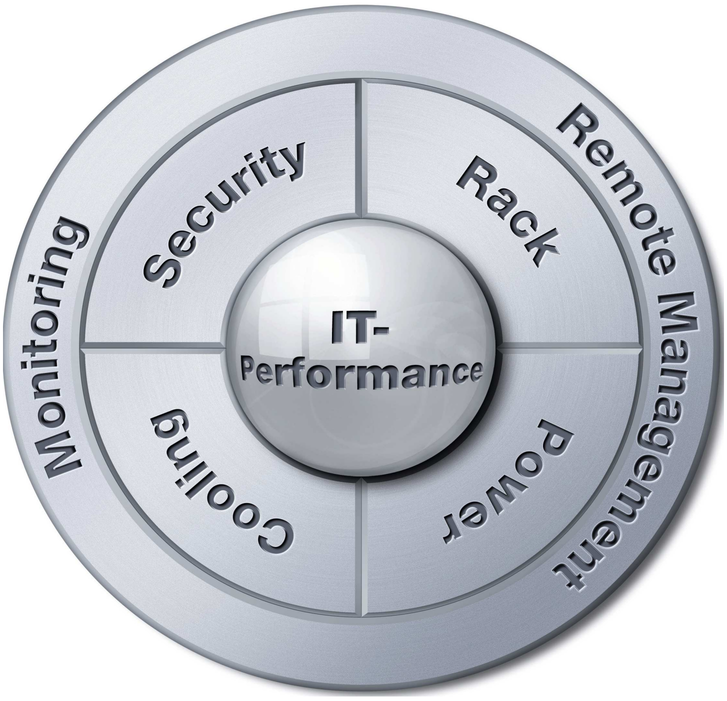
# Fire extinguisher systems in the data centre

**by Alexander Wickel**

White Paper 08



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## Contents

# 1 Abstract

In most enterprises, information and communication technology becomes more and more important.
Therefore, even small-scale fire damage can lead to disastrous complications there. Loss incurred by such fire damage can range from the loss of single data up to the failure of complete systems. Any failure of the SAP servers can, for example, cause the inability to write invoices. This would have very serious consequences for the whole enterprise.
In this regard, the existence of fire protection systems is very important to every enterprise and constitutes a precondition for an adequate insurance coverage.
The fire protection systems must be individually designed for this purpose, since there are different conditions in every data centre.
There are the following important influencing variables:

- Building properties and escape routes
- Ignition and fire loads
- Power supply
- Ventilation system
- Number of persons / frequency of visits of persons entering the data centre.

This document provides a brief overview of the operating principle of individual fire protection systems and their effects on the IT infrastructure of the data centre.

# 2 Three methods of a successful IT fire protection

Successful IT fire protection is characterized by three possibilities:

1. Early detection of fires
2. Fire fighting
3. Fire prevention

The interaction of all three philosophies allows a beneficial protection of the IT infrastructure against fire damage. The selection of fire alarm components, the fire extinguishing equipment to be used as well as further fire prevention measures depend on the use and the structural conditions.

# 3 Early detection of fires

By means of a highly sensitive, permanently active smoke extraction system, slightest and completely invisible sooty particles can be detected in a server rack at an early stage of a fire, i.e. as early as in the pyrolysis phase.
The air sucked in by the system is led to two independent fire sensors in the early fire detection system in order to exclude errors during the detection.
An optical "high sensity“ smoke detector for a pre-alarm (sensitivity: approximately 0.25 %/m light opacity[1]) as well as an optical smoke detector for the main alarm (sensitivity: approximately 3.5 %/m light opacity) are installed in an early fire detection system.
The systems are directly installed in the 19“ level of the enclosure, together with the associated pipework.
Early detection of fires is the basis of a successful fire protection concept and a very useful factor for prevention.
Such early detection allows the user of the data centre to take appropriate counter-measures to limit the scope of damage caused to the hardware and to avoid hardware failures.


**Illustration 1: Rittal/Lampertz Early Fire Detection (EFD)**

[1]Light opacity: The smoke density and the range of vision resulting from it
Light opacity 100%/m = 1m range of vision
Light opacity 3%/m = 33m range of vision
Light opacity 0.25%/m = 400m range of vision

**Possible counter-measures:**

The detected fire is reported by the early fire detection system to the central monitoring and administration station of the data centre.
This takes place via the floating relay contacts of the central building control systems or the RJ 12 slots of the Rittal Remote Control CMC TC®.
The CMC TC I/O Unit is directly connected to the early fire detection system and transfers its data to a Processing Unit II (PUII).
Up to 4 CMC I/O Units can be connected to the PUII. The Processing Unit II allows a SNMP (Single Network Management Protocol) -compatible transfer to the administration station of the data centre.
This ensures that several network elements, e.g. cooling devices of the server cabinets, can be monitored from a central station.

Special software allows the triggering of a "gentle" server shutdown in the case of fire now.
Now the RCCMD (Remote Control Command) software licence allows the data centre operator to perform some functions at the server cabinet in emergency situations.
A possibility would, for example, be the following order of activities:

1. Storage of the cache contents on the hard disk.
2. Storage of the current state of all open data files.
3. Finishing all applications in a proper manner.
4. Performance of any commands stored in the background (e.g. running a backup, saving the database.)
5. Performance of a proper system termination and a gentle shutdown of the servers.
6. Disconnection of the uninterruptible power supply (UPS).

Every server requires its own RCCMD shutdown licence.

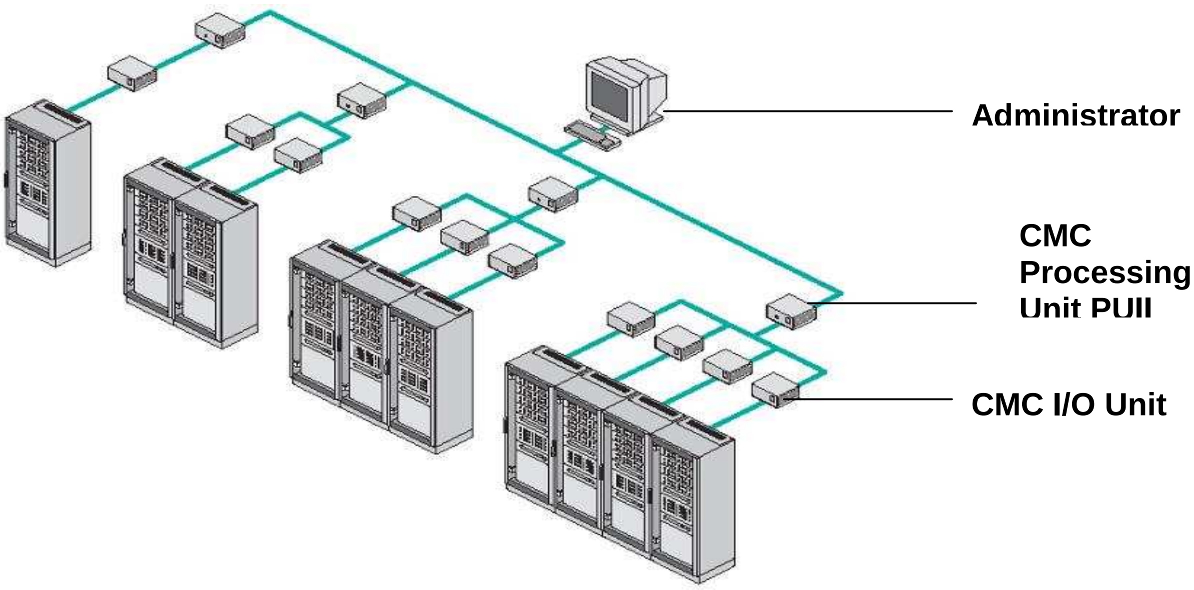


**Illustration 2: CMC monitoring system**

[1]SNMP: Network transfer protocol for the transmission of data
[2] RCCMD: Most frequently used software for shutting down computers in networks secured by UPS

By means of a sequential network/server shutdown, the energy which would be required for inducing another fire is removed from the hardware components.
The last step comprises the manual disconnection of the electric power supply which, in the case of fire, ensures an immediate de-energization of the relevant components if a "gentle" solution is no longer possible.
Although this measure causes the immediate failure of the data centre, it protects the entire building from further fires, since short circuits can no longer occur.
Afterwards the protected area can be flooded with the extinguishing gas.

## Fire detection: Aisle containment

The cold aisle containment as well as the hot aisle containment is a combination of door and ceiling elements allowing a consistent separation of the warm and cold air in the data centre.
This separation is an elementary one. Its purpose is to save energy and to increase the efficiency of the available air-conditioning technology.
This containment does not cause a fire load increase in a data centre, since real glass is used.

A data centre equipped with fire sensors below the ceiling might get problems with the fire detection in any aisle containment.
If a fire breaks out in the containment, it will be detected only after a delay time has elapsed, since the ceiling element constitutes a barrier for the sensors.
The problem is solved by means of installing the fire sensors below the ceiling element of the aisle containment.
Now the fire sensors monitor the entire aisle and report any possible fire without delay.
Furthermore, one also installs an extinguishing nozzle in the contained aisle to ensure that any fire will be extinguished in this aisle, as well. This is realized by means of leading the extinguishing nozzle from the ceiling into the containment.

**Illustration 3: Aisle containment**

**Illustration 4: Smoke detector**

# 4 Fire fighting with water

A very cost-effective fire fighting version is the water-based sprinkler solution. In this case, the sprinklers are installed below the ceiling of the protected room and are connected by water conduits. The sprinklers contain a glass ampoule with liquid which expands in case of heating up. The glass ampoule breaks up. Usually the tripping temperature of the sprinklers is 30℃ higher than the room temperature to be expected (60°C - 70°C). Water comes out of the nozzles. By means of the check valve, the other sprinklers recognize a pressure loss in the conduit and flood the room with water, as well. When the fire is extinguished, the open sprinklers are to be replaced with new ones so that the system is operational again.

Sprinkler systems are often used in the USA and are primarily intended for the protection of the building structure. They are a cost-effective alternative to other extinguisher systems.

Consequential damages arising from any water-based fire extinction are the major disadvantage of sprinkler systems. The complete hardware structure of a data centre could be destroyed in this way. Complete failures occur, since water is an electrically conductive substance.

This leads to short circuits which have considerably negative effects on the installed servers. The servers are destroyed in this way. Failures of the applications are often even more detrimental than the physical loss of the servers.

The data centre cannot be quickly re-commissioned after any fire extinction with water, since the water discharged from the sprinkler system must be removed from the entire room, apart from maintenance and repair of the damaged devices. To avoid the aforesaid, fire fighting on the basis of gas is applied.

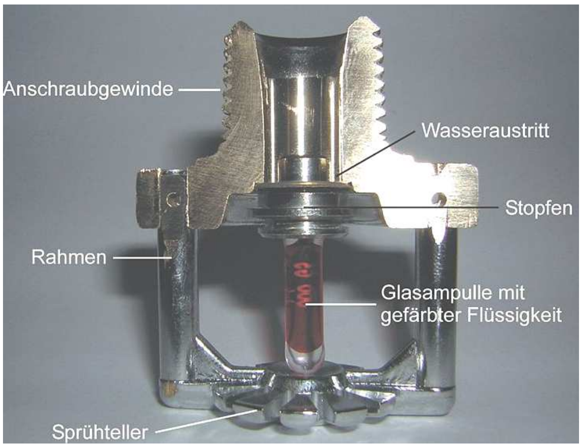


**Illustration 5: Sprinkler**

# 5 Fire fighting with gas

The effective, residue-free extinction by means of several extinguishing gases allows fire fighting in a well-directed manner where the fire occurs.
An extinction induced by a fire requires that the fire is detected by two independent sensors. In this way, the risk of an erroneous extinction is reduced.
If the two sensors of the early fire detection system recognize an abnormal light opacity value (soot), the upcoming extinction will be indicated by an audible (pre-) alarm and triggered within a few seconds (10s), and the protected area will be flooded.
Several gases come into question for this purpose. Every gas has its advantages and disadvantages.

## Comparison of fire-extinguishing gases

### Synthetic extinguishing gases

Synthetic extinguishing gases require less storage space. In most cases, the extinguishing agent containers are integrated in a 19“ system. They are neither electrically conductive nor corrosive. Damage due to short circuit cannot occur with regard to these extinguishing gases.
A quick release of the extinguishing agent (≤10s) must be guaranteed, since otherwise dangerous hydrofluoric acid developing a caustic effect might form.
Such quick release of the extinguishing agent can only be ensured by short pipework as well as by means of storing the extinguishing agent close to the object to be protected. The quick release of the extinguishing gas causes a pressure increase. Therefore, pressure relief flaps opening automatically in case of overpressure and relieving the protected area in this manner must be installed in the protected area.
The synthetic extinguishing gases fight the fire which has occurred in two ways.
With regard to the <u>physical aspect</u>, the molecules of the gas withdraw thermal energy from the fire. Therefore, the fire slows down.
With regard to the <u>chemical aspect,</u> the molecules split up due to this absorption of energy, and they directly bind the oxygen onto themselves. Thus, the combustion process which has occurred is interrupted.

| Comparison of fire-extinguishing gases | | | | |
|---|---|---|---|---|
| | Novec 1230 | FM-200 | Inert gases (Argon, Aragonite, Inergen, Azotes) | $CO_2$ |
| Abidance in the flooded room (in case of faulty activation or fire the area always must be left) | unlimited possible | unlimited possible | temporary possible | not possible |
| Concentration for flooding (including 10 % fill- and extraction tolerances) | 5,8% | 8,4% | 45…50,5% | 47…57% |
| Residual oxygen | 19,6% | 19,1% | 11,4…10,3% | $CO_2$ is toxic at >8 vol.-% |
| VDS-Approval | yes | yes | yes | yes |
| FM-Approval | yes | yes | constricted | yes |
| Fumigation in the fire-extinguish area | no fumigation | low fumigation | low fumigation | high fumigation |
| Lead time according to VDS | min. 10 sec | min. 10 sec | min. 10 sec | min. 10 sec |
| Lead time according to BGI | not necessary | not necessary | necessary | necessary |
| Time for effusion | max. 10 sec | max. 10 sec | 60 to 120 sec | 60 sec |
| Condensate formation on the pipes (after release) | no | no | yes | yes |
| Multi area system | limited possible | limited possible | possible | possible |
| Maximum pipe length | around 60m | around 60m | >> 150m | up to 150m |
| Danger for human | No | No | Yes | yes |
| Relation for over pressure relief | 100% | 115% | 240…300% | 280…360% |
| Required space for supply | low | low | high | middle |
| Environmental impact | very good | bad | good | very good |
| **Evaluation** | good procurement expensive | acceptable procurement expensive | conditionally operational procurement favourably priced | insufficient effect fatal |

**Illustration 6: Comparison of fire-extinguishing gases**

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Legend: VDS: Association of loss or damage insurers
FM: Factory Mutual (American industrial property insurance)

## FM200™

FM200™ is a trademark of Great Lakes Chemical™.
It is tasteless and inodorous.
It is used all over the world and is, therefore, one of the best examined synthetic extinguishing gases. Its use in rooms occupied by persons is regarded as harmless.
Due to the high loading pressure (50 bar), longer pipe distances can be covered and multirange systems can be reached.
FM200™ does not harm the ozone layer, but it increases the global warming. This gas is subject to the regulations of the Kyoto Protocol for the reduction of greenhouse gases. It has already been prohibited as extinguishing agent in Austria, Switzerland and Denmark.
Germany continues to permit its use as extinguishing agent without restriction.

## Novec 1230™

Novec 1230™ is a brand of 3M Cooperation™.
It is an environmentally friendly chemical extinguishing gas and is degraded in the atmosphere within 5 days after its discharge. It is regarded as relatively future-proof, since it is neither harmful to the ozone layer nor does it increase the global warming.
The Novac 1230™ extinguisher system is a very space-saving version. It can be compactly stored like water at room temperature (approximately 20°C). However, it enters the extinguishing area in a gaseous state through the nozzles, and it extinguishes fire without remains.
Air swirls are necessary in the enclosed extinguishing area, since
Novec 1230™ is heavier than air (13.6kg/m$^3$) and, thus, quickly sinks to the ground. There are sufficient air swirls in most cases, since the installed components alone circulate sufficient air. As an option, special swirl fans must be installed.
The vapour pressure of Novec 1230™ is ten times less than that of FM 200™. This leads to a lower density in the piping system and an increased pressure drop in the extinguishing agent container, at the valve and in every metre of pipe. Therefore, a Novec 1230™ extinguisher system and its pipework must be planned very carefully.
This extinguisher system is very well suited for the use in smaller systems (extinction of individual racks), e.g. in the Rittal/Lampertz Det AC version up to a 3m$^3$ protection volume. With regard to larger protected areas, its use in a master-slave application is also possible. In this case, up to 4 slave units can be connected to one master unit. The master unit detects the fire and triggers the extinction, and the slave units only store the extinguishing agent.
In large multirange systems, a Novac 1230™ solution is rather unsuitable, since the procurement / refill of the extinguishing gas is very expensive.

## Inert gases

Fire extinction by means of so-called inert gases [argon (Ar), nitrogen ($N_2$), carbon dioxide ($CO_2$)] occurs by displacement of the oxygen of the air in the seat of fire. If the $O_2$ value for the combustion drops below a specific value, the fire "quenches" abruptly. The fire extinguishes at an air oxygen concentration of less than 13.8vol.-%[1]. To extinguish a fire, the existing air volume must be displaced by one third which corresponds to an extinguishing gas concentration of 34vol.-%.

Inert gases are often used for the fire extinction in rooms. The protected area is larger and a higher amount of extinguishing gas must be calculated. In this case, the cheaper inert gases come into question, rather than the cost-intensive synthetic gases.

Due to the high availability, the extinction with inert gases is a very cost-effective solution, since a quick refill can be carried out almost everywhere.

### Carbon dioxide ($CO_2$)

$CO_2$ is stored in large low-pressure tanks (cost-effective from 2000 kg up) at –20°C. A weighing device for the refill as well as the continuous cooling of the tank must be provided for.

Depending on the required amount, it is also stored in high-pressure tanks at a pressure of approximately 60 bar.

Carbon dioxide has the best tested extinguishing effect of all inert gases, but it requires special safety measures if its concentration exceeds 5vol.-%.

It is considerably heavier than air and, thus, quickly sinks to the ground. Air swirls are required for extinguishing fire thoroughly.

After the flooding with $CO_2$ a slight smoke screen and a temperature decrease occur in the extinguishing area. Thus, highly sensitive components might get damaged.

$CO_2$ extinguisher systems are often used in engine rooms of vessels, hazardous material warehouses and silos.

$CO_2$ is rarely used in data centres, since data centres are frequently entered by people for maintenance and installation work. People must not be endangered.

**Important!** $CO_2$ is a breathing poison and always deadly in high concentrations.

**Illustration 7: $CO_2$ gas pressure system**

[1]percent by volume: (abbreviation: vol.-%) designates the measure for the proportion of a substance in a mixture, in relation to the volume.

## Nitrogen ($N_2$)

Nitrogen is a colourless, inodorous and tasteless gas. It is included in the atmosphere at 78.1vol.-%.
Nitrogen is stored in high-pressure bottles at 300 bar.
After the flooding, the cooling of the protected area sets in. This is to be attributed to the expansion process of the gas. This could have a negative effect on sensitive equipment, and condensate formation could also occur.
$N_2$ has the best extinguishing effect of all inert gases, after $CO_2$. Nitrogen disperses very homogeneously in the protected area where a fire is to be extinguished, since its density is similar to that of air. Thus, it is universally applicable.
In the case of any flooding, nitrogen forms - together with oxygen - a mixture which is harmless for the respiratory tracts.
The high-pressure bottles can be refilled quickly and cost-effectively.

**Illustration 8: Group of extinguishing gas bottles, nitrogen**

## Argon (Ar)

Argon is an inert gas extracted from the ambient air, and is included in the atmosphere at 0.93vol.-%.
Thus, apart from nitrogen, argon is the most environmentally friendly extinguishing gas, since it does not harm the atmosphere.
It is stored in a gaseous and compressed state in high-pressure bottles. A maximum working pressure of 300 bar can be reached in this case. Argon can be compactly placed in a central extinguishing agent station, since no weighing device is required as in the case of $CO_2$. Ar is, similar to Novac 1230$^{TM}$, heavier than the ambient air and, thus, quickly sinks to the ground. A homogeneous distribution of the extinguishing gas requires the creation of swirls.
Argon is not toxic.
During the discharge of Ar no formation of condensation mist takes place. Quick and cost-effective refill, similar to that of nitrogen, is possible. The cooling of the protected area by argon is not to be expected, as in the case of nitrogen. However, in the case of flooding, slight personal injury can occur, since the flooding with argon might lead to a lack of oxygen.

**Illustration 9: IT safety space with extinguisher system**

# 6 Extinguishing fire in racks

The rack extinguisher system is installed at the top in the 19"-level of the enclosure, together with the associated pipework. The reason for this type of installation is the specific property of the extinguishing gas which is heavier than air and, thus, quickly sinks to the ground.
The extinguisher system only functions in enclosed server cabinets and constitutes an independent, compact unit which is able to detect and extinguish fires.

**Ranges of application**
The rack extinguisher system is used for the protection of high quality technical equipment which must be highly available at all costs.
Such equipment comprises:
**- EDP, server and network technology**
ensuring that the data relevant to the company process are continuously made available. Furthermore, the data flow must be ensured.
**- production control systems**
the technical equipment of the aforementioned systems ensures that the production processes run without interruption
**- telecommunication devices**
ensuring that the communication of the company functions without interruption
**- electric power supply and control systems**
ensuring that sufficient electric energy is supplied to the right place in the company in due time

## Setup of the 19“ rack extinguisher system Rittal/Lampertz Det AC Plus ®

1. extinguishing agent container with level monitoring, overpressure safety device and el. triggering device.
2. propellant gas cartridge
3. extinguishing nozzle
4. fire sensors, (2-stage diffused light system)
   - optical smoke detector „high sensity“ for pre-alarm (sensitivity: approximately 0.25 %/m light opacity)
   - optical smoke detector for main alarm (sensitivity: approximately 3.5 %/m light opacity)
5. suction fan
6. connections for suction and exhaust air pipe
7. emergency power supply (batteries, 4h bridging time)
8. mainboard
9. power supply unit
10. front panel with display and control panel
11. detector interface
12. filter, air flow monitoring

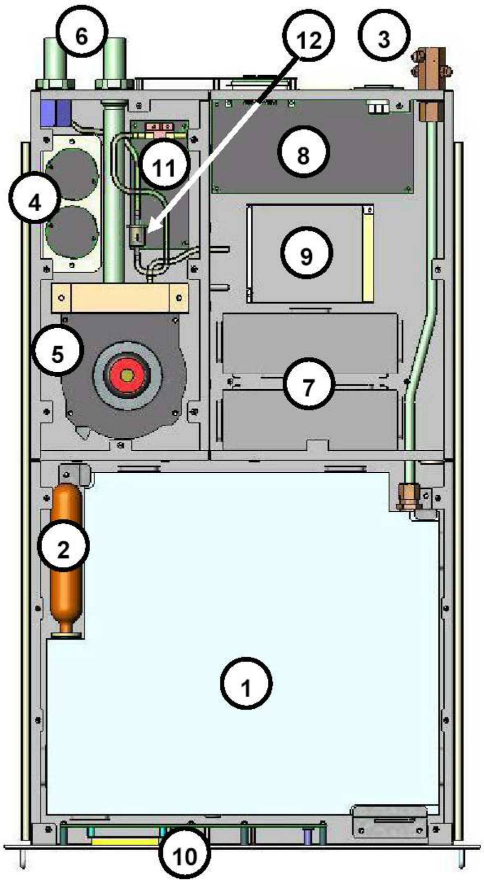


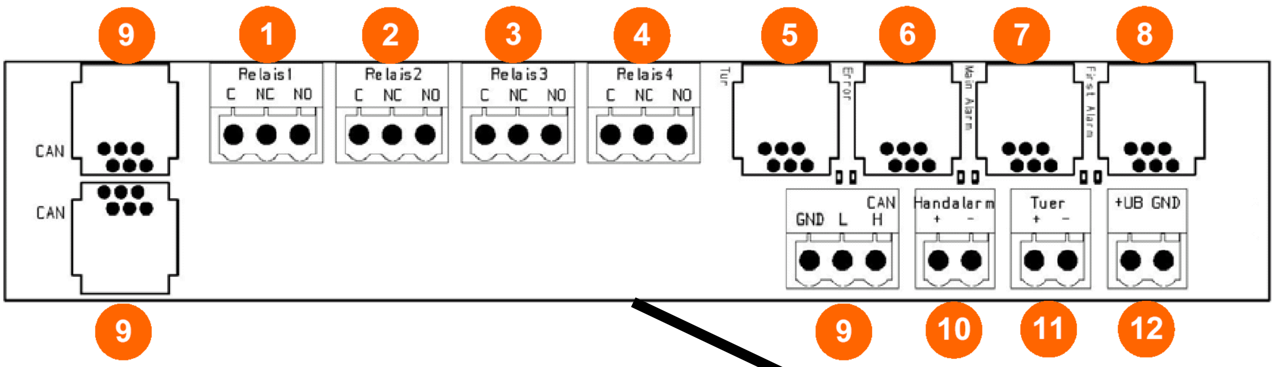

**Illustration 10:**

**Det AC setup, source: assembly instructions**

## Function

By means of a pipe system, a fan (5) continuously aspirates air samples from the monitoring area (6) and guides them via the fire sensors (4).
The sensors are permanently monitored by the electronic evaluation unit and the control electronics (8) for functional performance and possible dirt accumulation.
Upon reaching the first fire alarm criterion, the electronic evaluation unit controls the operational sequence programmed for this case:
It indicates the alarm state on the indication display (10), induces the transmission to superordinate systems if applicable, and activates optional, audible and optical alarming devices.
Upon reaching the second alarm criterion, after expiration of a preset analysis time, the triggering device (2) is electrically activated as a result of which the propellant gas cartridge (2) is opened and the propellant flows into the extinguishing agent container (1).
The propellant presses the extinguishing agent through an extinguishing pipe to the extinguishing nozzle (3). The extinguishing agent vaporizes at this nozzle and builds up the extinguishing agent concentration required for extinguishing the fire in the extinguishing area.
The extinguishing agent container is secured against overpressure.

## Illustration: 19“ rack extinguisher system, rear side




1. relay output "pre-alarm“
2. relay output "fire alarm“
3. relay output "extinguishing“
4. relay output "composite error“
5. RJ12 connection to Rittal CMC I/O Unit (door contact 1
6. RJ12 connection to Rittal CMC I/O Unit (malfunction),
7. RJ12 connection to Rittal CMC I/O Unit (main alarm) – forced server deactivation is possible
8. RJ12 connection to Rittal CMC I/O Unit (pre-alarm),
9. still without function -

   is intended for future applications
10. connector, manual triggering
11. door contact plug 2
12. external voltage supply (UB)

**Important**
If CMC TC is connected, the relay
outputs of the central building control systems may not be assigned.
CMC is able to send the information of the extinguisher system directly via SNMP to the central monitoring / administration unit of the data centre.

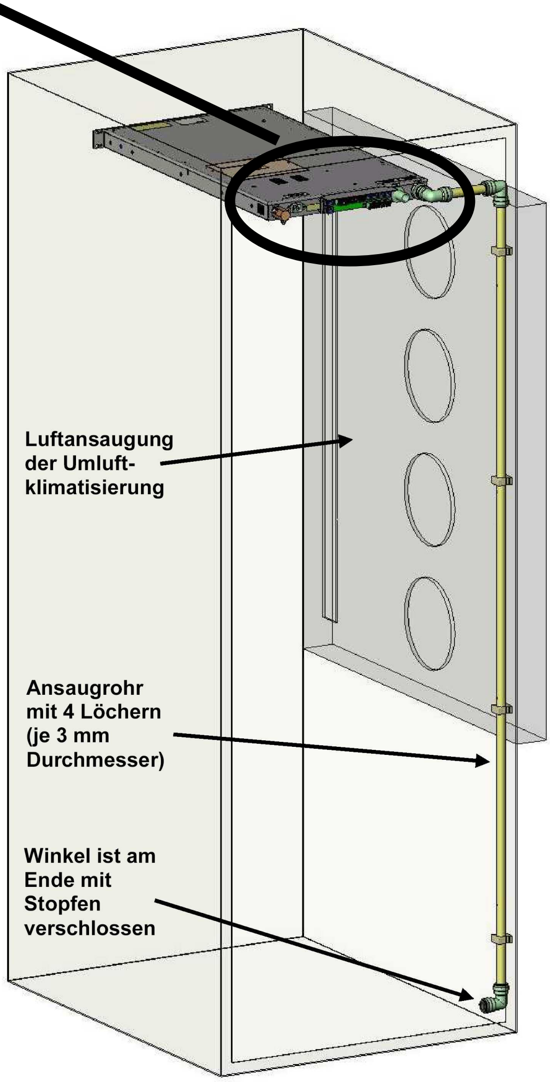



**Illustration 11: Installation of the suction pipe**[1]

[1] ***(with accessories in the scope of delivery),*** **in case of installation on the right side. Suction bore holes are to be directed against the air flow.**

# 7 Extinguishing fire in rooms

In a data centre with a low-density area with a power loss of 2 to 5 kW and with a mid-density area with a thermal power loss of up to 10 kW, the air-conditioning systems and double bottoms are usually cooled with recirculating air. Normally, perforated front doors are used there in racks so that the cool air from the cold aisle can flow into the rack.
The room extinguisher system is exactly designed with regard to its individual components. This also includes the stockpiling of extinguishing agent which will mostly be differently dimensioned, depending on the size of the data centre. Normally, the extinguishing gas will be stored in groups of high-pressure gas bottles outside the protected area.
The pipework is connected to the extinguishing gas bottles via an electrovalve. The extinguishing gas bottles lead the extinguishing gas into the protected area. The pipes as well as the outlet nozzles are installed below the ceiling of the data centre.
If the early fire detection system detects a fire, it sends optical and audible signals to indicate the upcoming fire extinction in the protected area
Within a delay time of 10 seconds, the extinguishing gas is released from the high-pressure bottles, and can flow into the protected area.
In this way, it can unproblematically enter the rack interior through the perforated front door, and extinguish the fire which has occurred.

In a high-density area with power losses between 10 and 30 kW, the room extinguisher system must be designed differently.
In this area, cooling takes place by means of water heat exchangers. This cooling philosophy requires a solid server enclosure directly connected to the heat exchanger.
An automatic door opening device must open the enclosure in the case of fire so that the extinguishing gas can enter the enclosure interior.

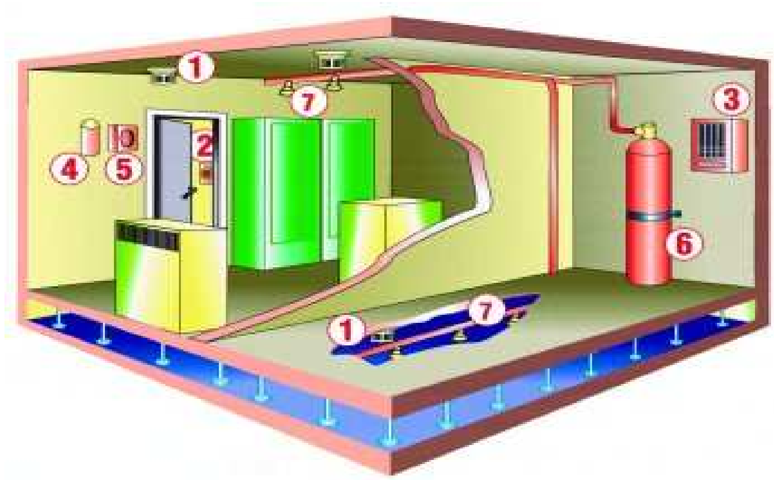



**Illustration 12: Data centre with room extinguisher system**

Upon recognition of a fire by the automatic detectors **(1)** or upon activation of a manual alarm **(2)**, the alarming devices (**4 audible and 5 optical**) are triggered via the central fire alarm system **(3).** After expiration of a specific delay time **(10 seconds)** the extinguishing agent bottle **(6)** is electrically opened and the extinguishing gas flows through extinguishing nozzles **(7)** into the room.

# 8 Automatic door opening device

The common sizes of extinguishing areas comprise fire extinction in individual racks, multirange fire extinction as well as fire extinction in rooms.
A closed system is required for multirange fire extinction and fire extinction in individual racks. The extinguisher system has already been integrated into the 19“-level of the enclosure here. The doors must be closed so that the rack can be flooded.
Existing data centres are very often equipped with an already existing room extinguisher system. If a rack-based "high-density" cooling system (LCP family) is used in closed cabinet systems, the extinguishing gas will be unable to enter the rack interior in the case of any activated room extinction.
The closed inspection door and the high IP degree of protection do not allow the extinguishing gas to enter the cabinet interior.
As soon as a fire is detected in an enclosure / protected area, the relevant server rack door (ideally the front and rear door) must automatically spring open so that the extinguishing gas can enter the rack. This is called sequential detection and general extinction, since every server cabinet is equipped with an own fire sensor.
The CMC system can also activate individual racks which open individually.
Beyond that, the door opening can be regarded as emergency cooling. In the case of any malfunction of the rack-based cooling (e.g. failure of the water supply), the internal temperatures of the cabinet can increase very quickly while the servers are running (in case of a power loss of 15 kW, from 20°C to 32°C within 90 s.). Due to the open door, the internal heat generated in the rack can disperse in a larger area and colder ambient air can flow into the rack.
The automatic door opening device and the aisle width in the data centre must be exactly designed in advance, since otherwise considerable escape route restrictions could occur, if the enclosure doors open in emergency situations.

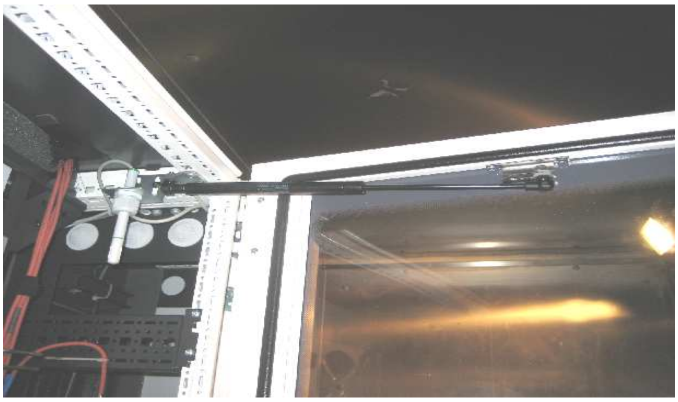


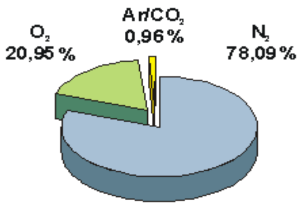
**Illustration 13: Automatic door opening device (compression spring)**

# 9 Fire prevention by oxygen reduction

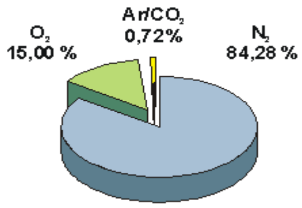
Fire prevention is the last step in a fire-protected IT area.
Three things are absolutely necessary for the occurrence of a fire.

1. heat
2. oxygen
3. combustible

In the case of this procedure, the oxygen content in a data centre is permanently minimized by supplying nitrogen.
If the oxygen content decreases, the flammability of the materials in a data centre will be reduced, as well. The normal air oxygen content is 20.95vol.-% and reaches a value of ≤ 15vol.-% due to the fire prevention measure. In this situation, the surrounding conditions have been established so that no fire can occur anymore.




Composition of normal atmosphere




Composition of atmosphere with reduced oxygen content

**Illustration 14: Composition of air**

The major problem of this type of fire prevention is to ensure that personnel can safely enter the protected area, as well.
Special attention must be paid to the aforesaid, since otherwise complications might possibly arise.
Apart from that, the time period is long until the desired reduced oxygen content is reached, since it takes a long time for the system to reduce the desired oxygen content to 15.0vol.-% in a large protected area.
A healthy person (without known heart, circulation, airway and vascular problems) can stay without any problems in an area with an air oxygen content ranging between 20.9vol.-% and ≥ 17.0vol.-%.
Persons who have undergone a work-related preventive medical checkup can stay in areas with an air oxygen content ranging between <17.0vol.-% and ≥ 13.0vol.-%.
Staying in areas with reduced oxygen content below 17.0vol.-% is possible for 4 hours and below 15.0vol.-% for 2 hours. Staying in areas with the oxygen content being lower than the aforementioned is very risky and harmful to health.

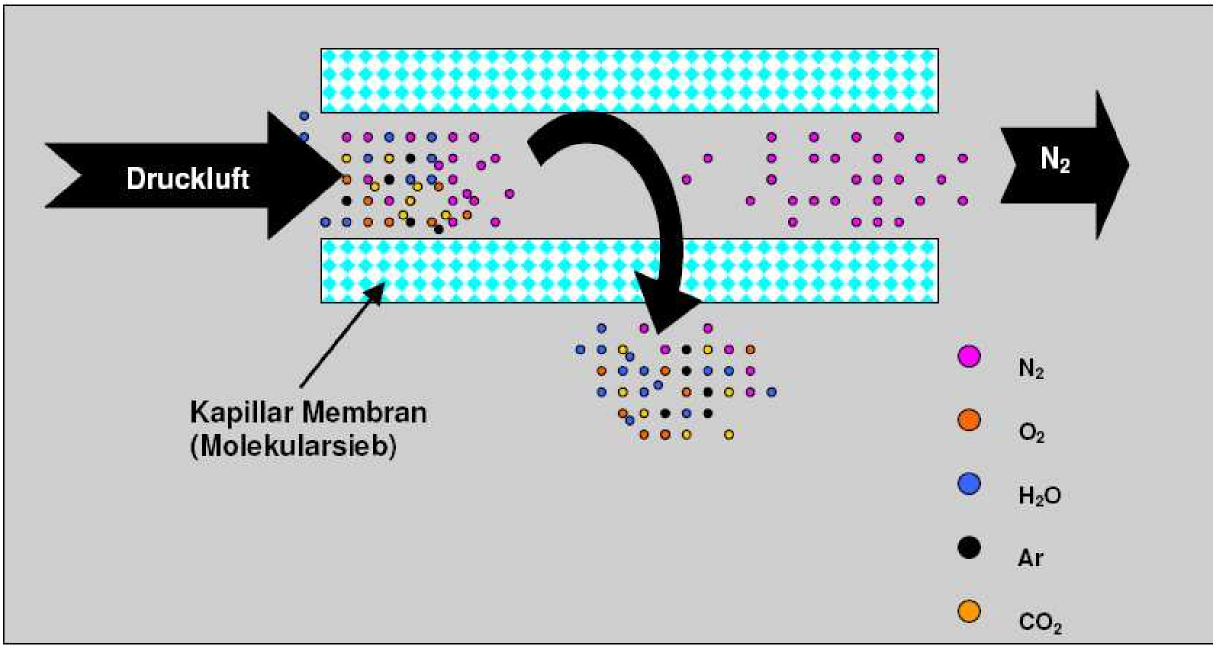



**Illustration 15: Physical principle of the fire prevention system**

## Operating principle

Surrounding air flows into an air compressor. The air compressor leads the pressurized air into the nitrogen generator where the air is split up into its constituents. In the nitrogen generator, there is a molecular sieve filtering individual air particles ($O_2$,$H_2O$,Ar,$CO_2$) out. The $N_2$ passes by the capillary membrane and can flow into the protected area in this manner. The nitrogen content slowly increases and the oxygen content is reduced to ≤15vol.-%. A control range is determined (approximately 0.4vol.-%) in which the $O_2$ value can deviate from the absolute minimum. The fire prevention system operates in this range.

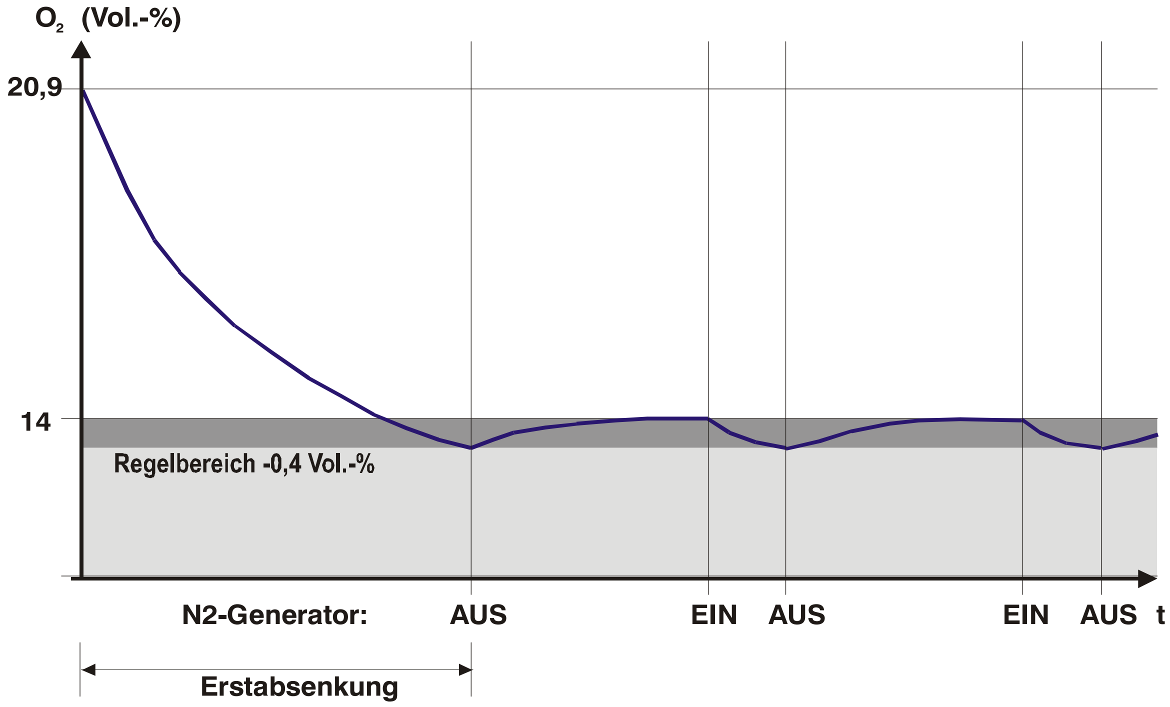



**Illustration 16: Oxygen regulation with regard to Oxy Reduct ®[1]**

A fire prevention system must be designed similarly to a fire fighting system. Many parameters play a crucial role in the fire prevention concept.
During the planning of the fire prevention system one has to bear in mind that the protected room requires a very high outside tightness so that not surrounding air can subsequently flow in and, thus, the O2 content would increase.
Access to the protected area through a security gate is recommendable for the fire prevention system. It regulates the frequency of visits of persons to the data centre and minimizes the ingress of outside air.

[1]Oxy Reduct: is the fire prevention system made by Wagner

# 10 Summary

Complete protection against fire is never possible, but you can do a lot of things to keep the risk as low as possible.
Apart from the aforementioned issues of fire detection, fire fighting as well as fire prevention, there are some other possibilities of limiting the risk, as well.

1. Information signs stating emergency procedures should always be prominently displayed in the data centre.
2. The alarm system should always consist of multistage alarms (pre-alarm, main alarm).
3. All electrical components must be easily accessible to ensure troublefree maintenance.
4. Every exit should be provided with emergency telephone numbers.
5. The data centre area is a non-smoking area.
6. Waste should be removed from the data centre area.

The issue of fire fighting in the data centre is a complex topic.
For this reason, the solutions must be thoroughly reviewed in advance, and an exact project design of the individual fire fighting components must be carried out.
To establish a safe and maybe also highly available data centre nowadays, strong partners ensuring best possible, comprehensive support from planning until realization are required.
Only in this way can it be ensured that all described risks and influence factors will be taken into consideration right from the start, and a need-based protection of the IT structures, in consideration of the circumstances and budgetary limits, will be possible.

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# Index of illustrations