CORROSION STUDY ON ELECTROMAGNETS

What is an electromagnet?

1. Main features:

a. Holding force:

This is what provides locking on installation and also over time, as long as the installation is performed according to the best practices of the trade.
This mainly depends on the quality of the materials used.

Unfortunately, at this time (Summer 2016), there are no standards or official texts in Europe, although standardised tests are commonly used in the factory and by many laboratories using an axial force machine.

b. Corrosion resistance:

This is a crucial matter that is nevertheless deliberately swept under the carpet by some.

An electromagnet that has been poorly treated or not treated at all will initially have a pulling force that is somewhat superior but which will quickly but quickly decrease a lot when rust attacks the flat surfaces.

iGEM Qmag and HQmag electromagnets have been specially protected from corrosion as confirmed by the tests performed according to the standards ASTM B 117 and ISO 9227 and particularly the millions of locks we have installed over the last 30 years.

c. Residual magnetism:

This is an insidious defect as it only appears after a certain amount of time.

Some manfuacturers, neglecting quality for the benefit of their profit margin, attempt to compensate for this defect by adding a push-pin/disc on the armature plate known as a “repulsor”. As well as upsetting the balance of the magnetic field and therefore the holding force of the lock, this mechanical trick is very unreliable and renders the lock dangerous when it becomes ineffective and can no longer compensate for the endemic defect in this type of lock.

iGEM Qmag and HQmag electromagnets do not need any tricks to compensate any residual magnetism, as they do not suffer from any serious flaw delayed. They give access immediately as soon the power supply is switch-off.

2. The basics of quality:

An electromagnet is made with steel, copper, and resin, and also electronics of varying quantities depending on the model.
It does not attract it’s armature plate, it maintains it.
This is why the plate must fit the electromagnetic body perfectly.

What is expected of a electromagnet?

- *To have sufficient retaining force, at least equal to the amount claimed, + or – 10%*
- *To have received very effective corrosion treatment*
- *To have no magnetic remanence even 30 years after continuous use.*

There are dozens of different steel grades, not to mention alloys.

The principle of a electromagnet seems simple, but only a handful of manufacturers throughout the world are able to build them correctly. The steel grade is crucial as it must have strong magnetic permeability and, despite this, must be able to resist corrosion.
However, the more stainless a steel is, the less magnetic it is!

a: The Steel Grade

First point:
Finding the balance between anti-corrosion treatment and holding force.

The steel is also a “magnetisable” metal. It is sufficient to place a steel tool, such as a screwdriver, on a permanent magnet, to see that it also becomes a magnet

Second point:
Preventing magnet body tracks or the armature plate from becoming a permanent magnet. Only special steels meet this important criterion.

Note:

This helps us to understand that adding a piece acting as a spring against the armature plate is not a valid solution. This is undeniably a bad transformation with dangerous consequences that will transform a static and therefore extremely reliable product, into a mechanical product that will sooner or later seize up depending on the humidity and dustiness of the environment. Simple on-site tests prove it: when this part becomes rusty, or seized up, its effect is nullified, and the door seems to stick, with all the dramatic consequences that you can imagine in panic scenarios, especially for children, the elderly or the disabled.

Furthermore, this type of part disturbs the magnetic field in the armature plate and considerably reduces its holding capability due to a simple imbalance.

b: Resin Quality

- Quality and finish are visible to the naked eye.
- Must be particularly resistant to the wide temperature ranges encountered in the field.

In certain conditions, under the sun in the deep south, for example, the temperature of a lock can exceed 80°C. In northern Europe, or in cold rooms, it can go as low as – 60°C.
In these conditions, the resin used cannot crack or melt as this would have the effect of permanently “gluing” the lock, with all the disastrous consequences that would result from this.

Our resin is chosen for its wide temperature tolerance.
Its height between the magnetic strips is precisely calculated so that the difference in values between its thermal expansion and that of the steel never affect the quality of the lock regardless of the conditions of use.

c: Copper Grade

The magnetic field of an electromagnet is generated by one or more copper coils. It is transmitted and amplified by the E structure of the steel.

The performance depends on the copper grade: Electricity consumed in relation to the armature plate’s holding force.

3: Advantages common to the entire iGEM: HQmag, Qmag and VORTEX®

Quality Control: All coils and functions are tested at the end of the chain of production before leaving our factory.

High-quality anti-corrosion protection: Each lock series undergoes salt spray exposure tests according to the standards ASTM B 117 and ISO 9227.

Anti-dismantling device: Aluminium plates block the access points to the lock's screws.

The steel grade: Prevents any possibility of residual magnetism.

Our electromagnets can be fitted on the outside of a building:
For this purpose, it is sufficient to insulate the electrical parts during installation against damp and water infiltration using silicone seals.
For high-stress installations, the electromagnets from the 4500, 4700 and 5000 ranges are provided with an INOX AISI 304 or AISI 316 box and are IP 67 certified

CE Marking: EMC, Security, safety, corrosion and RoHS.
Extruded aluminium assembly accessories: These ensure strength in relation to the holding capacity of the lock which cannot be claimed by folded metal accessories.

What every locksmith professional should know:

Basic values:
- Since the magnetic is of US origin, its force was originally expressed in pounds (lbf)
- One lbf is equivalent to 0.453 kgf. A 1,200 lbf lock therefore has a holding force of about 540 kgf.
- One kilogram-force (kgf) is not a kilogram of weight (kg). It is therefore more correct to use the unit of measure for force, that is, the Newton.
- 1 kgf = 9.80N = 2.20 lbf

History:

The original electromagnets that we introduced into Europe in the 1980s therefore had a holding force of ~540 kgf (1.200 lbf), and not 600 kgf as claimed by some competitors.

Although this value remains the same for our OEM electromagnets and for the HQmag models described in this catalogue, unfortunately it is not the same for the classic range that we have set apart here under the name Qmag.

What happened?

In the first few years following the introduction of our electromagnets in Europe, several competitors emerged, mostly industrial manufacturers, who in Germany and northern Europe launched their own production in their European factories. These products were globally comparable to our own, both in quality and price.
A number of years later, other actors invaded the market, no longer driven by an industrial spirit but purely by commercialism. The only leitmotif was to sell more cheaply a product that looked like the original.

If we take into account that a magnetic lock is primarily composed of steel and copper, how could they explain a 50% drop in the price of a lock when over the same period, the price of metals such as copper increased by 300%? Low-cost labour in certain Asian countries could not explain this difference and metal prices are identical in every country all over the world. The explanation can be found in the use of inferior materials and more basic anti-corrosion treatment.

It is clear that those who market these electromagnets of very poor quality are wary of revealing the exact characteristics of their products.

So how do we tell good from bad?

The answer comes from an official laboratory that has tested the main so-called “300 kgf” locks in the European market.

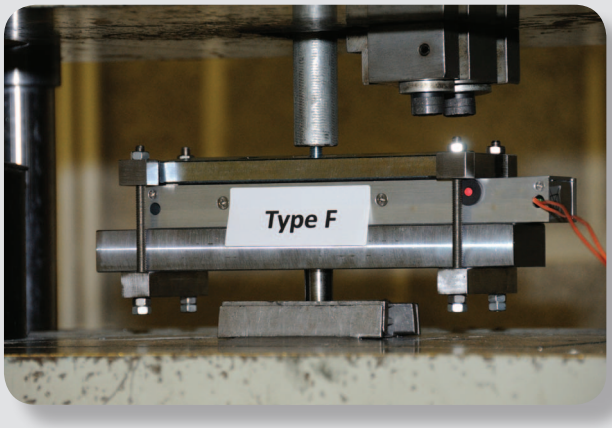
The tested electromagnets come from several distributors, mainly English and French. They are therefore models that any fitter can obtain from the same sales outlets.

The tests were performed in 3 separate phases, on two identical electromagnets from each manufacturer and/or distributor:

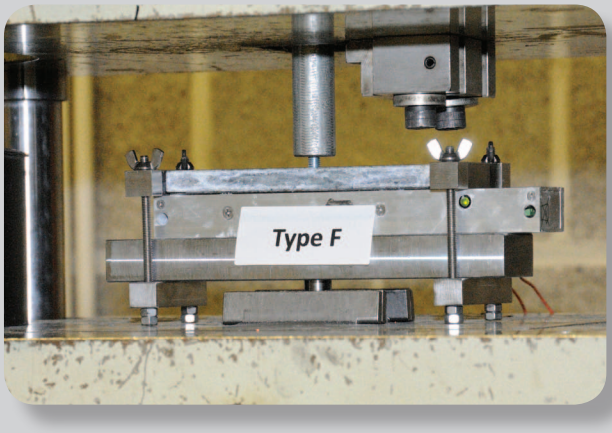
1. The first electromagnet is tested NEW on an axial testing machine in order to find out its maximum strength
2. The same electromagnet is subjected to a salt spray test in another specialist laboratory according to the standards ASTM B 117 / ISO 9227
3. The electromagnet emerging from the salt spray test, representing outdoor usage over a longer or shorter period is tested in the same machine to obtain the residual holding value of a electromagnet rusted as a result of time or its environment.

The images below illustrate the process:

Brand new electromagnets



Same electromagnets after 96 hours later ...



Summary of tests performed at the start of 2014:

Pull test + Salt Spray test - Sampling from competitors - “600 Lbf/300 Kgf” range

Item	References Mortise Mags	From	Newton/Kgf Brand new	ISO 9227 After 96h corrosion test	Loss %
IGEM 1	IGEM 1	IGE	2430 N/~243 Kgf	2250 N/~225 Kgf	7%
IGEM 1 HQ	HQmag 1	IGE	2870 N/~287 Kgf	2670 N/~267 Kgf	5%
TYPE A			1340 N/~134 Kgf	1260 N/~126 Kgf	6%
TYPE B			1490 N/~149 Kgf	810 N/~81 Kgf	45%

Item	*References Surface Mags*	*From*	*Newton/Kgf Brand new*	*ISO 9227 After 96h corrosion test*	*Loss %*
TYPE C			2040 N/~204 Kgf	1140 N/~114 Kgf	44%
TYPE D			2050 N/~205 Kgf	980 N/~98 Kgf	52%
TYPE E			2220 N/~222 Kgf	670 N/~67 Kgf	70%
TYPE F			2450 N/~245 Kgf	1370 N/~137 Kgf	44%

Tests done in AIB - Vinçotte and SNCB-Infrabel laboratories, between december 2013 and january 2014 - Power supply: 12 VDC - Traction speed: ~3mm/sec

What about our iGEM electromagnets?

Here are the logos which will help you identify our range of electromagnets:

To remain consistent, we have used the Newton as the unit of force to categorise the different electromagnet families.

A 3,000 N category lock is therefore part of the 300 kgf range.

This 3,000 N value is realistic for our OEM electromagnets (not included in this catalogue) and our HQmag type electromagnets.

However, in recent years, we have had to adapt our prices to pressure in the European market and therefore restrict performance in terms of force in our models mainly intended for distribution. These electromagnets are from our classic range now known as the Qmag range. The letter Q in this name emphasises the retention of essential qualities such as corrosion treatment and the absence of magnetic remanence.
We have never compromised on these two characteristics as we believe them to be essential.

However, in order to uphold our code of conduct as a manufacturer, we indicate the real holding force (+ or -10%) tested in our factory’s laboratory in the features of each electromagnet.

This summary of our experience spanning more than 30 years is not necessarily exhaustive and we are therefore entirely at your disposal to answer any of your questions.

Kind regards,

Michel LEQUY

Daniel DIERCKX