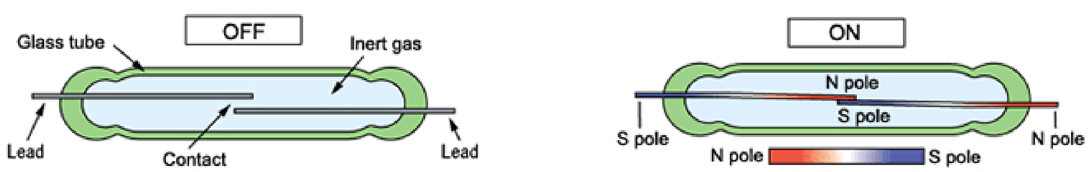
Technical Information

Measuring Reed Switches

The Clever Use of a Magnetic Field

Most switches are opened or closed by a physical force that either rocks, slides or rotates electrical contacts together or apart. A reed switch is a clever device that opens and closed electrical contacts without being physically touched, relying on the invisible force of a magnetic field. Inside a simple reed switch are two small metallic reeds with a gap between them. As a magnetic field is moved close to the reeds a positive magnetic force develops in one of the reeds, and a negative magnetic force developed in the other. Since these opposite forces attract, the reeds bend towards each other and make an electrical connection. If the magnetic field is removed, the two reeds are no longer attracted and relax back to their normal disconnected positions.

The key to using this device is knowing how much magnetic force will close the gap, and how fast it will open as the magnetic force is removed. This is not as easy as it sounds. The size of the gap makes a difference, larger the gap, the further the reeds need to bend, and the more magnetic force is needed. The reed switch gap generally averages less than 25 microns or 0.001 inches. (The diameter of a typical human hair). What the reed material is made of, how much the reeds overlap, and how thick it is will affect the force needed to bend it. The length of the reed switch terminals will also affect the magnetic force needed to actuate the reeds. In addition to the physical characteristics of the reeds, the shape and force of the magnet field will also affect how well the reeds connect (close), and how easily they release, (open).



Modern reed switches are made by the millions in very sophisticated automated processes that keep the size of the reeds and the gap between them very precise. Even with the finest automated equipment, there will be slight variations between reed switches made in the same batch at the same time. Leading reed switch manufacturers like OKI and Standex-Meder will 100% measure and sort millions of reed switches into ranges based on a measure of magnetic strength needed to close the reed switch. This measure is called Ampere Turns (AT).

A magnetic field can be generated when a coil of wire is energized. As the current through the coil is increased, so is the strength of the magnetic field. If a reed switch is placed in the coil, the reeds will bend and connect to each other when the coil's generated magnetic field gets strong enough. If you take the exact amperes meter reading that activates the reeds, and multiply it by the number of wire turns in the coil, the result is the Ampere Turns (AT). This is the standard measure used by the reed switch industry to categorize reed switches.

When a production lot of reed switches are measured and sorted, the resulting AT values will be a standard bell shaped curve centered at the manufacturing target value. The deviation around the mean will depend on the quality of the process, but generally plus or minus 5 to 7 ampere turns (AT). The sorted groups will generally be in a range of 5 ATs; for example 10 to 15, or 20 to 25 ampere turns, although closer AT ranges are possible.

Pull-In and Drop-Out Values

The magnetic force need to activate and close the reed switches is only half of the performance characteristics. If the magnetic force needed to close the switch is 15 AT, called the Pull-in value, there is a lower AT value where the magnetic force is not enough to overcome the natural stiffness of the reed, called the Drop-out value. This Drop-out value is usually about 5 AT lower than the Pull-in value. If the Pull-in is 15 AT, a typical Drop-out will be 9 or 10 AT.

This spread between Pull-in and Drop-out AT values is why reed switches below 7 or 8 Pull-in AT are mostly unavailable. The earth's magnetic field has an AT value of between 1 and 2. Also power lines, motors, and transformers all generate magnetic fields that can affect the ambient AT. With a Pull-in of 8 AT, the Drop-out can be as low as 3 AT, and any ambient magnetic field could be strong enough to keep the reed connected.

Determining the optimal spread between the Pull-in and Drop-out AT values is the key to selecting the best reed switch for an application. Having the manufacturer sort the reed switches into AT ranges is very helpful, but the magnetic forces a reed switch will experience in a sensor or relay application will be specific to each application. Reed switch characteristics, lead length, lead shape, connection method, sensor housing, magnet strength, magnet shape and field orientation will affect Pull-in and Drop-out values. The switch designer will balance these variables to develop a stable dependable switch system. Once the optimal reed switch and AT value is selected, the manufacturer's sorting reed switches into known AT ranges assures future reed switch purchases will perform as expected in the design.

Correlating AT Values Between Manufacturers

All reed switch manufacturers rank their product in AT ranges, but each manufacturer's test fixtures and coils will not be identical, so AT results can differ. Hamlin may rank one of their reed switches as 15 AT, however if OKI measured the same Hamlin reed switch on their equipment, they may get a 13 AT ranking. When changing from one manufacturer to another, there needs to be a correlation process to assure consistent results in the application.

A Hamlin switch marked with a specific AT range would be sent to Reed Rex or OKI, where they would compare the Hamlin switch in their test fixtures and correlate readings. For example a Hamlin 15 AT may correlate to an OKI 13 AT. In this example, the magnetic force needed to Pull-In or Drop-Out the two reed switches is identical, only the reading from each manufacturers test fixture is different. Using this correlation process, the user then knows that a Hamlin switch marked as 15 AT or OKI switch marked at 13 AT will both work in the design.

For more technical or application information on Reed Switches, go to: www.reed-rex.com/technical or www.reed-rex.com/applications