Types of Clutches

Before you learn about the different types of clutches, answer a quick question to check your knowledge of what a clutch is.

Which of the following statements defines a clutch accurately?

- 1. A device used to engage or disengage power from a driving shaft to a driven shaft
- 2. A mechanical device that slows or stops a moving object by absorbing energy
- 3. A device that joins two or more objects mechanically to create non-permanent joints
- 4. A machine element that constrains relative motion to only the desired motion while reducing friction and handling stress

Correct answer: 1

When engaged, a clutch provides for power transmission from one component to another, especially from driving shaft to driven-shaft. The driven shaft may be stopped without stopping the driving shaft. Also power is transferred, the clutch can disengage, and the driven shaft can be stopped without stopping the driving.

In automobiles with manual transmissions, the power from the engine crankshaft flows to the drive wheels through a clutch located between the engine and the gear box.

Introduction to Clutches

Introduction	What Clutches Do	
Clutches fulfil the necessity to engage or disengage a machine without starting or stopping the driving. Clutches may be dry or wet.	 Enable slower, smooth, and quick engagement and disengagement Protect from overload by limiting maximum torque loads Prevent accidental machine reversal 	
Dry Vs. Wet Clutches		
Dry clutches are typically air cooled.		
• Wet clutches are immersed in oil or coolant, which helps dissipate heat when the		

clutch slips.

There are five types of clutches. In this document, you will learn about the first four types of clutches and their sub-types and applications.



Positive Contact Clutch

Introduction

A positive clutch has machine elements resembling jaws that interlock with each other to connect shafts. It allows no slippage while engaging or disengaging.

Elements

A standard jaw positive-contact clutch has two elements—one fixed and the other moving. These elements are illustrated here.



Types

Based on the use or application, you can choose from different types of jaw machine elements in a clutch. Let's look at the features of the two positive clutches.



	Spiral Jaw
Engaged Spiral Jaw Clutch	 Components A locking device keeps it engaged. In some cases, the locking device may be spring loaded, allowing the spiral jaw clutch to become an overload mechanism. Depending on the amount of force applied by the spring, the clutch disengages automatically when its threshold torque is reached.
	Engagement Speed Should be engaged at low speed.
	Variation A taper-tooth design using the same mechanism serves as an overload device regardless of the direction in which the clutch is turning.

synchronous drive is required.

Friction Clutch





Axial Friction Clutch

In axial friction clutches, contact pressure is applied perpendicular to a rotating shaft.

Key Features	Key Components
 High horsepower capabilities due to larger surface area. May be designed to run dry or wet. Used to engage or disengage only, or they may act as torque limiters by slipping under excessive torque 	 One or more metal pressure plates and friction discs (the friction disc is free to move or float on the driven shaft by using keyways or splines). Spring-loaded pressure plate to engage and disengage friction disc. Throw-out bearing for support when clutch is disengaged.

Here are a few examples of types of axial friction clutches.

Multiple-Disc Clutch



Friction Discs Between Metal Plates

A multiple-disc clutch is usually wet.

Application

Used in motorcycles to increase torque while minimizing space and weight requirements. Automatic transitions in modern automobiles may use three or more multiple-disc packs.

How It Works

Additional friction discs are sandwiched between metal plates to add to the surface area, thereby increasing torque capacity.



Mechanical Axial Brake

Advantages and Disadvantages

 \checkmark Low Maintenance and dependable.

* Requires larger force to brake than radial and drum brakes.

Application

- Automobiles may use power-assisted hydraulics to actuate disc brakes.
- In industrial application, disc brakes may be actuated by mechanical, pneumatic, hydraulic, or electric actuators.

Hollow discs with ribs and slots for air to flow between braking surfaces may be used to dissipate excessive heat.



Fluid Clutch



• The impeller and runner vanes have a small clearance between them, allowing a little slippage, varying with the amount of fluid. The more the fluid, the less the slippage.

Variation

Another common industrial fluid clutch uses dry pellets called shot instead of oil or liquids as the fluid media. Physically, it looks the same as a fluid clutch. Take a look at how it works.



Application

Dry fluid clutches constitute a simple, efficient, and economic solution for industrial applications needing soft start and overload protection.

Magnetic Clutch and Brake

Introduction

Similar to dry fluid clutches, magnetic-article clutches use electricity to activate a clutch or brake. They are used mainly for starting or stopping and are not suited for continuous slip operation. Their horsepower capabilities range from fractional to several hundred.



- A rotor is mounted in a sealed housing.
- The **electromagnet is energized**, and the metal particles lock into patterns formed by the magnetic flux lines and immobilize the rotor inside the housing.
- When the **electromagnet is de-energized**, the magnetic field is lost and the rotor returns to inside the housing.

Types

Two types of magnetic clutches are eddy current clutch and hysteresis clutch. Let's take a look at their key features.



- A non-contacting, non-ferrous rotor, usually made of copper or aluminium, is sandwiched between two magnetic discs mounted in a housing.
- The electric current induced in the rotor by the magnetic field causes the rotor to rotate.

The torque can be adjusted by misaligning the magnetic poles of the two magnetic discs on either side of the rotor. Max torque obtained by northsouth magnetic-pole arrangement. Min torque obtained by north-

north and south-south magneticpole arrangement.

Application

Eddy current clutches are used in industries where overloads frequently occur. They work well in applications that require constant torque but should never be used in applications where synchronization between input and output is required.



Physically, the main difference between a hysteresis clutch and an eddy current clutch is that that rotors in hysteresis clutches are made of a ferrous material.

Hysteresis Clutch

Key Features

- Like eddy current clutches, these clutches have no contact surface to wear. Therefore, clutch characteristics are stable over a long life.
- The performance and life depends on heat generation and dissipation.

Torque Adjustment

- Clutch input and output synchronize as long as the rated torque value is not exceeded.
- Torque is proportional to the coil current and can be adjusted.

Application

Hysteresis clutches are typically used in tensioning applications such as winding operations, conveyors, and rewinding. They also work well in any constant tension or torque applications.

Selecting a Magnetic Clutch	Limitations
 Make sure that the heat generated by cycling and slip doesn't exceed a value that would cause damage to the metal powder. 	 Rotational speeds that exceed manufacturer's recommendations will generate excessive centrifugal force, which causes the slip and torque to
 Check with the manufacturer for temperature limitations of specific models of clutches/brakes. 	 become erratic. In extreme cases, the clutch may even engage due to centrifugal force, locking the metal powder and rotor.

Application

- Manufactured in a wide range of configurations and sizes, these clutches and brakes may be integral to a motor or another piece of equipment or may be mounted separately.
- The lifespan of a carefully selected and sized clutch is excellent, without much maintenance required.
- These clutches are used in applications where rapid cycling is required.
- This clutch forms a good choice for automated production processes as its lock-andunlock torque characteristics are consistent and predictable.