

# Next-Generation Electro-Mechanical/High Performance Brakes 1: “Next-Generation Brakes”

## What is an Electro-Mechanical Brake?

An Electro-Mechanical Brake is a system that includes a device that operates until the driver applies the brakes and a device that operates with electrical power within the connection between the devices. Because hydraulic piping is no longer necessary, the brakes help improve fuel efficiency by reducing vehicle weight and also contribute to environmental preservation because they do not use brake fluid, which must be properly disposed of whenever repairs are made.



Electro-Mechanical Brake

## Types of Electro-Mechanical Brakes

### Electro-Mechanical Service Brakes

This brake system employs an electro-mechanical operating mechanism that presses the disc brake pad against the brake rotor. Stepping on the brake pedal while driving generates an electric signal, starts up the motor built into in the brake caliper, and generates braking force on the wheel. Since minute movements can be controlled through software programming, safety and comfort will be improved.

### Electro-Mechanical Parking Brakes

This electro-mechanical brake system activates the parking brake. Instead of the conventional parking brake lever, which requires force to operate, the parking brake can be operated with a switch or a pedal, thereby reducing the driver’s burden. Because it is controlled by an electronic control unit (ECU), this brake helps to prevent the parking brake operation failure and improves safety.

## Low Drag Calipers

The low drag caliper is a brake that ensures that the pad to rotor gap is precisely maintained at the micron level. This reduces brake drag due to contact between the pad and rotor when the brake is released, contributing to improved fuel economy.



Low Drag Caliper

## MR Fluid Brakes that Emit No Brake Dust

At the Akebono Research & Development Centre, we are conducting research and development into magneto rheological (MR) fluid brakes that eliminate brake dust. This product accommodates the increasing use of electro-mechanical systems in automobiles and is environmentally friendly.

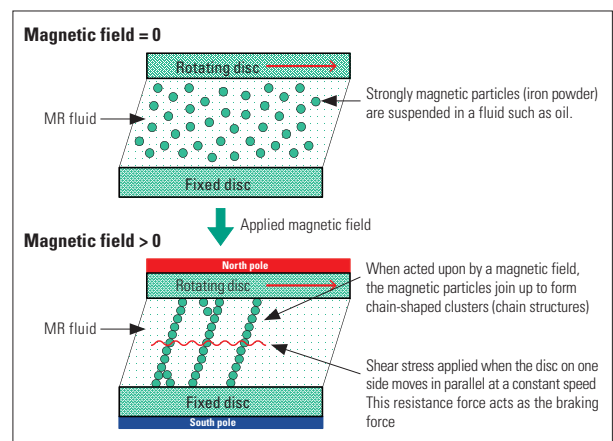
A functional material that has been researched since the 1960s, MR fluid has the characteristic that it changes from a liquid to a semi-solid state in reaction to magnetism. When a magnetic field is applied, the strongly magnetic particles (iron powder) several

microns in diameter suspended in the fluid align with the direction of the magnetic field, forming chain-shaped particle clusters that change the fluid to a semi solid state.

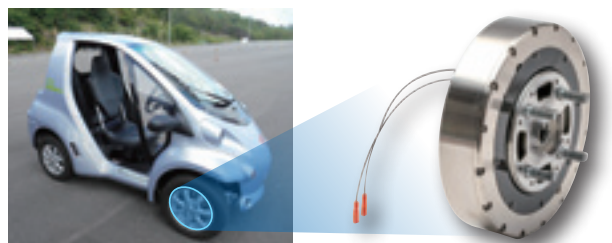
MR fluid brakes are constructed with a space filled with MR fluid between a disc fixed to the vehicle and a disc that rotates together with the wheel hub bearing. When electricity is passed through a magnetic coil mounted inside the brake, a magnetic field is generated in an orthogonal direction to the discs, causing chain-shaped particle clusters to form between the fixed disc and the rotating disc. As the rotating disc continues to rotate, the chain-shaped particle clusters are broken by shear stress, and then form connections to the neighboring cluster, before being broken again in a repeated cycle that generates a resistance force on the rotating disk. This resistance force is the braking force.

Using MR fluid for brakes can reduce the emission of environmentally damaging substances by eliminating abrasion powder because the brakes do not wear. Moreover, MR fluid responds to a magnetic field in less than a micro second, enabling sensitive and stable braking. Since the voltage (excited magnetic force) is electronically controlled, users can select their preferred brake feel from among several preset patterns.

In collaboration with the Institute of Fluid Science, Tohoku University (Professor Masami Nakano), Akebono conducted research and development on ultra-compact mobility and completed its prototype product in March 2015. We will continue to test and improve MR fluid brakes as a smart brake suitable for smart cities and smart mobility, aiming for implementation in 2020.



MR Fluid Brake Principle



MR fluid brake (prototype) and ultra-compact mobility vehicle fitted with it