Next-generation sprinkler system that protects life and property from fires and water leaks

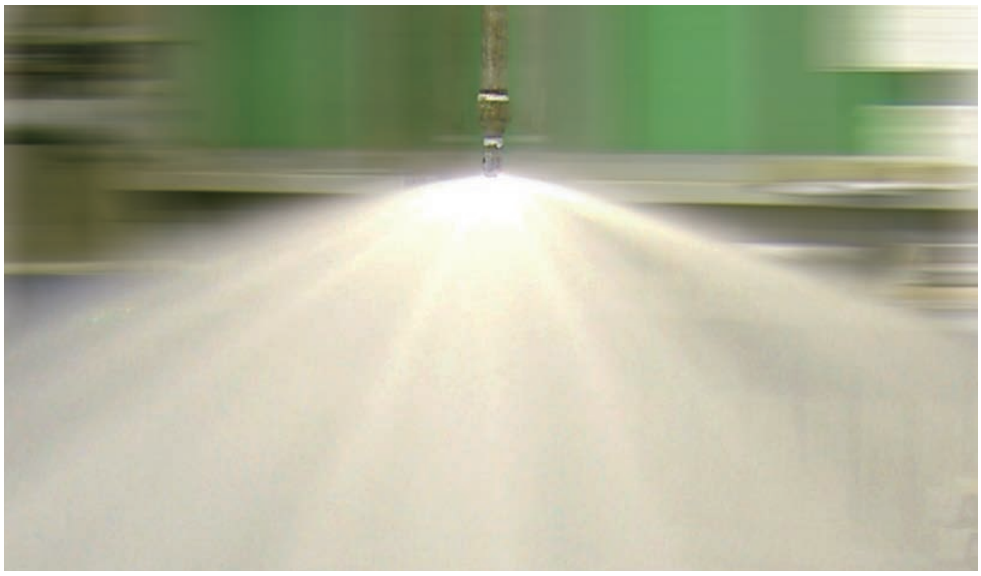
Vacuum Sprinkler System

Disadvantages of conventional sprinklers

Pressurized water and related piping has been the cause of many cases of water damage due to leaks.

Water damage caused by pressurized water

The most common type of sprinkler systems currently used are wet pipe systems. Wet pipe sprinkler systems discharge large amounts of pressurized water from the sprinkler heads in response to heat from fire in order to extinguish fires.

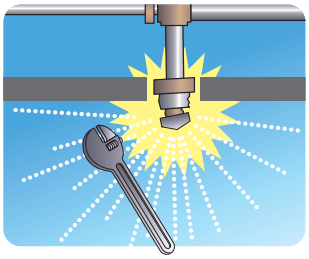


However, these wet pipe sprinkler systems can cause accidental release of large amounts of pressurized water when not needed to extinguish a fire.
This significant amount of water leakage causes serious water damage.

Water damage cause 1 : Broken sprinkler heads

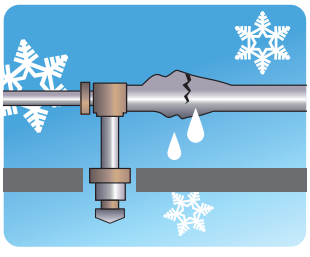
Causes of water damage

Subjected to impact



Sprinkler heads may be subjected to impact during renovations or other construction, or when carrying in and out.
This results in the entire floor being flooded with water.

Freezing



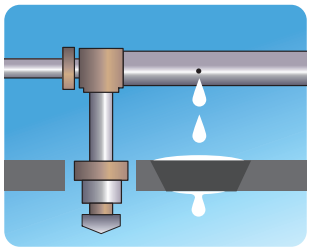
Common damage type in cold climates. Pipes and heads can be damaged due to the freezing and expansion of the water in the pipes resulting in water leaks and damage after the ice melts.

Countless number of water damage cases

Conventional wet pipe sprinkler systems prone to water leakage account for over 90% of the installations in buildings and facilities in Japan.

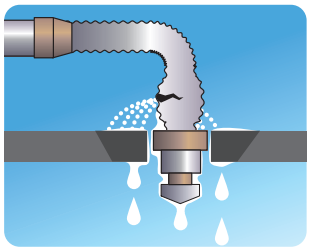
Water damage cause 2 : Deterioration and breakage of old pipes

Pinholes



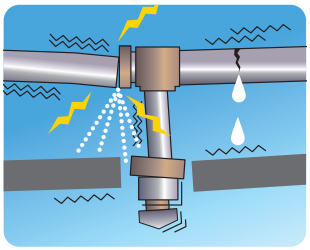
Water leaks from small holes that open in pipes due to deterioration and corrosion. This type of damage is caused from the inside and so cannot be detected from the appearance.

Abnormal pressure



Changes in ambient temperature can cause water in pipes to repeatedly expand and contract, which can cause flexible areas to rupture and leak.

Earthquakes



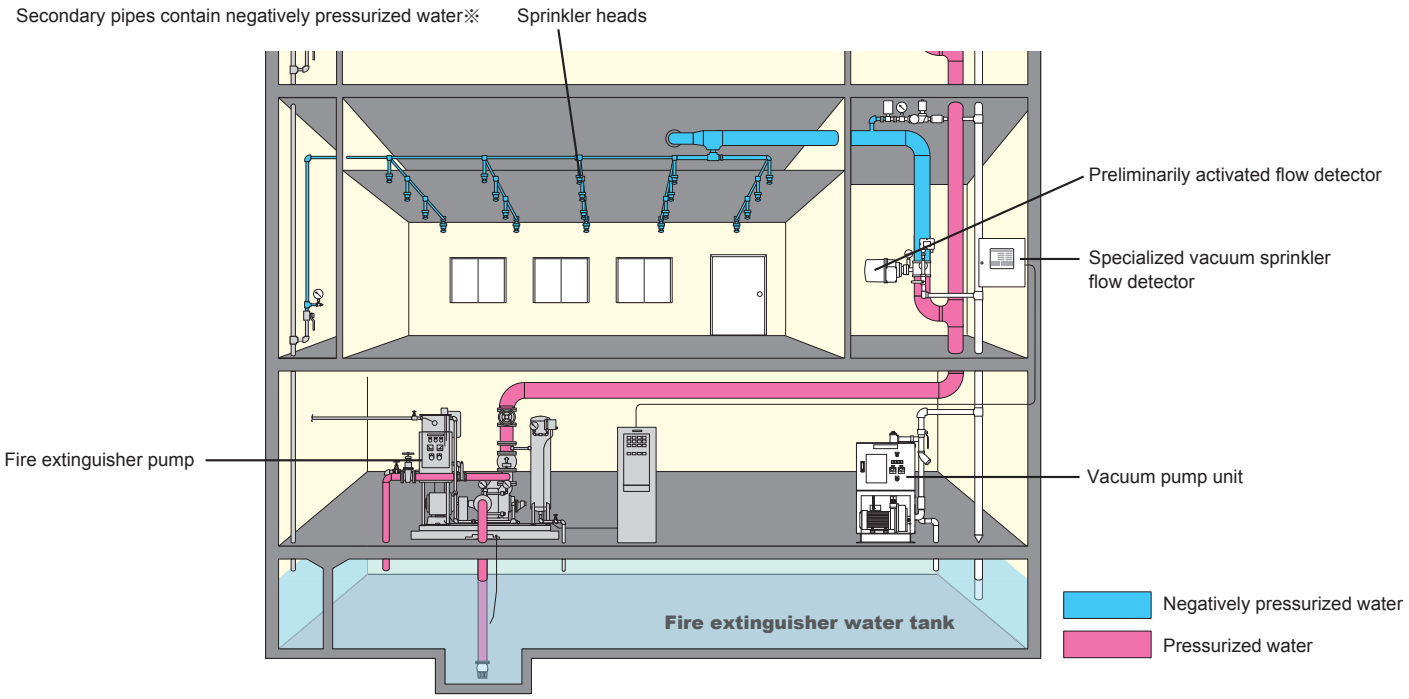
There are many reported cases of fire pumps automatically operating and releasing large amounts of pressurized water due to the rupture of pipes caused by earthquakes and tremors.

Revolutionary system that does not cause water leaks

Our vacuum sprinkler system prevents water leaks by using a negative-pressure system to keep water at pressures lower than atmospheric pressure

Brief description of the vacuum sprinkler system

The pressure of water in pipes is at a negative pressure lower than atmospheric pressure, which prevents water from leaking even when pipes rupture or break. Instead, this revolutionary sprinkler system actually suctions surrounding air when there are ruptures and breaks in pipes.

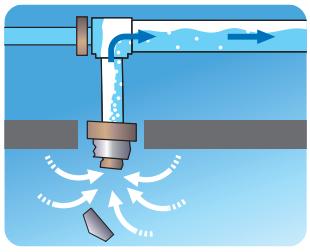


When a fire occurs, the valve body of the preliminarily activated flow detector opens to apply the positive pressure on the primary side to the negative pressure on the secondary side. The negatively pressurized water in the secondary piping becomes positively pressurized.
At this point, the sprinkler heads operate and discharge water to begin extinguishing the fire.

Water leaks prevented by negatively pressurized water

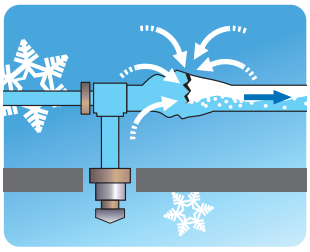
Prevents water leaks even when sprinkler heads are damaged

Subjected to impact



If heads fall off, air is suctioned instead of water leaking.
This also enables broken heads to be easily replaced.

Frozen pipes

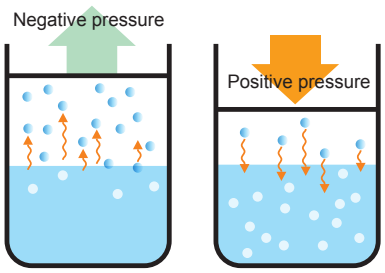


This system cannot prevent water from freezing, but water will not leak from ruptures caused by frozen water after it melts. Instead, air will be suctioned.

Other indirect benefits of this system

Corrosion prevention

This vacuum sprinkler system prevents corrosion and related pinholes from developing in pipes, which extends the service life of facilities and thereby significantly reducing total costs.



With conventional sprinkler systems, air trapped in pipes is compressed by the pressurized water resulting in dissolved oxygen.
The concentration of this dissolved oxygen increases in proportion to the amount of pressure. Eventually, this dissolved oxygen corrodes the pipes.

With the vacuum sprinkler system, the pressure of water in pipes is less than that of atmospheric pressure. This actually produces an effect of removing the dissolved oxygen in the water.
As a result, pipes are protected from corrosion, which extends the service life of the system.
(Application of Henry's Law)

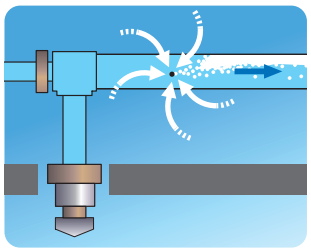
Henry's Law: "The amount of a given gas that dissolves in a given type and volume of liquid is directly proportional to the partial pressure of that gas. " (Dictionary of Biological Terms)

Received the Ojuhosho Award

The capability to prevent water leaking from sprinklers when sprinkler heads or pipes break during the Great East Japan Earthquake was highly recognized and well-received.
The developers of the vacuum sprinkler system received the 2011 Ministry of Education, Culture, Sports, Science and Technology Award and the 2012 Ojuhosho (Yellow Ribbon for Industriousness).

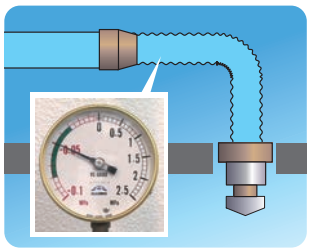
Prevents water leaks even if pipes deteriorate and rupture

Pinholes



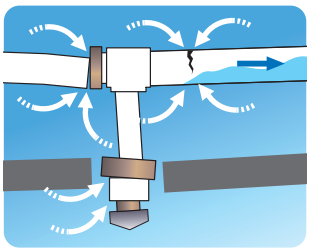
Air is suctioned when pinholes develop. This is detected and causes an alarm to sound. This feature is not available in other sprinkler systems.

Situations of abnormal pressure do not occur.



Situations of abnormal pressure do not occur as the system is monitored by the negative pressure.

Earthquakes



The vacuum pump automatically operates when a pipe is damaged to reduce the amount of water loss.

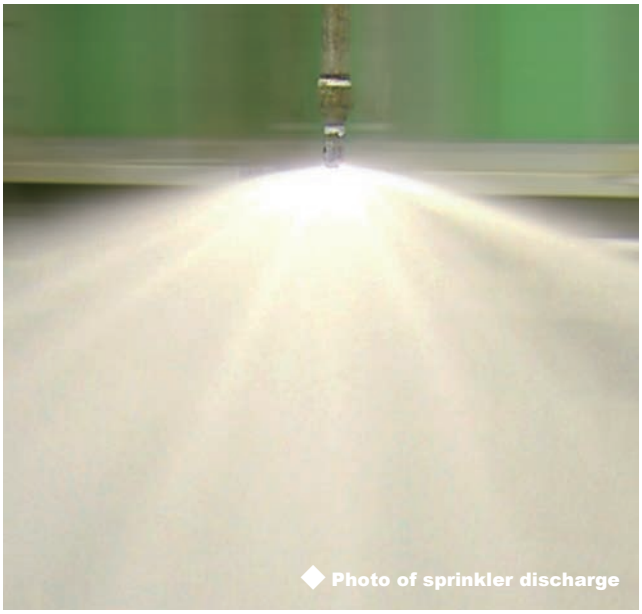
Vacuum Sprinkler Features

Next-generation vacuum sprinkler systems are revolutionary in that water is only released during a fire.

Sudden discharge of water from fire-extinguishing facilities (*Note) in hospitals, hotels, laboratories, intelligent buildings and others should never happen.
Though various preliminarily activated sprinkler systems have been developed to deal with this issue, none of these have been successfully able to fully resolve it.
Next-generation vacuum sprinkler system is truly revolutionary in that water is only released during a fire.

Prevents water damage

This system prevents water leaks caused by failures in the secondary piping.



◆ Photo of sprinkler discharge

◆ Enlarged photo of damage to flexible area

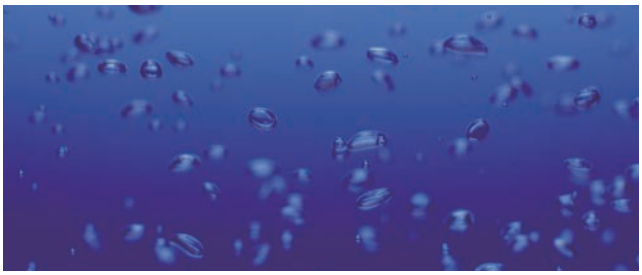
Causes of sudden water discharge (*Note) (untimely discharge)

■**Heads**：Damage from carrying in and out or during renovations, damage from freezing water in cold climates, damage caused by earthquakes, damage caused by abnormal pressure due to increased temperatures

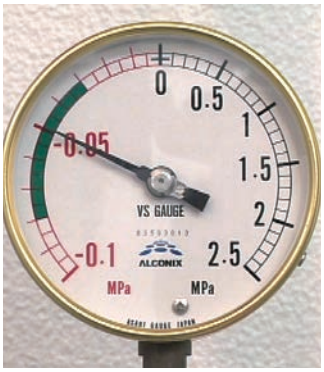
■**Pipes**：Pinholes caused by deterioration and corrosion

Prevents corrosion in secondary pipes

Dissolved oxygen and oxidizing gases are removed via the negative pressure, which helps prevent corrosion of the secondary piping.

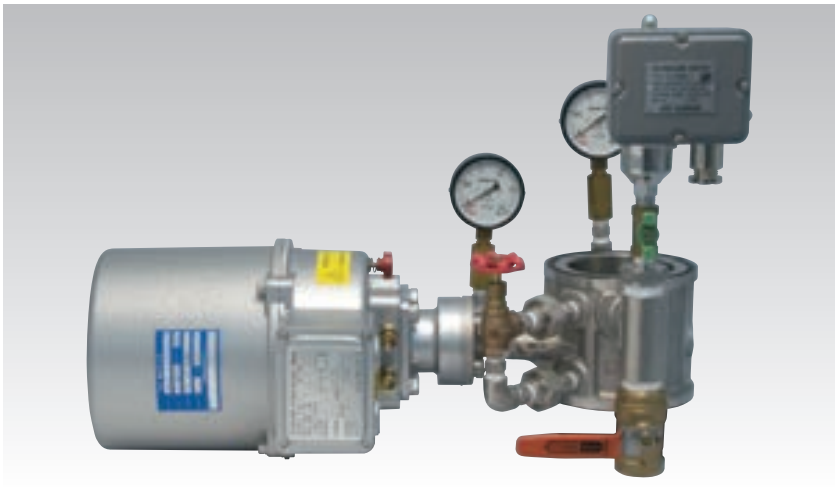


Prevents abnormal pressures in the secondary pipes



The temperature of water in pipes located in the top-floor ceiling rises abnormally during the summer.
As a result, water expands and creates abnormal pressure, which may cause pipes and machinery to rupture or break.
As global warming continues to worsen, the risk of damage caused by abnormal pressure will also increase.
Abnormal pressure cannot occur with the vacuum sprinkler system as the secondary pressure is constantly monitored and regulated to a maximum of -0.03 Mpa.

The water flow detector has excellent reliability



Light and compact	**A butterfly valve is used to reduce both weight and size as well as significantly shorten operation time.**
Minimal pressure loss	**The butterfly valve also reduces pressure loss.**
Can be manually operated	**The manual release button can be used during power outages or other emergencies to open the valve.**
Erroneous operation prevention	**Complex valve operation has been replaced with a simple arrangement of surrounding piping to eliminate erroneous operation.**
Improved operational reliability	**The required number of pipes has been minimized to eliminate the occurrence of operational failures due to clogging.**
Resistant to corrosion	**Stainless steel has been used in the valve body and surrounding piping to achieve excellent anti-corrosion properties.**

Reduces fire insurance premiums

Installing a vacuum sprinkler system further reduces fire insurance premiums.

*We will work with designated insurance companies on your behalf.

Ideal for renovation projects

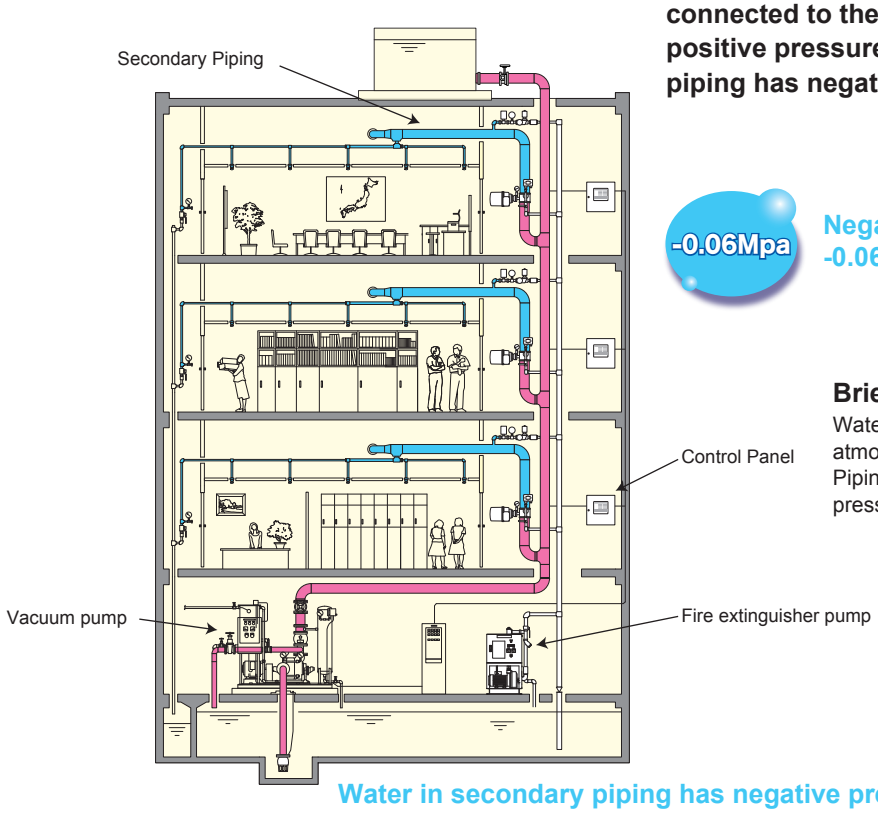
Refer to pages 5 and 6.

Comparison of conventional and our new systems

System Comparison

▶Vacuum Sprinkler (utilizing negative pressure)

As with conventional systems, the water in piping connected to the flow detector on the primary side has positive pressure, but the water in the secondary piping has negative pressure.



-0.06Mpa

Negatively pressurized water
-0.06 Mpa

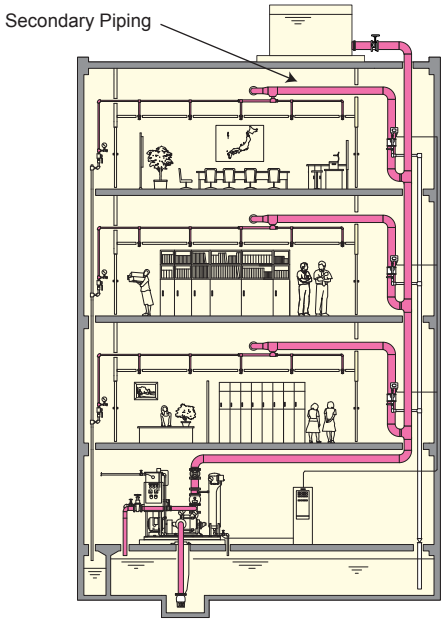
Brief description of negative pressure:
Water that is at a state of pressure that is less than the atmospheric pressure.
Piping is filled with negatively pressurized water at pressures between -0.05 to -0.08 Mpa.

Water in secondary piping has negative pressure

▶Conventional sprinkler system (utilizing positive pressure)

Water in both primary and secondary piping connected to the flow detector has positive pressure.

Wet Pip Sprinkler System

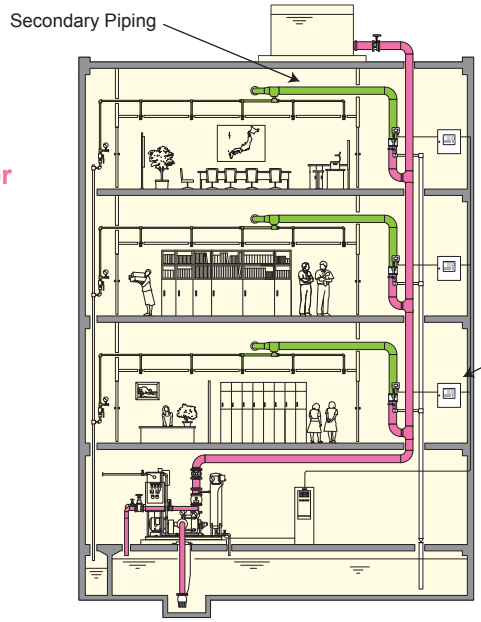


1.0Mpa

Pressurized water
1.0 Mpa

Water in secondary piping has positive pressure

Preliminarily Activated Dry Pipe Sprinkler System



0.3Mpa

Pressurized Air
0.3 Mpa

Air in secondary piping has positive pressure

Vacuum Sprinkler Equipment Layout Diagram

1～6 The Vacuum Sprinkler SystemTM comprises the following main components labeled 1-6

1 Specialized preliminarily activated flow detector for vacuum sprinklers

- Fire Extinguishing Pump Approval Number 20-14, Diameter of 80 mm
- Fire Extinguishing Pump Approval Number 20-1, Diameter of 100 mm
- Fire Extinguishing Pump Approval Number 21-12, Diameter of 125 mm
- Fire Extinguishing Pump Approval Number 20-15, Diameter of 150 mm

2 High pressure vacuum switch

Vital pressure switch that opens and closes the orifice magnetic valve

3 VS gauge

Gauge with excellent display of negative pressure values at 25 times the precision of positive values

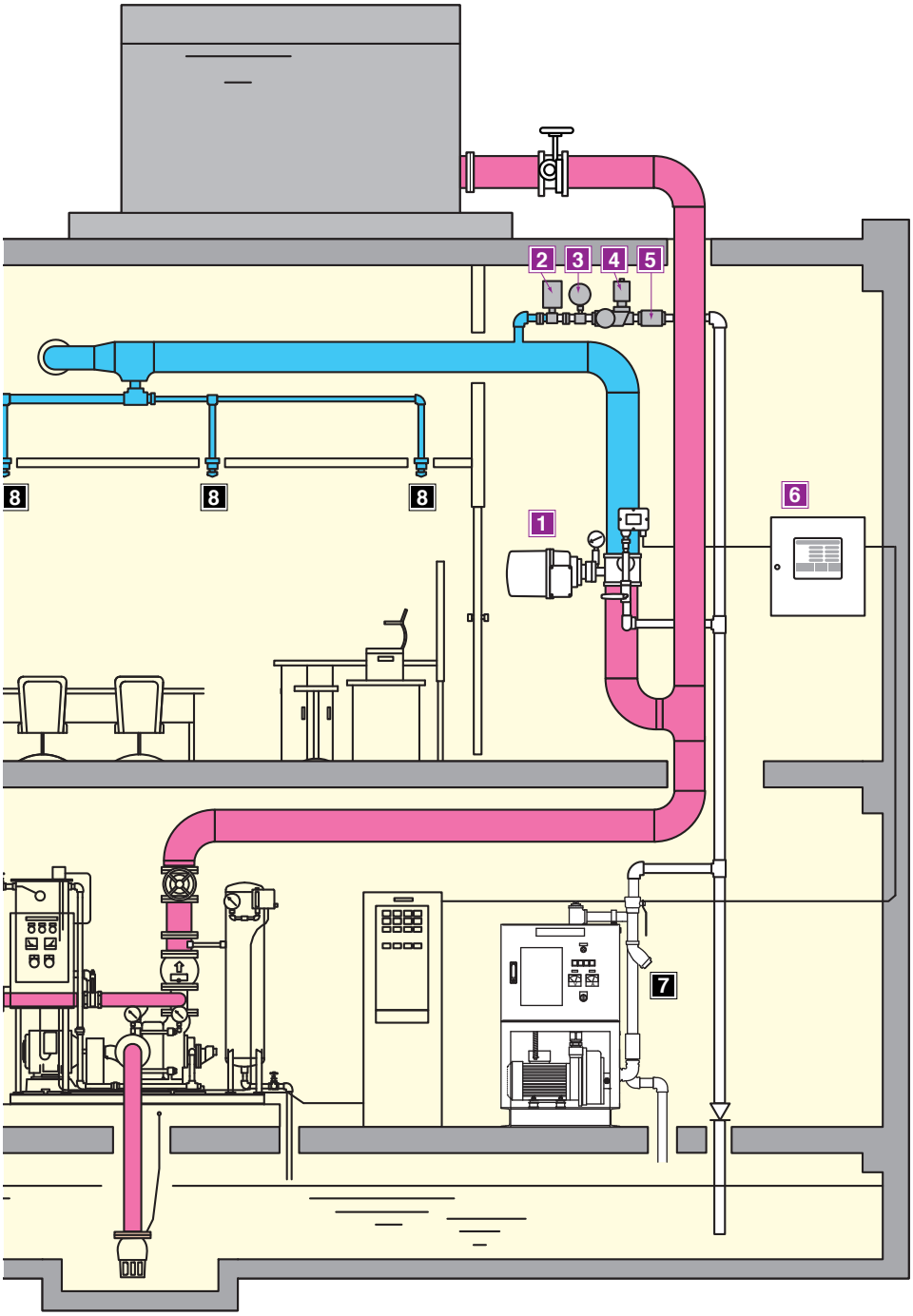
4 Orifice magnetic valve

This valve uses a 2-mm hole to control the negative pressure

5 VS chuck

Chuck that provides excellent prevention of water and air backflow

The vacuum sprinkler system is sold as a complete system. Refer to the pricing sheet for more information.



6 Vacuum sprinkler control panel

7 Vacuum pump unit

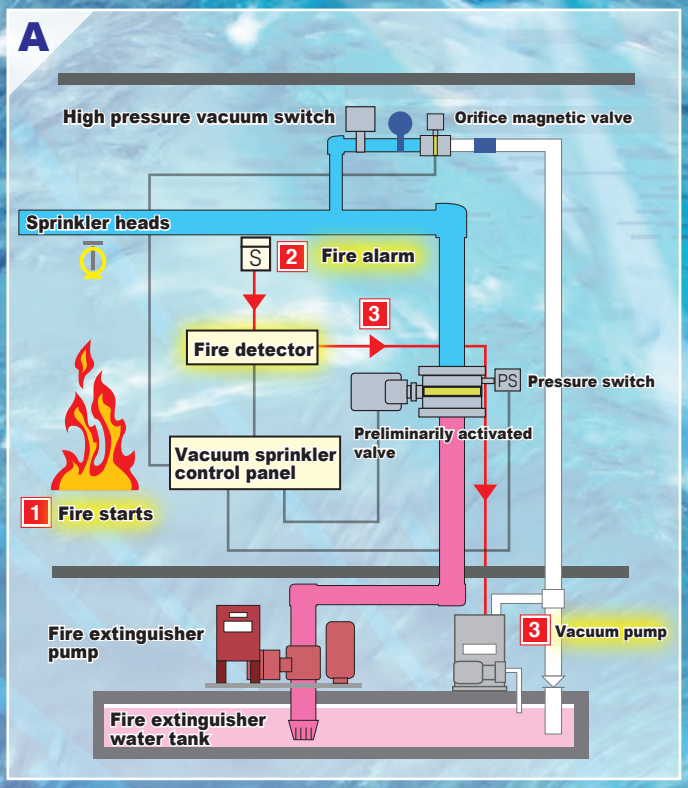
8 Sprinkler heads

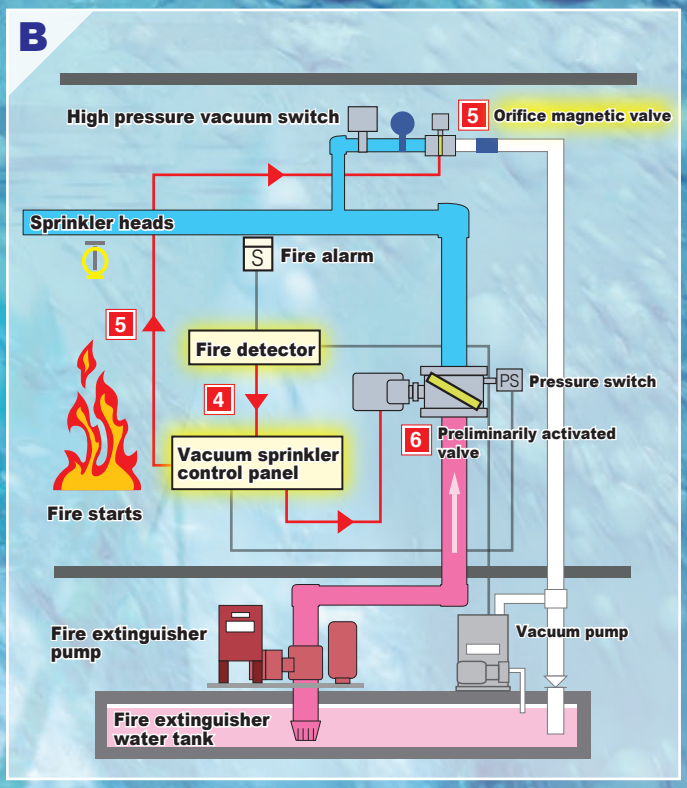
Be sure to use heads recommended for use with vacuum systems.

Negatively pressurized water

Pressurized water

Process Flow during Fires





1 Fire starts

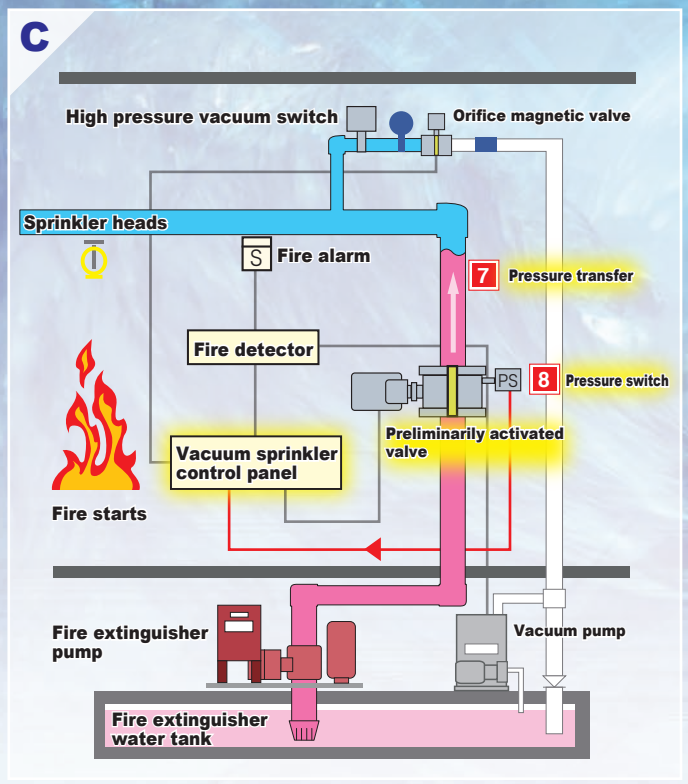
2 Fire detector activates (fire display → fire warning signal → fire determination → fire broadcast)

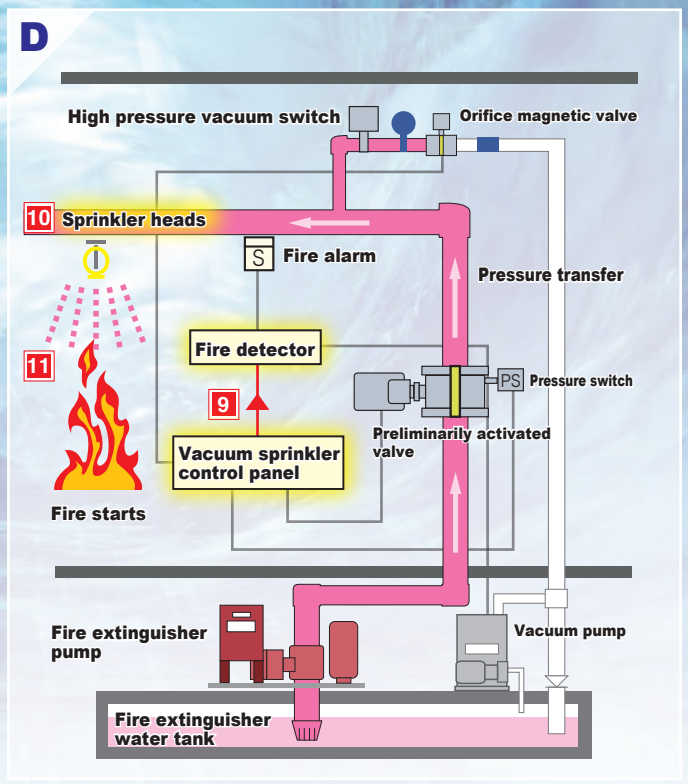
3 Fire alarm activates (control to interrupt and stop the vacuum pump)

4 Fire signal is sent to the vacuum sprinkler control panel (Sends fire signal after making the fire determination)

5 Vacuum sprinkler control panel (fire mode) shuts off the orifice magnetic valve

6 Vacuum sprinkler control panel (fire mode) opens the preliminarily activated valve





7 Pressure transfers to the secondary piping by opening the preliminarily activated valve (pressure of water in secondary piping changes from negative to positive pressure)

8 Flow detection signal from the preliminarily activated valve (+0.1 Mpa)

9 The flow detection signal is sent to the fire detector (Active display on the fire alarm)

10 Sprinkler heads activate

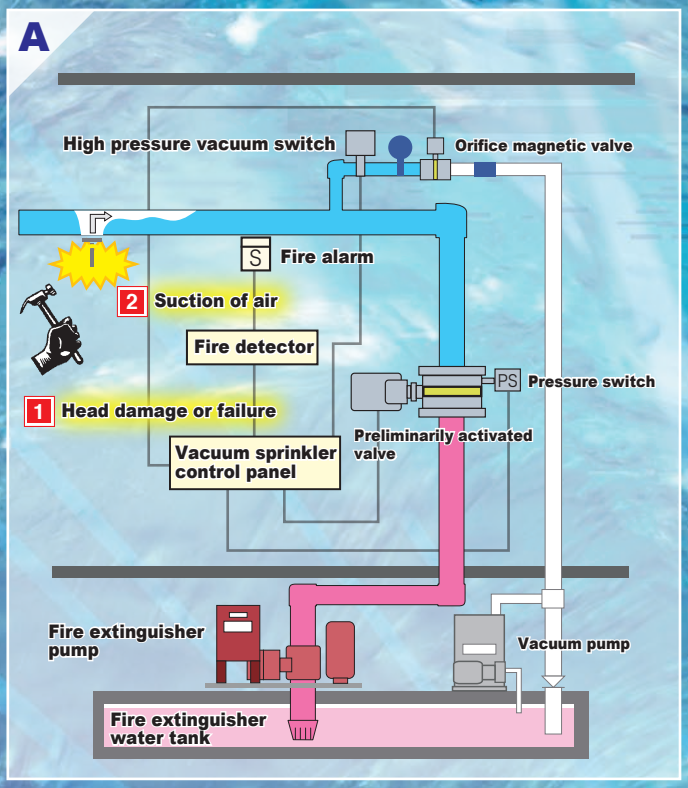
11 Fire is extinguished

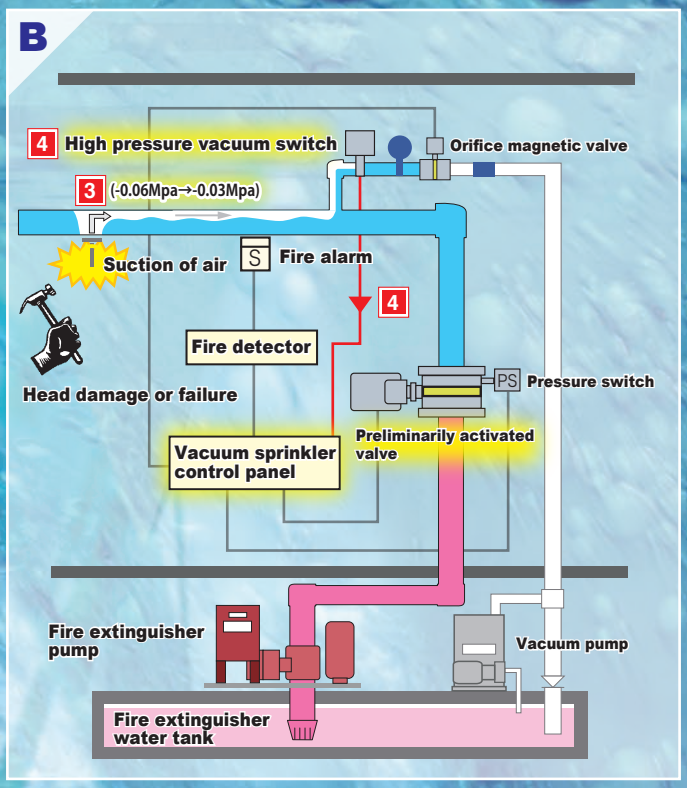
*Orifice magnetic valve is opened when energized (normally closed). In other words, the magnetic valve cannot be opened when the power is out. Thus, there is no negative impact to the discharge of water from sprinklers during fires.

Process Flow during Head Failuresr

Pressurized water

Process Flow during Fires



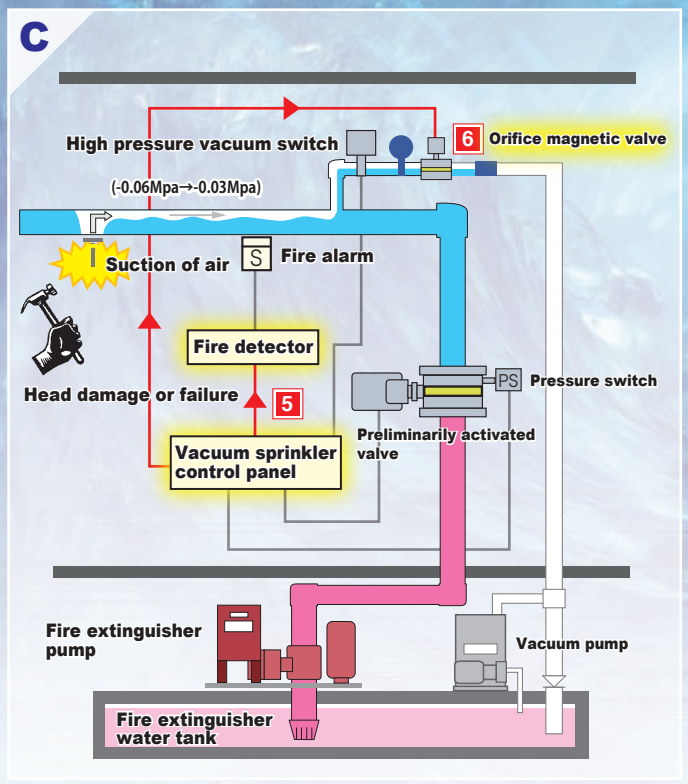


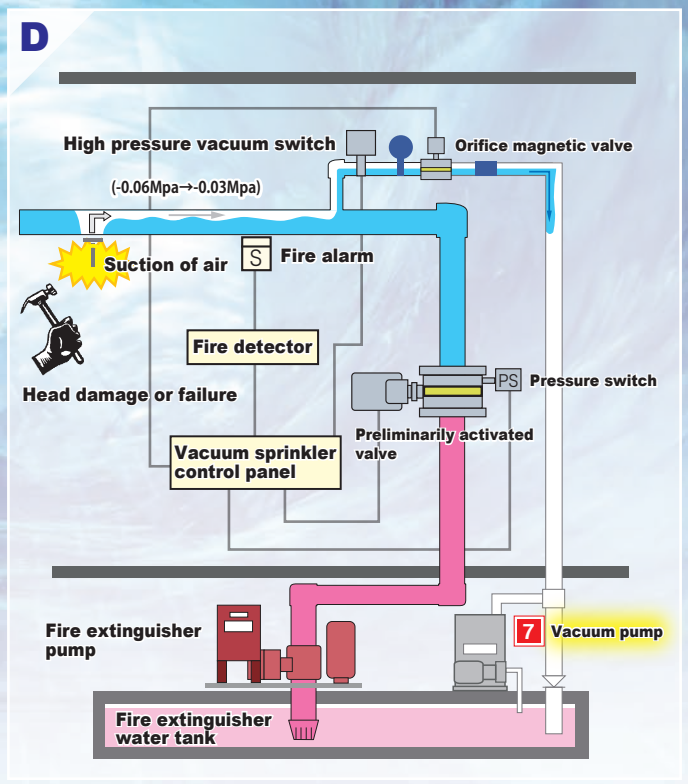
1 Head damage or failure (fire is not occurring)

2 Suction of air

3 Pressure rise in secondary piping (-0.06 Mpa to -0.03 Mpa)

4 High pressure vacuum switch (HVS) activates (turns on when pressure is at -0.03 Mpa)





5 Signal indicating a failure in sprinklers or piping (Sprinkler abnormality displayed on the fire alarm)

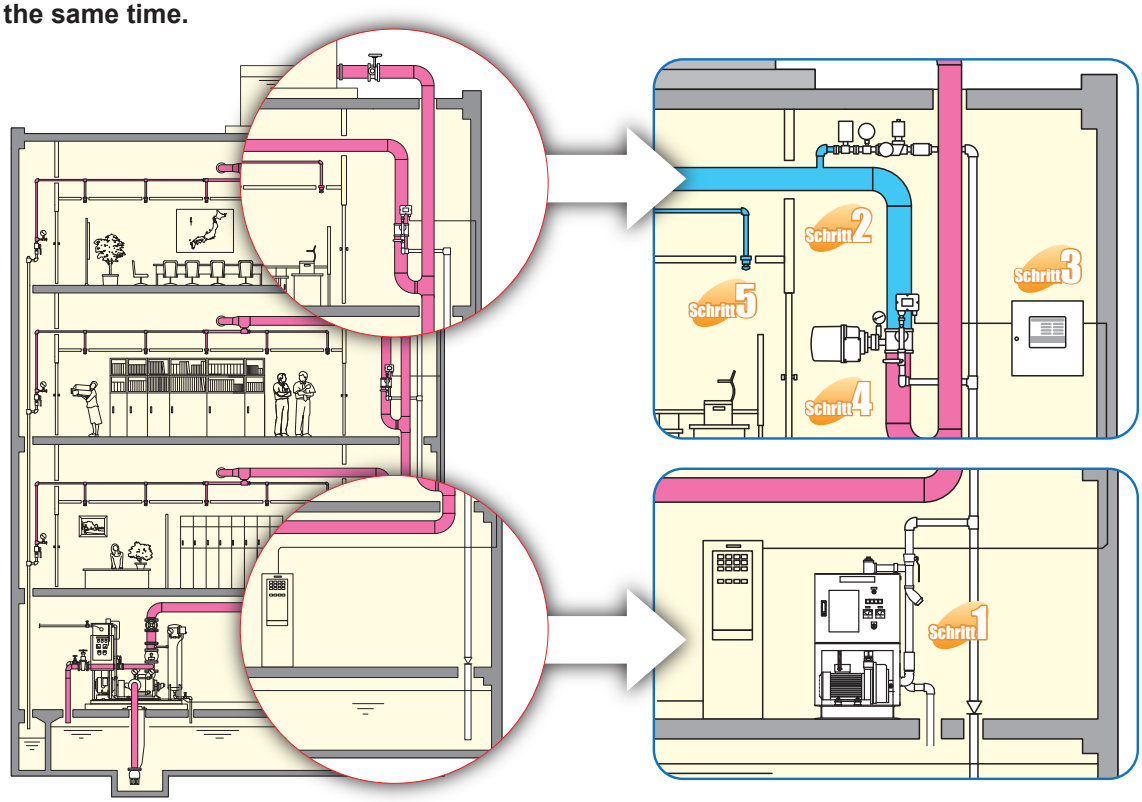
6 Control to open the orifice magnetic valve

7 Continuous suction (operation of the vacuum switch) (turns off when pressure is between -0.05 to -0.06 Mpa)

Renovations

Renovation Procedure

Renovations are the perfect time to add this system as the existing piping and ceiling does not need replacement or serious modification.
You can also renovate only specific floors as desired. It is not necessary to renovate all floors at the same time.



STEP 1 Add the vacuum pump

STEP 2 Add the vacuum piping

STEP 3 Add the vacuum sprinkler control panel

STEP 4 Replace the alarm valve with the preliminarily activated valve

STEP 5 Replace the normal heads with vacuum heads ※

*Using normal heads may result in failure of the system to operate. Please contact us to discuss an appropriate solution.

Renovations are the perfect time to add this system as the existing piping and ceiling does not need replacement or serious modification.
You can also renovate only specific floors as desired. It is not necessary to renovate all floors at the same time.

System Benefits

▶Prevents water damage
You can protect your assets from water damage.

▶Prevents corrosion of the secondary piping
Pipes are protected from dissolved oxygen and oxidizing gases, which significantly extends the service life of the sprinkler system.

Cost Benefits

▶Reduced piping expenses
Piping expenses are reduced as existing piping can be used when upgrading to this system.

▶Removal and replacement of ceiling is not necessary
Costs to install this system are significantly reduced by not having to modify or replace the ceiling.

▶No costs related to moving tenants
Tenants do not need to be moved and therefore no such costs are incurred.

▶Lower fire insurance premiums
Fire insurance premiums are reduced whether installing this system during construction of new buildings or renovating existing ones.
*We will work with designated insurance companies on your behalf. Please contact us to get further information.

Construction Phase Benefits

▶Construction time is shortened

Construction time is reduced due to the ability to use the existing piping and ceiling as well as not having to move tenants.

▶Construction is simplified

The amount of construction work is significantly reduced.

▶Construction is simplified

The system does not need to be installed in all floors of multi-storied buildings at the same time. Install the vacuum pump during the initial phase, and then renovate floors as desired to more easily manage construction time and costs.

Environmental Benefits

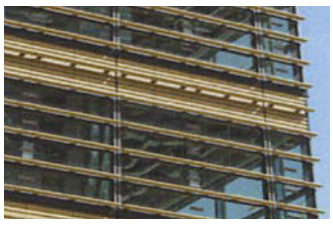
▶Installing the system does not generate any waste, which is good for the environment.

The installation of this system does not produce a significant amount of waste as the existing piping can be used and the ceiling does not need to be modified or replaced.

	Conventional sprinkler system installation			Vacuum sprinkler system installation		
Item of installation	**Installation details**	**Environmental concerns**		**Installation details**	**Environmental concerns**	
Ceiling	Demo and new construction work	Produces waste	×	No demo work	Produces no waste	◉
Piping expenses	Demo and new construction work	Can be recycled as scrap metal	△	No demo work	Produces no waste	◉
Sprinkler heads	Demo and new construction work	Can be recycled as scrap metal	△	Demo and new construction work	Can be recycled as scrap metal	△
Flow detector	Demo and new construction work	Can be recycled as scrap metal	△	Demo and new construction work	Can be recycled as scrap metal	△
Move tenants	Tenants must be moved	Produces packaging and moving material waste	×	Tenants do not need to be moved	Produces no waste	◉
Renovations	Positive-pressure system installation	State of system must be reviewed after 20 years	△	Negative-pressure system installation	State of system may not need to be reviewed after 20 years	◉
Total assessment	**Produces environmental problems**		△	**Environmentally sound process**		◉

*Some of these details may vary depending on the details of the necessary construction work.

Suitable locations

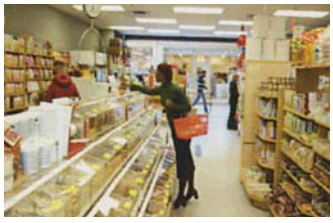


◆Intelligent buildings

◆Hotels

◆Hospitals

◆Research institutes



◆Department stores

◆Factories

◆Warehouses

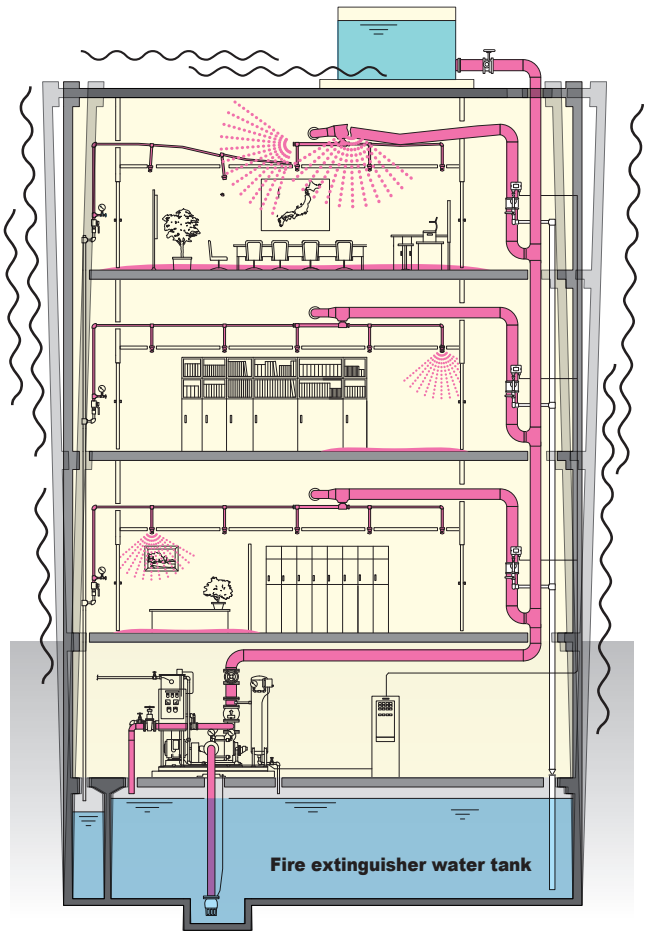
Are BCP earthquake preparations suitable?

The Vacuum Sprinkler System protects business resources from earthquakes and enables business to continue afterwards.

Let's take a look at what happens when an earthquake occurs while using a conventional system.

When an earthquake occurs and ruptures pipes, conventional wet pipe sprinkler systems, which account for more than 90% of sprinkler systems in use, incorrectly detect this as a fire and begin to activate the sprinklers.

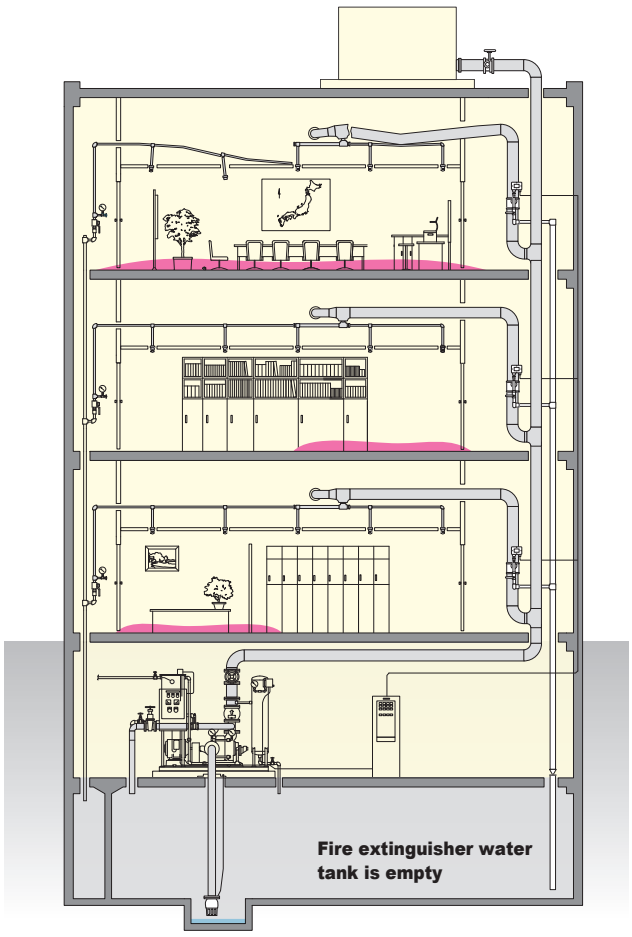
Sprinklers are mistakenly activated due to earthquakes.



Significant water damage

Several dozen tons of water are instantly released inside the building, which renders the building physically impossible to use.
The building also cannot be used during the time required to remove and clean up the water.

The fire extinguisher water tank becomes empty after the system activates in error due to an earthquake.

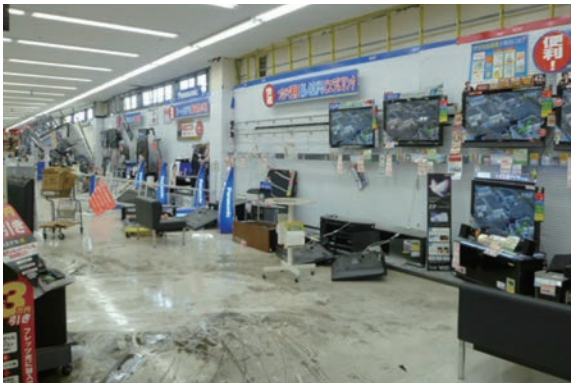


Fire Services Act restrictions on building use

After the system activates in error due to an earthquake, another similar inadvertent activation could completely empty the fire extinguisher water tank.
The Fire Services Act restricts the use of buildings in such cases.

Water damage examples

An earthquake caused the sprinkler pipes in the ceiling of the 8th floor of this building to rupture and discharge water.
The 8th floor of this hospital flooded with ankle-deep water levels. 120 patients had to be moved to an annex ward.
It took 9 days before the hospital could be used again.



The sprinklers on the third floor of this building broke causing inventory on the third floor and display items on the second floor to be damaged beyond repair.

Interesting points of reference

- **26.3% of sprinklers in large building in Iwate, Miyagi, and Fukushima prefectures were damaged or activated in error during the Great East Japan Earthquake.**
- **114 cases of sprinkler damage were reported in the Tokyo area during the Great East Japan Earthquake (magnitude of 5).**
- **According to the Tokyo Metropolitan Disaster Prevention Planning Organization, 34.5% of sprinklers inadvertently activate during an earthquake with a magnitude of 6.**
- **It would take an estimated 30 days to recover from inadvertent activation of sprinkler systems after an earthquake.**

This damage can be minimized.

Preliminarily activated vacuum sprinklers do not incorrectly detect a fire simply because of damage to piping as with conventional wet pipe sprinkler systems. This also ensures that there is always enough water in the fire extinguisher water tank.
Repairing broken sprinkler pipes and heads is much easier and does not take nearly as long to complete as recovering from inadvertent sprinkler system activation after a disaster.
The sprinkler system running out of water could prove fatal.

No water leakage

Many cases of water damage occurred due to damaged conventional sprinklers in the Kanto and Tohoku regions during the Great East Japan Earthquake.
However, By using the vacuum sprinkler system in these buildings, water damage did not occurred just from damage to sprinkler heads or the secondary piping.

Past examples of actual system installations

■Renovations:
A securities exchange, capitol buildings, motorcycle laboratory, and large electronics retailers
■New construction:
Large distribution terminals, Tokyo head office of a major newspaper, famous university campuses

If you have any questions or comments,
please contact our general sales office.

K&G International

7-7-26-508 Yatsu Narashino City, Chiba Prefecture 275-0026, JAPAN

TEL: 81-47-474-9376　FAX: 81-47-474-9376
Cellphone: 81-90-2452-8229
E-mail：gng@s8.dion.ne.jp
http://kandg.jimdo.com　You-Tube:gng716

2016.06