Clutches for Automobiles and Light Trucks
What does the Clutch do?

Connects the engine torque to transmission when ENGAGED

Unhooks engine from transmission when DISENGAGED

Where is the driver’s foot when clutch is Engaged?
OFF the clutch pedal

Where is driver foot when clutch is Disengaged?
ON the clutch pedal
Bellhousing
Clutch housing
Release Bearing
Throwout bearing
Diaphragm Spring
Pressure Plate
Clutch Fork
Throwout fork
Flywheel
Clutch Shaft & Pilot Bearing
Clutch disc hub
Clutch disc
Clutch linkage
Bellhousing

Clutch housing is also called the Bellhousing

Connects and aligns the engine to the transmission.

Protects the clutch assembly from water, road debris, etc.

Often separate housing for transmission and integral to transaxle housing
Transaxle (transmission AND differential)

Bellhousing

Differential
Flywheel

Acts to dampen power stroke acceleration

Adds inertia to crankshaft on compression stroke

Provides a friction surface for the clutch disc

Friction surface finish and cleanliness is critical

(Can cause clutch to chatter)

Thickness is critical

(can be machined too thin to cause dragging clutch)
Flywheel add weight to crankshaft for momentum on non-power strokes

Has a ring-gear for cranking the engine
Dual Mass Flywheel Absorbs Engine Vibrations

Reduce Gear Noise

Smooth Shifting
Flywheel and pressure plate friction surfaces must be free of dirt, grease, and oil prior to installation.
Flywheel friction surface must be perfect
Can be removed for re-surfacing or machining

If flywheel is over-machined (too thin), the clutch moves away from release fork and may drag (not fully release).

Also clutch disc may rest on crankshaft bolts causing the clutch to slip

Greasy finger prints will cause clutch chatter
Flywheels are HEAVY – get help when removing
Retaining bolts are critical – use torque wrench – use loctite
If one bolt is bad replace them as a matched set
Any imbalance causes vibrations!

Wash newly machined flywheel.

Brake Clean new flywheel to remove sealer
Greasy finger prints will cause clutch chatter
Clutch Shaft  

also called  

Input Shaft  

of Transmission

Projects from the front of the transmission

The clutch disc is splined to the clutch shaft

Clutch Disc and Clutch Shaft spin independent of Flywheel

...when the clutch is disengaged
This end supported by Pilot bearing or bushing

Clutch Shaft or Input Shaft

Input shaft Bearing Cover supports sliding Throw Out or Release Bearing

Operating Shaft

Fork to Shaft Pin

Operating Arm
Clutch Shaft or Input Shaft

The clutch shaft supported by pilot bushing or bearing.

Pressed into center of the crankshaft or flywheel.

Pilot bearing is critical to supporting and centering input shaft AND clutch disc.

Transaxles do not use a pilot bearing.

Input shaft is centered with 2 bearings inside the transaxle.
Transmission input shaft supported by one bearing in transmission and Pilot bushing or bearing located in the crankshaft or flywheel.

Only one Bearing on shaft. Needs Pilot bearing for centering.
Flywheel and pressure plate friction surfaces must be free of dirt, grease, and oil prior to installation.

Pilot bearing or bushing to support input shaft
Clutch disc or Driven disc is splined to Input shaft

- Driven disc located here on spline
- Pilot bushing supports here
- Front transmission bearing
Transaxle input shaft supported by bearings on each end.
Pilot Bearing – Pilot Bushing

Pilot bearing/bushing will wear out
Always use a new bushing or bearing with new clutch
Make sure it fits the pilot shaft BEFORE installing
Read procedure or instructions with bearing
Many need no lubrication, some use very specific lubricant
Bushings often use motor oil – NOT grease
Clutch disc or Driven disc

Very sensitive to ANY oil or grease
Clutch disc or Driven disc

Clutch hub is splined to Input shaft
Clutch disc must freely slide on clutch shaft

Lube with dry graphite or Disc Brake grease

Too much grease will contaminate clutch disc!
Cushion springs, Wave Springs or Marcel springs

Waved spring metal between 2 friction clutch surfaces

Dampens clutch engagement.

Easy to bend if dropped and may cause clutch to not fully release (clutch drag)

Slight bend in clutch disc can also cause clutch to chatter
Torsional Coil Springs

Dampens sudden shock from acceleration or deceleration
Has stop pins to limit amount of twist.
Installing clutch disc facing wrong direction will damage the torsion springs and cause clutch to not release (drag) AND slip.

Over-machining flywheel may cause coils to drag on crankshaft bolts.
Pressure Plate or Clutch Cover
Pressure plate assembly
Squeezes clutch disc onto flywheel
Can be engaged or disengaged
Acts like a spring-loaded clamp
Pressure plate assembly

Squeezes clutch disc onto flywheel

Can be engaged or disengaged

Acts like a spring-loaded clamp
Diaphragm Pressure Plate

Most clutches use Diaphragm pressure plates
Coil Spring Pressure Plate
Older and extra heavy clutches use Coil Spring pressure plates
Pressure Plate friction surface must be PERFECT
Do not re-use old Pressure Plate
Pressure plate springs lose tension from heat
Mechanical pivots will wear out and bind
ALWAYS replace pressure plate with new or remanufactured unit
Keep friction surface clean and dry – NO OILY Fingerprints!
Brake-clean the new pressure plate to remove sealer
Dropped pressure plate is probably bent and should not be used
Pressure Plates are easily damaged by improper installation – especially torque pattern

Finger tighten all bolts

Tighten one full turn -
- on each bolt
- in a star pattern
  to reach final torque value

Torque is low - often 20ft. Lbs so use loctite on threads

If one bolt needs replaced change them ALL
Release or Throw Out Bearing

- Flywheel
- Clutch Disc
- Pressure Plate
- Release Bearing
- Release Fork
Release or Throw Out Bearing

The clutch release bearing is operated by the clutch linkage.

When clutch pedal is depressed, the bearing moves toward the flywheel.

This moves the pressure plate away from the clutch disc.
Clutch Release Bearing or Throw Out Bearing

Transmits movement of the clutch linkage to pressure plate

Usually a ball or roller type bearing

Use new throw out bearing when replacing clutch

Lightly grease bearing retainer shaft to allow bearing easily slide and fully release
Use light coating of disc brake grease or dry graphite lube on bearing retainer and input shaft splines.
Check fit – should slide freely
Ensure release fork is secured to throw out bearing
Hydraulic Throw Out Bearing
(No release fork – activated by clutch master cylinder)
Clutch Linkage

Transfers clutch pedal movement to the release bearing

Can Be Mechanical or Hydraulic

Mechanical clutch linkage –
- Uses shafts and levers, or a cable

Hydraulic clutch linkage –
- Uses master cylinder, hydraulic tubing, and a slave cylinder
Rod & Lever clutch linkage

- Overriding spring
- Clutch pedal
- Torque shaft
- Clutch pedal rod
- Clutch fork
- Return spring
- Locknut
- Adjuster
- Protective boot
- Pivot ball
Rod & Lever clutch linkage

Used in Rear-wheel drive vehicles

Many wear points and has lubrication points

Freeplay decreases as clutch disc wears

Freeplay may increase as linkage pivot points wear

Requires the most maintenance and adjustment

Very sensitive to broken motor mounts
(bad motor mounts may cause hard shifting, clutch drag)
Cable clutch
Cable clutch linkage

May be adjustable or self adjusting

Not as sensitive to motor mount problems

Worn cable often causes a “binding” clutch
(harder to press down on clutch pedal)

Freeplay generally decrease as clutch wears
Cable

• When clutch is being serviced inspect for frayed cable

• Operate cable independent of clutch to check for binding
Hydraulic Clutch Linkage

No Clutch Free Play Adjustment Required
Maintains Light Contact With Release Bearing
Hydraulic Clutch Linkage

Generally use DOT 3 brake fluid

Recommend gravity or vacuum bleeding

May require special bleeding procedures
Hydraulic clutch linkage

- Master Cylinder
- Slave Cylinder
- Bleeder
Hydraulic Clutch Linkage

May or may not be adjustable at slave cylinder

Sensitive to over machining of flywheel (may not fully release clutch)

If not replaced, master cylinder may fail if manually bled by pumping clutch pedal (seals move past corrosion inside cylinder)

If Hydraulic clutch is not replaced, gravity or vacuum bleed until ALL old brake fluid has been replaced with new fluid
Hydraulic Throw Out Bearing

Recommend new with every clutch job

May need to bleed BEFORE installing
Hydraulic Clutch Linkage

Leaking system may cause clutch to not fully release (dragging)

Air in hydraulic clutch may cause clutch to not fully release (dragging)
Clutch Linkage Adjustment

Rod & Lever and manual adjusting cable linkage require throw out bearing to pull away from clutch release levers when clutch is engaged.

Insufficient free play wears out these types of throw out bearings

Insufficient free play may cause clutch to slip and wear quickly

Hydraulic and self adjusting linkage utilize constant running release bearings
How can you check for a slipping clutch?

Shift to a high gear, open throttle, engage clutch.
Non-slipping clutch will stall the engine
Clutch is most likely to slip with high torque.
  High RPM plus 4th gear = high torque

As clutch disc wears – clutch free play goes away.
A clutch that is out of adjustment should be tested for slipping to avoid an unhappy customer
Clutch Problems – Slipping Clutch

If engine speed increases, but vehicle speed does not, the clutch is slipping.

Worn out clutch disc

Insufficient free play  (often combined with worn out clutch disc)

Oil soaked clutch disc

Weak – worn out pressure plate

Broken Motor Mount

Misalignment of transmission to bellhousing (improper install)

Badly Warped clutch disc (improper install)
Clutch Problems - Binding (high clutch pedal effort)

Be suspicious of cable type linkage, check with cable disconnected

Worn or Damaged Pressure plate

Dry / bent/ out of place throw out fork

Release bearing binding on bearing retainer

Over-center spring broken / popped off (part of clutch pedal)
Clutch Problems - Chatter / grabbing

Loose – broken motor mounts
Oil on clutch disc
Clutch shaft splines binding on input gear
Warped pressure plate / flywheel
Hot spots, damaged friction surfaces (on flywheel OR pressure plate)
Worn out pressure plate
Damaged to clutch disc on installation
Misalignment of transmission to bellhousing (improper install)
Greasy fingerprints on clutch disc, flywheel, or pressure plate (improper install)
How can you check for a dragging clutch?

With transmission in first gear, disengage clutch (step on pedal) and rev the engine up. (input shaft will not turn as car is in gear)

Shift to neutral – engine still revved up foot still firmly on clutch pedal (clutch disengaged).

Wait 5 seconds

If clutch is dragging (not fully releasing) this will get input shaft and counter gears spinning.

Shift into reverse – IF it grinds the clutch is not fully releasing.

If reverse gear is synchronized it will not grind but will be difficult to shift
What causes a dragging clutch?

IF the clutch has not recently been replaced check for:

Air in hydraulic clutch linkage
Leaking hydraulic clutch linkage
Too much pedal free-play
Failed - seized pilot bearing or bushing
Exploded clutch disc or torsion spring fallen out
Idle speed set too high (causing longer than normal spin down time)
What causes a dragging clutch?

IF the clutch was just replaced check for:

Mis-adjusted linkage (too much freeplay)

Air in hydraulic clutch linkage or low fluid level

Warped clutch disc (damaged during install)

Clutch disc splines binding on input shaft

Flywheel machined too much
(this moves the pressure plate away from the release bearing and fork)
Removing the Clutch

Properly support vehicle on hoist with jack stands.
   This is needed to maintain balance of vehicle on hoist.

Use a transmission jack.

Make sure transmission is strapped or chained to transmission jack

Support engine before removing transmission

Keep engine square to transmission when removing.
   Damage to input shaft bearing if tranny hangs on this shaft.
Clean everything

Dust may contains asbestos and other nasty things
Wash with brake washer – DO NOT CLEAN with COMPRESSED AIR!

Lubricate all pivot and sliding points
(use dry graphite or synthetic disc brake caliper grease)
  
  Do Not Over Grease

Make sure clutch disc splines match input shaft and it slides freely
Center clutch disc before installing pressure plate
Clutch Disc
Friction Material or Facing
Must be absolutely clean of any grease or oil

Repair any engine or transmission oil leaks before reassembly

Oil on clutch disc facing will cause chatter
(even from greasy finger prints)
Don’t Screw it Up!

Clean everything before reassembly

Check the fit for:  
1 - throw out bearing (on bearing retainer)  
2 - clutch disc (on input shaft) and 3 - Pilot bearing/bushing (on input shaft)

Lube sliding parts - but don’t over lube

Keep all friction surfaces spotless

Don’t force tranny on to engine!

This is the #1 most common mistake for beginners

Keep engine square to bellhousing - be patient wiggle & jiggle