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Selecting the Correct Electrical Power-Off Brake

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Warner Electric

An Altra Industrial Motion Company

Selecting the Correct Electrical Power-Off Brake

By Greg Cober, Altra Industrial Motion Product Training Manager

When selecting a brake to control unbalanced or vertical loads, designers have a wide variety of choices ranging from simple locking devices to electrically or pneumatically powered units. One of the most common configurations is the electrically-released brake which can be found either integrated into motors or as stand-alone units.

Within the electrically-released brake family there are several types and they are not all created equal, nor are they intended to be. Some units are designed for occasional load holding usage. Others are developed for relatively high cycle rates and are designed to stop as well as hold the load. This is one of the key differences in brake function: Static Holding versus Dynamic Stopping.

Static Holding versus Dynamic Stopping

An analogy most of us can relate to are the brakes in our car. There is a set of stopping brakes designed for use any time we need to slow or stop the car. There is a different brake used as a parking brake. When we depress the brake pedal we apply our brakes and the car will slow and stop. These brakes are designed for all of the wear and tear that is associated with stopping and holding a vehicle. There is also a parking brake. It is designed to be engaged after the vehicle is already stopped and it is designed simply to hold the vehicle in place. Engage the parking brake and it stays engaged until you actively release it. It is not designed for repeated use as a stopping brake. Imagine your situation if you used the parking brake at every stop sign or traffic light. Your mechanic would love you as you would be replacing the worn components frequently.

There are similar distinctions in industrial brakes. Some brakes are designed to stop and hold; others to simply hold. Use the wrong one in an application and you may end up replacing or rebuilding it often and suffering production down time as a result.

Holding Brakes

Within the families of holding brakes there are two common designs: spring-set/solenoid- released and spring-set/coil-released units.

In spring-set designs, either solenoid or coil released, the brakes function very much alike: When there is no power, springs compress the friction disc against the housing, holding the load stationary. When power is applied, the solenoid will engage or the coil will magnetically clamp a disc and compress the springs releasing the friction facing so that the load is free to rotate.

All of these spring-set brakes basically function the same: when power is applied, they will be disengaged or released; and when power is removed, they will engage or lock-up. Therefore, all spring-set brake designs meet the important task of engaging if power fails unexpectedly which will stop and hold a load stationary and safely.

Solenoid-Released Brakes

Beyond the emergency stop function, solenoid-released designs are constructed as holding brakes not as cycling/stopping brakes. When they are used in cycling applications customers often find that they must either rebuild or adjust these brakes often. Depending upon load, speed and cycle rate it is not unusual to see these brakes requiring adjustment on a monthly basis to compensate for wear. It would be easy to denigrate these units as poorly designed, but the reality is that they are designed just fine, but they are often poorly applied. Many have been adapted into motors by motor manufacturers for a long time. Years ago, motor cycle rates and solenoid- released brake cycle rates were similar. Brake designs have simply not kept up as motor construction and insulation have improved and cycle rate capability have increased.

Coil-Released Brakes

Within the coil-released brake designs, many spring-set, electrically-released models are designed for holding or static engagement applications. When they are subjected to rapid stopping cycles they wear out quickly.

Some spring-set, electrically-released brake designs compensate for wear by simply increasing the thickness and surface area of their friction facing so that the key wear component will last longer under cycling applications. This added friction facing may be sufficient to provide adequate life in some lesser cycling applications.

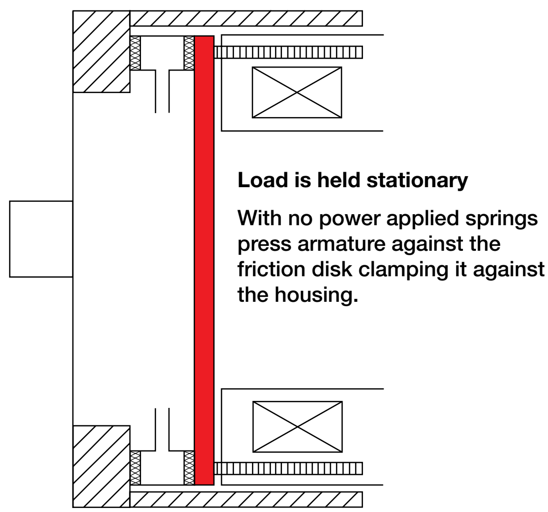
Coil-Released/Permanent Magnet Brakes

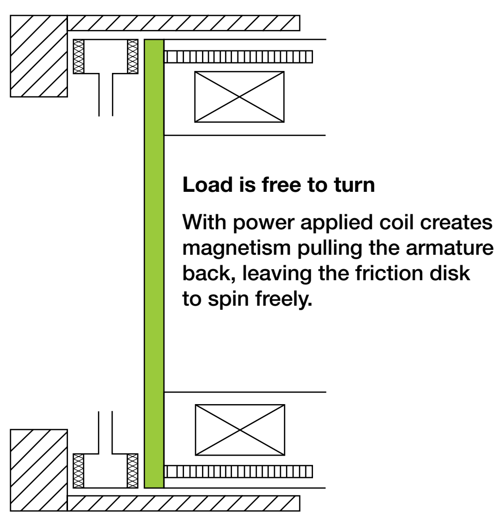
Coil-released/permanent magnet set brake designs do not suffer from the wear life issues that many of the spring-set designs do for one simple reason: they are designed for high cycle rates as a core part of their function. The basic design for a permanent magnet, electrically-released brake is the same as for an electrically-engaged brake. Both are designed for long-life in rapid dynamic stopping applications. While more expensive than the simpler static engage designs, these units are a viable choice as they will provide three to four times longer wear life than the static designs in cycling applications. Further, as a result of their configuration, permanent magnet designs can include an airgap adjusting feature so that they require no wear adjustment throughout the life of the unit.

Proper Brake Selection

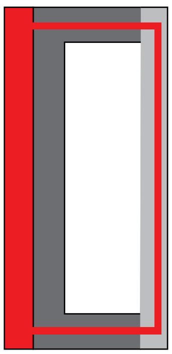
When choosing a power-off brake for an application it is important to consider how the brake will be used. Static engagement units are commonly used in applications where a servo or step motor provides deceleration and stopping torque, but where the load needs to be held safely once it is stopped. Vertical-mounted lead screw applications or loads that are unbalanced or eccentrically-loaded are two common examples.

The friction disc on the left is for a unit designed for primarily holding only applications. The disc on the right, with a significantly greater amount of friction material, is for a brake designed for occasional stop cycling. The increased amount of friction material provides higher total cycle life.



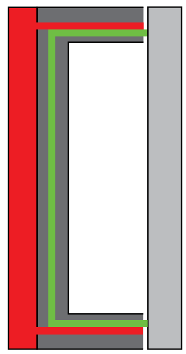


Spring-set brake: Engaged



Permanent magnet brake
No power: Engaged

Spring-set brake: Released



Permanent magnet brake
Power applied: Released

Brake Type	E-Stop Engagement	Holding	Light Cycling	Rapid Cycling
Spring-Set, Solenoid-Released	●	●		
Spring-Set, Coil-Released	●	●		
Spring-Set, Coil-Released (with thicker friction material)	●	●	●	
Permanent Magnet Set, Coil-Released	●	●	●	●

In both instances, the e-stop function is needed, but for most engagements the load will already be stopped and simply need to be held. Properly applied, holding brakes will last almost infinitely since they are engaging at zero speed and seeing little to no rotational movement.

Brakes designed for cycling are commonly found on declining conveyor systems in warehouse applications that may be subjected to dozens or even hundreds of stopping events per shift. The frequency of stopping events will determine if a low cycle rate or a high cycle rate brake is appropriate.

Within the permanent magnet designs, a set of permanent magnets clamp the steel friction disc against the unit housing. When power is applied, an off-setting magnetic field is created so that the net amount of magnetism is zero; at that point, the friction disc and load are free to rotate.

Proper selection of power-off brakes can make the difference between long life performance or recurring downtime and adjustment events. In many cases, the lowest purchase cost choice may result in the highest cost of usage and ownership. Consultation with brake suppliers to ensure the best brake is being selected for the application at hand can yield best results.

Warner® Electric
An Altra Industrial Motion Company

US (Application Assistance)
800-825-9050
www.warnerelectric.com

Europe
+33 (0) 2 41 21 24 76

Asia Pacific
For a list of our AP sales offices:
www.AltraMotion.com/ContactUs

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