



When the magnetic force's capacity needs to be affirmed

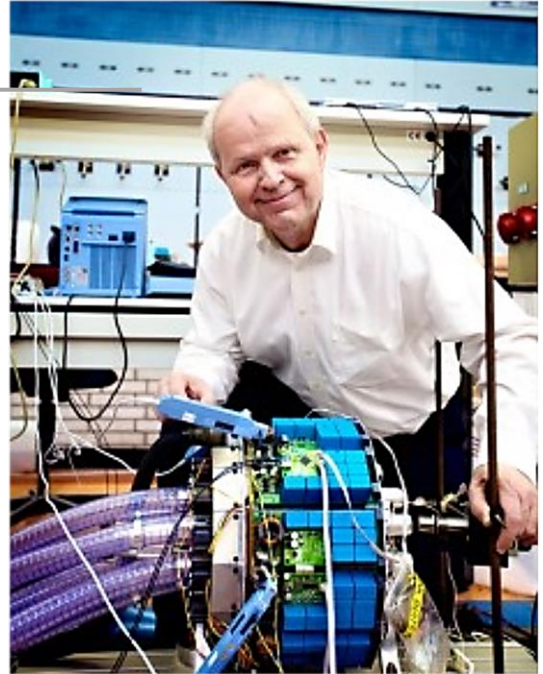
EVERYTHING YOU'VE ALWAYS WANTED TO KNOW ABOUT
MAGNETIC FORCE IN THE INDUSTRY: INFLUENCES, TESTING,
SOLUTIONS.

AUTHOR

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Dr. ir. Bas Gravendeel; Co-founder and shareholder of McNetiq BV, Early Minute-EM Power Systems, and Conductis BV.

Mr. Gravendeel is an electrical engineer and physicist who invented patented techniques in the field of control of electromagnetic fields such as traction applications. He also developed and patented innovations like: force measuring system for magnetic scaffold anchors and an insulating contact wire connector for rail application.



Customers: including NedTrain, Mapper, ProDrive, RET, HTM, GVB, Mors Smitt, Leiden University, Ministry of Defense, Ministry of Economic Affairs, TU Delft, LOFAR, and Technasium Foundation.

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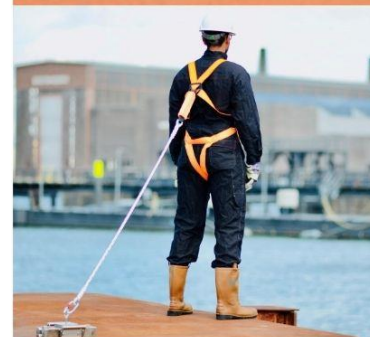
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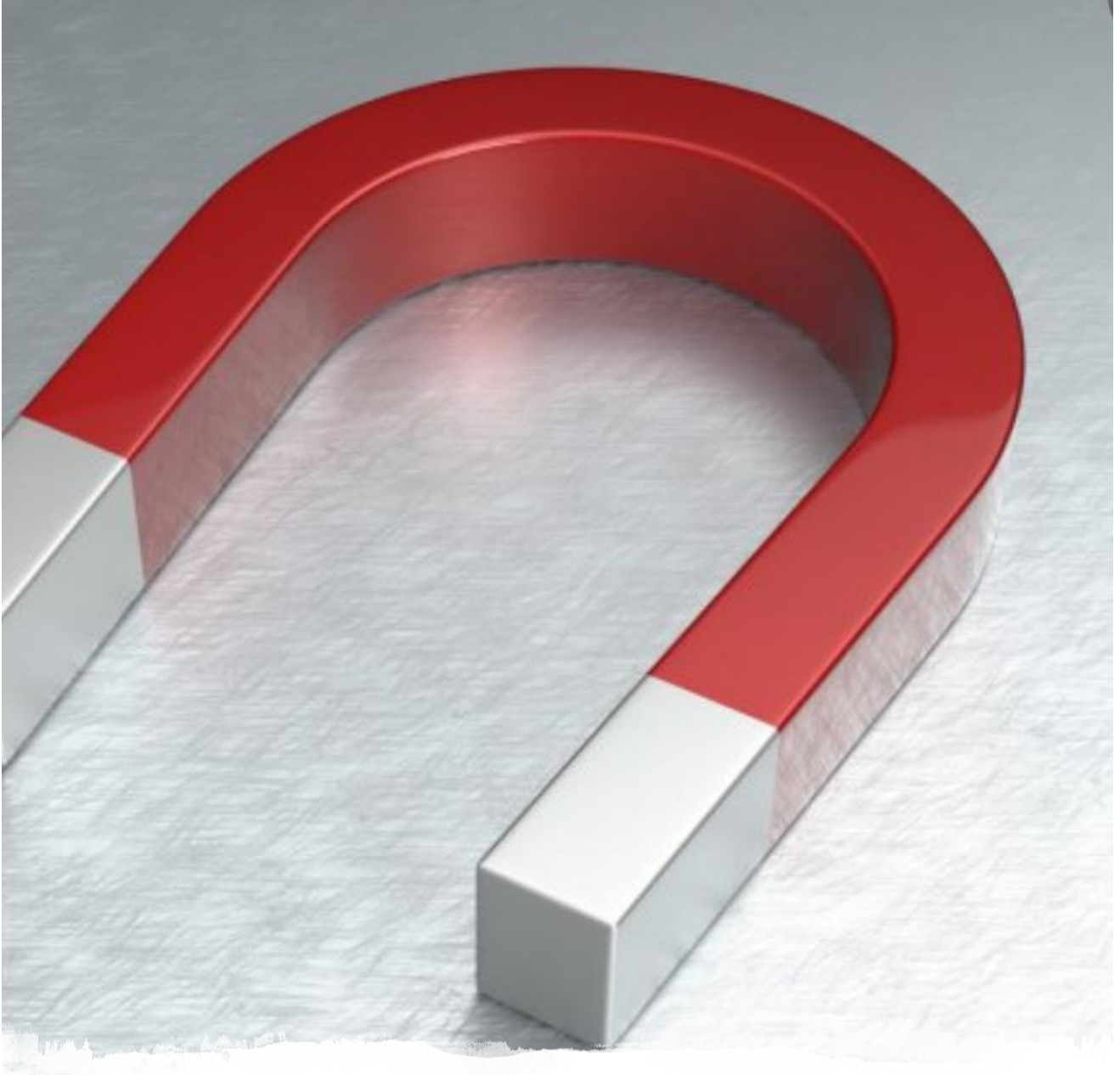
PARTNERS/
CUSTOMERS

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ABOUT MCNETIQ

THE FORCE IS
YOURS





CHAPTER 01: INTRODUCTION

This guide describes temporary and permanent steel connections, magnets, and how magnets work for industrial purposes. Besides, there is an explanation provided of how the actual magnetic forces depend on local circumstances. This document also describes the technical solution for complying with legal requirements to work safely. Finally, there is an introduction designed to introduce the first patented magnet force testing technology, the Controlock®, and its industrial applications.

CHAPTER 02:

PERMANENT VS. TEMPORARY STEEL CONNECTIONS

Permanent Steel connections.

Types, usage, advantages, and disadvantages

Connections such as drilling, welding, and bolting are an intimate part of a steel structure. Their proper treatment is essential for a safe formation.

Some of the advantages of the mentioned methods are

- Widely used in the industry
- No highly skilled labor required (short learning curve)
- Portable
- Reliable and strong



Welding. Retrieved from. Bigstockphoto.com

Despite the advantages of permanent steel connection solutions they are not suitable in every scenario because of many factors such as;

- Damage the steel surface
- Long construction time and excessive noise
- Labor intensive
- High overall costs
- Risk of explosion
- Harmful to the environment and human health due to exhaust fumes



Drilling. Retrieved from. iStockphoto.com



Bolts. Retrieved from. Bigstockphoto.com

Temporary steel connections: Industrial hoisting magnets.

Types, usage, advantages, and disadvantages

Magnets are widely known and used, starting from rubber seals in refrigerators and ending with massive MRI machines in hospitals. In the industry, they are used for hoistings' purposes, such as massive steel plates, bars, rails, and rolls of steel up to 25 tons.

There are two types of industrial hoisting magnets; Electromagnets and switchable permanent magnets.

Electromagnets; are energy-dependent, which means the magnet needs to be connected to an electric power source to be turned ON. Disconnect the power source, and the magnet deactivates instantaneously. Electromagnets are used in all kinds of electric devices. Applications are including hard disk drives, speakers, motors, generators, MRI systems, and scrap yards to pick up heavy scrap metal.



Generic Magnetic Resonance Imaging (MRI) system.

Retrieved from iStockphoto.com

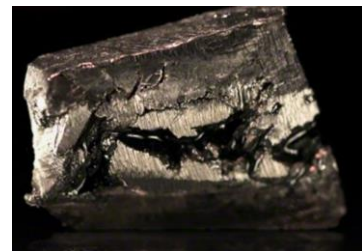


Industrial magnet. Retrieved from iStockphoto.

Switchable permanent magnets; are materials where the magnetic field is generated by the internal structure of the material itself. Therefore, its magnetism is 'always ON

In a switchable permanent magnet, two sets of permanent magnets are rotated towards each other in such a way that in the OFF position, the magnets create an internal magnetic field, not feeling it at the outside.

In the ON state, the two sets of magnets work together to create a magnetic field at the outside. Some switchable permanent magnets applications are; Hoisting magnets, welding magnets, and temporarily fixing of steel parts magnets. The most powerful switchable permanent magnets are Neodymium magnets.



Rare earth neodymium magnet

Retrieved from pinterest.com

Industrial magnets can be implemented in situations where temporary steel connections are needed.

As a temporary fastening method, magnets can be the ideal solution because

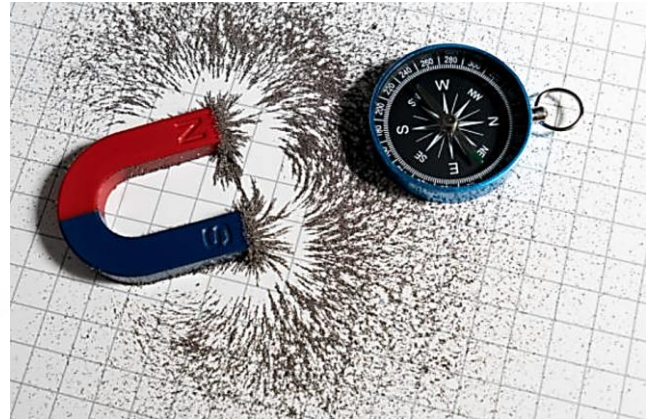
- No damage to the steel surface
- Environmentally friendly
- Low steel consumption in building scaffolds
- Easy to be installed or uninstalled
- Shorter lead time and no noise generated
- Atex proof



*Industrial permanent magnet with a handle.
Retrieved from McNetiq.com*

However, industrial magnets have a serious disadvantage, which is the capacity of the used magnet is not known.

Due to the lack of testing technology, many possible applications could not be realized with magnets because, until so far, there wasn't a proper way to work safely with them.



*Permanent magnet. Retrieved from
iStockphoto.com*



*Industrial electromagnet in scrap yard. Retrieved
from iStockphoto.*

How does it work? Does it always work? Is there a limit in maximum force?

In all the mentioned examples, a static magnetic field is used. It is turned **ON** and **OFF** by quite simple means. There are several ways to turn a magnet **ON** and **OFF**. Each one of them has its advantages and disadvantages.

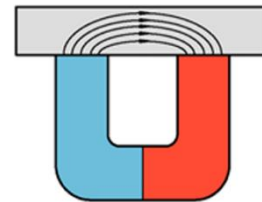
In order to activate an **electromagnet**, it needs to be connected to an electric power source. As long as the magnet is connected to a designated power source, it stays active, i.e., **ON**. Disconnect the power source, and the magnet deactivates instantaneously, i.e., **OFF**. The advantage of using electromagnet is that it is very powerful. However, electromagnets have the hazard of losing the load they lift if the power stream is lost.

Switchable permanent magnet, however, can be turned **ON** and **OFF** manually. Turning the magnet **ON** and **OFF** is simple: rotating the attached handle from left to right and the other way around activates and deactivates the magnet. The advantage of using switchable permanent magnet is that it does not need an external power source. Nevertheless, if the counterface is too thin, turning **ON** the magnet requires an effort. The user is thus warned to consider a reduction in hoisting capability.

Steel surface in magnetic field



The leakage flux lines are not drawn here.

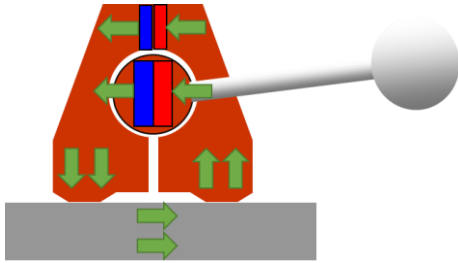


- Always between two poles.
- Same poles repel.
- Opposite poles attract.
- Flux lines leave the magnet at 90°.
- Air creates high magnetic resistance.
- Steel conducts 2000x better than air.
- Magnetic field concentrates on the steel surface.
- Removing the steel leads to increased energy in the air gap; a certain force is required.
- North and south poles must be covered equally.

The power of the magnet is limited. Therefore, to keep hoisting safely, the breakaway force of a hoisting magnet must be at least three times the nominal hoisting capacity. Furthermore, the thickness and size of the load have to be taken into account.

CHAPTER 03: WORKING MECHANISM

How does this hoist magnet work?

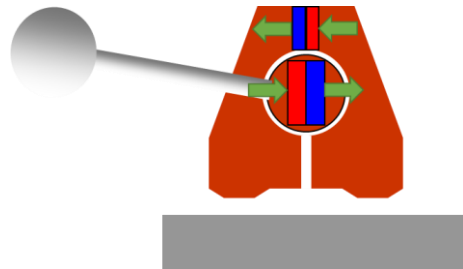


The working principle of a hoisting switchable magnet

In this type of magnet, only permanent magnets are used. By changing the mutual position of these magnets, the external force changes from zero to maximum. In the figure above, the magnetic field is represented by the green arrows. The blue-red blocks represent the permanent magnets: blue the North (**N**) pole and red the South (**S**) pole. The magnetic field flows by definition from **N** to **S**. Be aware: magnetic field lines are always closed! So the magnetic field line that leaves the **N** pole always returns into the **S** pole. The permanent magnets at the top are fixed mounted inside the housing.

When the cylinder is rotated counterclockwise by using the handle, the permanent magnets inside the cylinder change position. The end state of the rotation brings the hoisting magnet into the OFF position.

Now, the magnets magnetic field inside the housing has the opposite direction towards the magnets inside the cylinder. The magnetic field is captured inside the housing, and no external field is felt. The load is not attracted anymore. The magnet is in the OFF state, such as illustrated in the figure below.



The working principle of a hoisting switchable magnet

CHAPTER 04: EXTERNAL INFLUENCES

Is the use of magnets really that easy?

The bare truth is no. The magnet force can be influenced negatively by several external factors.

External factors influencing the magnet force are

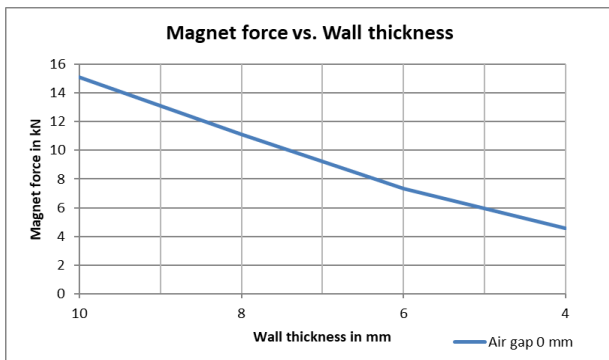
- Wall thickness
- Airgap

If the load is too thin, the magnet's magnetic field is too intense to pass through the load. The load shows magnetical saturation.

Field lines from the magnet are seen outside the load. This reduces the magnets' force strongly.

By reducing the thickness of the material from 10 mm to 4 mm, the magnetic force reduces from 15 kN to 4,5 kN.

See the graph below, magnet force vs. wall thickness.



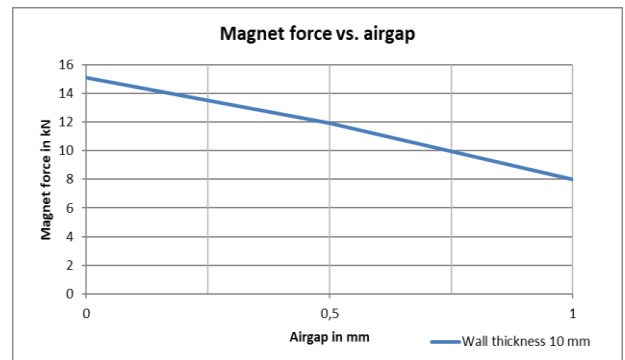
Also, if there is a non-magnetic gap between the load and the magnet, the force will be negatively influenced. Examples of non-magnetic materials are

- Paint
- Rust
- Coatings

Even small airgaps like 0,5 mm or 1 mm may reduce the magnetic force enormously from 15 kN at 0 mm air gap to 8 kN at a 1 mm air gap.

The effects of wall thickness and airgap drawn in the graphs are valid for one type of magnets. Other magnets will show different dependencies.

See the graph below, magnet force vs. airgap.



Using magnets means that the user must know quite a few things about the magnets' properties, the magnet's counterface, the wall, and the load. There have to be many safety factors or somewhat oversized magnets for safe usage. And still, without knowing the exact capacity, one is not sure whether the magnet will hold or not.

CHAPTER 05: INTRODUCING CONTROLOCK® TO THE MARKET

Catch the magnet force!

McNetiq Controlock® is the first global technology that enables force measurement after positioning a magnet. This technology has a certainty of 100% to precisely measure the capacity at the final position of the magnet, before attaching the final load or clearing for safe use.

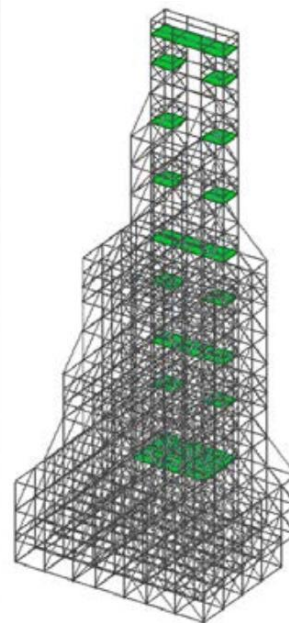
Controlock® technology allows:

- Measurement of tensile and shear force.
- Saving materials.
- No damage on the steel surface.
- In use since 2013.
- Applicable to a range of our standard products.
- Able to customize to the client's needs.
- Extensive experience with setting up specific processes and training for users.

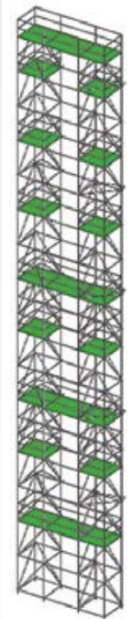


"Magnets fascinate me for as long as I can remember. Permanent magnets are reliable, by applying force measurement we can now use them for many more purposes and that is wonderful"

Dr.ir. Bas Gravendeel
Co-founder of McNetiq.



Traditional way:
24 tons of material



Controlock way:
6 tons of material

CHAPTER 06: TESTING THE MAGNET FORCE

Local testing

This is where the solution of McNetiq comes in. The protocol is to measure the magnet force directly, in which a force is applied and measured between the wall and the magnet. This force is measured on the location where the magnet has been placed. So, always the actual force is measured. With the measurement, the influence of local material thickness and the local paint thickness have been taken into account.

In the perpendicular force measurement, the tester can be placed over the magnet. With a scaffold ratchet, the bolt on top of the tester is screwed down onto the load cell. By rotating the screw further, the force on the load cell increases until it reaches a maximum. Just before a small air gap is created between the wall and the magnet, the maximum magnet force will be reached.

The measurement of the Controlock® magnet force includes testing the shear and the pull force.



*The perpendicular force measurement
Pull force testing set*



Shear force testing set

CHAPTER 07: SOLUTIONS



"My personal belief is that, if you want to reach high, you need a high-end solution as the revolutionary Controlock® technology. Its magnets are working without power and offer scaffold builders to work clean, lean, and mean and above all, very safe."

MA. Edwin van der Heide
Co-founder of McNetiq.

Scaffold anchors

Using McNetiq anchors with Controlock® technology, a scaffold can be securely anchored. Applying the magnetic anchors only where required on a minimal footprint while omitting many scaffold components like buttresses.

"The result: savings of >40% on lead time and >70% on materials."



This is how the scaffold looks like when magnets are used to build it.

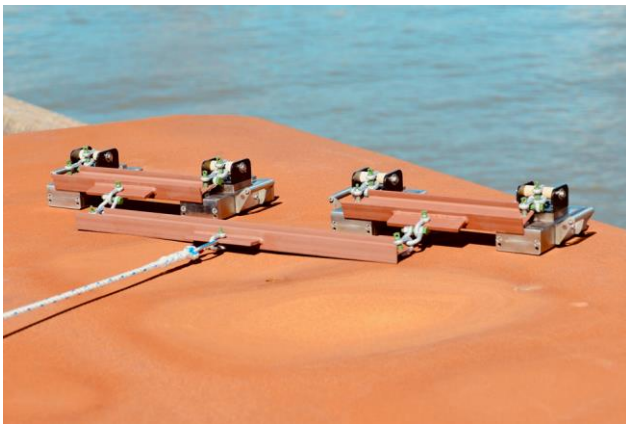


To know more, please visit
mcnetiq.com
Or send us an email at
info@mcnetiq.nl

Fall Protection: Fall Arrest

McNetiq's patented Controlock systems are providing instant testing on the pull or shear forces. After installing, it is mandatory to test the magnets to verify the required force. All equipment is ATEX-proof.

Fall Arrest stops a worker in the process of a fall



Fall Protection System is especially of value in situations where permanent fixing points cannot be used. In circumstances where, for example, hand railings cannot be installed, then McNetiq magnets with Controlock® technology can be attached to lines to form a safe and secure basis for fall protection purposes.

To know more, please visit
mcnetiq.com
Or send us an email at
info@mcnetiq.nl



" Our new magnetic products allow the users to apply fixtures without welding finally. Also, without damaging the surface, quick to install, and without stopping operations. We are excited about our new applications for fall protection and pipe support."

Ir. Willem van der Graaf

CEO of McNetiq.

Pipe support

Installing pipe supports during operations

With McNetiq **Pipe Supports** the installing can take place without putting on hold any petroleum and chemical processing or tank storage operations.

See the **blue Rubber Block Magnet** and the installing device photos.

Process industries and tank storage companies are critical to supply the world with basic products. When running complex installations in the petroleum or chemical industries it is often difficult to stop operations to install or remove structures and pipes.



The **RBM** installing device



The Rubber Block Magnet (**RBM**) used for mounting the pipe supports.

To know more, please visit
mcnetiq.com
Or send us an email at
info@mcnetiq.nl

CHAPTER 08: PARTNERS/CUSTOMERS

PORTXL
world port accelerator



HYTORC[®]

EBERT  **HERA**

BRAND
ENERGY & INFRASTRUCTURE SERVICES



BRAND  **SAFWAY**[™]



BILFINGER

Scaffolding Solutions
THE SCAFFOLDING SPECIALISTS
OFFSHORE & ONSHORE



ProEn
SCAFFOLD



CHAPTER 09: ABOUT MCNETIQ

Since 2007 Bas and Edwin have been developing and promoting different magnet applications, out of a passion for the "magical" effect of magnets. In 2014 they founded McNetiq B.V. to market the Controlock® magnet technology.

In January 2018, McNetiq and Rotterdam Port Fund forged cooperation, and RPF took an interest in McNetiq.

The firm mission is to use Controlock® technology to create the safest, most sustainable, and cost-efficient temporary steel connection.



"We've been using McNetiq Controlock® since 2015. We have discovered that using Controlock® for scaffolding is much easier, quicker, and safer. There are less scaffolding people on site, and it saves a lot of materials and, consequently, more cost-efficient than standard configurations."

Bart van der Meer

Innovation Engagement Leader at Vopak.

The strategy is to develop and deliver magnetic applications, where magnetic forces can be instantly tested using the patented Controlock® technology.

Following the proven benefits of the mentioned scaffolding anchors, the organization focuses on specific markets where potential users are indicating to be seeing a definite need. The company connects internationally directly with users, distributors, and agents that passionately share McNetiq's vision.



MCNETIQ.COM