Permanent magnet brakes
PERMANENT MAGNET BRAKE

Conventional ‘power-on electromagnetic brakes’ have been utilised in a wide range of motion control applications for decades. The technology and application is well understood in various industries, quite literally, where any form of linear or rotary motion needs to be dynamically arrested or statically held until released. These devices need the application of power to generate the magnetic field in order to give the required braking action.

Although this is acceptable for many applications, this is generally not the case for ‘safety critical’ or ‘emergency stop’ scenarios. More recently industrial applications and government legislation has tended to focus more on the need to prevent injury in the case of catastrophic failure/total failure of machines or processes.

Whilst there are various fail-safe alternatives including conventional spring applied brakes, there are many advantages to our permanent magnet brakes. These brakes are truly fail-safe devices which require no power/current to give the desired braking action.

The permanent magnet brake is available in the same mounting style as a conventional power on brake with flange or spigot mounting options therefore it is easier to incorporate into existing designs. Due to its precision, it is suited to high safety applications in the robotics, medical and military sector.

This brake can be used in fail-safe applications to automatically stop the motion when the electrical power fails, this means that when the power is removed from the unit, the rotating armature or drive hub engages with the brake field.

Therefore the permanent magnet brake is typically used for static holding or parking brakes (E-stop brakes), with some dynamic capability.

Permanent magnet brakes may be considered as virtually backlash free as the diaphragm spring and fasteners are torsionally rigid, where as spring applied brakes tend to utilise splines or hexagonal drive elements which need to slide, so inherently have internal clearances.

Existing drive components such as gears and pulleys can be easily incorporated within the drive hub assembly where needed. These are ideal for high precision positioning systems such as printing, machine tools, pick and place, medical equipment, aerospace and military applications.

The multi pole version of the permanent magnet brake provides a solution to give increased torque in the same size envelope. The torque is boosted by doubling the number of working poles and this technology can also be applied to clutches and power-on brakes.
Permanent magnet brakes tend to be more compact than comparable spring applied brakes. These are ‘power-off’ devices and are designed so that when the power is removed from the unit, for whatever reason, the magnetic energy of internally mounted permanent magnetic elements are channelled and controlled to give the required braking effect. The brake field is fitted to a stationary surface of the machine structure and the armature plate or drive hub is fixed in place to the rotating machine element. Between the working faces of these two parts there is a small air gap, defined in our datasheet as dimension G.

When power is removed and the internal coil is de-energised, the armature disk is attracted across the air-gap (deforming the diaphragm spring) and onto the pole face of the brake magnet through the action of the internal permanent magnet field. In this state a frictionally engaged and virtually backlash-free connection is created between the stationary field and the rotating armature assembly which will be decelerated accordingly.

Conversely, when a current is applied through the brake’s internal field coil, the magnetic field generated is equal in magnitude and opposite to that of the permanent magnets therefore cancelling each other out. The brake will disengage as the armature plate is pulled off the brake surface by the action of the diaphragm spring. Obviously it is vital that the correct polarity is made, otherwise disengagement will not occur.

At SG Transmission, we use rare earth magnets to create a higher flux density (tesla/gauss) than comparable, older design ferrite magnets. These rare earth magnets allow for relatively high torque densities in small envelope volumes. Our design engineers can create customised armature styles depending on the application.

SG Transmission brakes can be supplied, as standard with C.L., C.C. and C.R. armature types and feature bores and keys to suit specific requirements.
Particular attention must be paid to the following points:

1. Keep grease and oil away from the friction surface (use only sealed bearings).
2. The armature disks should be cleaned thoroughly prior to mounting. Don't apply oil-based solvents to the friction surface.
3. The armature disk must be free to move axially across the air-gap. It is fitted with a circular diaphragm spring on the reverse side to allow it to move.
4. For armatures without a hub, the customer must provide clearing holes for the bolt and rivet heads in the counterpart.
5. The fastening screws of the armature without a hub must be secured (e.g. retaining washers).
6. All tapped holes should be burr free but leave the edges unfinished so that the armature can be mounted as flat as possible.
7. With regard to the air-gap setting, maintain the dimension `G` as close as possible. Parallelism and concentricity must be maintained between the brake field and armature assembly.
8. The method of fitting must secure all components in an axial direction.
9. For flange mounted designs, the brake field should be mounted to a stationary face of the machine structure and controlled concentrically with the drive shaft and armature assembly.
10. For mid-shaft mounted brakes, the units must be secured to prevent rotation.
11. Metal turnings or other particles which may be attracted by permanent magnets are not allowed to get on the friction surfaces.
12. To prevent damages at the armature while assembling rated voltage must always be applied.

Ideally the units should be controlled by a constant current power supply, particularly in applications where the environmental temperature can be very hot or cold. However, in most applications the use of a controlled voltage source is sufficient. The following illustration indicates the effect of changing temperature on the effective disengagement point of these brakes. However, this is an indication only as individual application parameters can vary significantly.
When voltage/current is applied, the brake will disengage. Heat will be generated by the coil. This heat changes the coil resistance and causes a shift in the release voltage/current. Therefore, the SG Transmission permanent magnet brake is tested at an ambient temperature of 20°C when hot to optimise the disengagement window. To eliminate the effects of temperature a constant current power source could be employed.
These power-off devices are designed so that when the power is removed from the unit, the magnetic energy of permanent magnetic discs are channelled and controlled to attract the steel armature plate across an air-gap which is attached to the relating machine element. Therefore holding it in its place against the stationary field housing to give the required braking effect.

When power is returned to the brake coil in the brake field, the armature plate is released from the brake field allowing free movement of the rotating machine element. Two types of permanent magnet brake are currently available from SG Transmission. Designs can be supplied as a flange mounted unit (A) or as a spigot-only design (B) depending upon the actual customer application.

SG Transmission brakes can be supplied, as standard with C.L., C.C. and C.R. armature types and feature bores and keys to suit specific requirements. Available in a range of voltages.

UL versions available on request (subject to tooling).
## STANDARD TYPE 62 BRAKES

| Size | Torque TS (Nm) | Max P20 (w) | A1 (h8) | A2 (h8) | A3 | A4 (AF) | C4 | E2 max (H8) | E4 (H8) | E5 | E8 | E9 | G | K | N1 | N2 | N5 | R | S1 | S4 | T | U1 | U2 | U7 | U11 | V | W1 | W4 |
|------|----------------|-------------|---------|---------|-----|---------|----|------------|--------|----|----|----|----|---|---|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|
| 03   | 0.4            | 6            | 38.5    | 28      | 28.5| 30      | 7.8| 8          | 16     | 17 | 9  | 0.15| 4  | 33.5  | 19.5| 22  | 16  | 10.5| 2.7| 1.5| 2.6| 2.15| M3 | M2 | 1.6 | 5.3 |
| 04   | 1.25           | 8            | 62.5    | 40      | 40  | 45      | 14.2| 8          | 13     | 16 | 13 | 12  | 0.15| 6   | 54 | 29  | 32.5| 21  | 17.5| 3  | 3   | 3.5| 3.2 | M3 | M2 | 1.5 | 12.2| 5.3 |
| 05   | 2.5            | 12           | 75      | 53      | 56  | 56      | 17  | 15         | 24     | 24 | 23 | 0.20| 6.5| 61   | 46  | 48  | 20.8| 20.5| 3.4| 3.3| 4.5| 3.1| M3 | M3 | 1.5 | 13.5| 7.0 |
| 06   | 9              | 20           | 80      | 63      | 63  | 66      | 15  | 17         | 35     | 27 | 32 | 0.20| 6.5| 8.0  | 72  | 46.0| 50.0| 49  | 26.6| 19 | 4   | 3.8| 3   | 4.5| 3.1| M3 | M4 | 1.5 | 11.5| 7.5 |
| 07   | 5              | 20           | 90      | 70      | 73  | 70      | 20  | 20         | 30     | 30 | 30 | 0.25| 8   | 79.5| 60  | 61  | 25.3| 24.2| 4.2| 3.5| 5.5| 4.1| M5 | M3 | 1.5 | 15.0| 9.2 |
| 09   | 12             | 18           | 115     | 85.5    | 90  | 90      | 25  | 30         | 40     | 40 | 40 | 0.25| 10  | 102  | 76  | 75  | 26.6| 30  | 5.0| 3.5| 6.5| 5.1| M5 | M3 | 2.0 | 20.0| 10.0|
| 11   | 30             | 22           | 132     | 110     | 110 | 110     | 30  | 35         | 50     | 49 | 52 | 0.30| 13  | 121  | 95  | 90  | 33.0| 36.2| 6.2| 3.75| 6.5| 6.1| M6 | M4 | 4.7  | 24.0| 12.2|
| 12   | 60             | 28           | 150     | 126     | 126 | 126     | 30  | 40         | 60     | 57 | 62 | 0.40| 12.5| 137  | 95  | 106 | 37.8| 37.2| 7.1| 5   | 6.6| 6.1| M6 | M6 | 3.2  | 20.0| 13.0|

## SPECIAL TYPE 62 BRAKES

| Size | Torque TS (Nm) | Max P20 (w) | A1 (h9) | A2 (h8) | A3 | A4 (AF) | E2 max (H7) | E4 (H8) | E5 | E8 | E9 | G | K | N1 | N2 | N5 | R | S1 | S4 | T | U1 | U2 | U7 | U11 | V | W1 | W4 |
|------|----------------|-------------|---------|---------|-----|---------|------------|--------|----|----|----|----|---|---|----|----|----|---|----|----|----|----|----|----|----|
| 4 (HT)| 2.2            | 8           | 62.5    | 40      | 45  | *       | *          | *      | 15 | *  | 13 | 0.15| 6.5| 54 | 32 | 23 | 23 | 5.05| 2  | 3.5| 3.2 | *  | 1.5 | *  | *  |
| 6 (HT)| 12             | 20          | 88.9    | 66      | 67.7| *       | 35/34      | 27     | 35/34| *  | 0.2| 8   | 79.4| 46 | 56| 27.6| 18.5| 3.9| 3.5| 4.3 | 3.1| M5 | 3xM4| 1.5| 11.1|*   |
| 9 (HT)| 22             | 18          | 115     | *       | 90  | 90      | *          | 40     | *  | 43 | *  | 0.25| 10  | 102 | 76 | 26.6| 5   | 3   | 3.5| 6.5 | 5.1 | *  | 2   | *  | *  |
| 11 (HT)| 40             | 22          | *       | 104     | 110 | 30      | 35          | 50      | 49 | 49 | 0.3 | 13  | 95   | 90  | 30.7| 5.8 | 6     | *  | 6.3 | 6xM4| 2   | *  | 12  |    |
| 16   | 120            | 40          | 190     | *       | 160 | ROUND   | *          | 68     | *  | 63 | 0.4 | 13  | 175 | 120 | 41.2| 9.4 | 10   | 6x6.4| 8.3 | *  | 6   | *  |    |

## MULTI POLE TYPE 62 BRAKES

| Size | Torque TS (Nm) | Max P20 (w) | A1 (h9) | A2 (h8) | A3 | A4 (AF) | E2 max (H7) | E4 (H8) | E5 | E8 | E9 | G | K | N1 | N2 | N5 | R | S1 | S4 | T | U1 | U2 | U7 | U11 | V | W1 | W4 |
|------|----------------|-------------|---------|---------|-----|---------|------------|--------|----|----|----|----|---|---|----|----|----|---|----|----|----|----|----|----|----|----|
| 08   | 18             | 24          | 100     | 80      | 80.2| 80      | 20         | 22      | 35/42| 38 | 38 | 32 | 0.25| 8  | 90  | 60 | 63 | 29.9| 24.7| 4.7| 3   | 5.5| 4.1 | M5 | M4 | 1.5 | 16 | 8.7 |
| 09   | 22             | 18          | 115     | *       | 90  | 90      | *          | 40     | *  | 43 | *  | 0.25| 10  | 102 | 76 | 26.7| 5   | 3   | 6.5 | 5.2 | *  | *  | 2   | *  | *  |
| 10   | 35             | 22          | *       | 100     | 100 | *       | *          | *      | 52 | *  | 52 | 0.3 | 10  | 78  | 76 | 37.5| 5.8 | 5   | 5.1 | M5 | 2   | *  | *  |    |
| 11   | 40             | 24          | *       | 104(h9)| 109.6| *      | *          | 56     | *  | 58.5| 0.3 | 12.8| 95  | 90  | 30.7| 5.8 | 6   | 6.4 | M4 | 4.7 | *  | *  |    |

* Available on request
SG Transmission has designed a curved permanent magnet brake to be used in specialist medical equipment. The customised brake has been designed to control the height of a vertical and extendable pole, which moves linearly in oncology treatment machines.

The dual curve surface brake increases the working face of the brake to match that of the curvature of the pole, this ensures maximum contact and therefore a higher holding force.

Paul Short, Technical Manager at SG Transmission said: “As this brake is used in an operating theatre to control a system suspended above the patient, it is very important to the customer that the brake is fail-safe. In the event of a power failure, the suspended weight of the mechanism must not fall freely.

“The challenge was to maximise the working pole area within a specific envelope size to suit the customer’s needs. We delivered this unique concept to the customer in just 15 days.”

This bespoke, curved brake is suited to applications in the medical, military and robotics industries, due to its precision, increased holding force and fail-safe qualities.

SG Transmission is celebrating its 45th year in the power transmission industry. The UK manufacturer of electromagnetic clutches and brakes has a global customer portfolio, which is served from its head office in County Durham, England.
SG Transmission has launched an ultra-slim, high torque, permanent magnetic brake with a brake field depth of less than 13mm.

The design team at the British manufacturer of clutches and brakes, designed the brake specifically for a robotics manufacturer where length was restricted and footprint size limited.

The ultra-slim brake has been developed by using extremely high energy permanent magnets to obtain its high torque in a small space. The brake has a small outside diameter and a brake field of less than 13mm, with a comparatively large bore through the centre for the application's drive shaft.

The design engineers at SG Transmission were also faced with the challenge of designing an efficient magnetic circuit to fit in such a small envelope, which incorporated the coil to de-energise the brake.

Paul Short, Technical Manager at SG Transmission, said: “We initially designed this product for a customer who had an already specified envelope size. We achieved the desired specification in a very limited time scale to meet the customer's expectations.”

“Since providing this solution for the customer we have further developed the brake, after receiving a number of enquiries from customers regarding the high torque brake within a small space.”

The high torque brake is suitable for most industries including robotics, medical and military due to its inherent backlash-free construction. Additionally, it is low in power consumption which reduces heat build-up when compared to spring applied alternatives.
The permanent magnet toothed brake offers a fail-safe braking solution with a higher torque than conventional single face friction brakes in a compact size.

The permanent magnet toothed brake is designed so that when the power is removed from the unit, the magnetic energy of a permanent disc is channelled to attract the steel toothed armature across an air gap. This will then clamp in place against the stationary housing to give the required braking effect.

The permanent magnet toothed brake may be engaged while at a standstill or synchronised with the toothed driving ring speed to give precision holding and no slip.

The permanent magnet toothed brake gives the perfect solution for many types of applications providing positive braking and is available in various sizes and torques to meet your requirements.

**Features**
- Compact size
- Power-off brake engagement
- Precision holding
- Optional number of teeth
- No slip
- Fail-safe