Magneto Rheological fluid is a non-Newtonian fluid. These types of liquids change their state depending on the pressure and force applied to them.

A typical Magneto Rheological (MR) Shock Absorber fluid consists of soft iron particles, typically 3–5 microns in diameter, suspended in a carrier liquid such as mineral oil or synthetic oil. A variety of proprietary additives like those found in commercial lubricants help to keep particles suspended, enhance lubrication, change viscosity, and reduce wear.

Magneto Rheological (MR) fluids are materials that respond when they meet a magnetic field and change their behaviour. The essential characteristic of these fluids is their ability to reverse from a free-flowing viscous liquid to a semi-solid with controlled strength in milliseconds (as shown in Figure 1).

Introduced for the first time in 2002, on General Motor vehicles, the so-called MR suspension system is slowly becoming main stream. Although it has been made available on several vehicles, the system has been made famous by Audi, with its introduction on the TT and R8. In Australia, M.R. units are optional fitment to the Holden Special Vehicles (HSV).

What sets it apart from other suspension systems is the fact that it lacks any regular style valving and has no small moving parts. It is based on the MR Fluid, passing through a regulated magnetic field.

When the magnetic coil of the damper system, is not energized – the oil has a high viscosity and the iron particles move about randomly, acting like a regular damper fluid (as shown in Figure 2a).

However, when the system is charged the magnetic field is applied, the particles align into fibrous structures, with low viscosity (as shown in Figure 2b). This restricts the movement of the fluid, and the velocity of the piston. The magnetic field only needs to be generated in the piston of the damper so it only effects the fluids viscosity as it passes through. This creates greater efficiency and the need for only a relatively small magnetic device.

Fig. 1

Fig. 2a

Fig. 2b

Fig. 2c

Fig. 3 MR Suspension System
Controlled by the vehicle Electronic Control Unit (ECU) and the sports or comfort ride chosen by the driver, the system adjusts every millisecond. Sensors monitor road and vehicle conditions, while the controller modifies the dampening characteristics.

The use of a MR suspension system allows for more tunable ride conditions. The system can allow for each wheel to be dampened at individual rates if needed to enable the vehicle’s stability on gravel, and slippery road surfaces and do so with a fast response.

The charging of the fluid is not affected by temperature and will perform over a broad temperature range (-40 degree Celsius – 105 degrees Celsius).

If you looked at the fluid under high magnification in the absence of a strong magnetic field it would be similar in appearance to Figure 4a. Once a strong magnet field is applied the iron particles would appear uniformly orientated (as shown in figure 4b).

Note: This style of suspension is found on many of the high performance super cars and luxury style vehicles. As it is controlled by the vehicles ECU there is a chance that some programming exists to control its behavior. Caution should be observed if replacing it or removing it from the vehicle as vehicle performance may be affected and warning codes may be lodged in the ECU. Contact the vehicles manufacturer to resource correct specifications before performing work on vehicles with this suspension.