MASS CUSTOMISATION

THE ALMOST ENDLESS POSSIBILITIES OF
MASS CUSTOMISATION

MINKELS
A brand of legrand

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A brand of legrand

MINKELS:
the worldwide specialist

in scalable and integrated data centre infrastructure solutions

ABOUT MINKELS

Minkels is a knowledge-driven producer and worldwide supplier of high-quality solutions for data centre infrastructure. The Minkels brand is part of the product portfolio of Legrand, a publicly traded company (NYSE Euronext Paris: LR) with worldwide sales in the low voltage installation, data network and data centre markets. Legrand operates in more than 180 countries and achieved worldwide revenues of 4.8 billion euros in 2015.

Minkels products stand out for their innovativeness and flexibility. Customers can always be assured that they will get the very latest data centre technology: modular solutions that respond to evolving, customer-specific business requirements.

OUR PROMISE
Powered by experts

OUR
CORE VALUES

All our products are future-proof by nature. We see that as a 'must', because the role of data centres is changing rapidly, driven by factors such as the cloud, the Internet of Things (IoT), Big Data and IT cost reduction. Minkels believes that modularity and complete integration are the key to a future-proof data centre. Only this makes offering the right degree of flexibility and efficiency possible. These are not just buzzwords for Minkels - it's something we really stand for. These are our core values:

• Innovation and flexibility
Minkels handles its development, production and sales in-house. Combined with the requisite knowledge and expertise, this ensures customers are always receiving the latest data centre technology.

• From standard to customer-specific
With Minkels, you are always provided with a data centre solution that will suit you, whether it's a standard solution or a customer-specific product.

• Energy efficiency
Legrand and Minkels value Corporate Social Responsibility (CSR) very highly. Minkels therefore aims to retain its leading position in energy-efficient solutions, allowing both the customer and the environment to benefit.

• Modularity and integration
Modularity and complete integration are the foundations for a flexible, efficient and future-proof data centre.

• Global presence, local excellence
Minkels aims for consistent quality and availability of its products worldwide, complemented by local service.

Solutions for your data centre or server room

Powered by experts!

The emphasis of this brochure is on mass customisation. Would you like to know more about mass customisation or our the customised products we offer? We would be happy to help you! You can find the contact details on the back side of this brochure.

Minkels is part of the publicly traded company Legrand (NYSE Euronext Paris: LR). Whereas Legrand focuses on building-related infrastructure, Minkels makes a distinction between:

• data centre and cloud infrastructure
• building-related IT infrastructure

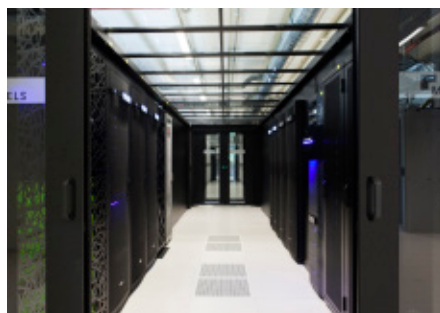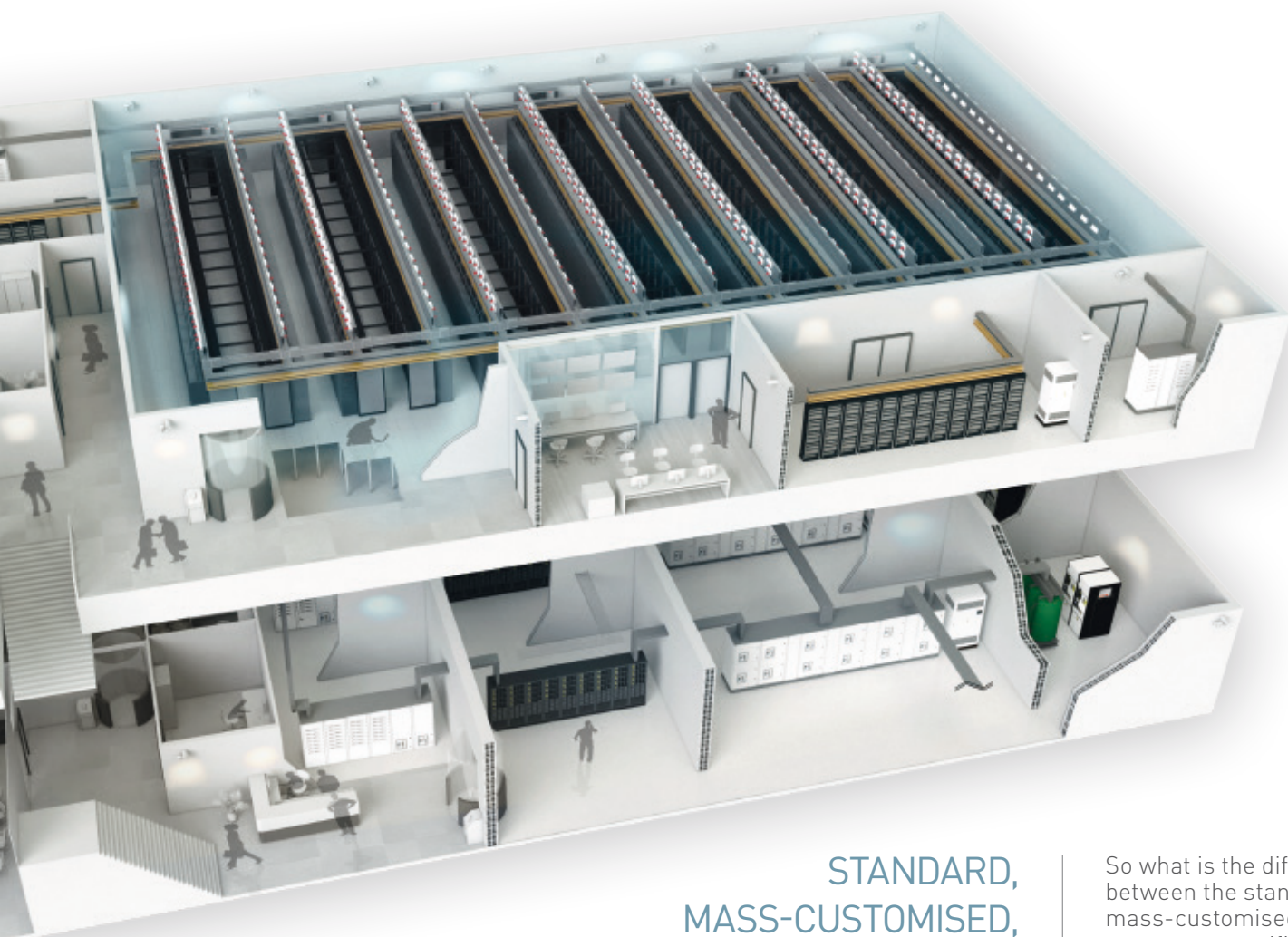With Minkels, you are always provided with a solution that will suit you, whether it's a standard solution or a customer-specific product, or something in-between the two. The focus of this catalogue is on our mass customised solutions. These products are characterised by their flexibility. If a standard solution which can be delivered from stock is more suited to your needs, taking a look at our Standard Product Catalogue could be the right option for you: (minkels.com/downloads). If you would like a fully customised solution, our sales department will be glad to help.

STANDARD, MASS-CUSTOMISED, OR CUSTOMER-SPECIFIC PRODUCTS?

So what is the difference between the standard, mass-customised and customer-specific products?
Here is a brief overview:

	Standard	**Mass customised**	**Customer-specific**
Product-type	Predefined products	Standard 'building blocks' can be put together in a extremely large number of combinations	Entirely customised: co-development between you and our engineers
Logistics	Most products can be delivered straight from stock	Optimum logistical process	Depending on your requirements (based business case)

See page 65 for an overview of all our brochures

MINKELS
SERVICES

When it's about more than just the products

Installation service

Minkels has extensive capabilities for pre-assembly. Accessories can for instance be fitted in our racks in advance, enabling you to save on the installation costs. Minkels can also install its integrated solutions for you on site. We are a manufacturer with an extensive network of service partners who can provide you with support during the purchasing process and the installation.

Technical Support

Minkels engineers are highly qualified data centre professionals. They will be happy to brainstorm with you to find the best conceivable solution.

Initial use and training

Support from Minkels doesn't end with the delivery. Together with our partners, we facilitate commissioning and training of e.g. row-based cooling.

Logistical services

Minkels can also offer you a range of logistical services such as worldwide transport and various stock control options.

Customer service

Any questions? We will be happy to help you! You can find the contact details on the back side of this brochure.

Online

Information available
24 hours a day

Minkels.com

Youtube.com/c/minkelshq

Twitter.com/Minkels_HQ

Facebook.com/Minkels

Linkedin.com/company/minkels

MINKELS
A brand of legrand

The virtually infinite possibilities of
MASS CUSTOMISATION

A standard data centre which appears designed especially for you? That's mass customisation!
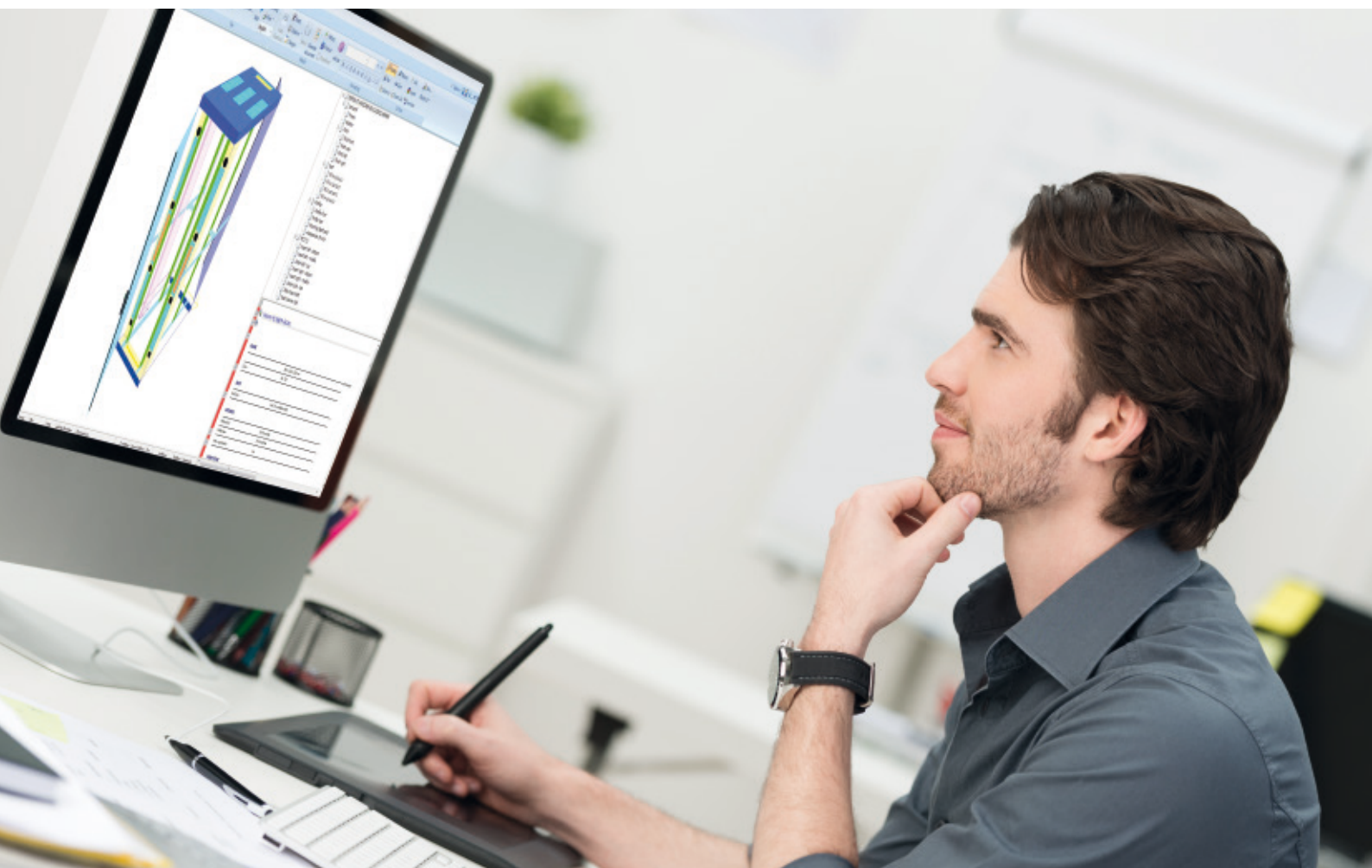
Infinite combinations

Mass customisation is the combination of the best aspects of 'mass production' and 'customisation'. We are not talking about full customisation, but rather about an enormous choice of components which can be combined in an almost infinite number of ways in order to achieve a product which suits your needs. Minkels is one of the few data centre suppliers which can truly offer mass customisation. After all, such a strategy involves quite a few things... read more on page 10.

Modularity, even in the details

Minkels has very thoroughly implemented its core value of 'modularity' in its product portfolio. Thanks to this modularity –in even the finest details- our data centre solutions are very scalable and easily adaptable. The solutions you come across in this Mass Customisation brochure can be viewed as a 'building stones' which can be combined and integrated into a fitting solution for your data centre. The beauty of this is that you are provided with a solution which fully suits your wishes and needs, without having to pay top price for customisation. In addition, you profit from a fast delivery and consistent quality and logistics, no matter where in the world you are.

Securing and implementing knowledge

Mass customisation starts with the securing of knowledge, as a large amount of expertise is needed in order to offer a data centre solution. Minkels' experienced employees used this knowledge in the development of a configuration tool. They know that a choice of one component will lead to the exclusion of other components. New employees and partners can now also easily access this information, because this knowledge has been stored in the smart configuration tool. The enormous amount of information which has been put into this tool ensures that Minkels' data centre solutions are always manufacturable. Whoever is offering them, wherever they are offering them, the final solution always fits and is well-integrated on a technical level.

Your configured product, up to a maximum of 10 units, can be delivered within 5 working days!

Smart product configurator

The configurator works using a question and answer-setup. In this setup, all possibilities and impossibilities have been entered, which eliminates any mistakes. Based on the choices made, a quotation is automatically generated, which includes an overview of all price and delivery terms and the configuration itself: types of products, amounts and specifications, from height and width to capacity. The tool even calculates the total production, assembly and packaging time. Is the quotation agreed upon? If so, the bill of materials –which was created during the configuration- is sent to production.

Our guarantee

Mass customisation is a guarantee for quick and reliable delivery of a data centre solution which suits your wishes. This guarantee is made possible because of the strong integration of the configuration tool with the ERP and production systems. In addition, order processing, production and montage are continuously in contact with each other, which ensures you always feel that you are in direct collaboration with Minkels' production facilities.

Mass
CUSTOMISATION
BROCHURE

The core values of modularity, flexibility and energy-efficiency are reflected throughout our extensive product portfolio. In this way, you always profit from the latest technologies and can count on a quick and reliable delivery of these mass customised solutions; a data centre solution which suits your wishes. In the remainder of this brochure you will be introduced to our mass customised products which fall into the categories Housing, Cooling, Power & Connectivity, Monitoring and Micro Data Centre.

1. Housing

Minkels has a large assortment of housing solutions where flexibility, durability and modularity are key. We offer a choice of standard (www.minkels.com/downloads) or mass customised housing solutions. The mass customised products are comprised of building blocks which you can combine and integrate into a fitting solution for your data centre and/or server room. More information can be found in chapter one.

2. Cooling

By cooling your data centre in the right way, you can reduce your energy costs considerably. Aisle containment solutions are the answer to a challenge which has been facing data centres since day one: how to optimise the cooling and energy efficiency by optimally separating warm and cold airflows. Minkels' solutions can be adapted to the specific building environment due to its modular build. Choose your desired dimensions, colour and any options/accessories, and we will create the right solution for you. Chapter two elaborates upon this.

3. Power & Connectivity

Power is an operationally critical component of any data centre. Even the slightest interruption to the power supply can have a huge impact. Through Legrand and Raritan's Power & Connectivity solutions, the risks of a power outage can be managed. The products can be seamlessly integrated into the Minkels racks and are very energy efficient. The products can be assembled to your wishes in order for them to fit your specific needs. You can read more on this in chapter 3.

WANT TO KNOW MORE?

The emphasis of this catalogue is on our mass customised products. Are you wondering what exactly we mean by mass customisation? Or would you like to know more about our standard solutions or the custom solutions we offer? Do read on!

4. Monitoring

Minkels' monitoring systems are capable of monitoring the direct surroundings of your racks, providing you with valuable information which can be used to optimise your data centre. The modular and efficient construction of the system makes it easy to check up on a single rack or an entire room. These systems can of course be seamlessly integrated and managed using your existing Network Management Software. Several products are available, and this is further elaborated upon in chapter four.

5. Micro data centre

Simplicity, reliability, ease and efficiency are of foremost importance in these solutions. The ready-made solutions can be ordered using the Minkels standard product catalogue. (www.minkels.com/downloads). Naturally, all solutions can be expanded upon with a number of options and accessories. In any case, the ease of configuration and ordering is a priority. Chapter 5 briefly explains the advantages of these solutions.

HOUSING

Modularity and flexibility are always key

Minkels has an extensive portfolio of housing solutions for your data centre and/or server room. The Minkels housing solutions are very suited to the installation of (blade) servers, switches, patch panels, routers and storage equipment. Modularity and flexibility are always key in the design of our products.

You can select a solution from our standard housing assortment (www.minkels.com/downloads), but if you are in need of more flexibility because our standard dimensions do not suffice, Minkels offers the option of a mass customised housing solution.

The products consist of building blocks which you can combine and integrate into a suitable solution for your data centre and/or server room. This chapter contains an overview of the housing solutions which we can configure for you.

Exploded view Sofon configurator

1.1 Server- and network rack

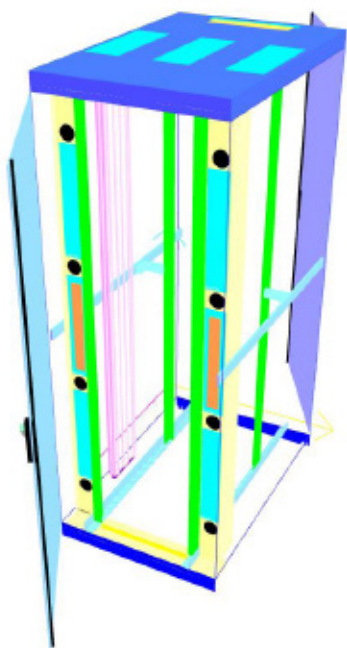The server- and network racks are versatile and modularly constructed. What type of rack is most suitable depends highly on its application. The server- and network racks can be configured in varying heights, widths and depths.

Height in HE and mm	25 U / 1300 mm 37 U / 1800 mm 41 U / 2000 mm 46 U / 2200 mm 50 U / 2400 mm 52 U / 2500 mm
Width in mm	600 and 800 mm
Depth in mm	1000 and 1200 mm
Colours	RAL 7047 (Light grey) RAL 9011 (Black)

The 600 mm wide rack is a compact rack with a high carrying capacity on a small surface. The 800 mm wide rack is extremely suited to patching, network and server equipment with enough space for power and network cabling.

Using the configuration tool, you can determine more than just the size and colour of the rack. Below is an overview of the other factors which can be configured:

Floor layout	blind/brushes
Roof layout	blind/brushes/fan unit
Plinth	front/back and left/right
19-inch profiles	distance from front/back (position in the rack)
19-inch accessories	plateau, cable management, PDU, blind plate
Air flow optimalisation	yes/no, if yes what level of airtightness
Accessories in the rack	PDU, cable management, fastening material
Door	blind/perforated/glass and left- or right hinged
Side panel	Yes/no, if yes what type

Sofon configuration of a server rack

Contact our sales support department or your account manager and we will configure the solution which best suits your situation. You can find the contact details on the back side of this brochure.
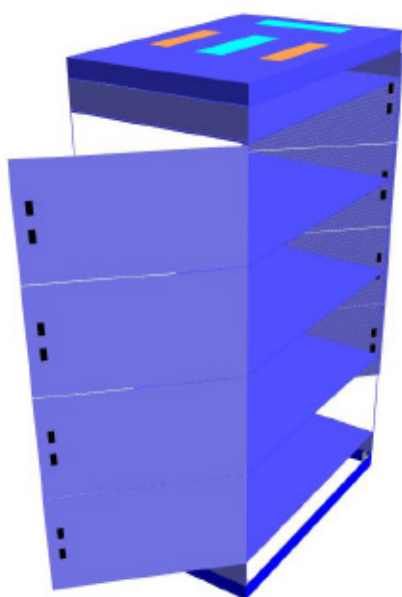
1.2 Co-location rack

Minkels' compartmentalised co-location racks are ideal for combining multiple end customers in one rack while keeping them safely separated. We offer a choice between a twice and four times compartmentalised rack. For the latter, each compartment has a height of 10 HE. The twice compartmentalised rack has a compartment height of 20 HE. The compartments are fully separated by a fixed plateau and all have separate and protected data and power cable trays. If the data centre owner no longer has need of separated compartments, the co-location rack can be converted to a rack without compartments. The co-location rack can also be converted from a twice compartmentalised rack into a four times compartmentalised rack and the other way around. An extra 2 HE compartment for the data centre owner in which e.g. monitoring solutions and power strips can be installed is also a possibility.

Co-location racks	
Height in HE and mm	46 HE / 2200 mm
Width in mm	600 en 800 mm
Depth in mm	1000 and 1200 mm
Colours	RAL 7047 (Light grey) RAL 9011 (Black)
Rack division	two- or fourfold
Door	left or right hinged
Side panel layout	blank or with cable entry brushes
Management compartment	top/bottom 2 HE

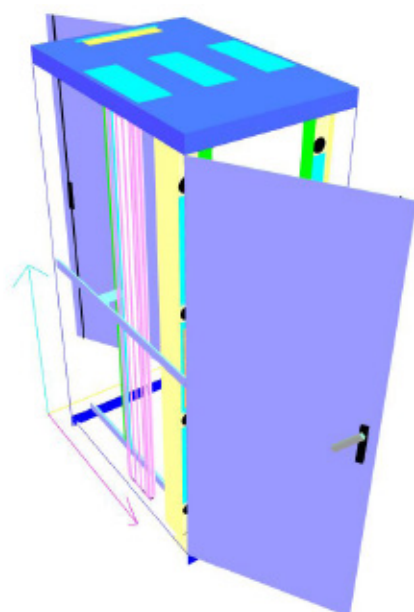The configuration tool offers the possibility of adding several accessories.

Accessories

Minkels' co-location racks can be fitted with several accessories:
• Brushes cover the cable entry and thus prevent air leaking out.
• Set of extra 19-inch 2HE profiles, suitable for installation in the management compartment on the top and bottom side of the co-location racks.

1.3 Varicon-M door

When configuring your rack there are various doors you can choose from: single or double doors, glass, blind or perforated doors. All doors are made of plate steel and finished in a powder coating. The locks must be ordered separately, the hinges are included.
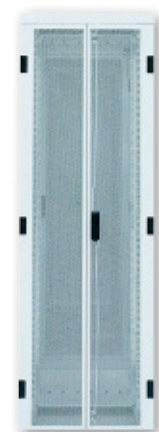
Single door

The single doors are available in various heights and widths.

Double door

In addition to single doors, Minkels also offers double doors. The double door provides you with easy access to the rack with a minimal turning circle of the door. With this application you save space and ensure an optimal use of your space.

	Blind doors	**80% perforated doors**	**Glass window doors (clear)**
Description	A plate steel door without ventilation slots	A plate steel door with a perforation degree of 80%. This perforation degree ensures the highest possible airflow. The 600 mm wide door has a perforation width of ± 450 mm. The 800 mm wide door has a perforation width of ±585 mm.	Clear safety glass window door
Colours	RAL 7047 (light grey) RAL 9011 (black)	RAL 7047 (light grey) RAL 9011 (black)	RAL 7047 (light grey) RAL 9011 (black)
Hight in HE and mm	25 HE / 1300 mm (only RAL 7047) 37 HE / 1800 mm (only RAL 7047) 41 HE / 2000 mm (RAL 7047 and RAL 9011) 46 HE / 2200 mm (RAL 7047 and RAL 9011)	25 HE / 1300 mm (RAL 7047 and RAL 9011) 41 HE / 2000 mm (RAL 7047 and RAL 9011) 46 HE / 2200 mm (RAL 7047 and RAL 9011) 50 HE / 2400 mm (RAL 7047 and RAL 9011)	25 HE / 1300 mm (only RAL 7047) 37 HE / 1800 mm (only RAL 7047) 41 HE / 2000 mm (RAL 7047 and RAL 9011) 46 HE / 2200 mm (RAL 7047 and RAL 9011)
Width in mm	600 mm 800 mm	600 mm 800 mm	600 mm 800 mm

	80% perforated double doors
Description	The perforated surface runs across the entire width of your equipment, so that optimal circulation of cooling air can take place
Colours	RAL 7047 (Light grey) RAL 9011 (Black)
Height in HE and mm	41 HE / 2000 mm 46 HE / 2200 mm 50 HE / 2400 mm
Width in mm	600 mm (46 and 50 HE) 800 mm (41, 46 and 50 HE)

1.4 Mechanical accessories

Minkels offers a number of accessories with which you can complete your rack. These accessories include various shelves, plinths, adjustable feet and so on. Many of these products are offered in the Minkels standard product catalogue (www.minkels.com/downloads), but they can also be configured. Below is an overview of the possibilities.

Shelves
• Variable shelves
• Variable shelves 100 kg
• Semi-floating shelves
• Minkels Fix Easy shelves

Top
• Insert modules

Side
• Side panels
• Partition panel
• Plinth, 25 mm, side

If the accessory you are looking for is not among them, don't hesitate to contact us and we will be happy to help you. You can find the contact details on the back side of this brochure.

Other accessories
• Fitting brackets
• Corner guide rails
• Earth rails
• Fluorescent lighting sets
• Door switch
• Connecting sets

Bottom
• Adjustable feet
• Plinth, 25 mm, front/back
• Castors
• Anchoring set
• Insert modules

Front and back
• Expansion set (available through the Minkels standard product catalogue)

Accessories which can be added with the configuration tool are:

Side panels
The side panels can be detached quickly and easily using locking clips. A side panel always needs a plinth.

Partition
There are two types of partition panels: with and without cable entry rings.

Expansion sets (available through the Minkels standard product catalogue)
This expansion set makes extending the depth of your (existing) rack possible. The set is easy to install and adds 100 mm in depth. It is possible to link multiple expansion sets. 19-inch profiles can be installed in the expansion set. The advantage is that all equipment and cabling can remain intact and deeper equipment can be installed.

Plinths 25mm front/back
These plinths are available as blanks. The plinth is attached to the frame using a handy click-fit system.

Plinth 25mm side
These plinths cover the adjustable feet and at the same time support the side panel.

Adjustable feet
The adjustable feet are needed to position the rack horizontally.

Castors
Castors provide you with the ability to move your rack more often, more quickly and more easily.

Anchoring set
The anchoring set can be attached to the frame. Using a bolt, the set can be anchored to the floor.

Insert modules
The roof and/or floor plate of the rack have cut-aways that can be filled using various inserts. Depending on your situation you can choose between a blank cover plate or cable entry brushes.

Fan units
The triple fan unit allows you to create an airflow.

Connecting sets
Connecting sets are needed to connect the racks.

Earth rail
The copper earth rail ensures additional grounding of the rack.

Assembly brackets
The universal assembly bracket can be used for e.g. fitting various accessories and PDU's. These brackets can be used in numerous places on the rack

Corner guide rails
The corner guide rails support the server and network equipment.

Fluorescent light sets
The fluorescent light set provides improved visibility inside your data centre or server room.

Door switch
The door switch can be used in combination with the lighting set described above. Switches when the door is opened and closed.

Shelves
Minkels' assortment includes a number of shelves for supporting your valuable equipment.

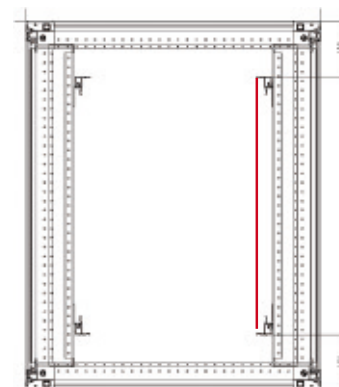| Type of shelf	Maximum carrying capacity
Variable shelf	50 or 100 kg
Semi-floating shelf	12 kg
Fix easy shelf	50 kg

How do I choose the right shelf for a rack?

The step-by-step plan below will help you choose the right items.

Should the shelf be supported by four 19-inch profiles? $\longrightarrow$ No $\longrightarrow$ Semi-floating shelves can be used. Be aware of the limited depth (max. 350 mm) and maximum load (12 kg). Semi-floating shelves can also be used in a number of wall housings. Using semi-floating shelves requires 2U rack height.

$\longrightarrow$ Yes $\longrightarrow$ Four-point shelves can be used. You can choose between the following types:
- Variable shelves – load capacity 40, 50 and 100 kg
- Telescopic shelves – load capacity 50 and 75 kg

After selecting the type of shelf, the correct depth has to be determined. This is because all four-point shelves have a minimum and maximum built-in depth. This does not depend on the external dimensions of the rack.

Example: The drawing on the right shows an example situation. The rack is 1000 mm deep. The front 19-inch profiles are 150 mm from the front and the rear ones are 150 mm from the back of the rack. The distance between the 19-inch profiles is therefore 1000 – 150 – 150 = 700 mm. The built-in shelf depth is equal to that separation, i.e. 700 mm.

The above step-by-step plan helps you select the correct shelf. If despite this plan you are in need of assistance, please feel free to contact our sales department. You can find the contact details on the back side of this brochure.

Semi-floating shelf

Variable shelf

Fix Easy shelf

1.5 Cable management

The configuration tool allows you to configure various cable management solutions within your rack. Structured cabling is important for the reliability and optimal performance of your data centre or server room. Flexibility and accessibility in the case of trouble shooting or expansion, too, is essential.

Reliability

Good cable management ensures the equipment's air intake points are kept as clear as possible. This allows sufficient air to pass through to the equipment so that it is cooled well. Proper cooling helps avoid equipment failures and results in longer equipment lifespans.

Optimal performance

Good cable management ensures that cables do not become damaged or break and that they have the correct radius of curvature. An incorrect curvature radius reduces the performance of the cable. The radius of curvature must never be less than what has been recommended by the supplier.

Flexibility and accessibility

Cabling should have a neat and structured appearance. This keeps the moving or adding of cables uncomplicated.

Reliability

Optimal performance

Flexibility and accessibility

Horizontal cable management

In the 19-inch section, cables can be guided horizontally using cable combs. Both metal and plastic cable combs are available.

Cable comb plastic

Cable comb metal

In order to guide cables to the 19-inch section, cable guides and cable clips can be used.

Cable clip

Cable guides

It is possible for cables to run from the front to the back of the cabinet, for example because of the use of a switch on the cold side. For guiding cables from the front to the back cable ducting can be used. Cable entry brushes and cable entry foam –also in combination with cable ducting- can also be used for this purpose.

Cable ducting front and back

Cable entry brush

Cable entry foam

Vertical cable management

Through vertical cable management, cables can be guided from the top to the bottom of the equipment, and the other way around. Products which can be used for this include cable trunking, cable clips and cable guides. It is also possible to place cable combs in the side panels for this purpose.

Cable clips on 19-inch profile

Cable clips on the frame upright

Cable clip on the frame upright

Cable trunking – cables entered from the bottom

Cable trunking – cables entered from the top

Cable guides

Cable comb

Storing overlength

Cable overlength can be stored using a cable storage cassette and cable reels. The cable reels can be installed onto the 19-inch plane and next to it. It is also possible to install them onto the side panel.

Cable storage cassette installed – closed

cable storage cassette installed – open

Fastening material

Velcro is an ideal product for fastening cables without pinching them.
In addition, the product can be easily detached and reused.

Many cable management products are also listed in our standard product catalogue (www.minkels.com/downloads) and in most cases have a very short delivery time. Are you looking for something else? We are always happy to help you, so don't hesitate to contact us! You can find the contact details on the back side of this brochure.

Top of rack cabling system

Rack to rack
(cable trays)

rack row to rack row
(cable bridge)

From building to cabinet
For the optimal guidance of cables to the cabinet Minkels cable trays can be used. Cable trays are flexible, modular, easily installable and possible to seamlessly integrate into the cabinet. Because this cable system is affixed directly onto the cabinets, it becomes independent of its surroundings. Thus, if the data centre expands, the cable management can expand with it without requiring any changes to the construction of the building, unlike ceiling anchoring systems.

From rack row to rack row
Cable bridges can be used for crossing a cold or warm corridor. The cable bridge can be used for both small and wide cable trays. These can also be used in combination with aisle containment. Because cable bridges are telescopic, no sawing is required in the data centre. This helps avoid outages of critical equipment.

From rack to rack
For cabling from rack to rack, cable trays are also usable. In this case cables do not run horizontally through the racks but are guided over the top, across the roof towards the neighbouring racks.

The cable trays can be ordered using the Minkels standard product catalogue (www.minkels.com/downloads) and cannot be configured using the product configurator.

1.6 Airflow optimisation

Data centres are increasingly using energy efficient cooling techniques such as free cooling and fresh air cooling. The first step in this process is separating warm and cold air using aisle containment solutions. The next step is the airflow optimisation in the rack. This step, however, is often not fully or effectively implemented, although it is the next step in energy efficient data centres. Airflow optimisation is also important for the proper functioning of the server, network and storage equipment, for temperature control and for the general stability of a data centre.

The configuration tool allows for the configuration of several products for airflow optimisation into your rack.

THE RIGHT AIRFLOW OPTIMISATION ACCESSORIES ENSURE AN ENERGY EFFICIENT SOLUTION

Research by Minkels shows that the use of the correct airflow optimisation accessories leads to an enormous reduction in power usage. Based on this research, Minkels has developed accessories which provide concrete products for specific airflow optimisation needs. More information on this topic can be found in Minkels' Whitepaper 04: 'Rack Airflow Optimisation', available for download on the Minkels website:

www.minkels.com/whitepaper

Cable entry brush

Cable entry foam

Airtight sealing of a rack

Aisle containment solutions prevent cool air leakage!

Preventing cool air leakage
Research has shown that there are several locations within a data centre where cool air leakage usually takes place. Using aisle containment is a first step in preventing cool air leakage. The most important cool air leakage takes place in the rack. Unwanted recirculation of cooling air takes place here, for example. Badly sealed cable entry holes and floor openings in the back of the rack also contribute to the interrupted airflow and temperature maintenance.

Why apply airflow optimisation accessories?

1. A more energy efficient data centre
Airflow optimisation prevents the blending of cold and warm air in the rack. This ensures all cold air is used solely for cooling the equipment.

No blending of the air between the aisle containment solution and the warm side cause a higher temperature difference between the warm and cold side, Delta T (temperature). This higher delta T ensures that the cooling equipment can cool more energy efficiently.

2. Making full use of cooling equipment
By utilising airflow optimisation, all air is used for cooling server and network equipment. This leads to less transport losses and the possibility of saving on the fan power in the cooling equipment.

3. A more stable data centre
In the absence of airflow optimisation, warm air can enter the rack on the cold side and the server equipment. This leads to local hotspots in the aisle containment. Because of this, the servers are not cooled properly, influencing the lifespan and stability of the servers.

To optimise the Minkels racks for airflows and still profit from flexibility, there is also the possibility of integrating foam and foil into the rack. Gaps can then be filled –when they are not in use- and the possibility of using the gaps later on for fitting, for example, cable clips is not lost. Thus you maintain full flexibility.
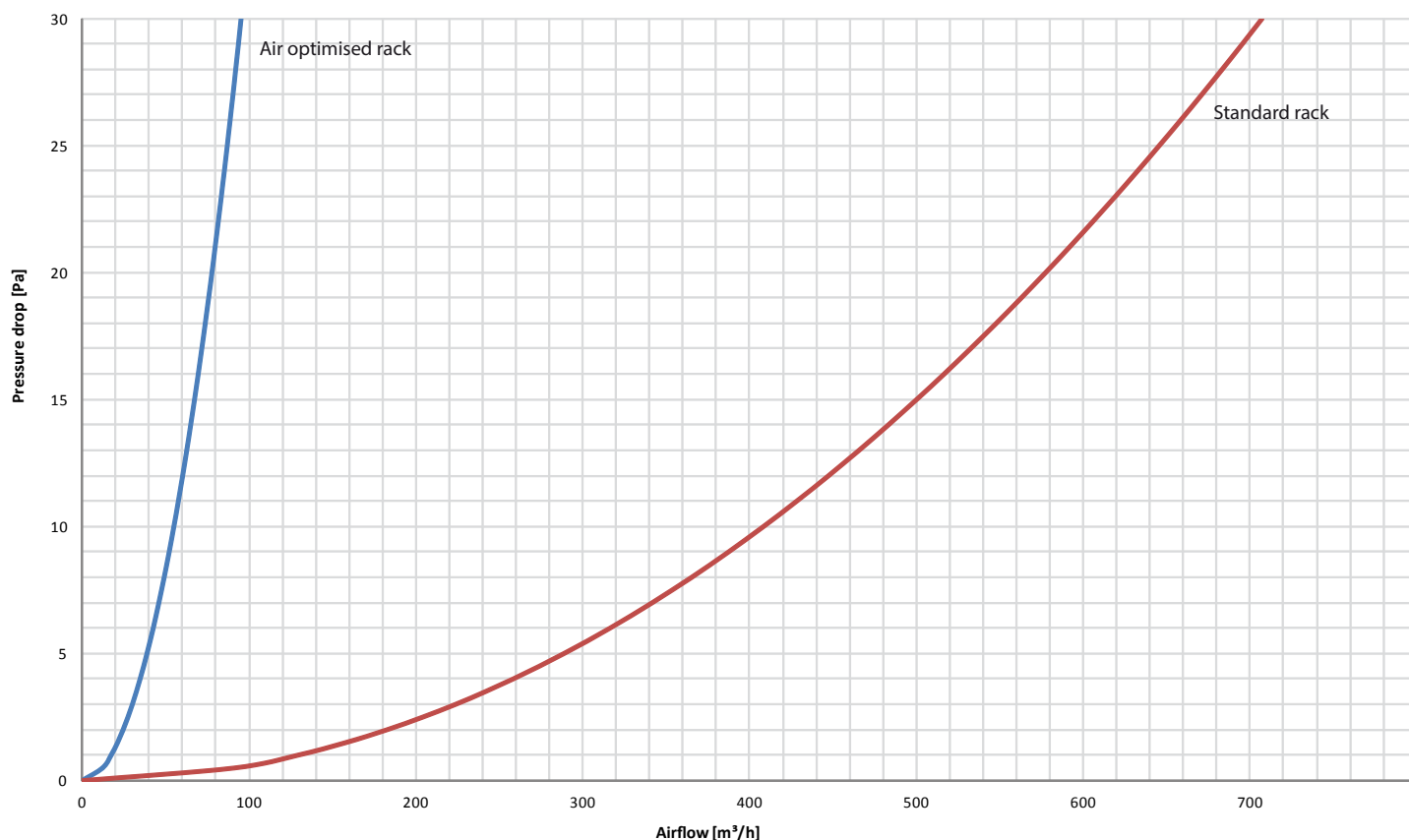
Minkels has developed several rack accessories for air flow optimisation. In the 19-inch, the following products can be used:

• Plastic and metal front plate
• Cable entry foam
• Combination of both

Tests have shown that the application of airflow optimised accessories pays for itself relatively quickly. Depending on the situation, investments can be earned back within 2 years.

Test air leakage in server rack

Dimensions: 800 x 1000 x 2200 (b x d x h)

The graph above illustrate the savings which can be achieved through the application of an airflow optimisation package.

Optimally making use of the cooling equipment produced savings of 0,32 euros per m3/hour per year in the test case presented in Minkels whitepaper 04 'Rack Airflow Optimisation'. The new plastic front plate gives 70% less air loss. This can produce savings of 2,25 euros per year per front plate. For a rack filled with front plates this adds up to yearly savings of 103 euros. Additional effects are that a higher delta T causes an efficiency improvement in the cooling equipment and that the prevention of hotspots produces a more stable data centre.

Airflow optimisation packages
In order to meet our customers' varying wishes two airflow optimisation packages have been developed: Basic and Plus. The airflow optimisation packages cannot be added to the cabinet after delivery. However, they can be installed into a new rack using our Sales Configurator. Our sales department will be happy to help you further.

Airflow optimisation	Solution uses	Depth of the 19"uprights
Basic	Metal	0-300mm
Plus	Metal, foam and foil	0-300mm

Airflow optimisation packages: Basic
Using airflow optimisation package Basic, a rack can be made almost airtight in a cost-efficient manner. A side sealing plate and a side sealing plate side panel close the 19-inch surface on the left and right side. In addition, a seal is placed to make the surface on the bottom and top airtight. The package is suitable for 19-inch distance profiles up to 300mm from the front of the rack.

Airflow optimisation packages: Plus
Using the airflow optimisation package Plus you can reach the highest level of airtightness. The side sealing plate and the side sealing panel are covered with foil. Every assembly opening in the side sealing panel is still usable, but all unused openings are sealed with foil to prevent air leakage. The bottom and roof plates have an identical level of airtightness. Special foam pieces are even placed around the profiles on the bottom side. The package is suitable for 19-inch distance profiles up to 300mm from the front of the rack.

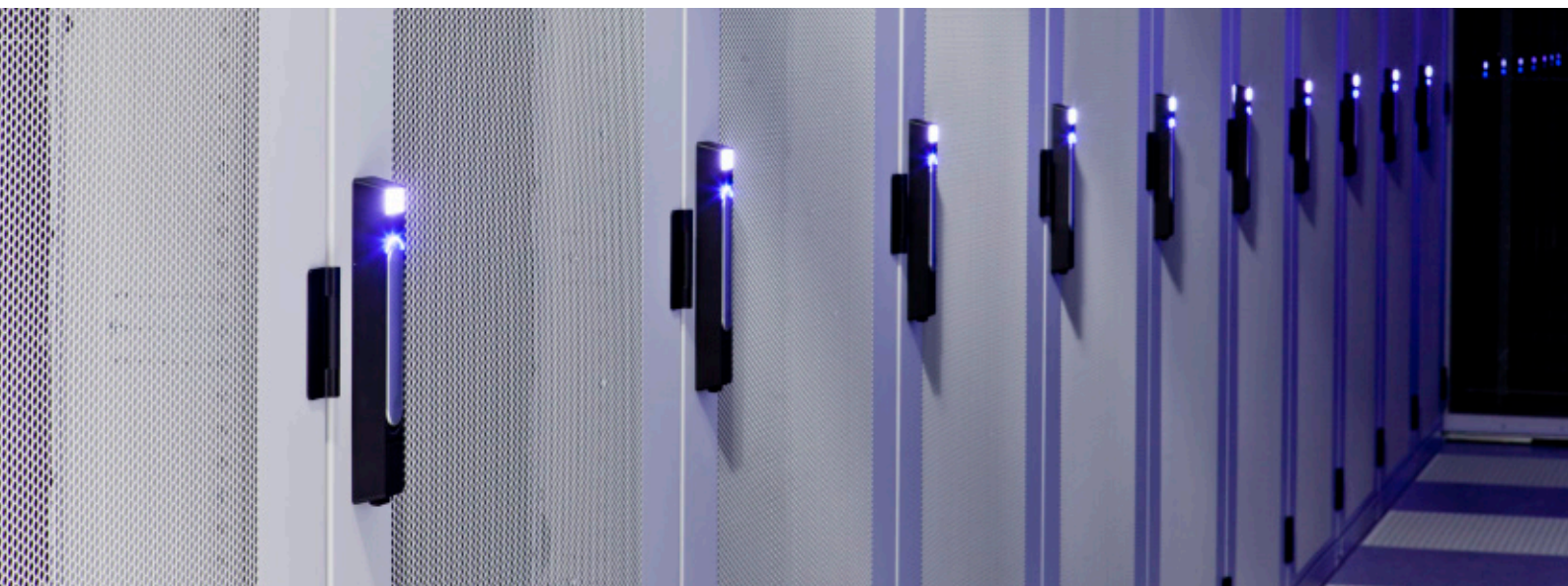# Using the plus package, you can achieve an airtightness of 99,8%!

1.7 Safety

IT-infrastructures are vulnerable. Therefore, the protection of access to data and equipment does not end at the walls of a data centre or server room. Safety at rack level is becoming more and more important to organisations.

Commercial data centres, government organisations, financial institutions and other organisations with sensitive data contained in their systems, are increasingly choosing to protect their equipment at rack level. A growing demand for rack safety solutions is partially fuelled by the realisation that an IT-infrastructure remains vulnerable when several persons have access to the rack and it is not or insufficiently secured.

The security solutions which are needed include not just cylinder locks on the racks but also electronic security with pass systems, such as RFID-technology for authorising and registering actions. In this way, a user can check who was at a specific rack at a specific time after the fact. There is also a demand for movement sensors (to check if side panels are being taken out), side panel locking from the inside and door contacts (to check if a door is closed). In addition to the standard locking systems (www.minkels.com/downloads), Minkels also offers a large assortment of electronic locking systems.

NPF 5313 & EN50600 norms
Stricter laws and regulations are also contributing to the enormous growth in demand for safety solutions. In the Netherlands this concerns the Nederlandse Praktijk Richtlijn Computerruimtes en Datacenters (NPR 5313). A significant emphasis is now put on safety measures in a data centre or server room in this norm. The norm serves as a base for tightening guidelines within EN50600, the European standard for the design of data centres and computer rooms.

Electronic closing systems

Minkels offers a data centre security product line with three different solutions, varying in intelligence and closely attuned to a wide range of customer specific needs.

BASIC

Basic can be integrated into an existing building management or access control system. Basic opens a rack by receiving a signal from an authorised user through the host system. In addition, a Basic handle can be linked to an HID handle, where it will function as a 'slave'. Depending on the entry status of the HID handle, the Basic will automatically open or close along with it. Advantages of this 'master-slave' combination are cost reduction and simplification of management and cabling.

HID

Complete entry control solutions at rack level in which handles, software and HID-cards are offered. For the authorisation, built-in antennae with RFID (Radio Frequency Identification) technology are used. The accompanying software can be installed centrally on a server and can communicate with all locks and corresponding equipment using the network (Ethernet). The difference between HID-Direct and HID-485 is in the communication with the network.

HID-Direct is very suitable for racks which are spread out over a larger area with connectivity via a single network.
• Each handle receives an IP address
• Each handle is directly connected to the Ethernet Network
• Easy cabling
• High security: little components/connections
• Suitable for multiple rows with cabinets and isolated cabinets in the building
• Very simple installation

HID-485 is a smart and cost-efficient solution for centralised data rooms, for areas with a maximum of 32 handles which share a single gateway on the network.
• Only the gateway receives an IP address, the handles are identified by an ID number on an RS-485 bus
• 32 handles maximum on each gateway
• BUS-cabling between the junction boxes, handles and gateway
• Cabling runs from cabinet to cabinet
• Very cost efficient if all cabinets are positioned in a central room

Both the HID-Direct and the HID-485 can be delivered with an integrated keypad. The keypad with numerical code can add extra functionality to the HID-handle in two different ways. It can generate a code, in which case for example the manager always has access to all racks using this code and users are provided with access using an HID proximity pass. Another function would be to add a second level of security where to gain access a user must be in possession of both an HID proximity pass and a code.

HID ADMIN SUITE
Together with the HID rack safety concept, Minkels delivers the HID Admin Suite, a software solution through which the intelligent HID rack safety solution can be managed. The software solution can be centrally installed on a server and can communicate with all locks and corresponding equipment through the network (Ethernet). Configuration and management of the solution – with regard to users, the authorisation policy, the handles, the HID-cards and corresponding peripheral devices- can be centrally managed through the software solution.

HID BASED RACK SECURITY, YES OR NO?
There are several arguments in favour of the HID based rack security. The most important reasons customers mention when asked about their choice for HID are: safety, central access management and remote control, plus the advantage of lower operational costs.
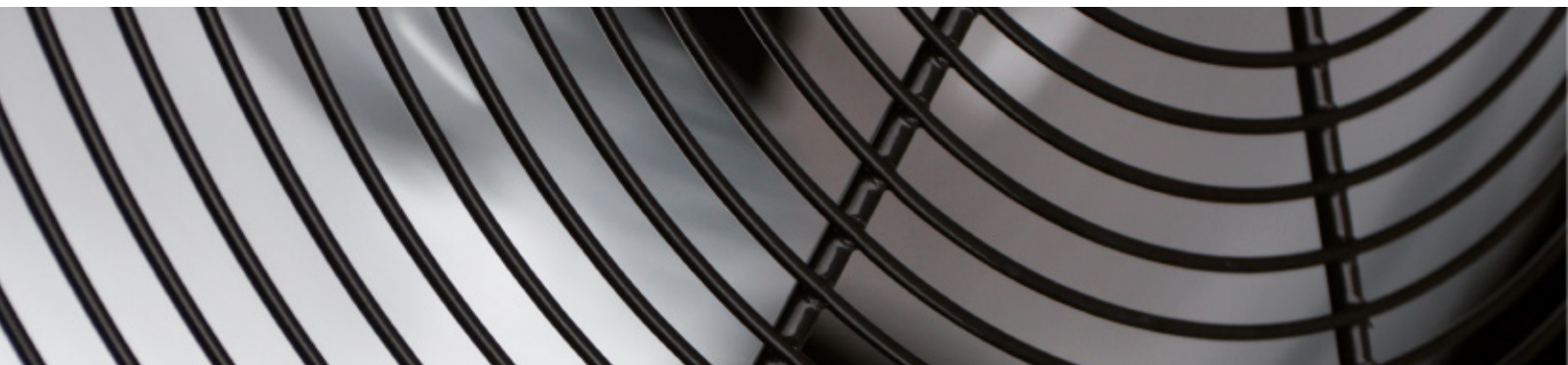
**Safety** – The loss of rack keys leads to an unsafe situation in the data centre which can persist for hours or even days. The loss of HID-passes can be remedied within seconds of a notification of loss. Furthermore, the maintenance of a pass system as opposed to a key system is more flexible and effective. This raises the safety level of a rack considerably. In addition, it is possible to further improve rack safety using the 'four-eye' principle. The software can be set to require the presentation of 2 HID proximity passes before access to a rack is offered. This means that two people will have to be present in order for a rack to be opened. Looking at power outage protection, the system has built in redundancy. In addition to the standard power supply, the handle can be supplied with power using a battery pack. In this case, access is granted – with the right HID proximity pass. This provides the opportunity for rack accessibility and safety even in the event of a power failure.

**Central access management & remote control** – HID based rack security offers extensive registration and management overview of all actions on rack level. Even in the case of a network outage, actions are registered. When connections are restored, the information synchronises with the database. In addition, HID based rack safety offers the possibility of remotely opening rack doors, groups or entire zones in the data centre.

**Lower operational costs** – In the case of HID based rack security a one-time investment in the HID Admin Suite is made. After this, the operational costs are limited to the personal management costs with regard to the issuing of passes and any setting changes in the interim. These costs are significantly lower than those incurred in the management of a traditional key plan.
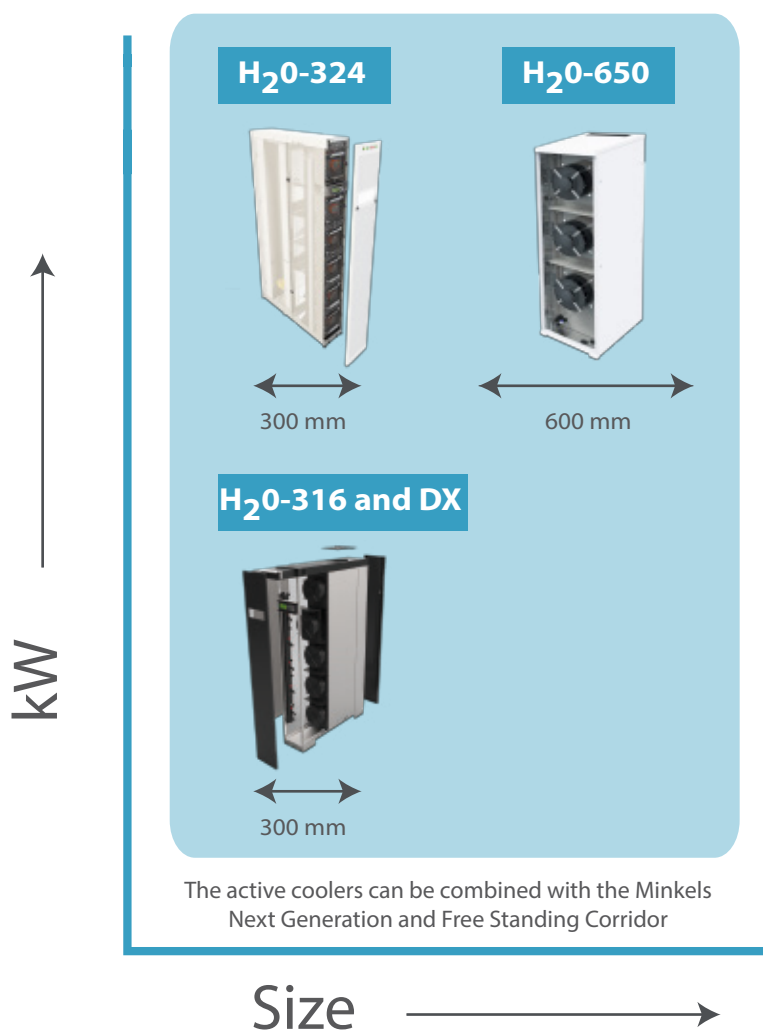
COOLING

Energy bill savings

By cooling your data centre in the right manner, you can significantly reduce your energy spending. Minkels has developed an extensive range of energy efficient cooling solutions.

H$_2$0-324

H$_2$0-650

300 mm

600 mm

H$_2$0-316 and DX

300 mm

kW

Size

The active coolers can be combined with the Minkels Next Generation and Free Standing Corridor

Minkels offers a wide range of flexible and energy efficient cooling solutions to offer the best possible data centre solution in all circumstances and for every situation, whether for a small server room or a large data centre, newly built or existing office buildings, high or low capacity per rack or air or water cooling. You can make a selection from our standard cooling assortment (www.minkels.com/downloads) but you may be in need of more flexibility. If this is the case, Minkels offers the possibility of a mass customised cooling solution. These products consist of building blocks which can be combined and integrated into a solution which suits your data centre and/or server room. Please contact our sales support department or your account manager and we will configure the solution which best suits your situation. You can find the contact details on the back side of this brochure.

The following pages contain an overview of the cooling solutions which we can configure for you.

The VariCondition portfolio consists of both passive and active systems for cooling or optimising cooling of your valuable IT-equipment. The applications of these products are versatile.

2.1 Passive cooling

A distinction is made between passive and active cooling.

2.1.1. AISLE CONTAINMENT

Aisle containment is the solution to the challenges which data centres have been presented with since day one: the optimisation of cooling and energy-efficiency through the separation of hot and cold airflows.

However, this is not the only challenge which data centre managers and owners have been confronted with. Because of a shorter life cycle of the IT-equipment, data centre managers and owners encounter a higher rate of change in the data centre. Traditional corridors do not offer the flexibility and modularity needed to take on this dynamic. In addition, data centre managers and owners are increasingly confronted with systems –such as storage equipment- which do not come in a standard housing and therefore are hard to fit into a traditional corridor. Furthermore, traditional systems do not offer enough possibilities for the optimal integration of sensors and so on. The challenges outlined require corridor solutions which offer higher flexibility and modularity and more integration possibilities.

With the Next Generation Corridor and the Free Standing Corridor, Minkels offers data centre managers and owners 'future-proof' solutions which offer the flexibility and modularity needed to be able to anticipate the dynamic of the modern day data centre. Minkels offers the best solution for every situation with the Next Generation Corridor and the Free Standing Corridor. The choice of a certain solution will depend on both the required flexibility and the building structure (existing, renovated or new).
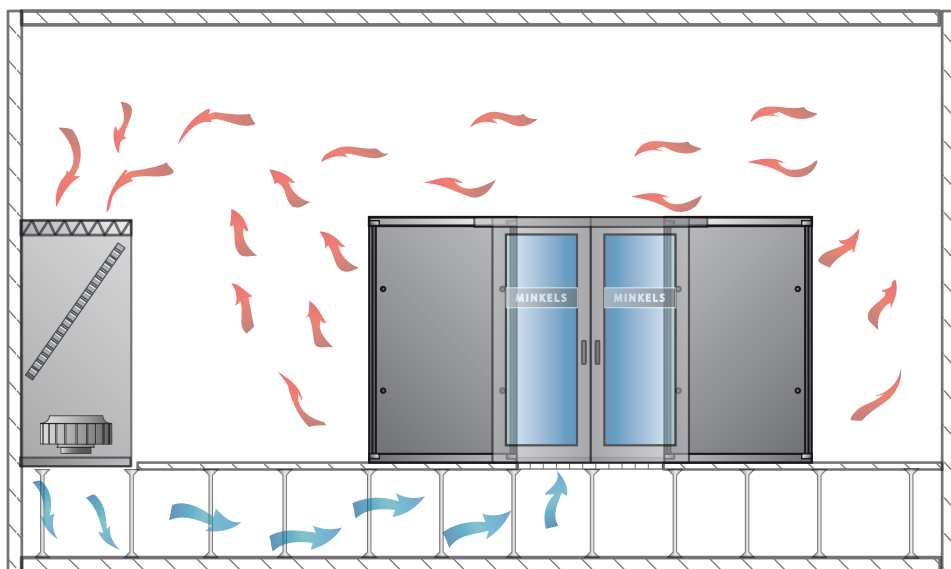
The main difference between the Free Standing Corridor and the Next Generation Corridor lies in their realisation of the expansion of the number of racks. In the case of the Free Standing Corridor, the containment is placed in one go and filled with new racks, racks with a non-standard dimension or racks by other brands as time goes on. In the case of the Next Generation Corridor, an expansion in the number of racks means the expansion or addition of a containment.

MINKELS NEXT GENERATION CORRIDORS (RACK DEPENDENT)

Minkels was the first data centre supplier in Europe to introduce the Corridor solutions commercially. Since then, these solutions have been used to separate the airflows of many a data centre in an energy-efficient manner. Minkels' Next Generation Corridor is the ultimate answer to the ever increasing demand for flexible and modular solutions. In the form of the Next Generation Corridor, Minkels lifts modular thinking and energy-efficient data centre design to a higher level.

Important features of the Next Generation Corridor are:

Modularity
Through the highly modular concept of the Next Generation Corridor, Minkels offers extensive possibilities to implement a Corridor solution in a phased and thus cost-efficient manner.

Flexibility
Because of its modular design, the Next Generation Corridor is flexible and thus can be adapted to fit the specific building environment.
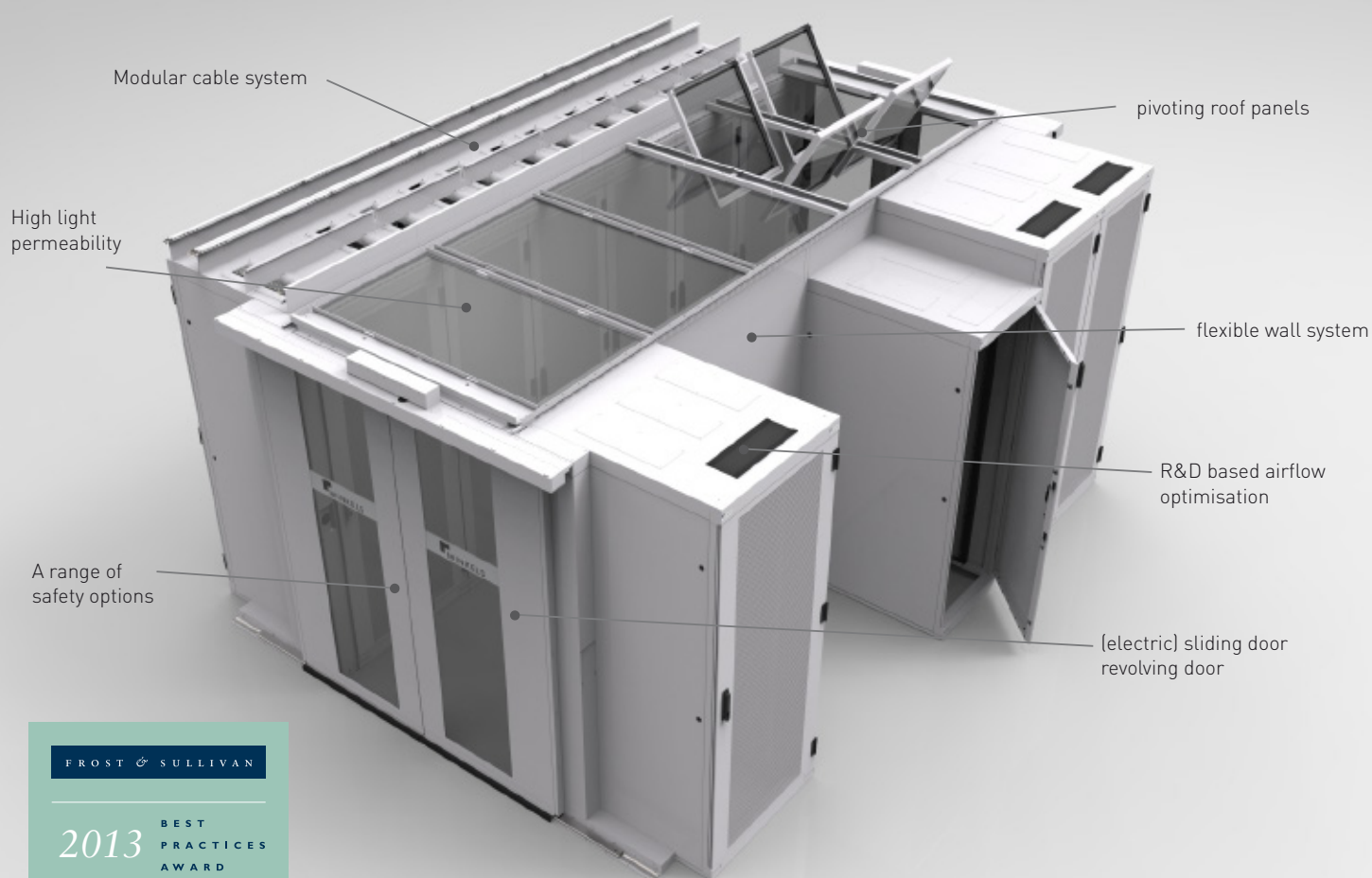
Ease of installation
Modularity in the construction details ensure that the solution is easily and cost-efficiently installed.

Energy-efficiency
With the Next Generation Corridor, Minkels offers a solution which is more energy-efficient than other Corridor-models on the market.

Optimal integration
The Next Generation Corridor can be integrated with row-based cooling systems which bring cooling close to the heat source, but also with more traditional forms of cooling which require a raised floor. In addition, this concept offers plug & play integration with e.g. fire detection and suppression systems, monitoring sensors and access control.

Modular cable system

High light permeability

A range of safety options

pivoting roof panels

flexible wall system

R&D based airflow optimisation

(electric) sliding door revolving door

FROST & SULLIVAN

2013 BEST PRACTICES AWARD

EUROPEAN RACKS & CABINETS
ENTREPRENEURIAL COMPANY OF THE YEAR AWARD

MINKELS FREE STANDING CORRIDOR (RACK INDEPENDENT)

When the highest amount of flexibility is required, the Minkels Free Standing Corridor is the most optimal solution. The Free Standing Corridor is a fully self-supporting aisle containment system, with which closed off aisles can be created independent from the IT-racks –which is not usual in the data centre market. Immediately after implementation, the Free Standing corridor reaches the same energy-efficiency as a regular aisle containment system with IT-racks would. The Free Standing Cold corridor can be used for both cold isle containment and hot isle containment. The system –a modular design consisting only of a carrying construction, wall panels, roof panels and sliding doors- offer corporate and commercial data centres a cost-efficient 'pay-as-you-grow' solution in order to create energy-efficiency at low initial investments (CAPEX).
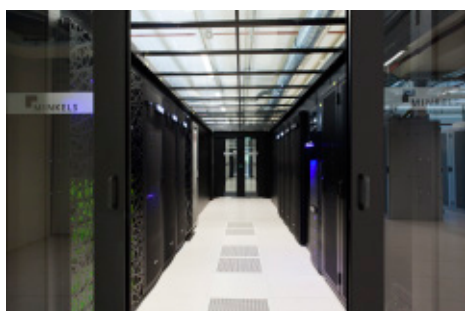

The Free Standing Corridor can be used in combination with an existing infrastructure and already fitted racks, and drastically improves the airtightness and with this the energy-efficiency. The Free Standing Corridor can also be used for a new room where the end user will fill the corridor themselves based on their own demands and requirements, or those of a customer. This allows for a start with a minimal initial investment. Depending on the length of the corridor, racks can be added stepwise while the required airtightness is maintained.

The free standing frame carries the sliding door systems, roof systems, corridor walls and vertical panels/chimneys, without any support other than the floor onto which the entire construction is installed. The frame consists of two sheet metal rigid door portals at the beginning and end of the construction and modular, plate steel beam sections. The minimum length of the free standing frame is 1800 mm and can be added onto with 600 mm sections. The maximum length of the free standing frame is 26400 mm. You can choose between a light grey (RAL 7047) or black (RAL 9011) Free Standing Corridor. The standard walkways are enclosed by the containment system, and have a width of either 1200 or 1800 mm.
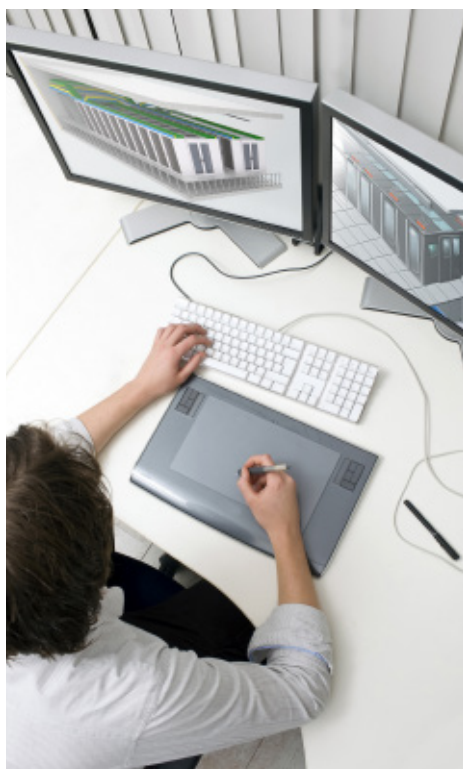
CONCLUSION

With the Next Generation Corridor and the Free Standing Corridor, Minkels offers the best scenario for every situation. Which scenario is eventually preferred depends highly on the demands placed on the aisle containment (see also the table on the next page). A Next Generation Corridor, for example, might be preferred if busbars and cable management systems are used on top of the racks. If there is much uncertainty surrounding the number of racks which are to be placed and a high diversity of systems, the Free Standing Corridor might be preferred.

FROST & SULLIVAN

2015

BEST PRACTICES AWARD

EUROPEAN RACKS & CABINETS
NEW PRODUCT INNOVATION AWARD

Features	AISLE CONTAINMENT	
	Next Generation Corridor	Free Standing Corridor
Integration differing rack depths	●●●	●●●
Integration differing rack heights	●●○	●●●
Integration differing rack widths	●●○	●●●
Integration differing brands of racks	●○○	●●●
Modularity	●●○	●●●
Integration sensors	●●●	●●●
Expansion with extra racks	●●○	●●●
Row-based cooling	●●●	●●○
Integration fire suppression systems	●●●	●●●
Initial investments*	●●○	●●●
Separation of hot and cold air	●●●	●●●
Pivoting roof	●●●	●●●
Cold corridor setup	●●●	●●●
Hot corridor setup	●●●	●●●
Avoidance of hotspots	●●●	●●●
Possibility for energy-efficiency	●●●	●●●
Power per m²	●●●	●●●
Cable management on top of rack**	●●●	●●○
Busbar integration	●●●	●●○
Transverse wall	○○○	●●●
Adjustable side wall	●●○	●●●
Flexibility in adaptation or replacement of cabinet	●○○	●●●

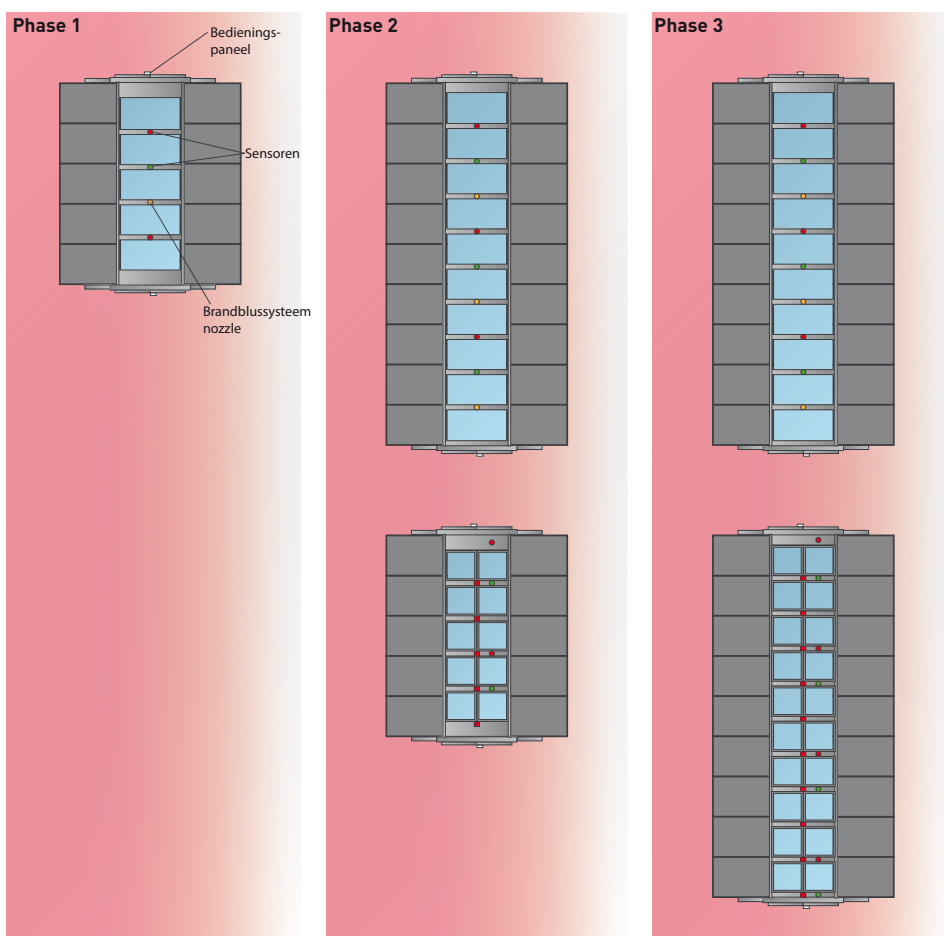*   including supporting racks (necessary)
**   Minkels-development

Configure your aisle containment completely to your own wishes and have your solution delivered within 15 working days (ex works).

2. Cooling 2.1 Passive cooling

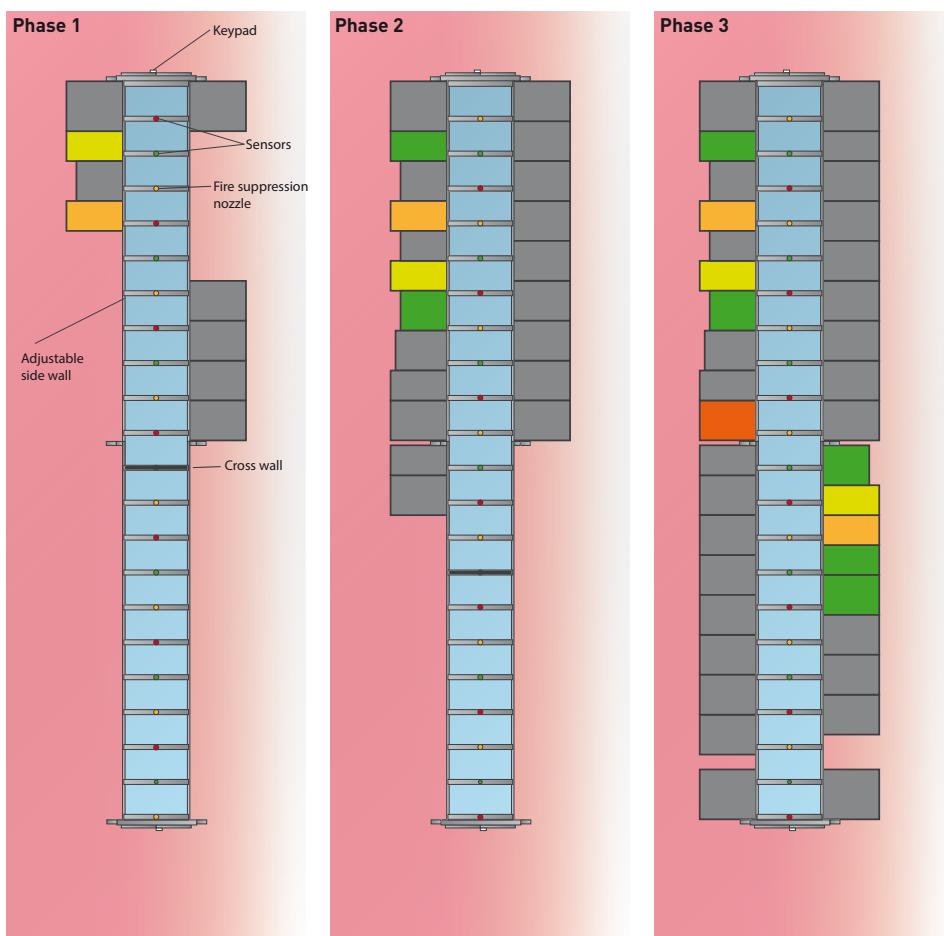theoretical example of the step-wise expansion of a Next Generation Corridor

Phase 1	Phase 2	Phase 3
Next Generation Corridor with 10 standard racks.	The first aisle containment is expanded and the second aisle containment has been built. On one side, the aisle containment doors are disassembled and reassembled.	The second aisle containment is expanded upon through the disassembly and reassembly of the doors.
Automatic sliding doors with operating panel.	A pivoting roof is installed in the second corridor to avoid re-certification of the fire suppression system.	The expanded section is fitted with a pivoting roof and new sensors.
Sensors are installed in the corridor roof.	New sensors are installed in the roof of the expanded and new corridor.	The sensors, the security system and the pivoting roof are implemented in the management system.
The corridor is fitted with nozzles for the fire suppression system.	The sensors, the security system and the pivoting roof are implemented in the management system.	
The sensors and security are implemented in the management system.		

Theoretical example of the step-wise expansion of the number of racks within a Free Standing Corridor.

Phase 1 — Keypad, Sensors, Fire suppression nozzle, Adjustable side wall, Cross wall

Phase 2

Phase 3

Phase 1	Phase 2	Phase 3
Free Standing aisle containment with 8 standard racks and 2 integration racks.	Racks in differing sizes have been added. One rack has been replaced by a new rack.	Racks in differing sizes have been added.
Automatic sliding door with management panel and the possibility of fitting a transverse wall in order to save costs.	No reprogramming of the management system is necessary.	Gradually the data centre is filled without installation or reassembly of doors, roofs, sensors or fire suppression systems.
Sensors have been installed in the roof of the corridor.	Transverse wall is moved.	
The corridor has been fitted with nozzles for the fire suppression system.		
The sensors and safety are implemented in the management system		

ROOF SYSTEMS

For your Next Generation or Free Standing Corridor, a choice can be made between a high transparency roof, Drop Away Panels, an active pivot roof or a passive pivot roof.

High Transparency roof
Your aisle containment can be fitted with a high transparency roof. These roof panels provide a high light permeability/light transmission, up to 83%. The roof panels are installed onto rails, separate from the server racks.

Drop Away Panels FM Approved
Drop Away Panels ensure the seamless integration of aisle containment solutions with sprinkler or water mist systems. In the case of a fire in the data centre, the plastic Drop Away Panels automatically soften and fall down so that they do not form an obstruction when sprinklers are activated. The system is specifically designed for use with sprinkler installations which activate at 74 degrees Celsius and upwards.

Active pivot roof or Passive pivot roof
Through the use of rotating panels, this type of roof allows for the roof panels to automatically open. This ensures that fire suppression gasses or fluids can reach the enclosed construction.

Passive pivot roof: The activation of the rotation panels occurs through use of thermic fuses which are activated at 57 degrees Celsius.

Active pivot roof: The activation of the rotation panels occurs through the release of electromagnets which are engaged by a micro controller which is part of the system. The system can be tested using a special test function. The activation takes place through the fire alarm control panel. The fire detection can take place through smoke or heat, for example.
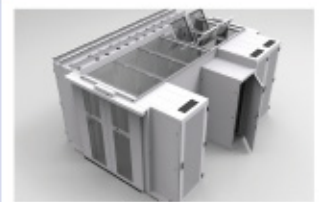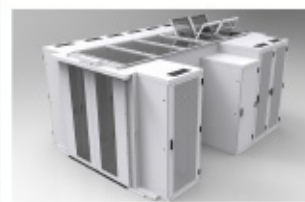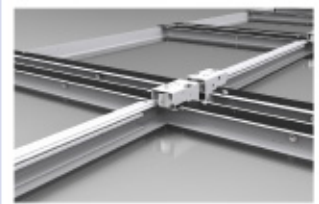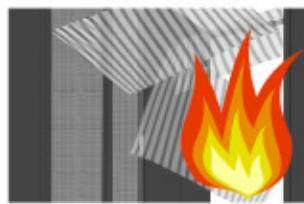
HIGH TRANSPARANCY	DROP AWAY PANELS	PIVOTING ROOF PASSIVE (thermal fuse)	PIVOTING ROOF ACTIVE (remote activation)

ROOF SYSTEM

WORKING PRINCIPLE

	High Transparency roof with Nozzles in Corridor and Manual Doors	High Transparency roof with Nozzles in Corridor and Automatic Doors	Pivot Active Roof	Pivot Passive Manual Doors	Pivot Passive Automatic Doors	Drop-Away panels and Manual Doors	Drop-Away panels and Automatic Doors
FM approved*						●	●●●
Weight of panel	●	●	●	●	●	●●●	●●●
Roof transparency	●●●	●●●	●●●	●●●	●●●	●●	●●
Obstruction level for sprinklers	●●	●●●	●●	●●	●●	●●●	●●●
Retro fit?	●●●	●●●	●●●	●●●	●●●	●●●	●●●
Applicable all heights	●●●	●●●	●	●	●	●●●	●●●
Remote activation		●	●●●		●●		●
Fire suppression method	Water (mist)/gas	Water (mist)/gas	Water (mist)/gas	Water (mist)	Water (mist)/gas	Water (mist)	Water (mist)
Cooling configuration (hot/cold?) FS-C Versus NXG-C Modularity/Flexibility	Open Loop/Hybrid Loop	Open Loop/Hybrid Loop	Open Loop/Hybrid Loop	Open Loop/Hybrid Loop	Open Loop/Hybrid Loop	Open Loop/Hybrid Loop	Open Loop/Hybrid Loop
Activation temperature	N.A.	Fire Panel	Fire Panel	Fuse activation at 57°C	Doors on Fire Panel Fuse activation at 57°C	Designed for sprinkler activation at 74°C	Designed for sprinkler activation at 74°C, Doors on fire panel
Smoke activation of doors or roof possible		●●●	●●●		●●●		●●●
Pressure equalization		●●●	●●●		●●●	●	●●●

Watch the Free Standing Corridor and the Drop Away Panels clip on the Minkels YouTube channel:

Youtube.com/c/minkelshq

DOOR SYSTEMS

Minkels offers self-closing sliding doors, with which you can close off your aisle containment in an airtight seal. The self-closing sliding door system is available in two different colours, RAL 7047 and RAL 9011. During the closing of the doors, a soft closing mechanism prevents the doors from unexpectedly striking against each other. The door panels have been fitted with safety glass panels to ensure the safety of persons and to allow light to enter the containment, as well as to provide the possibility of viewing the walkways from outside the containment.

• **Double sliding doors**
Manually operated sliding door
Mechanic self-closing sliding door
Electrical sliding door

• **Single sliding doors**
Manually operated sliding door
Mechanic self-closing sliding door
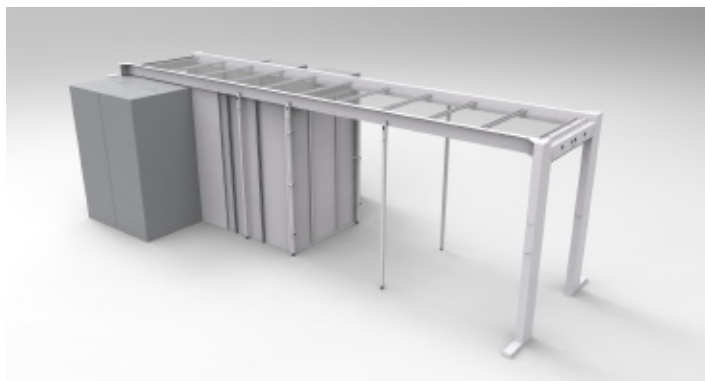Electrical sliding door

WALL SYSTEMS

Minkels highly values the efficient cooling and optimal airtightness of her aisle containments. Many different racks with possibly differing dimensions can be present in an aisle containment system. For this reason, Minkels offers an extensive portfolio of wall systems.
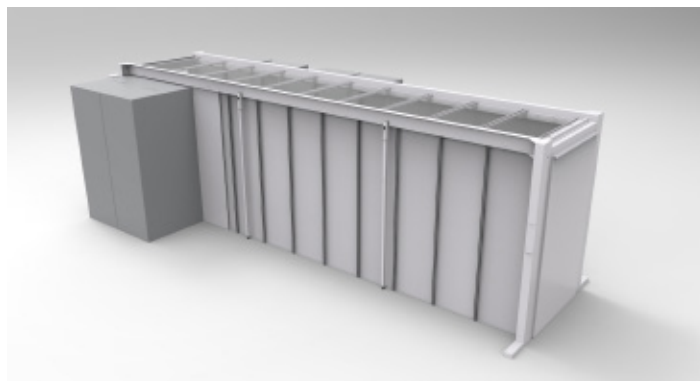
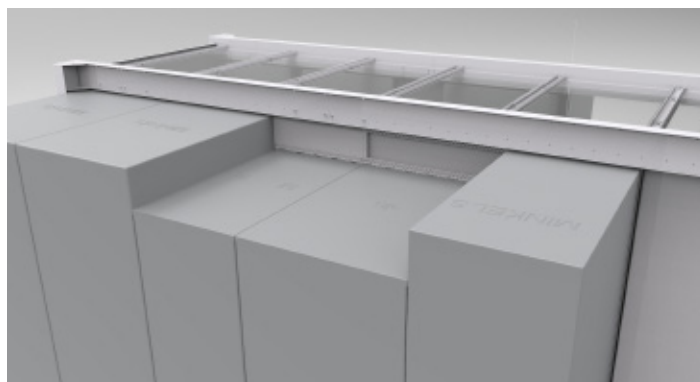| AISLE CONTAINMENT	
Next Generation Corridor	**Free Standing Corridor**
Full height panels: steel and HPL	Full height panels
End panels	End panels
Filler panels	Filler panels: steel and HPL
	Cross walls

2. Cooling   2.1 Passive cooling

Apply a cross wall for a spread investment.

Fully airtight Free Standing Corridor thanks to wall panels.
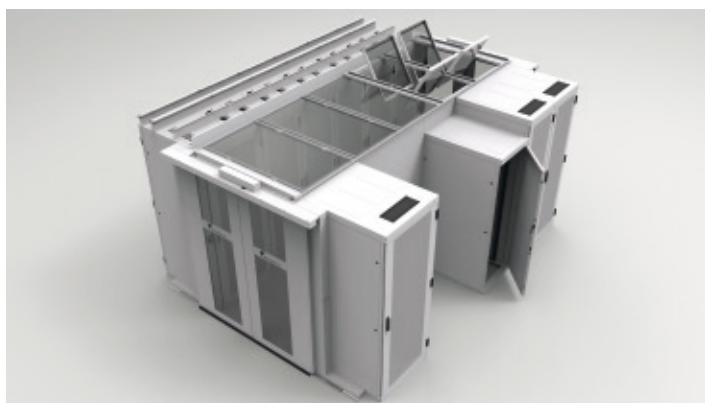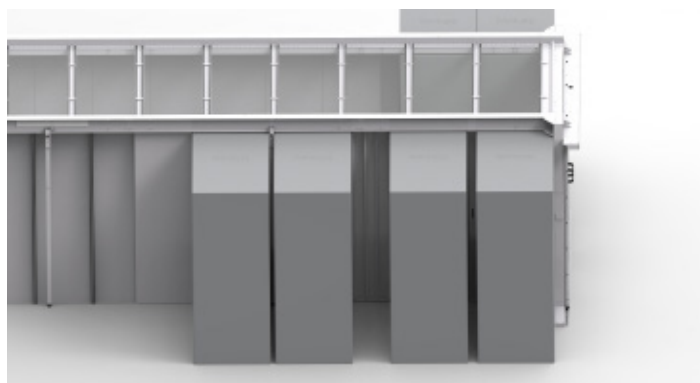

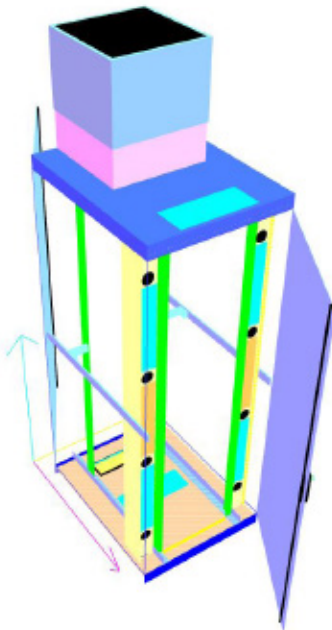End wall instead of a sliding door.

Top filler panels.

Minkels can supply suitable filler panels for any open parts.

Minkels Next Generation Corridor

2.1.2. VED: VERTICAL EXHAUST DUCT SYSTEM

Efficient airflow separation at rack level

Airflow optimisation is certainly the next step in creating more energy-efficient data centres. Furthermore, airflow optimisation is very important not just to the proper functioning of the server, network and storage equipment, but also to the temperature control and the general stability of the data centre. Minkels supplies high quality solutions for the efficient management of airflows in your data centre. Solutions include the Minkels Next Generation Corridor. In order to provide even higher flexibility in several airflow optimisation applications, Minkels has developed the 'Vertical Exhaust Duct' system.

There are many ways in which airflows can be separated, such as through the application of cold aisle containment, hot aisle containment or closed loop setups. In all cases, the mixing of hot and cold airflows is prevented at rack or row level, thus eliminating inefficiency.

THE MINKELS 'VERTICAL EXHUAST DUCT' (VED) SYSTEM

The VED system transports warm airflows from the top of the (server) rack to a central cooling system using an air duct. The VED system is attached to the (server) rack with a specially designed roof plate. The upper part of the VED is telescopic and can easily be slid under the lowered ceiling. A packing seal at the top ensures a proper air seal, even if the lowered ceiling is not fully level!

In order to achieve the best result, the total rack solution must be viewed as including the VED. This will generate the highest savings. Minkels has developed a number of accessories which contribute to this:
• Optimised roof panels
• Rack airflow optimisation packages
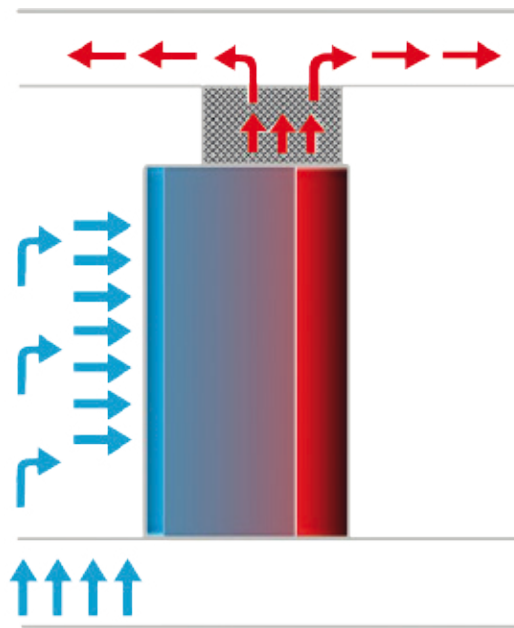• Door sealing strips to prevent from leaking around the doors

The following is a typical configuration:
- Perforated doors at the front for the intake of cold air for the IT-equipment.
- An optimised 19-inch interior for an airtight separation between the cold and warm side of the rack.
- A closed backdoor with airtight sealing strips. This prevents the warm air from leaking into the data centre.
- A specially designed roof plate with the Minkels VED system. The VED system ensures that the hot air which emanates from the IT-equipment can only flow back to the central cooling installation through the lowered ceiling.

Cold air is provided at the front. Because of the airtight sealing, this can only be removed as hot air through the VED system. This VED system allows you to cool up to 15 kW per rack.

MINKELS' SERVICE
Minkels' service team is optimally qualified and equipped to provide a quick, efficient and low-cost installation of your racks, aisle containment and VED-system.

We offer complete service through:
- Assessment of the situation on location before installation
- (internal) transport
- our installation service
- waste disposal management
- commissioning and user training

The Minkels sales and service team are happy to help you!

2.2 Active cooling

The VariCondition portfolio includes active cooling equipment based on H2O (water) and DX (refrigerant). These products are typically placed as frames between the 19-inch racks.

2.2.1. VARICONDITION-H$_2$O
Minkels offers a complete 'row-based cooling' portfolio. These 'row-based' cooling units are placed between the 19-inch (server) racks and offer cooling power in a very efficient and flexible manner. Supplemented by the total Minkels portfolio, a state-of-the-art total solution emerges.

Why row based cooling?
Row based cooling has taken off immensely in server rooms and data centres in the past years, as there are a number of fundamental advantages to this type of cooling as opposed to traditional cooling using a raised floor and air conditioning units (CRACs).
• The IT-equipment (heat source) and cooling installations are situated much closer together. This shortens the cooling air distribution paths considerably, resulting in a much lower energy use in the fans.
• The cooling air is better distributed in the to be cooled volume. This leads to a higher reliability of the cooling installation and a lower chance of hotspot development.
• Scalability/expandability. As the necessary cooling volume grows, the cooling installation too can easily expand. In this way, an investment is only needed when the actual cooling demand increases.
• Compact construction as a raised floor is not necessary.
• Row based cooling also offers new possibilities in existing situations. Such a situation could be the construction of high density zones in a data centre designed for a low density application. Many (older) data centres conclude that the existing cooling installation is not suitable for use with the latest generation of IT-equipment. Of course, this is inextricably tied to the quickly increasing energy use per rack.

As an endorser of the European Code of Conduct for Data Centres, Minkels focuses strongly on minimising the energy use of her products. Thus, all VariCondition-H2O cooling units have been equipped with variable speed, energy efficient fans, proportional control water valves, optimised internal airflows and smart control system.

Minkels distinguishes between the following products:
• VariCondition H$_2$O–316
• VariCondition H$_2$O–324
• VariCondition H$_2$O–650

VariCondition H_2O–316

The VariCondition H_2O–316 has a cooling capacity of 16 kW (TW,in = 12°C , TW,out = 18°C. TL,Return = 35°C, 30% RV). These products are typically used in small and medium sized server rooms. This provides customers with a reliable IT-cooling solution at an attractive investment cost.

Features
• Product-specifically designed for the cooling of IT-equipment
• Favourable price performance
• A solution for every situation or capacity
• Compact construction which allows for use without a raised floor

VariCondition H_2O–324

The VariCondition H_2O–324 has a cooling capacity of 24 kW (TW,in = 12°C, TW,out = 18°C. TL,Return = 40°C, 20% RV). This product was designed for use in medium-sized to large server rooms and small data centres. Extra robustness and redundancy has been incorporated into the design. For example, it is possible to switch a controller which is in use without any loss of functionality and an extra fan has been added (n+1) to ensure the flow of air. Special attention has been paid to energy savings, which is why the VariCondition H_2O-324 has a very good ROI.

Features
• An energy efficient product through use of an EC fan with good ROI
• Very high reliability and extra built-in redundancy
• Is delivered as a flat-pack and constructed between the 19-inch racks
• Suited for use in difficult-to-reach spaces
• Independent of each other, the fans can assume a variable speed

VariCondition H_2O–650

The VariCondition H_2O-650 has a cooling capacity of 50kW (H_2O–650: TW,in = 12°C , TW,out = 18°C. TL,Return = 40°C, 20% RV). Because of the still increasing energy density per rack, Minkels has chosen to offer a 50kW capacity on the footprint of a server rack. This makes the VariCondition H_2O-650 suitable for larger server rooms and data centres. Because of its standard dimensions, this product is also suited to supporting local energy density (high density zones) in existing data centres.

Features
• High capacity in a small footprint
• Dimensions are identical to that of a server rack
• Lay-out of the room does not need to be adapted specifically to fit the cooling equipment
• 3-phase power supply to simplify electric balancing in the power network
• Possibility for applying moistening
• Possibility for measuring/displaying the actual supplied cooling capacity
• Independent of each other, the fans can assume a variable speed

2.2.2. VARICONDITION-DX

VariCondition-DX is the modular cooling solution for small server rooms. It is an easily installed, energy-efficient cooling solution. The product was designed to provide professional and reliable cooling of your IT-equipment. Because of precision cooling, it is a much better alternative than traditional comfort cooling. VariCondition-DX was designed for both smaller businesses and larger organisations with decentralised server rooms and SER's. This cooling solution can be placed in-between the 19-inch racks. This can be realised in many ways. The cooling air is directly guided to your valuable IT-equipment. It is not necessary to install a raised floor. The VariCondition-DX is offered with 4,5 – 8 – 11 – 14 – 22 kW cooling capacity.
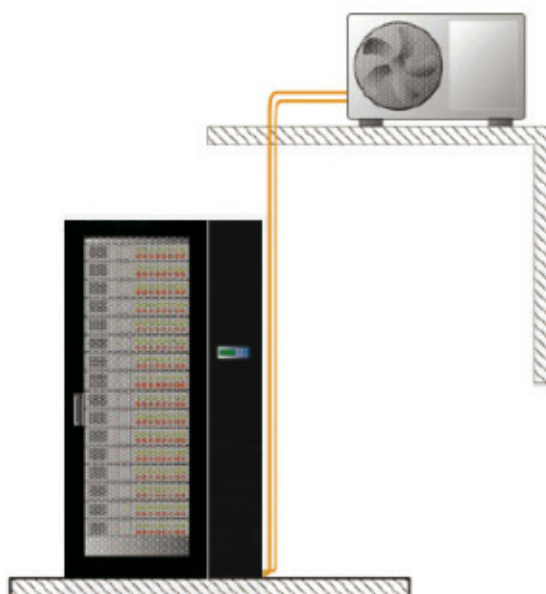
The advantages of VariCondition-DX
• Precise air conditioning
• Scalable capacity
• Raised floors not required
• Can be integrated perfectly in rack rows, cold and hot aisle containments
• Can deal with all usual airflow patterns

The VariCondition-DX system consists of an indoor and an outdoor unit. The indoor unit is placed inside the server room and linked to the outdoor unit using specialised cooling pipework. These pipes can be fitted to the indoor unit both on the top and bottom. This ensures high flexibility in the design of a room. The system can be applied in three different ways: closed loop, open loop and hybrid loop.
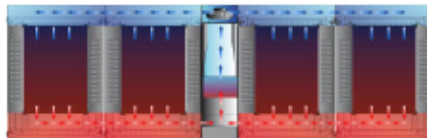
VariCondition outdoor unit
The compact VariCondition-DX outdoor unit uses an energy-efficient inverter-controlled compressor. The inverter compressor has a low inrush current which means you do not experience a peak demand on the network. The energy-efficient compressor adapts its frequency and thus the cooling capacity continuously, based on the actually required cooling capacity. This makes this solution much more efficient and ensures that there are no temperature fluctuations in your server room. Additionally, the VariCondition-DX outdoor unit makes use of the energy-efficient refrigerant R410A.

KNOWLEDGE AND EXPERIENCE
Minkels has amassed extensive knowledge and experience in implementing row based cooling in server rooms and data centres. Of course, we would be happy to help you make the right product and design choices. The Minkels sales and service team would be happy to help you! Please do not hesitate to contact us. You can find the contact details on the back side of this brochure.
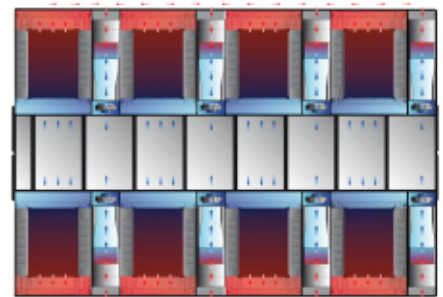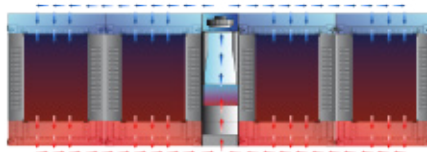
Closed loop solution

In a closed loop solution, the indoor unit's airflows are directly guided into the adjacent 19-inch racks. During this process, the indoor unit extracts the hot air directly from the IT-equipment and, as cold air, guides this back to the front. No exchange of air in the room in which the setup is located takes place. The system enables you to divide the cooling capacity over several racks.
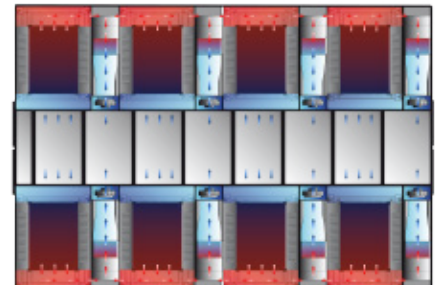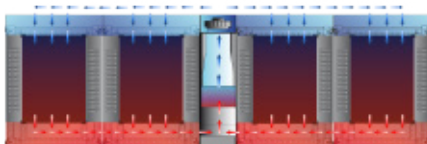

Open loop oplossing

In an open loop solution, the cooling air is brought directly into the room outside of the racks. The module extracts the hot air from the room (warm corridor) and, as cold air, guides this back to the front (cold corridor) of the cabinet. For an optimal result, it is advisable to apply the Minkels aisle containment system when using an open loop solution.

Hybrid 'Cold' loop solution

This solution is a combination of a closed and an open loop solution. The hot air is extracted from the cabinet in the same way as in a closed loop solution, so directly from the back of the rack. This hot air is cooled in the DX-module and presented at the front of the racks in the same way as in an open loop solution. In this configuration, too, the application of a Minkels aisle containment will lead to savings. In addition, it is possible to fully reverse the airflows. This will lead to a hybrid 'hot' loop solution.

POWER & CONNECTIVITY

Front and back tap-off boxes

Integration top of rack

Smart meter for total measurement

Redundant ring connection

Configurable tap-off box

Smart meter internal or external

Tap-off box is located on the center of the top of the rack
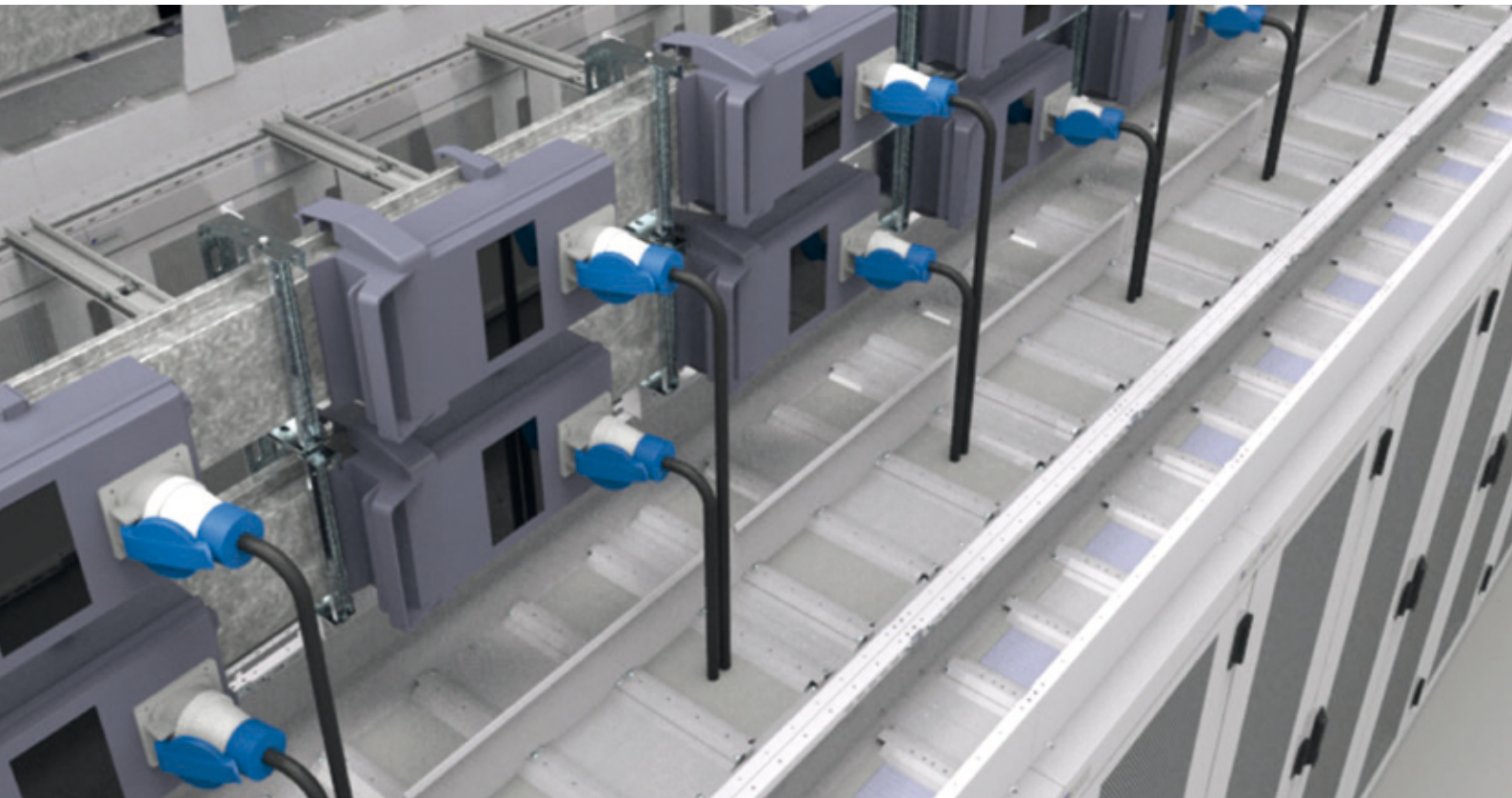
The ultimate scalable solution

Minkels has developed an innovative solution within its portfolio for power distribution: modular busbar systems with smart tap-off boxes, which can be flexibly configured in customer specific aisle containment layouts in data centres. Using the busbar system, data centres possess a power distribution infrastructure for capacities from 160 to 1000 ampere, available with aluminium conductors. The system can be used for both commercial data centres and corporate data centre environments. It is a safe and structured alternative to a power distribution using traditional cabling. The busbar can easily be upgraded when an existing installation must be expanded. It allows for a safe, simple and flexible planning and installation.

3.1 Busbar system

The busbar system is optimised to better fit the needs of the average data centre customer. The system has been adapted in such a way that placing the smart tap-off boxes on top of the rack in the middle is now possible. This makes the installation more organised and decreases the risk of human error. This sets the system apart from the current systems on the market, which only take into account the distance between the tap-off boxes and not their general position on top of the rack. This increases the risk of the power supply of an entire rack being cut off.

The capacity for connecting the tap-off boxes to the busbar has also been improved. Until recently most busbars only supported 5 connections per

3 metres. This would mean that in the case of one tap-off box per rack, all connection points would be occupied from day one, and expanding the tap-off boxes thus would not be possible. The new layout of the busbar provides support for a maximum of 10 connections per 3 metres: 5 at the front and 5 at the back. This leaves open the possibility of adding more power in the future or of carrying out further upgrades, all without leaving the IT-equipment with less power at their disposal.

INTEGRATION WITH THE NEXT GENERATION CORRIDOR
The busbar system with tap-off boxes is offered as a modular layer on top of the Next Generation Corridor. The most important advantage of this aisle containment system is that it is not only energy-efficient, but also modular. The modularity of the Next Generation Corridor –which is evident in even the smallest details of the system- means that the system for aisle containment can be adapted to suit needs of customers in data centre environments in a flexible and scalable manner, much like the busbar systems. Investments in busbars can be postponed until an expansion of the IT-equipment is actually needed; the busbar can then be expanded along with the IT-racks. In addition, the postponing of the busbar installation also means that there is more flexibility in choosing the correct busbar, and the choice can be based on the actual power demand. Thus it is also no longer necessary to specify the busbar type during the data centre construction, which could cause the services to be outdated when the IT-systems are expanded.

3.2 Archimod HE UPS
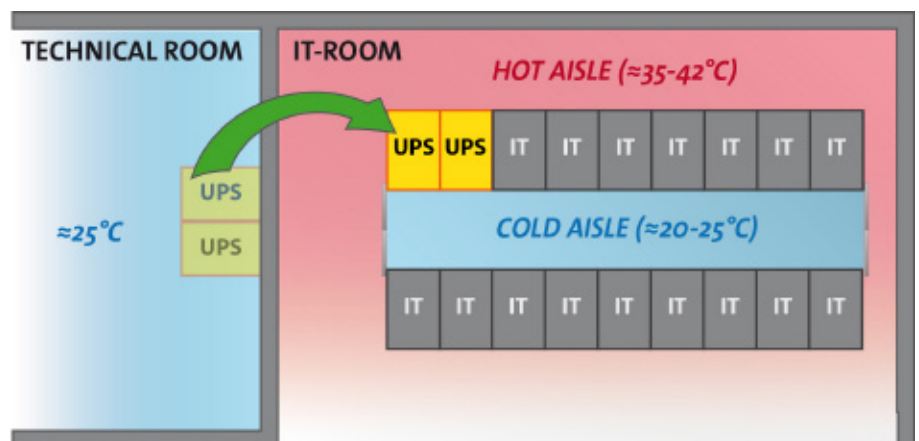
Modular
three-phase system
for 20 to 120 kVA

> The Archimod HE UPS system has a modularly constructed power capacity of 20 to 120 kVA and is intended for small and medium sized server rooms. The system was originally developed by Legrand, Minkels' mother company. Minkels has continued to develop the UPS into a specific system for data centres and converted it into an integrated total concept which is suited for data centres and server rooms.

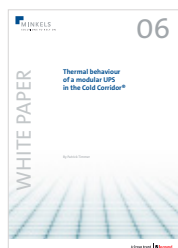**USE OF UPS IN DATA CENTRES**

The use of uninterruptable power supply (UPS) in rows within a cold corridor configuration in a server room, for example in-between data centre racks with hot and cold corridors, is considerably different from using an UPS in a normal technical room with a constant and limited temperature range. In data centres with cold corridors, the temperature can increase considerably, while the UPS's batteries cannot reach temperatures over 25 degrees Celsius. For this reason, Minkels' development department has adapted the UPS system and equipped it with 'cold zone protection'. The system is also fitted with a housing especially developed by Minkels for use in data centres, with which the system can be seamlessly integrated with other modular data centre systems by Minkels.

Minkels has conducted exploratory research in order to determine the exact usage conditions for the Archimod HE system in a cold aisle containment. For these exploratory thermal behaviour tests, Minkels built a test environment in its own server room, including a cold corridor configuration, with both hot and cold corridors and a simulated IT-workloads. Temperature sensors were installed on the batteries, which are essential components of any UPS system. Next, Minkels performed a number of tests. During these exploratory tests, a differing pressure levels between the hot and cold corridors were used. A difference of 2 Pascal was needed to create cold corridor conditions surrounding the UPS batteries and to keep the UPS' performance at the same level as when not placed in a cold corridor setup.

The results of the exploratory thermal behaviour test using the Archimod HE System have been incorporated in whitepaper 06 'UPS Thermal Behaviour Test'.

DOWNLOAD WHITEPAPER
Minkels has conducted exploratory research in order to determine the exact usage conditions for the Archimod HE system in a cold aisle containment. This thermal behaviour test was executed in a server room and the results have been incorporated in whitepaper 06 'UPS Thermal Behavior Test'. Whitepaper 06 is available for download at www.minkels.com/whitepaper.

1 CONTROL MODULE
This module has been equipped with a microprocessor and controls 3 power modules. When used together with a power expansion module, 6 power modules can be controlled, which increases the capacity from 20 to 40 kVA. The module contains a screen and a multifunctional keypad for monitoring the UPS's operational parameters and for configuring several functions. The module can be connected in parallel to other control modules and can be used in combination with power expansion modules. The front panel contains a backlit status indicator, which allows for immediate checking of the system's operational status and an RS 232 port to which a computer can be connected for carrying out maintenance work.

2 POWER MODULES
The power modules (nominal capacity 6,7 kVA) are very compact and easy to handle. They use a plug-in system hot swap system, which makes them quick to install and maintain. The modules work in parallel with all other present modules and thus ensure optimal system performance.

3 POWER EXPANSION MODULE
This module must be used in combination with the control module. The module increases the capacity from 20 to 40 kVA and can be used to establish individual redundancy on each phase.

4 BATTERY MODULES
Each module contains batteries which can be connected in series, forming separate strings. The compactness and functionality, of the single (plug-in) module make it easy to handle, and expansion operations are possible without any modification of the structure of the installed system.

5 DISTRIBUTION MODULE
This module is used to configure the UPS's distribution type (three phase/three phase, three phase/single phase, single phase/single phase or single phase/three phase). The module has I/O connection blocks, handling and protection devices, and connection possibilities for additional battery cabinets. The power supply can be configured on two separate input sources (main and backup).

6 CABLE ENTRY
Special sleeves enable entry and exit of the input and output cables. They are located at the top and bottom.

UPS WITH MODULAR ARCHITECTURE

The Archimod HE System is an expandable UPS with a modular structure, with has a capacity ranging from 20 to 120 kVA in a 19-inch rack. The system consists of a set of pre-installed standard components, which simplify and optimise the design and construction of infrastructures.

The innovative modular design of these UPS means that the available power can be optimised, the flexibility of the system can be increased and the total cost of ownership (TCO) can be reduced.

ADVANTAGES OF THE ARCHIMOD HE SYSTEM

• An efficiency of op to 96% when used in online double conversion
• Plug-in modules with a self-configuring plug & play system
• A power factor at the input which is close to 1
• Multiple I/O for the setting of multiple three phase/ single phase configurations, depending on needs

3.3 Power distribution units

Together with Legrand and sister company Raritan, Minkels offers basic and intelligent PDU's, which suit not just your wishes of today, but also your needs of tomorrow.
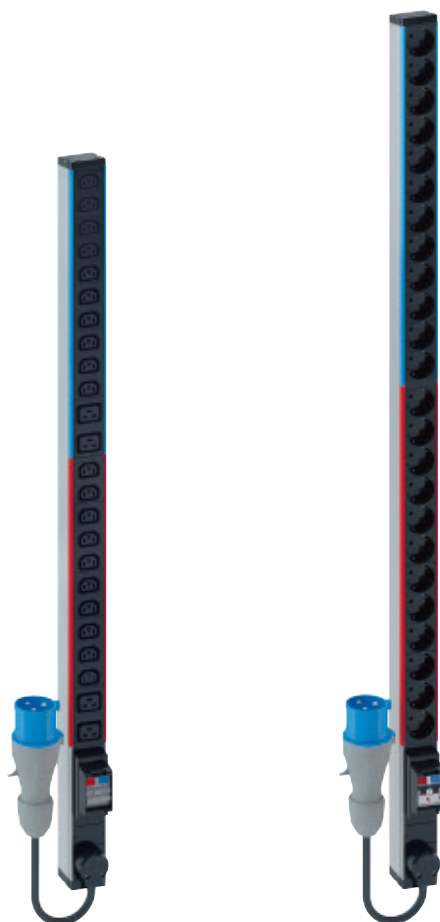
LEGRAND BASIC PDU'S

A number of the Legrand Basic PDU's are offered via the MInkels standard product catalogue. In order to provide our customers with maximum flexibility, the majority of the portfolio can be compiled using the configuration software. The model supports:

• Single phase- three phase connections with colour coding per phase
• 16 and 32A versions with pre-installed cable and hard wired version
• Fuses and breakers
• A choice between the most used outputs, such as SCHUKO, UTE, C13, C19, BS as well as the option of using several output types in one PDU
• 0 U vertical assembly

GENERAL FEATURES:
• Constructed in aluminium housing, high quality finish
• Completely modular, from simple 19-inch models to high density PDU's
• Furnishes all common passive PDU applications in data centres

legrand®

The platform can fit a number of interesting innovations:
• Rotating cable connection. Using this, the power cable can be twisted into any position desired without unnecessarily burdening the cable mechanically. This allows for the cable to be concealed in a very compact manner.
• A safety system prevents power plugs from unintentionally being removed from the connectors. In addition, it is possible to physically block a connection so that a cable cannot be wrongly connected.
• Ampere-meter which can be turned in order to simplify the readability in relation to the installation position in the rack.
• Surge protector which is replaceable, so that after a power surge the PDU can be easily made ready for use again.
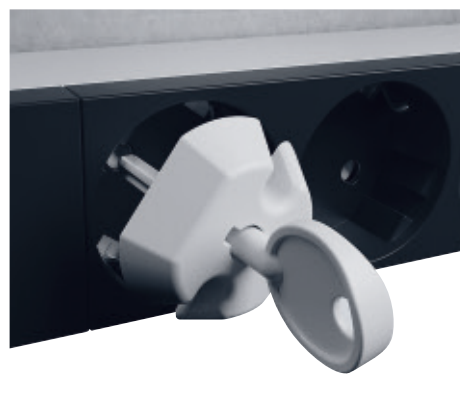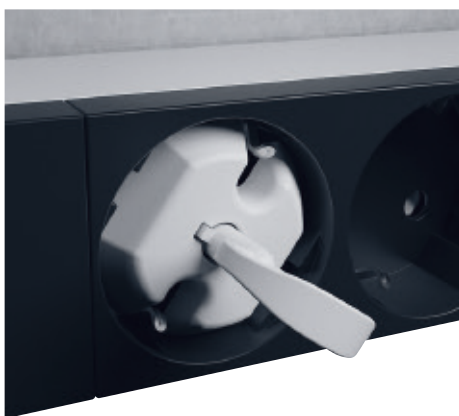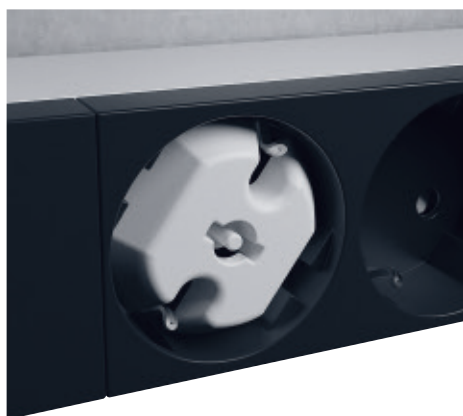
The ease of installation for these innovative 19-inch Basic PDU's is a major advantage. If the PDU is fitted horizontally, no tools or montage materials are needed. The PDU's are also easy to assemble vertically.

The power meter can be turned 90 degrees in order to guarantee the readability, no matter the assembly position (horizontal or vertical)

A safety system prevents the plugs from being pulled from the connectors unintentionally

Sealing caps are used to lock access to the PDU. A special key is needed to open them.

RARITAN INTELLIGENT PDU'S

The PXE-series by Raritan is an intelligent rack PDU which allows the user to read the power consumption at PDU and fuse level, both locally and remotely. A broad range of models are offered, which are shown in the Minkels standard product catalogue.

Additionally, the optional plug and play humidity and temperature sensors can be used to accurately measure the server cabinet surroundings. The user receives an alarm if freely adjustable values are exceeded, so that downtime can be avoided.

The rack PDU's can also be delivered as a fully integrated, pre-assembled solution in combination with other data centre and server room solutions by Minkels.

If you have any questions about our power solutions, please contact us. We would be happy to advise you. You can find the contact details on the back side of this brochure.

MONITORING

4.1 Environmental Monitoring System

Minkels monitoring systems are capable of monitoring the direct surroundings of your racks. The modular and efficient construction of the system makes it easy to check up on a single rack or an entire room. The systems can of course be integrated seamlessly and managed using your existing network management software.

A variety of products are available. The various versions feature different numbers of ports. We make a distinction here between intelligent ports and the so-called 'dry contact' ports. The intelligent ports are used e.g. for measuring temperature, humidity and air flows. The dry contact ports, on the other hand, are simple on/off switches where e.g. alerts can be read out from CRAC or UPS systems, or which can be used for door contacts.

Alerts
In the event of an emergency, the relevant people can be alerted in a variety of ways: by e-mail, text messaging, a web interface and SNMP. The monitoring system therefore allows you to always rest assured of the conditions in your computer and the control rooms.

Several products are available within the monitoring assortment. These products can be found in the Minkels standard catalogue:

www.minkels.com/downloads

MICRO DATA CENTRE

5.1 MatrixCube

Minkels micro data centre solutions are all about making ordering easy. Simplicity combined with reliability, efficiency and cost-effectiveness. The fully assembled solutions can be ordered through the Minkels standard catalogue. All solutions can of course be expanded upon with a number of options and accessories.

MATRIXCUBE
One of the Minkels micro data centre solutions is the MatrixCube. Minkels and Legrand have brought power distribution, cooling, housing and mechanical infrastructure together in a single solution. This turns the MatrixCube into a complete and compact server room. The MatrixCube does not depend on the room it is in and can be implemented at almost any location within a business. No radical modifications to the building are needed.

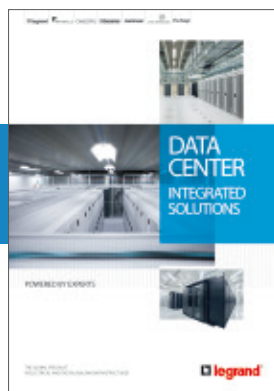# Ready-made, cost-efficient professional IT-infrastructure which can be ordered easily and quickly!

Power distribution rack
DX-cooler
Serverrack
Serverrack

DX-cooler
Power distribution rack
Serverrack
Serverrack

Back of matrix cube

Front of matrix cube

Legrand Data Centre Integrated Solutions
If you would like to know the possibilities for the data centre market offered by the Legrand Group as a whole,
consult the brochure 'Legrand Integrated Data Centre Solutions'

Building Infra
Minkels and Legrand know what works!
This brochure allows you to discover the
total solutions which Minkels and Legrand
can offer for your building-related IT
infrastructure.

Data Centre Integrated Solutions
Minkels and Legrand know what works!
This brochure allows you to discover what Minkels and Legrand
can mean for data centres specifically. Minkels focuses on the
'white space' – the heart of the data centre – and Legrand on
the 'technical space' with its building-related infrastructure.

Standard Product Catalogue
This catalogue provides details
on our entire product range:
total solutions for data centres
and building-related systems.
The standard products can be
delivered from stock.

Mass Customisation Brochure
You are now reading the Mass
Customisation Brochure. A mass
customised product is made
up of preconfigured blocks.
These building blocks ultimately
provide a modular and integrated
solution which matches your
requirements.

Minkels Magazine
Minkels issues the Minkels
Magazine twice a year.
The magazine is full of
interesting and relevant
customer cases, product
introductions and the latest
market trends.

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