## Clutch

A **clutch** is a mechanical device which engages and disengages power transmission especially from <u>driving shaft</u> to driven shaft.

In the simplest application, clutches connect and disconnect two rotating shafts (<u>drive</u> <u>shafts</u> or <u>line shafts</u>). In these devices, one shaft is typically attached to an engine or other power unit (the driving member) while the other shaft (the driven member) provides output power for work. While typically the motions involved are rotary, linear clutches are also possible.

In a torque-controlled <u>drill</u>, for instance, one shaft is driven by a motor and the other drives a drill chuck. The clutch connects the two shafts so they may be locked together and spin at the same speed (engaged), locked together but spinning at different speeds (slipping), or unlocked and spinning at different speeds

## **Inter-locking Parts clutches**

This type of clutch has protruding circular edge and a hole for them that engages and disengages during operation. This type is less effective since human foot or hand power on clutching reaches about 10 KN or 1,000 kg.

### **Friction clutches**



A friction clutch

The vast majority of clutches ultimately rely on frictional forces for their operation. The purpose of friction clutches is to connect a moving member to another that is moving at a different speed or stationary, often to synchronize the speeds, and/or to transmit power. Usually, as little slippage (difference in speeds) as possible between the two members is desired.

#### Materials

Various materials have been used for the disc-friction facings, including asbestos in the past. Modern clutches typically use a compound organic resin with copper wire facing or a ceramic material. Ceramic materials are typically used in heavy applications such as racing or heavy-duty hauling, though the harder ceramic materials increase flywheel and pressure plate wear.

In the case of "wet" clutches, composite paper materials are very common. Since these "wet" clutches typically use an oil bath or flow-through cooling method for keeping the

disc pack lubricated and cooled, very little wear is seen when using composite paper materials.

# Push/pull

Friction-disc clutches generally are classified as *push type* or *pull type* depending on the location of the pressure plate fulcrum points. In a pull-type clutch, the action of pressing the pedal pulls the release bearing, pulling on the diaphragm spring and disengaging the vehicle drive. The opposite is true with a push type, the release bearing is pushed into the clutch disengaging the vehicle drive. In this instance, the release bearing can be known as a thrust bearing (as per the image above).

## Dampers

A clutch damper is a device that softens the response of the clutch engagement/disengagement. In automotive applications, this is often provided by a mechanism in the clutch disc centres. In addition to the damped disc centres, which reduce driveline vibration, pre-dampers may be used to reduce gear rattle at idle by changing the natural frequency of the disc. These weaker springs are compressed solely by the radial vibrations of an idling engine. They are fully compressed and no longer in use once the main damper springs take up drive.

### Load

Mercedes truck examples: A clamp load of 33 kN is normal for a single plate 430. The 400 Twin application offers a clamp load of a mere 23 kN. Bursts speeds are typically around 5,000 rpm with the weakest point being the facing rivet.

## **Cone Clutch**

A **cone clutch** serves the same purpose as a disk or plate <u>clutch</u>. However, instead of mating two spinning disks, the cone clutch uses two conical surfaces to transmit <u>torque</u> by friction.<sup>[1]</sup>

The cone clutch transfers a higher torque than plate or disk clutches of the same size due to the wedging action and increased surface area. Cone clutches are generally now only used in low peripheral speed applications although they were once common in automobiles and other combustion engine <u>transmissions</u>.<sup>[2]</sup>

They are usually now confined to very specialist transmissions in racing, rallying, or in extreme <u>off-road vehicles</u>, although they are common in <u>power boats</u>.<sup>[3]</sup> This is because the clutch does not have to be pushed in all the way and the gears will be changed quicker. Small cone clutches are used in synchronizer mechanisms in <u>manual</u> transmissions and some <u>limited-slip differentials</u>.

# **Heat Sink Considerations**

Rather than being a heat absorber that consumes heat by magic, a thermoelectric cooler is a heat pump which moves heat from one location to another. When electric power is

applied to a TE module, one face becomes cold while the other is heated. In accordance with the laws of thermodynamics, heat from the (warmer) area being cooled will pass from the cold face to the hot face. To complete the thermal system, the hot face of the TE cooler must be attached to a suitable heat sink that is capable of dissipating both the heat pumped by the module and Joule heat created as a result of supplying electrical power to the module.

A heat sink is an integral part of a thermoelectric cooling system and its importance to total system performance must be emphasized. Since all operational characteristics of TE devices are related to heat sink temperature, heat sink selection and design should be considered carefully.

A perfect heat sink would be capable of absorbing an unlimited quantity of heat without exhibiting any increase in temperature. Since this is not possible in practice, the designer must select a heat sink that will have an acceptable temperature rise while handling the total heat flow from the TE device(s). The definition of an acceptable increase in heat sink temperature necessarily is dependent upon the specific application, but because a TE module's heat pumping capability decreases with increasing temperature differential, it is highly desirable to minimize this value. A heat sink temperature rise of 5 to 15°C above ambient (or cooling fluid) is typical for many thermoelectric applications.

Several types of heat sinks are available including natural convection, forced convection, and liquid-cooled. Natural convection heat sinks may prove satisfactory for very low power applications especially when using small TE devices operating at 2 amperes or less. For the majority of applications, however, natural convection heat sinks will be unable to remove the required amount of heat from the system, and forced convection or liquid-cooled heat sinks will be needed.