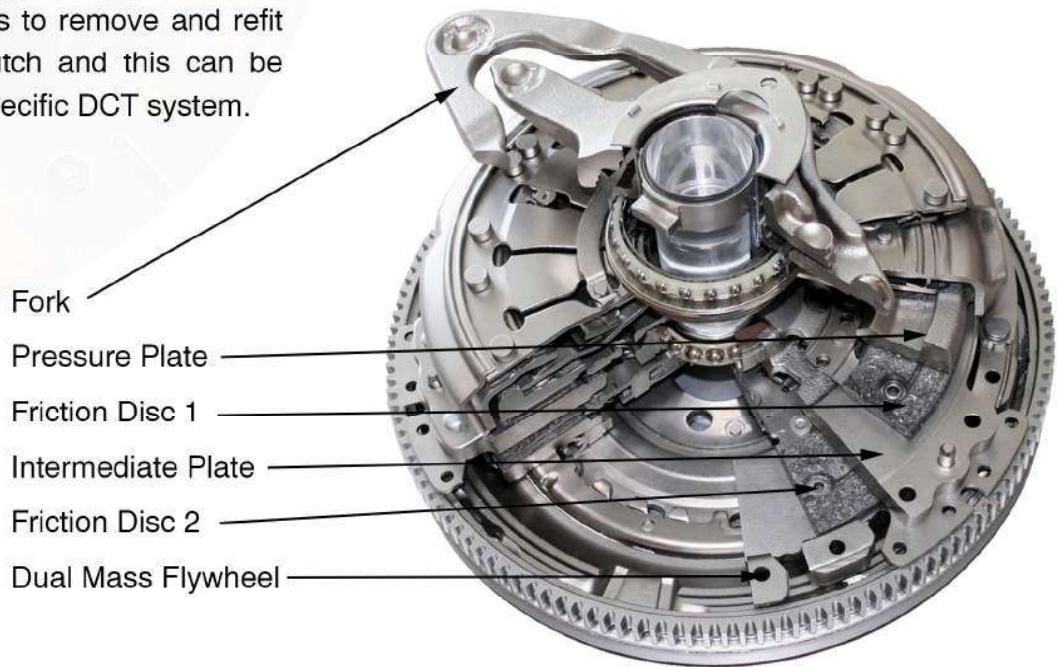
Dual-Clutch Transmission



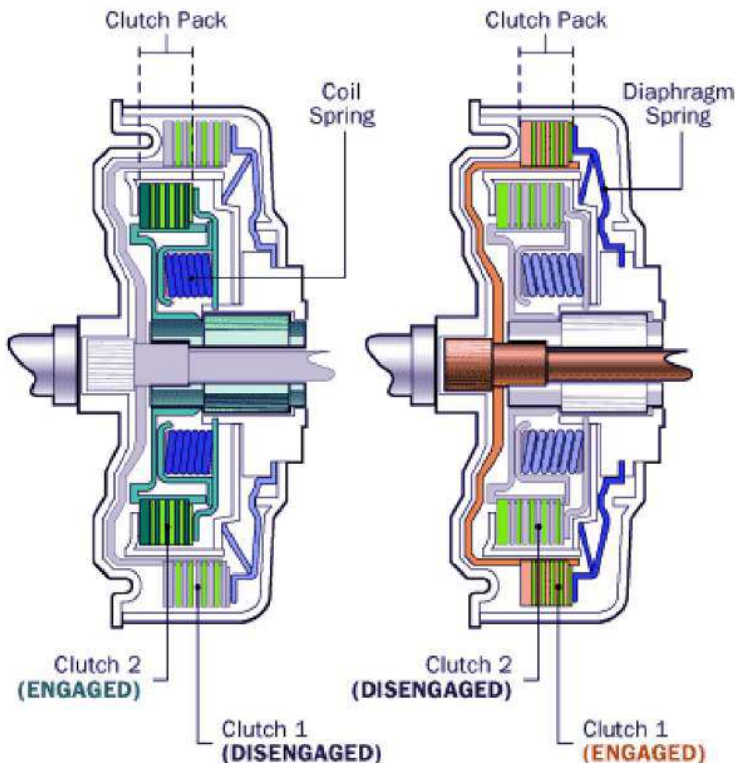
TYPES OF DOUBLE CLUTCH TRANSMISSION

DRY DOUBLE CLUTCH

Dry Double Clutches are serviceable and do wear. Replacing a DCT does require some speciality tools to remove and refit the replacement clutch and this can be dependent on the specific DCT system.



WET DOUBLE CLUTCH

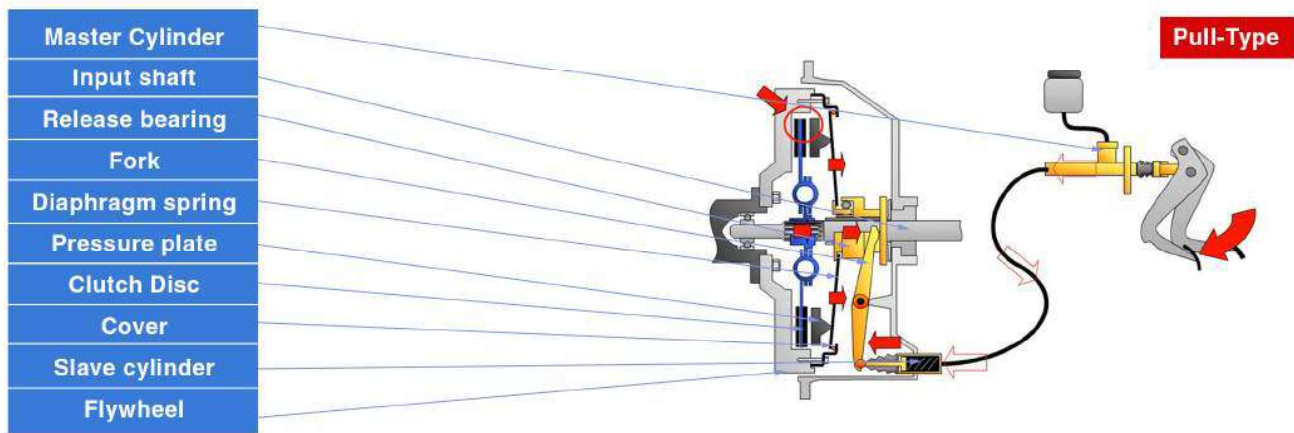


Wet Double Clutches are designed to last the lifetime of the vehicle so replacement is uncommon. Replacement is still possible however as the clutch packs are housed as a sealed unit the entire clutch basket is replaced. Again some specialist tools are required for the removal and replacement.

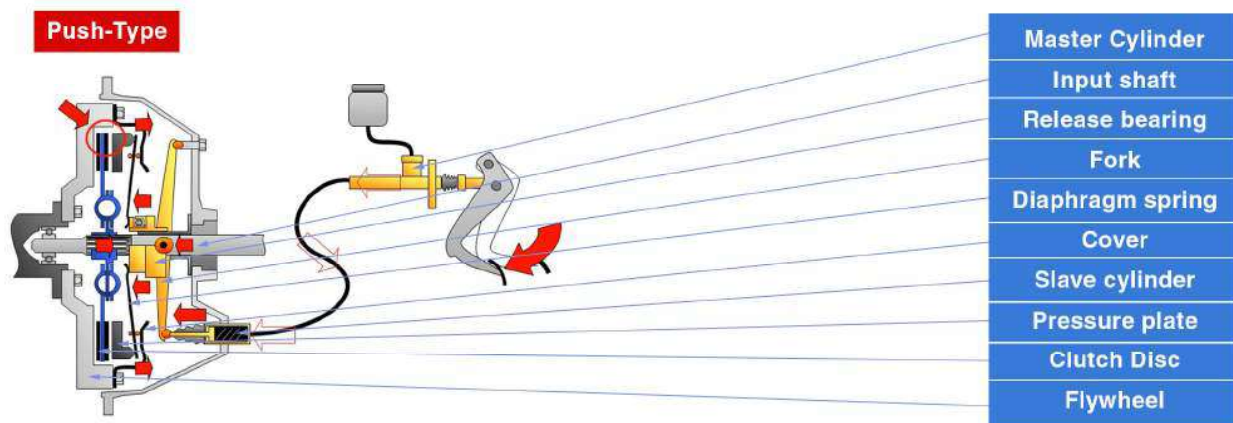
HYDRAULIC RELEASE SYSTEM

Most clutch release systems have either a semi-hydraulic or a fully hydraulic system. Originally a cable was used from the pedal to the clutch fork however as modern engine compartments are narrowing this method is no longer used.

SEMI-HYDRAULIC SYSTEMS



The clutch cable from the pedal to the clutch fork is replaced by a hydraulic line, master cylinder and slave cylinder. In this configuration the clutch fork is actuated by the slave cylinder.



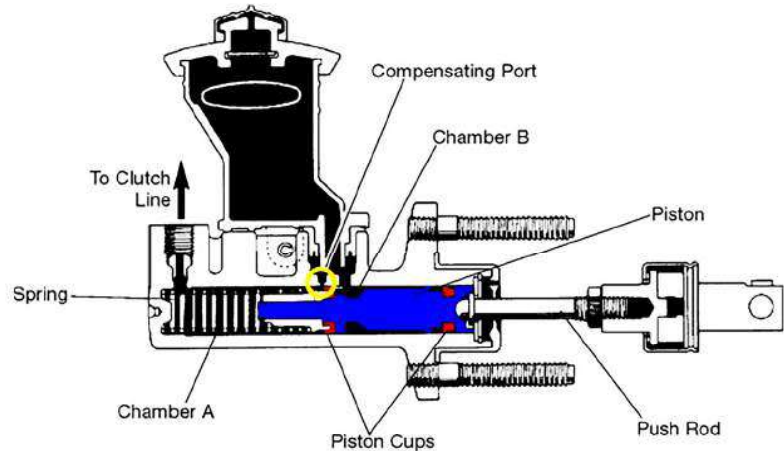
A fully hydraulic system sees the actuation of the clutch completely taken by the hydraulics through the Concentric Slave Cylinder (CSC).

MASTER CYLINDER

There are two types of master cylinders;

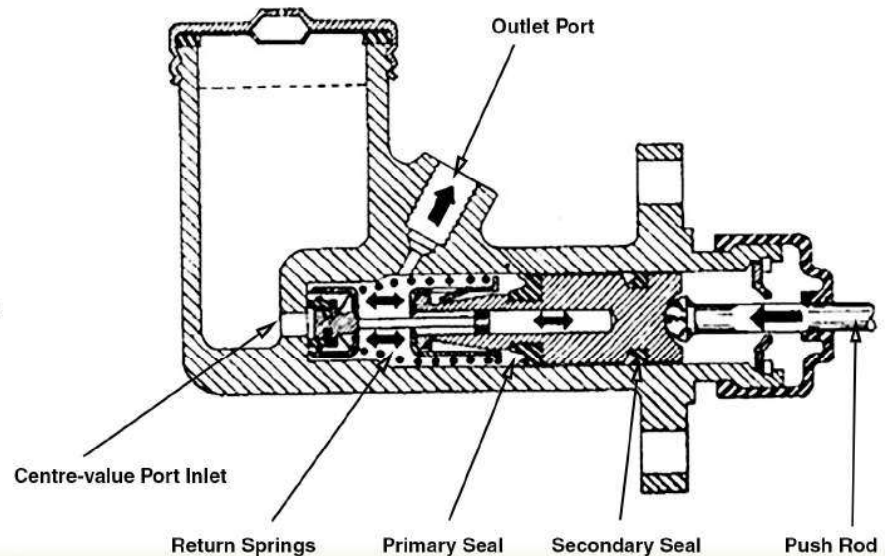
COMPENSATING PORT DESIGN

When the clutch pedal is not in use the piston in the master cylinder exposes a small hole to the reservoir. As the clutch pedal is depressed, the seal passes the compensating hole effectively closing the port, then the remaining fluid actuates the slave cylinder.

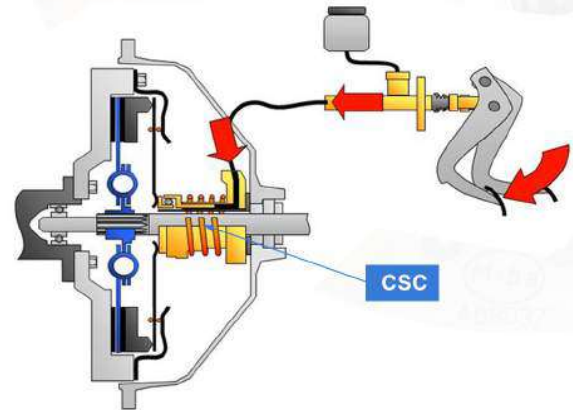


CENTRE VALUE DESIGN

When the clutch pedal is not in use the piston in the master cylinder retracts to open the port in the base of the cylinder. As the clutch pedal is depressed the centre valve is closed and the remaining fluid actuates the slave cylinder.



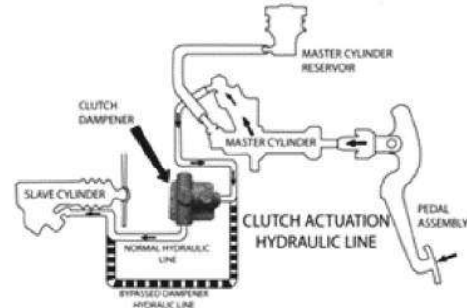
Concentric Slave Cylinder (CSC)



HYDRAULIC RELEASE SYSTEM

VIBRATION DAMPER

Hydraulic vibration dampeners are used after the clutch master cylinder to prevent the transmission of vibrations in the hydraulic lines. It uses either membrane dampers or anti-vibration units with two non-return valves.



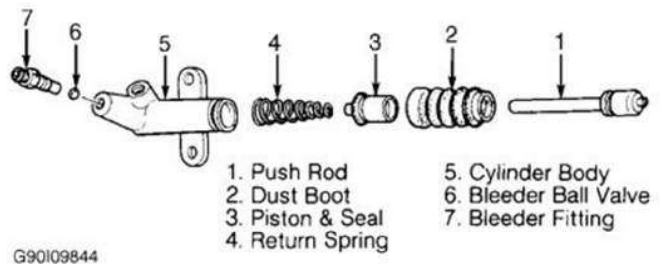
The dampening unit can sometimes malfunction which causes issues selecting gears. To troubleshoot this bypass the damper unit with a direct line from the master cylinder to the slave cylinder, if release occurs the clutch dampener is faulty and should be replaced.

PEAK TORQUE LIMITER

Peak torque limiters restrict the fluid to the slave cylinder; this is designed to prevent damage to the clutch and the Dual Mass Flywheel in the event of the clutch being release too quickly.

SLAVE CYLINDER

In a semi-hydraulic system the slave cylinder is located outside the bell housing and is used the active the release fork (applicable for both push and pull clutch systems).



CONCENTRIC SLAVE CYLINDER (CSC)

Fully hydraulic systems are equipped with a concentric slave cylinder mounted in the bell housing. The CSC consists of a ring-shaped hydraulic cylinder with a built in release bearing.



1. HANDLING OF THE NEW PRODUCT

On removing the CSC from the box, do not compress the cylinder by hand to replicate the bearing movement. By compressing the cylinder in this way the increased air pressure can cause the illustrated damage. Also, as the chamber is not pre-filled with hydraulic fluid, then damage will be caused to the internal seals due to excessive friction on the return stroke.



2. ENVIRONMENT

The area in which the CSC is positioned needs to be totally clean & free of debris. It must be located cleanly and squarely on to the gearbox case and any rubber face seal or sealant is used in accordance with the manufacturer's instructions.

3. FITTING

GENTLY slide the CSC over the gearbox input shaft and slightly rotate it to ensure the correct location on the gearbox case. Torque down evenly the fixing bolts using between 8-12Nm dependent upon manufacturer's specification.

4. HYDRAULIC CONNECTIONS

There are two types of connector; > Traditional screw in > Quick clip connector which is more common.

With the traditional type, tighten the screw using a torque of between 10-15Nm dependent upon manufacturer's specification.

The quick clip connector is released by either pulling or pushing the retaining clip, dependent upon type.

5. BLEEDING (PURGING) THE SYSTEM

Before attempting to purge or operate the clutch, ensure that the gearbox is fully located in the fitted position.

Bleed the system as per the manufacturer's instructions. Do not rapidly depress the pedal as this can damage the CSC end seal.

Note: Many CSC's do not have bleeding ports or screws making bleeding difficult after installation. In these cases the below procedure can be followed;



- > Connect the CSC to a hose and place the end of the hose in a container of brake/clutch fluid.
- > Gently slide the release bearing back and let it return slowly
- > Repeat until no air comes out of the pipe
- > Remove pipe and install CSC as per manufacturer's instructions

Note: Clutch Industries does not recommend the use of power bleeding systems, as some systems run a high air pressure. This can invert or roll the internal seal resulting in immediate fluid loss.

RELEASE BEARINGS

Release bearings link the rotating diaphragm to the actuation system on the transmission side. The release bearing is mounted on a carrier which slides on the gear box front bearing retainer tube. The release bearing assembly is actuated via the throw-out fork or via the concentric slave cylinder. The release bearing is an angular contact thrust bearing; filled with grease requiring no further lubrication during its service life.



PULL-TYPE RELEASE BEARINGS

Unlike a standard push-type bearing a release bearing in a pull-type bearing is designed to pull the diaphragm springs. The connection of the bearing to the diaphragm comes from a pre-tensioned snap ring which engages with the diaphragm after installation. If the snap ring is activated before installation the bearing cannot be installed onto the diaphragm. During installation the release bearing is fitted to the fork which is installed onto the transmission. Once the transmission is installed the release bearing can be located into the diaphragm by hand by applying force in the opposite direct to the slave cylinder.

Note: For removal pressure needs to be applied between the locking ring and the bearing, a flat blade screw driver can be used for this.



Here's our installation notes to help you get the job done

Essential Pre-installation Dos:

Diagnose the clutch malfunction before prior to replacement.

Use this checklist:

- ✓ Is the hydraulic system properly functioning?
- ✓ When the old clutch is being removed, are there oil leaks and any signs of red dust?
- ✓ Are cracks on the clutch release fork?
- ✓ Are there stretch signs on the clutch cable?
- ✓ Any wearing on release bearing guide tube?
- ✓ Anything wrong with the spigot bearing or the pilot bush? There is? Replace it.
- ✓ Any shipping damage on the clutch?

Basically, ensure that the above mentioned parts function well and do not have problems. Malfunctions, including wear and tear and breakage, must be properly addressed (corrected, replaced) before installing a new clutch.

Installation notes:

1. When fitting the clutch, mind the shaft splines, clutch disk, and bell housing.

- ✓ Clean the gearbox main drive shaft splines and ensure that the clutch disc slides freely on the shaft.
- ✓ Clean the bell housing: degrease, dust off and remove worn clutch fibres.
- ✓ LIGHTLY grease the shaft splines with high temperature grease. Using too much grease may contaminate the clutch plate/disc.



IMPORTANT REMINDER:

1. Use only the specified clutch. Malfunctions may result from using clutches that are not correct for the application. When in doubt: check either our online catalogue or contact our customer service for further clarification and guidance.

2. Flywheel must be replaced or machined.

2. Ensure that bearing carrier functions properly:

- ✔ Lightly lubricate the outside diameter of the tube to allow the bearing carrier to smoothly slide.
- ✔ Check the bearing on clutch release fork after installing the bearing on it and make sure it is placed securely. Move the fork forwards and backwards if nothing falls, then we are good to refit the gearbox.



3. Ensure correct pressure plate-clutch disc alignment.

- ✔ Remove any labels on the pressure plate and clean with a non-oil based solvent
- ✔ Place the clutch cover pressure plate assembly over the clutch disc. Ensure that the disc is precisely centered to the pressure plate for proper alignment.
- ✔ Apply pressure.
- ✔ Tighten/torque bolts in a diagonal pattern.

DO NOT use air tools to install a clutch cover assembly. Incorrect torquing down of the bolts may result in an uneven pattern and may cause the lever strut to dislodge from the pressure plate casting. Thus, bolts should be torqued according to manufacturer's specification.

- ✔ Make sure that the diaphragm tips (in the case of a lever type cover assembly, the release lever tips) are in a parallel or slightly upward position.



4. Finishing up

- ✓ Refit the gearbox.

BE CAUTIOUS:

- (a) not to bend the clutch disc;
- (b) not to hang the gearbox off the clutch disc;
- (c) use any force to align gearbox shaft.

- ✓ Tighten bell housing bolts and ensure that bell housing dowels are in correct position.
- ✓ Clean, clean, clean: Ensure there is no dirt or foreign material between the mating surfaces of the engine and the bell housing.
- ✓ Do any clutch adjustments to vehicle manufacturer's specifications and don't forget to reset the clutch master cylinder push rod to ensure comfortable pedal release position.

KEEP IN MIND THAT: (a) clutch taking up as close as possible to the floor prevents clutch shudder; (b) the installation of the new clutch changed the position of the diaphragm tip

5. Finishing up

- ✓ Check the clutch cable, if you are unable to get release when a new clutch is fitted start troubleshooting by replacing the cable.
- ✓ If it is a hydraulic clutch start by checking the clutch master cylinder and the clutch slave cylinder. Make sure that there is no air in the system and that nothing is blocking the compensating port. This is essential to obtain maximum travel for disengagement.
- ✓ Road test vehicle.
- ✓ After the first 1,000km adjust the free travel to ensure the correct adjustment.

Section #1 Loss of Drive



Cushion Plate broken

Cause

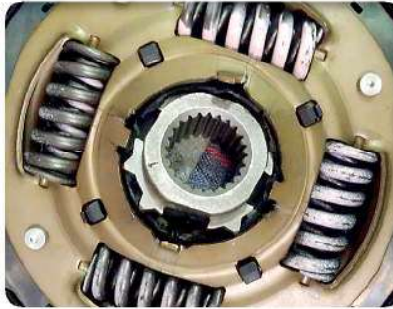
- The disc has been distorted when refitting the gear box on the engine.
- The engine and the gear box are misaligned.
- The pilot bearing is damaged.
- Aggressive driving.

Repair

- Replace the clutch kit.
- Realign the engine and the gear box.
- Replace the pilot bearing.

Caution

- Be careful in selecting the gears and do not over run the clutch.



Clutch disc plate broken

Cause

- Defective clutch installed or wrong direction for installation.

Caution

- Make sure that the correct kit is used on the application.

Section #2 Noise



Noise when in neutral

Cause

- Lack of care during installation, splines have been damaged by the gear box main shaft.

Repair

- Replace the main shaft.
- Replace the clutch disc.

Caution

- Make sure that the splines properly match up.
- Lubricate with a proper quantity of grease.

Section #2 Noise



Noise while depressing clutch pedal

Cause

- Off centering of the release bearing or mis-alignment of the main shaft.

Repair

- Replace the release bearing.
- Realign the engine and the gear box.



Noise during release

Cause

- Seized / worn pilot bearing / bushing.

Repair

- Replace pilot bearing / bushing.



Noise when bearing contacted

Cause

- Seal torn.
- Overheating during slippage.
- Leakage of the grease.
- Incorrect free travel adjustment

Repair

- Check diaphragm for damage
- Replace bearing and adjust free travel

Section #2 Noise



Damper spring break away

Cause

- Wrong clutch cover size used.
- Excessive release travel.
- The clutch disc is installed on the wrong side.

Repair

- Replace the flywheel.
- Adjust the clutch operating system (pedal height, self-adjusting system, clutch linkage...)
- Install the clutch disc properly.

Caution

- Make sure that the correct kit is used on the application.



Unusual wear on the torsion springs

Cause

- Over torque applied to the clutch disc.

Repair

- Replace clutch kit.

Caution

- Confirm specification of clutch is adequate for engine output



Rattle/Release Issue

Cause

- Retaining clip not correctly installed on fork

Repair

- Install new bearing ensuring bearing is secure to the fork

Section #3 Slipping & Chattering



Burn marks on the flywheel

Cause

- Excessive greasing of the spline hub when installed.

Repair

- Clean the flywheel and replace the clutch kit.

Caution

- Apply the correct amount of grease on the clutch disc splines and the input shaft



Burn marks on diaphragm

Cause

- Oil or grease contamination on the clutch linings or on the pressure plate.

Repair

- Locate and repair all sources of contamination.
- Replace the clutch kit.

Caution

- Apply the correct quantity of grease on the clutch disc splines and the input shaft. Do not use contaminated pair of gloves.



Heat spots on pressure plate/flywheel

Cause

- Excessive slipping due to aggressive driver/overloading/
- Clutch operating system is badly adjusted or defective.

Repair

- Replace clutch kit and resurface or replace flywheel
- Inspect and adjust actuation system

Caution

- Driver education may be required

Section #3 Slipping & Chattering



Failure to resurface flywheel

Cause

- Excessive slipping or shudder due to flywheel friction surface being too smooth or not flat

Repair

- Resurface or replace flywheel

Caution

- Flywheel should be replaced or resurfaced prior to installing new clutch



Clutch facing completely worn

Cause

- Use over product lifetime.
- Prolonged clutch slippage due to a malfunction or extremely severe use. Disc not changed during a previous flywheel / cover replacement.

Repair

- Replace clutch kit & replace/resurface flywheel

Caution

- If wear is premature further troubleshooting may be required or driver education



Clutch lining damaged

Cause

- Excessive slippage due to aggressive driving or overloading.
- The clutch operating system is badly adjusted or defective.

Repair

- Replace the clutch kit.
- Replace or machine evenly the flywheel.

Section #3 Slipping & Chattering



Circular grooves appearing on the pressure plate

Cause

- Linings worn out, heads of the facing rivets are in contact with the pressure plate.

Repair

- Replace clutch kit



Clutch lining contaminated with oil or grease

Cause

- Excessive greasing of the spline hub when installed.
- Oil leakage from engine or gear box.

Repair

- Replace the clutch disc.
- Locate and repair all sources of contamination.

Caution

- Apply the correct amount of grease on the clutch disc splines and the input shaft.



Deformation of the clutch disc

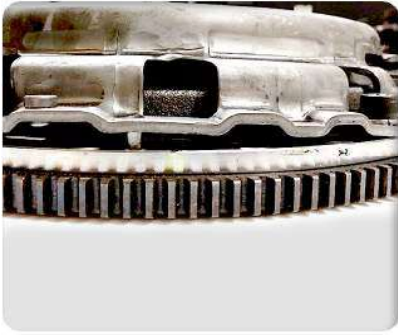
Cause

- Deformed during delivery or handling. Deformed during installation. (weight of the gear box, dropped) Deformation due to overheating during slippage.

Caution

- Handle with care.
- Do not place the clutch disc under a weight.

Section #4 Difficulty changing gears



Difficulty changing gears

Cause

- The cover assembly has been dropped.

Repair

- Install new clutch.
- Always inspect the drive straps for damage before installation.



The drive straps of the clutch cover are damaged

Cause

- Dropped during installation / overload.
- Using improper product.
- Improper gear selection.
(ex: from 5th to 1st)

Repair

- Replace the clutch kit.
- Careful handling.
- Operate to normal conditions.



Difficulty changing gears

Cause

- The transmission was forced into position damaging the splines of the disc hub.

Repair

- Install new clutch and carefully control the position and alignment of the transmission during installation.
- Use a transmission jack and possibly install temporary guide pins to assist in aligning the transmission to the engine.

Section #4 Difficulty



Unable to achieve correct release bearing travel

Cause

- Faulty linkage or hydraulics
- Damaged fork

Repair

- Replace faulty component

Section #5 Others



Too much grease

Cause

- Excess of lubrication grease on the nose of the release bearing.

Repair

- Clean the release bearing.
- Apply the correct quantity of lubricant.



Over torque

Cause

- Excessive engine brake operation.
- Incorrect disc for the application.
- Aggressive starting operation.
- The clutch operating system is badly adjusted or defective (clutch pedal)

Repair

- Replace the clutch disc.

Section #5 Others



Difficulty shifting

Cause

- Incorrect release bearing travel.
- The clutch operating system is badly adjusted or defective.
- The level of pre-load on the release bearing is incorrect.

Repair

- Adjust the clutch operating system (pedal height, self adjusting system, clutch linkage..) check the pre-load on the release bearing.



Clutch pedal binding

Cause

- The fork is out of shape.
- The release bearing guide tube is worn or the release arm / fork is bent / worn.

Repair

- Replace by a genuine release fork.
- Install new clutch and guide tube.
- Inspect all release bearing system components and repair or replace as needed.



The contact point of the fork is worn out, the fork is off-centered

Cause

- The fork is out of shape.

Repair

- Replace by a genuine release fork.

Section #5 Others



Red dust (Rust Particles)

Cause

- Misalignment

Repair

- Troubleshoot cause of misalignment before replacing clutch kit

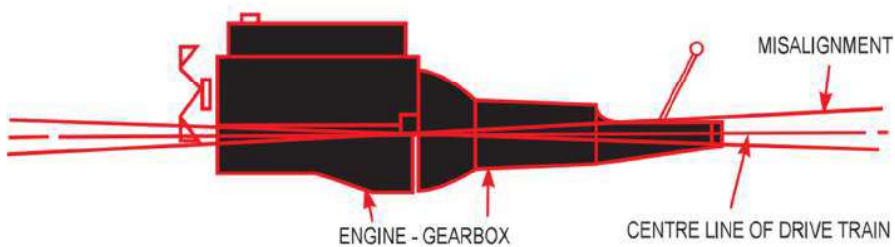
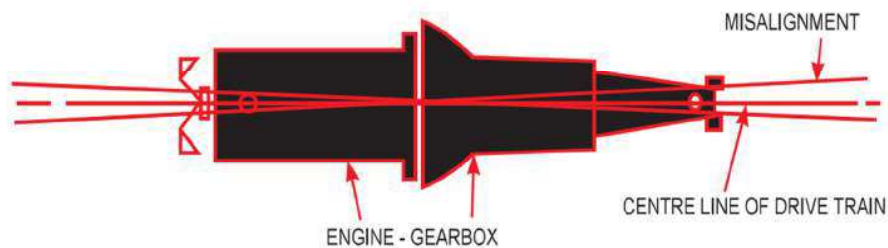
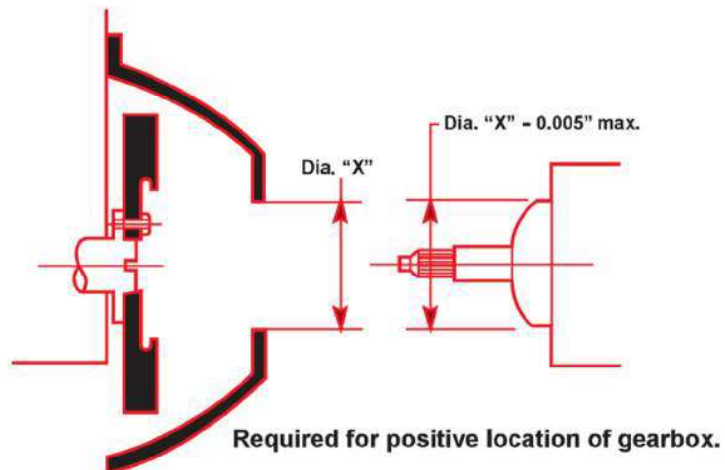
Caution

- If misalignment is present fitting a new clutch kit will destroy the new kit.

DOES THE CLUTCH YOU HAVE JUST REMOVED SHOW ANY OF THESE SIGNS OF WEAR?

- > Broken clutch plate.
- > Worn diaphragm fingers.
- > Red dust covering the clutch assembly.
- > Loose pivot rings inside the cover assembly.
- > Release bearing guide worn on one side.

If it does, the clutch has probably failed due to driveline misalignment. Fitting a new clutch without rectifying any misalignment will lead to possible premature failure of the new clutch.



DRIVELINE MISALIGNMENT

WHAT CAUSES MISALIGNMENT?

The most common causes of driveline misalignment are:

- > Missing or damaged dowel pins allowing the transmission to be bolted off centre.
- > Mislocated front bearing retainer.
- > Foreign matter between the engine block and the transmission mounting faces.
- > Missing or worn pilot bearing.
- > Broken block flange.

WHAT ARE THE SYMPTOMS OF MISALIGNMENT?

- > Pedal graunch with the engine running.
- > Deterioration of the clutch until non-release occurs.
- > Failed drive plate.
- > Red dust covering clutch and/or groove worn in the diaphragm by the release bearing.

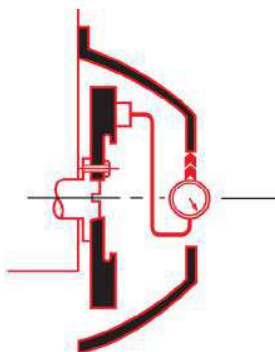
HOW DO I PREVENT MISALIGNMENT?

Whenever you are replacing a clutch, inspect the old components. If misalignment is present you will need to find the cause.

- > Inspect all dowels and dowel holes for condition.
- > Inspect release bearing guide and replace if necessary.
- > Clean all mating surfaces.
- > Inspect block flange for damage.

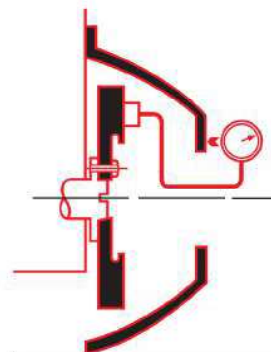
REMEMBER - IF MISALIGNMENT IS PRESENT, FITTING A NEW CLUTCH KIT WILL NOT FIX THE CAUSE OF THE PROBLEM AND THE MISALIGNMENT WILL QUICKLY DESTROY THE NEW CLUTCH.

How to check for engine/transmission misalignment



STEP 1


Mount indicator to flywheel and determine concentricity of bell housing bore to centre line of crank rotation, SPECIFICATION: 0.15mm max, T.I.R.



STEP 2


With indicator still mounted to flywheel ensure rear surface of housing is square. SPECIFICATION: 0.15mm max, T.I.R.

In the event a customer raises any concern with their Clutch Industries product purchased from GPC, it's our collective goal to get vehicle on road (VOR) as soon as possible. Therefore, our first priority is to ensure the customer has a copy of the Clutch Industries "Troubleshooting checklist", and they have worked through it as appropriate. If desired, Clutch Industries can walk through this checklist directly with the customer, or via the GPC store staff. Please involve the Clutch Industries GPC Tech Support team as soon as possible to assist in the troubleshooting process either by calling the dedicated GPC Tech Line, or emailing us – see below.

 1300 930 818

 engineering@clutchindustries.com.au



Additionally, we have created a business support portal to enable the store to login and raise a case directly, or track the status of existing technical issues live. This can be accessed from our website using the login button, and entering the credentials assigned to each individual branch

 [www.clutchindustries.com.au/\(Login - GPC User Name / Password\)](http://www.clutchindustries.com.au/(Login - GPC User Name / Password))



Clutch Industries aim to resolve all technical cases in 30 minutes, ideally assisting to get VOR or if necessary, proceeding to a warranty case.

Below is the Troubleshooting Checklist for all technical enquiries.



1. Verify complaint (If fitment / product related - skip this step)

-  Road test vehicle (ideally with customer / Replicate the concern)
-  Determine if concern is intermittent or continuous



2. Validate product suitability

-  Is the kit / part a genuine Clutch Industries part?
-  Is the kit / part suitable for the vehicle (correct part#, HD for modified engine etc)?

3. Review documentation

-  Has the Clutch Industries Tech Bulletin been reviewed and actioned (if applicable)?
-  Has the vehicle workshop manual been reference accordingly?



4. Review Clutch Industries training material

-  Review the relevant trouble shooting training material
-  Should fault continue - contact Clutch Industries > Step 5


5. Contact Clutch Industries Technical Support

-  Phone **1300 930 818**, email **engineering@clutchindustries.com.au** or start a technical support case in Business Support Portal, [www.clutchindustries.com.au/\(Login - GPC User Name / Password\)](http://www.clutchindustries.com.au/(Login - GPC User Name / Password))

6. Confirm concern rectified

-  Road test check operation normal
-  Process warranty claim (if applicable)

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