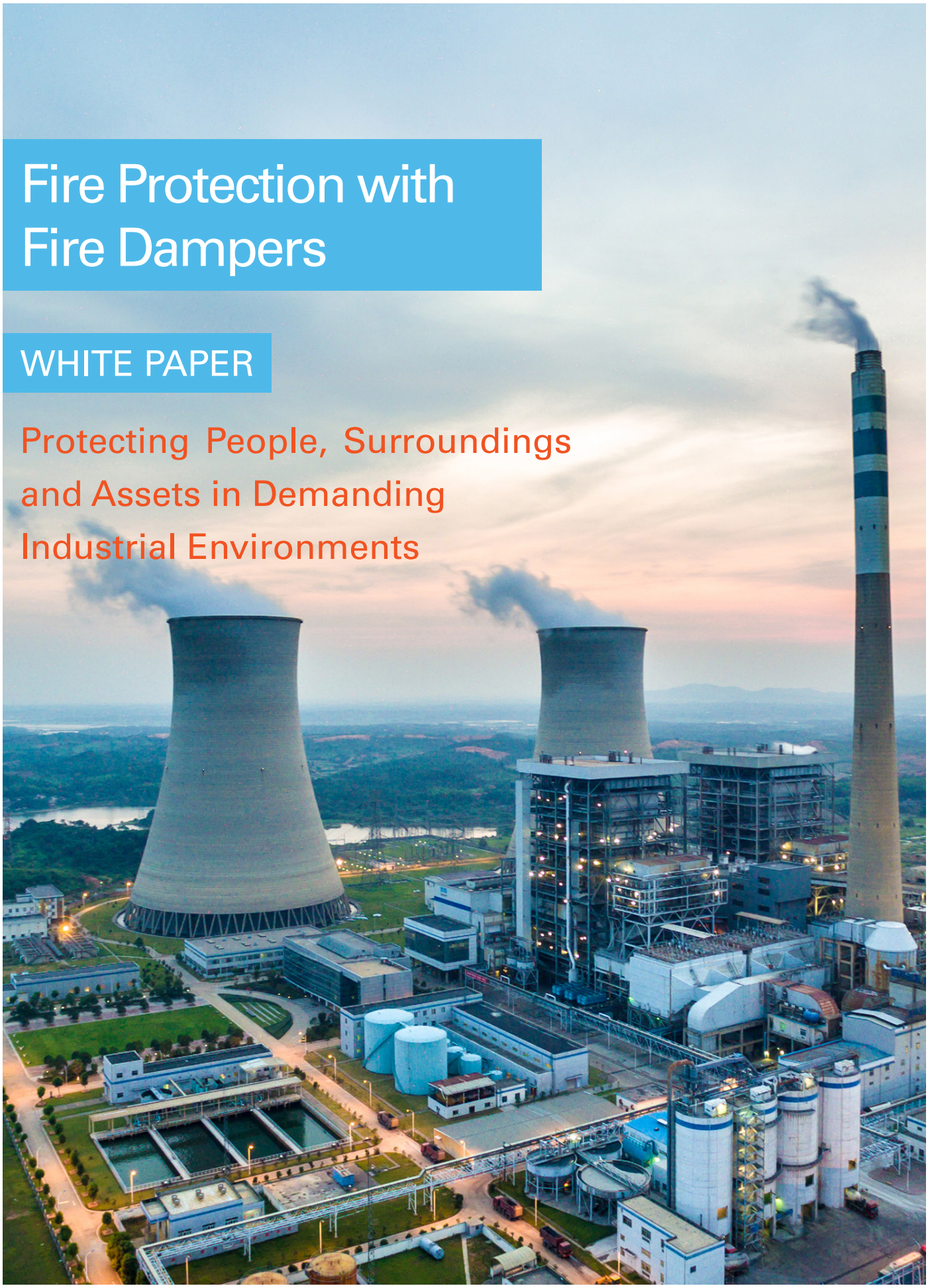
Fire Protection with Fire Dampers

WHITE PAPER

Protecting People, Surroundings and Assets in Demanding Industrial Environments



Enabling Wellbeing

Halton

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The author works in Halton Marine as a Sales Manager in Heavy Industry segment helping customers to find solutions for demanding industrial environments. He has several years of experience with industrial projects with needs for special protection. Feel free to contact him to discuss further about fire and gas protection or if you need any assistance with HVAC and protection related matters in demanding industrial environments.

About the paper

This text is the second article in Halton Marine's article series "Protecting people, surroundings and assets in demanding industrial environments". The series is focusing on helping stakeholders to understand the possible risks and protection solutions in demanding industrial environment. The second article focuses on fire protection. The first article about blast protection was published in December 2019.

About Halton Marine

Halton Marine is one of the world's leading suppliers of HVAC solutions specifically designed for demanding environments. Halton's track record includes deliveries to over 150 major cruise ships, 250 oil & gas projects both offshore and onshore and 150 naval vessels. In 2020 Halton Group become majority owner of Flamgard Calidair, that enables Halton Marine & Flamgard together to widen the offering in Heavy Industry to cover power generation, infrastructure and tunnel related projects as well.

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Foreword

Fire protection plays essential role in industrial environments and facilities. As with many other risks, also the risk of fire cannot be usually completely removed but preparation, proper support systems and right kind of equipment will remarkably decrease the risk of severe fire accident. National Fire Protection Association report (Fires in U.S. Industrial or Manufacturing Properties) published in 2018, states that *"between 2011 and 2015, municipal fire departments in the U.S. responded to an estimated average of 37,910 fires at industrial or manufacturing properties each year with annual losses from these fires estimated at 16 civilian deaths, 273 civilian injures, and $1.2 billion in direct property damage."*

It's worth noticing that as these figures are only for USA, so the total number will be multiple times bigger if we think about the global point of view. Although the fire protection related matters have been developing, there is still a lot of work to do to decrease the damages and losses related to industrial fires.

Please note that this article should be considered as common information about fire protection and especially damper solutions suitable for that. For exact information about specific project or local requirements and details, please contact necessary authorities responsible for fire safety related matters for your case.

1. The basics of fire protection

There's wide range of different fire protection related equipment available in the markets that are used to prevent fires or protect from them in unfortunate case. Nevertheless, the idea of fire protection is simple and all the available tools, methods and equipment to execute can and must be used to get the best solution for specific location or environment.

In this article we mainly focus on fire, gas and smoke dampers which have been Halton's corners stone for several decades in various environments from commercial buildings to very demanding offshore oil & gas environments.

1.1. Levels of fire protection

There are four different levels to be taken into consideration in fire protection:

1. **Preparing and anticipating the possible risk of fire**
   This is the base for fire protection. All fire and accident-related scenarios must be planned and anticipated to provide protection and safety for people, equipment, facilities and environment. There are different regulations (E.g. Governmental and industry related) that provide the baseline for protection related matters, but in many cases companies and owners set their own limits even higher. As explained earlier, there are wide range of different systems available for this that can be either active or passive protection systems.
2. **Restricting the fire, gas and smoke from spreading**
   In unfortunate case of a fire, it's essential to quickly restrict the fire from spreading inside the facility, building or other location. And this is also where fire dampers play essential role together with other fire safety equipment. The operation of fire dampers is presented further in the article.
3. **Preventing fire related chain reactions (e.g. explosions) from happening or protect from them**
   This step includes actions that must be taken into consideration in both planning & design phase as well as during fire. If the location is considered high risk as e.g. flammable or explosive material are stored in it or people and their safety is in risk, adding extra fire safety related matters must be determined already in design & planning phase. This might mean e.g. adding blast protection equipment in buildings where people or valuable equipment are present. During fire this step might mean to stop or control the manufacturing process in order to prevent further accidents from happening or evacuating the people or material to safety.
4. **Extinguishing the fire and monitoring & controlling the environments after fire**
   There are numerous different methods for extinguishing the fire. These may include e.g. automated sprinkler systems, gaseous fire suppression systems or traditional ways to extinguish fires. Nevertheless, the work doesn't stop here. Post-fire activities may take great amount of time and effort depending on the extent of the accident. Environmental issues and monitoring may take years if toxic substances have been present in the facility.

1.2. Guidelines for fire protection

Compared to blast protection, fire safety and protection related matters are highly regulated and standardized in different levels depending on project, location and other matters. Standardization together with local regulations ensure the products that are available in the market and used in fire protection will comply with requirements.

As stated in article's foreword, for exact information about specific project or local requirements and details, please contact necessary authorities responsible for fire safety related matters for your case.

1.3. Injuries and damages associated with fire

When talking about accidents related to fire, the total damages are usually much greater than anticipated. It is not only the fire and burns associated with this kind of accident, but also smoke and gases pose extreme danger in much greater extent than thought.

1. **Burn related injuries and damages**
    a. Burn injuries to people
    b. Burn & fire related damages to property, facilities and equipment
2. **Smoke and gas (released from the actual fire) related injuries and damages**
    a. Respiratory injuries for people, in worst case even fatalities
    b. Smoke and gas damages to property, facilities & equipment
3. **Direct and indirect consequences**
    a. Environmental issues and problems
    b. Losses for the business and operation
    c. Brand and reputation related losses

Especially smoke and gas related problems are difficult, as even a small fire can generate relatively big damages. Smoke and gasses are not only the main factor for fatalities, but smoke also contains small particles that will penetrate in the structures, equipment and other possessions in that area. This will basically mean extensive cleaning or even rebuilding of the area to get rid of those particles. This is really important especially in industries with high requirements for hygiene and odour control, e.g. pharmaceutical and food processing.

In big fires, gases are released in the air and in worst case scenario those can spread widely in the surrounding environment affecting the people living in that area. This means that the actual area where the fire is affecting, might be remarkably larger than the actual place of fire.

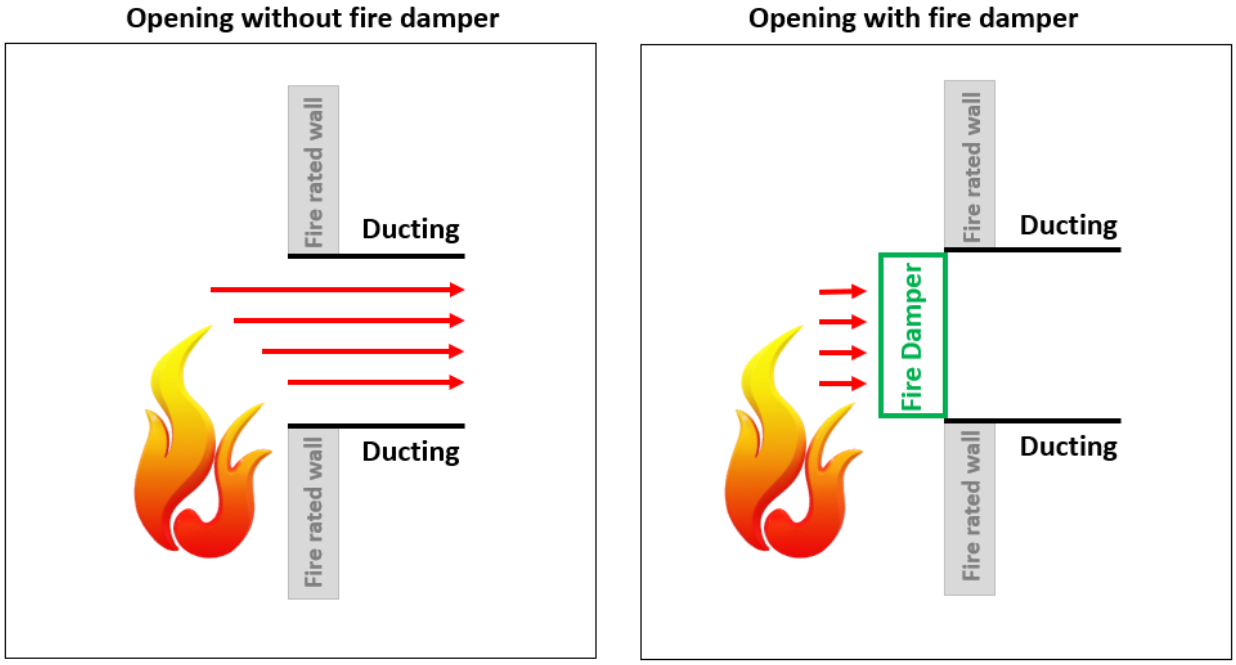
2. Fire dampers

2.1. The purpose of fire dampers

Fire Dampers are used in air transfer openings, ducts and other places where fire rated structures (e.g. walls, floors or other fire barriers) are penetrated. If these openings wouldn't be protected, the fire would easily spread to other spaces and damage the property and pose a danger to people working in this environment. The idea of compartmentation is to keep the fire in the start point and prevent it from spreading to other locations. This helps to limit & extinguish the fire and minimize the total damages to the facility and environment.

As illustrated earlier in the article, fire itself is not the only threat in fire related accidents. Smoke and other gases released in the fire can pose a great danger to people especially in environments where different chemicals are being produced or stored. These gases spread fast and depending on the substance, even small doses can be extremely dangerous or fatal to people. It's really important to remember that these gases and smoke move upward and especially in closed spaces they penetrate through any opening and spread throughout the surrounding spaces if gas tightness is not ensured.

Special seals can be used in fire dampers to obtain gas tightness to stop these harmful gases from spreading in addition to fire protection. These solutions are presented further in the article in chapter *2.4 Fire dampers and gas tightness*.



Picture 1. Fire Damper preventing the fire from spreading.

2.2. Operation of fire dampers

The operation of fire dampers is simple: they close when the temperature in the room or space rises over the threshold limit to prevent the fire from spreading. Halton fire dampers have fusible link, which is selected according to desired temperature. Once this temperature is reached, damper closes.

The damper itself can be electrically actuated, pneumatic or manually set. In electric and pneumatic actuated dampers, fusible link releases and cuts off operating voltage to the spring return motor, allowing the spring to close the damper blades. The fire damper opens automatically when the fuse has been changed and the operating voltage to the motor is re-established. In spring operated dampers, fusible link releases allowing the spring to close the damper blades. When the fuse has been changed, the fire damper must be reset into open position manually.

There are wide range of different components and parts available to ensure compliance with project specification and requirements. Although the basic operation of the fire damper will remain the same, Halton R&D team is working to find innovative solutions to support the systems where fire protection plays essential role.

Picture 2. Watch a video demonstrating the basic operation principle of a Halton fire damper with an electrical actuator. Click picture to see animation.

2.3. Fire types

Usually there are two types of fires considered as standard fires, cellulosic & hydrocarbon.

Cellulosic fire

These fires are the most common ones in residential and commercial buildings but also in industrial environments, where cellulosic products (e.g. wood, paper, furnishing, textiles) are burning. The temperature rise and fire spread in these fires is relatively slow, although temperatures will rise to high levels over time.

Hydrocarbon fire

Hydrocarbon fires are happening especially in industrial environments where oil-based products and chemicals are produced or used. The temperature rise is fast and the fire can reach excessively high temperatures in few minutes. As structural steel loses its strength in high temperatures, hydrocarbon fires can damage large areas in short times depending on the extent of the fire.

2.4 Fire ratings and certifications

Fire dampers are fire tested and certified according to specific requirements and standards. Different applications require different fire ratings. Some of these ratings are shortly explained below, especially the ones that Halton is working with.

2.3.1. European E & EI-rating

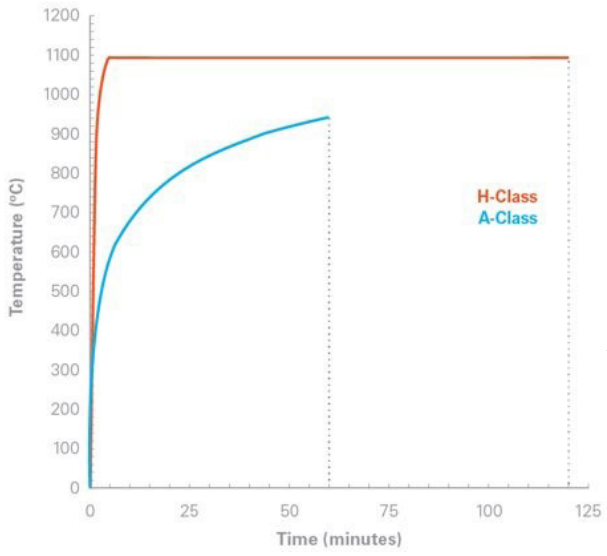
EN 13501-3 sets the fire classifications for land-based fire dampers in Europe. E- & EI-ratings are followed by number that indicates effective protection in minutes and letter S for smoke leakage protection. E-rating stands for integrity, where the damper prevents the passage of flames and hot gases to the other side. EI-rating (Integrity and Insulation) includes flame and gas protection, but also adds insulation to restrict temperature rise on the unprotected side. For example, EI60S rated dampers deliver effective protection against fire, gases, smoke and heat for 60 minutes. Examples of these ratings are shown below in picture 3.

Class	Fire Test Requirements		
	Integrity (minutes)	Insulation (minutes)	Smoke protection
E60	60	0	-
E60S	60	0	Yes
E120S	120	0	Yes
EI60s	60	60	Yes
EI120S	120	120	Yes

Picture 3. Fire test requirements according to EN 13501-3

2.3.2. H-rating

H-rated dampers are designed and tested to comply with hydrocarbon related fires. The main difference compared to e.g. cellulosic fire is that hydrocarbon fires have a very rapid heat rise after ignition and temperatures can be over 1000°C in just few minutes. This temperature requires special construction for the dampers to cope up with heat and gasses generated from the fire. H-rating is also followed by number that indicates minutes for insulation (preventing the heat from transferring to other side). H-rated dampers always require integrity of 120 minutes. Requirements are shown in the picture below showing fire curves and fire test requirements.



Class	Fire Test Requirements	
	Integrity (minutes)	Insulation (minutes)
H0	120	0
H60	120	60
H120	120	120

Picture 4. Hydrocarbon fire curve compared to A-rated curve & fire test requirements.

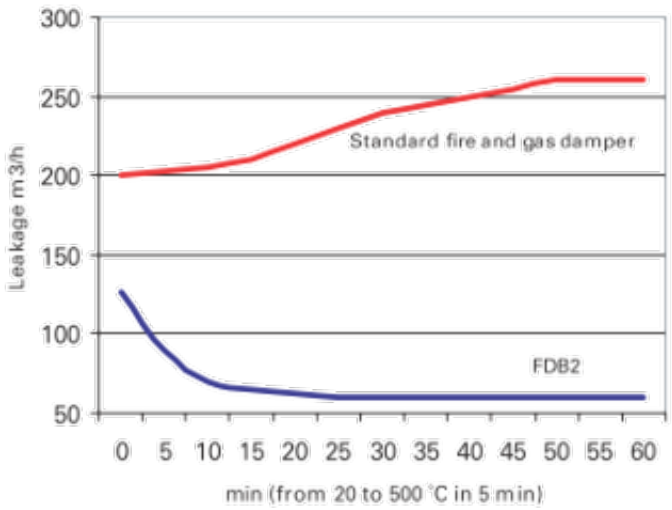
2.3.3. UL-rating

UL555 & UL555S are ratings originated from USA. UL stands for Underwriter Laboratories, which is a safety organization that sets industry-wide standards. Although UL-ratings include similar requirements than EI-ratings, there are different details involved in requirements and the EI- & UL-ratings cannot be directly compared. In UL-rating, operational reliability, fire testing, hose stream testing and dynamic closure test criteria are included depending on the application damper is used.

2.4. Fire dampers and gas tightness

Fire dampers can be equipped with different types of blade seals to add tightness for smoke and gases. This is essential especially in cases where fire can release highly toxic gases in the environment. Halton has different solutions starting from basic smoke protection up to really tight fire dampers which ensure that both fire and gases remain on the other side.

Especially when the heat is rising, the construction of regular fire damper is affected by the heat and gas tightness will drop dramatically as the damper frame and blades may deform out of the tolerances. Gases and smoke will start spreading rapidly and extent the damages generated from the fire. Because of this, it is essential to choose fire dampers that will ensure the gas tightness also in high temperatures during actual fire. Graph below shows tested results for Halton FDB2 Fire Damper.



Graph 1. Leakage rate of Halton gastight fire damper in high heat.

Halton fire dampers have different types of blade seals available for different applications. By selecting the right one for specific application, gas tightness can be ensured in both normal temperatures and also in high temperatures in case of fire. This will save lives and reduce the total damages generated from the fire.

Halton has also total isolation damper available, that can be used together with fire dampers to ensure zero leakage in the system once the damper is closed. This is important especially in situations where especially the gasses must be isolated in case of an accident or fire.

3. How can Halton help you?

3.1. Fire dampers configured according to customer needs for different industries

Halton has been working with commercial buildings as well as with demanding onshore and offshore projects for decades already. We have wide range of fire dampers with different certifications for various applications. One of the most highly valued features is that our fire dampers are extensively configurable according to customer needs. We can deliver products that are engineered-to-order and there are thousands of different product variants available when all available components are taken into consideration.

Our personnel will help you to find the most suitable solutions for your project according to project specific requirements.

3.2. ATEX/EX certified fire dampers

All our industrial fire dampers are available as ATEX/EX certified to be used in explosive environments. Our fire dampers are configured according the specified ATEX requirements and our solutions are suitable up to Zone 1. As these solutions are always engineered-to-order, all related drawings, configurations and other details are always checked and approved with customer before the manufacturing. This ensures that all the equipment is in compliance with requirements and specification.

ATEX certified fire dampers are available in spring release, electric and pneumatic operation with wide range of compatible components for added features.

3.3. Benefits of Halton Fire Dampers

Halton has been working with fire dampers for several decades in different industries and environments. As the world is developing, so are we. Halton want to be part of providing safety for future generations in different industries and be part of the energy transition for greener future. Our long expertise in this field helps us to move forward towards even better and safer solutions. So far, our track record includes hundreds of different projects, varying from small ones to mega projects happening once in decade. Some of our core competencies are shown below:

- Halton Marine has ISO 9001, ISO 14001, ISO45001 & ISO 3834-2 certifications
- All dampers are highly configurable according to customer needs (e.g. components, size, insulation, certification, ATEX etc.)
- ATEX certified products
- Large single damper sizes available:
    - Biggest single damper size over 3000x3000mm with one actuator -> Cost efficiency
    - Also modular construction available
- High level of customization and flexibility available
- Our global manufacturing plants can supply deliveries for projects in their area -> Shorter total lead time & cost efficiency
- Close co-operation with customer, after sales support, technical support, design support
- Products widely tested and certified by 3rd party research centres as well as internal testing conducted
- Project management, documentation and support services provided

Conclusion

As the old proverb says, "*Fire is never a gentle master*". The world has come a long way in past decades when it comes to fire protection, but we still have a lot of work to do.

Both active & passive systems are still developing and together with automated systems the fires can be prevented more effectively. But still active methods for preventing the fire from spreading in accidents are needed, and this is where fire dampers come to the picture. And we must remember that the most important goals of fire protection: protection people and preventing casualties, preventing damages for assets and minimize the possible downtime for operations.

We at Halton are happy to help you with any industrial protection related matter.

- Are you familiar with Halton offering?
- How would you benefit from our products?
- What are your main challenges in fire protection?
- For what kind of project are you considering using Halton fire dampers?
- How can Halton help you?

Useful links:

1. Halton' site dedicated to Heavy Industry solutions
   https://heavyindustrysolutions.halton.com/
2. Halton's HVAC for Heavy Industry Brochure
   https://www.halton.com/news/download-haltons-new-brochure-hvac-for-heavy-industry/
3. Test video of Halton FDH H-rated Fire Damper
   https://www.youtube.com/watch?v=8-WE1a5PLhQ&t=36s&ab_channel=HaltonGroup
4. Operation principle of Fire Dampers
   https://www.youtube.com/watch?v=LANYI5n5xgY&ab_channel=HaltonGroup

References

1. National Fire Protection Association (https://www.nfpa.org/)
2. Halton's internal education material & trainings
3. Confederation of Finnish Construction Industries RT
4. The Finnish National Rescue Association (SPEK)
5. The Fire Protection Association (FPA)

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About us

Halton Group

Halton Group specializes in indoor environment solutions, ranging from public and commercial buildings to foodservice facilities. Founded in Finland in 1969, Halton operates today in over 35 countries around the world, with annual sales of €220 million and over 1600 employees. The company has production facilities in Brazil, Canada, China, France, Finland, Germany, Malaysia, United Kingdom, and the USA.