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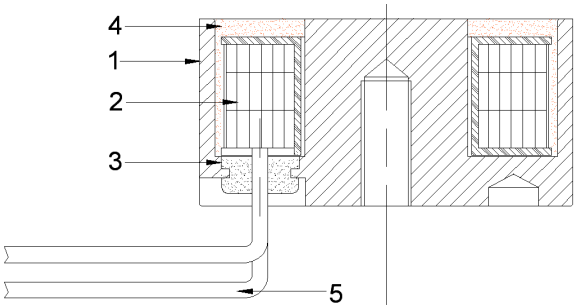
ELECTROMAGNETS FOR HOLDING AND LIFTING

INSTRUCTION MANUAL

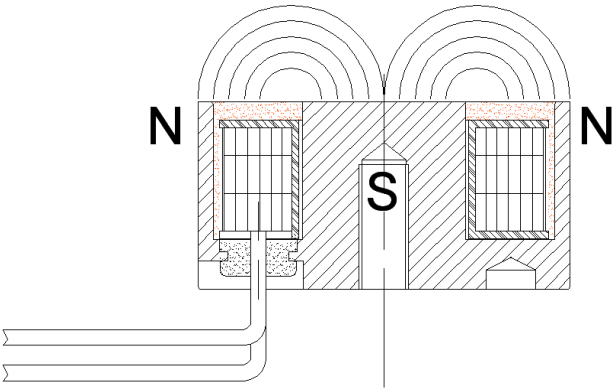
The electromagnet is intended to be incorporated to constitute machinery and must not be put into service until the final machinery, into which it is to be incorporated, is according to the regulations of the EC Machinery Directive 2006/42/EC, if applicable.

Rev.1 – 01/12/10

ELECTROMAGNET SECTION



Img.1



Img.2

INTRODUCTION

Please read the operating instructions carefully before using the solenoid to prevent accidents and ensure the trouble-free operation.
Make sure you keep the instructions at hand for quick reference. If you resell the solenoid or give it to another user, please include these instructions.
The following symbols are used in the instructions:

 DANGER

This symbol draws your attention to work processes or operating procedures that have to be carefully observed in order to prevent serious injury to the user or another person.

 CAUTION

This symbol draws your attention to information you need to ensure that your solenoid is not damaged due to improper or careless use.

 PLEASE NOTE

This symbol shows additional information or useful suggestions for the installation.

SAFETY MEASURES

The main rule is always working under safety conditions in order to safeguard one's own safety and that of other bystanders.
Always remember that this guidebook is addressed to skilled personnel, having received appropriate education and training, supplied with suitable equipment and acquainted with the features of the working environment where they are operating. Knowledge of working procedures and use of equipment is essential to prevent from injury or damages possibly arising from the same equipment.

The main voltage and current type specified on the electromagnet documentation must match the features of your electric system.

The electromagnet must only be employed for its intended use.

Before the operation, make sure that the connector or the feeding cable is not damage.

Do not lift the solenoid by the connector / cable.

Disconnect the electromagnet before starting any servicing activity or replacement. Carrying out any change or modification without prior authorization is prohibited.

Do not assemble the part with ambient temperature higher than 100°C or in presence of open flames.

ELECTROMAGNET DESCRIPTION (Img.1)

The basic parts of the electromagnet are:

1. Electromagnet body
2. Coil
3. Rubber cable clamps
4. Insulation (epoxy resin)
5. Power supply cables. The standard is Varpren class F (polyolefin without halogens; T_{max} =155°C)

The cables are standard type for cylindrical electromagnets type T, whereas for electromagnetic bars (type B) the standard is DIN 43650 A/ISO4400 connector

Upon request other types of power supply cables can be supplied

The electromagnets can be used to hold ferrous materials on plane N-S-N (fig.2), where there is the magnetic field. However, gripping force sideways or on the fastening plane is not sufficient.

Two product ranges are available:

- **TYPE T: cylindrical electromagnet** up to 350 Kg (3430 N) holding force
- **TYPE B: bar electromagnets** to lift and grip up to 950 Kg (9310 N)

Electromagnets normal power supply is 24VDC .

Other voltages can be supplied upon request.

Special products are also available for higher gripping forces with surfaces that can be profiled, for high temperature environments and with other customisations to meet all the requirements of the customer.

Special products

- **FIAT type bar size electromagnets** with profilable magnetic poles and removable coil, useful for the replacement of the electric part in case of damage without reworking the mechanical part.

FIG.3

- **Electromagnet with magnetic surface that can be profiled to improve contact with a part that is not flat.** A lowered coil is possible to have a profiled machining allowance thickness to be agreed according to requirement.

APPLICATIONS

Typical applications are:

- Cyclical moving operations of metallic pieces by robotized arms.
- Lifting of parts and metallic materials in general of considerable weight also.
- Holding of metallic pieces during metalworking and welding operations.
- Locking of doors and windows like the emergency exits

GENERAL INFORMATION

The electromagnets are appropriate to hold ferrous materials on plane N-S-N, where the magnetic field is active. As can be seen in the diagram of fig.2, the magnetic field is closed between central pole S and side pole N. Therefore maximum force is obtained when the ferrous material to be held or lifted is in contact with both poles. If one or both poles do not touch the material, useful force is reduced.
The magnetic flow has a “thickness" that depends on the electromagnet model: if the material to be held has a thickness that is at least the same as the magnetic flow, maximum force available is exploited.

Electromagnetic gripping force (necessary to detach the part when perpendicular to the electromagnetic surface) depends on the following factors:

- **Air gap between electromagnet and part:** maximum grip is obtained if the two surfaces are perfectly adherent and with minimum machining roughness (air gap zero). Also a protective enamel is an air gap.

The distance between the part and the electromagnet reduces holding force very quickly: 1 mm air gap reduces to 2-5% of the force available at contact .

- **Contact surface,** not to be less than the electromagnet surface

If there is not a good surface contact (for example, bars with circular section) shaped electromagnet surface profiles are recommended or addition of appropriate expansion poles (special versions). Consult CEI.

- **Thickness of part to be attracted:** maximum electromagnetic force is obtained if the thickness is at least the optimal value indicated in the technical sheet (fig.4a) and less if material is thinner (fig.4b).

a b

FIG.4

- **Material,** ferromagnetic; with same thickness and surface roughness in direct contact, magnetic grip decreases with pure iron, iron for structural work, steel, malleable cast iron, grey pig iron, high speed steel respectively.
- **Power supply voltage**, not less than 90% of nominal voltage.
- **Temperature:** magnetic force decreases with rise in temperature.

Lateral translation force

Electromagnetic holding force $\mathbf{F_h}$ is intended as the force necessary to detach the part in perpendicular to the electromagnet surface .

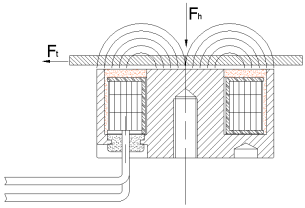


FIG.5

On the contrary, translation force $\mathbf{F_t}$ along the surface depends on the part friction, but is it approx. a quarter of the electromagnetic holding force $\mathbf{F_h}$ (fig.5)

$$\mathbf{F_t} \cong \mathbf{F_h}/4$$

Reduced grip with a force of F_t is to be considered in metal part handing operations.

Influence of temperature

The force indicated in the technical sheet refers to an environment temperature of 20°C. According to the power of the coil, force decreases over time as the winding temperature increases. This decrease, that may be even 30-40%, is to be considered when choosing the electromagnet. Contact the manufacturer to have more information.

Also a high environment temperature has influence on the electromagnet performance

Increase in temperature over time also depends on the application. If the part is mounted on a metal structure, this can contribute to disperse heat. Otherwise if it is embedded in insulating material (e.g. wood) the solenoid can heat rapidly.

Electromagnet operation

The technical sheet for each electromagnet indicates the operating capacity (ED), according to which it can operate without becoming heated or damaged:

- if the electromagnet is in continual operation (ED 100%), it can remain excited for an indefinite time.

A high, but stable external temperature is not an indication for malfunctioning.

- If an electromagnet is not in continual operation (ED<100%), appropriate cooling pauses are to be provided between one cycle and the next to avoid damage to the winding. Consider an indicative time of 1 minute to identify the maximum excitation time on the cycle according to electromagnet operation: e.g.. ED 30% →18" ON – 42" OFF

Since increase in temperature over time depends also on assembly and application, operation is influenced by the part cooling capacity.

The external working temperature limit that an electromagnet can sustain is 100°C (core temperature will be over 120°C).

ELECTROMAGNET ASSEMBLY

- It is first necessary to identify the most suitable electromagnet according to the indications given in the previous “General information” paragraph . Some important critical factors have already been indicated as well as the working temperature. For the handling of metal parts, to avoid separation at take off, also the translation speed, direction of motion and part inertia due to its mass are to be taken into consideration.

When handling metal parts a continuity unit may be useful to ensure grip on the part should there be a voltage drop.

- Construct a suitable support for the electromagnet. If this has to be embedded, use nonmagnetic material (aluminium, brass) to avoid influencing the magnetic flow. A ferrous material can be used if it is on the opposite side to the magnetic surface.

Every ferrous mass near the magnetic surface can influence the magnetic field and reduce gripping capacity.

- To fasten the part use the threaded holes

To avoid damage to the internal coil, do not drill holes on the body of the solenoid.

Do not widen or lengthen the fastening holes thus reducing the ferrous part of the electromagnet and the magnetic flow

Do not assemble the part near heat sources or free flames, or in very humid environments and where there is water splashing.

Protection against water and humidity can be improved taking some precautions during the construction. Contact the manufacturer for further information.

- In the case of part residual magnetism, that impedes separation at cut-out, the electromagnet surface can be coated with a thin nonmagnetic material.

Sheets of plastic, bronze, stainless steel, etc having a thickness of 0.5 mm can be used.

ELECTRICAL CONNECTION

- To grip ferrous material there is no polarity to be observed. On the contrary, if the part is magnetised, it is important to observe the polarity on the power supply cable.
- Use a battery or a power unit appropriate for the electromagnet power: check the consumption of the solenoid and the current supplied by the power supply

If voltage and current are less than the nominal value, the electromagnet has less force

Connection of DIN 43650 A/ISO4400 connector (bar type B)

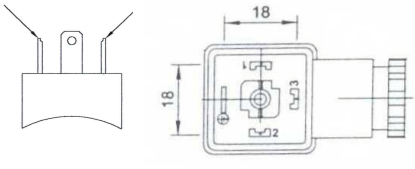


FIG.6

To power the electromagnet use the two faston connectors indicated in fig. 6. To connect the power supply cable to the connector, open the connector casing and connect the positive and negative wires on the terminals marked "1" and "2". Close the casing and fasten the connector with the screw supplied.

Upon request alternative power cables can be supplied

TECHNICAL DATA

(other specifications depend on the model)

Voltage supply:	24VDC
Duty ED:	standard 100%
Ambient temperature:	-40° to 100°C
Fitting position:	vertical or horizontal
Treatment :	zinc-plating Rohs conform
Protection type:	IP67
Insulation class:	H (180°C)
Vibration level:	none
Noise level:	none

SOLUTION OF TROUBLES

The following table is a check-list to find the most common problems that could occur. If the problem cannot be solved, or to replace a solenoid, contact CEI.

An individual failure event may happen, but if it occurs again after replacing the part, there is certainly a problem of application: model not appropriate or a systematic assembly error.

Problem found	Possible cause	Possible solution
Electromagnet does not grip	No current arrives, or current is insufficient	Check that supply battery supplies sufficient current. Check connector and/or power supply cable
	Voltage too low	Check that battery or power unit supplies the nominal voltage with tolerance of 10%
	Insufficient force because negative factors have not been taken into consideration : insufficient thickness, inappropriate material, insufficient contact surface, etc.	Use a larger model
	Foreseen force has decreased due to increase in temperature	Use a larger model or provide cooling systems . Contact CEI
Electromagnet burns	Coil in short circuit due to overheating caused by exceeding operation limits	Replace the part, reducing excitation time (only intermittent operation)
	Coil in short circuit due to penetration of humidity or water	Replace the part, protect electromagnet against humidity

INSTRUCTIONS FOR DISPOSAL

This article is classified as EEE (electrical and electronic equipment) and must therefore be disposed of in the appropriate recycling receptacles of WEEE (waste electrical and electronic equipment) and sent for recovery in an environmentally friendly manner (European Directive 2002/96EC). Do not dispose of electrical and electronic equipment in the environment or in household waste.

WARRANTY CONDITIONS

Producer guarantees good quality and good conditions of materials sold, with the obligation, during the warranty period of one year from the date of sale to replace free of charge in the shortest time possible any parts acknowledged as faulty under normal working conditions, providing this is not caused by natural wear, failures caused by incompetency or improper use, by unauthorised interventions, by tampering carried out or authorised by the user, by fortuitous events and/or conditions of use not foreseen by the design or in the instructions handbook.

Work regarding repairs and replacement of parts under warranty shall be carried out in the works of Producer.

This warranty incorporates ands replaces any other legal guarantee concerning defects.