



Warehouse Fires – An Underwriter’s Guide to Containing the Risks

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As far back as 1992, the National Fire Protection Association’s (NFPA) seminal text on fire safety, *The Fire Protection Handbook*, described warehouse fires as a unique challenge.¹ According to the handbook of this international non-profit organisation, the complex configuration of modern warehouses encourages fire to spread rapidly, whilst simultaneously making manual fire-fighting efforts particularly arduous. The handbook cited a properly designed and maintained automatic sprinkler system as the only tried and tested control method for such fires.²

While storage facilities have evolved over the past decades, adopting many new technologies, little to nothing has changed from a fire safety perspective since the handbook’s publication. Warehouse fires remain a global problem with incidents reported in the media almost daily.³ These fires often result in major losses, both for the businesses affected and the insurance sector.

This article uses information gleaned from past events to provide an overview of fire control measures for storage facilities, alongside recommendations for underwriters tasked with assessing the risks.

Types of warehouses

Warehouses are used to store raw materials, semi-finished goods, flammable materials, and auxiliary and finished products before they are transferred to manufacturers, distributors and consumers.

Storage areas can be vast, covering more than 100,000 m² and scaling heights of over 60 metres. They can be indoor or outdoor, with the goods themselves dictating the type of storage required (e.g., high-bay racking, block storage, bulk goods storage, liquid storage) or any specially controlled conditions like refrigeration.

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About This Newsletter

Created for our clients, our Property Matters publication provides an in-depth look at timely and important topics affecting commercial and personal lines of property insurance.

Goods can be stored manually (e.g., using forklift trucks, conveyor belts, etc.) or by computer-controlled, automatic storage and retrieval machines. Some facilities have a very low stock turnover over a year, while others are more rapid. Also, storage facilities are not always owned and managed by the manufacturers/retailers they serve but run by a third party who store and manage goods for a fee.

Warehouse fires around the world

In the U.S., the NFPA registered approximately 1,240 warehouse fires per year between 2009 and 2013, with annual property damages of around USD 155 million. This represents a reduction in the number of fires over a 30-year observation period, from 4,700 to around 1,200 per year.⁴

In South Africa, the Fire Protection Association of Southern Africa (FPASA) registered a total of 436 warehouse fires between 2011 and 2015 (81 fires per year), with a steady increase from 61 fires in 2011 to 127 fires in 2015.⁵ In most cases, the cause of the fire could not be determined.

In Germany, analysis of available statistics from the German Insurers' Association (GDV) from 2001 to 2016 shows a total of over 76,000 risks and approximately 7,000 claims from warehouses during this period – about 430 claims per year. Of these, 251 claims were for damages of more than EUR 0.5 million.

The potential for extremely high claims is ever present. For example, in Cologne (Germany) in 1977 a total loss for a car manufacturer resulted in a claim of approximately EUR 150 million. In the U.S. in 1982, a distribution warehouse for a supermarket chain saw a claim of over USD 100 million. While these are stand-out cases, spectacular warehouse fires are certainly not a thing of the past. Indeed, while the overall number of fires is trending downwards, the loss costs are rising significantly.

Analysing claim reports reveals the same findings again and again:

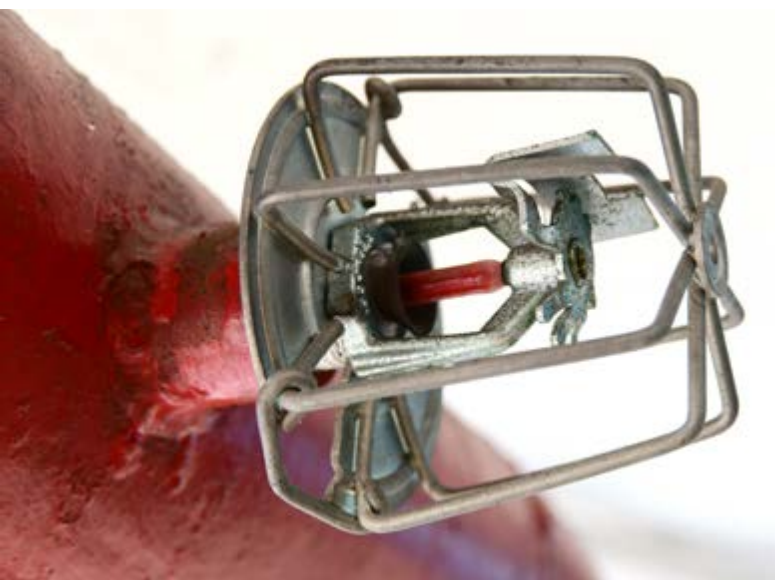
- **No fire extinguishing system.** Or, if a system is installed (e.g., sprinklers), the dimensions, installation, servicing and/or maintenance were inadequate for the fire load and risk at the site.
- **Insufficient water supply.** The amount (or pressure) of the available supply is not enough for systems and/or fire brigades to successfully fight the fire.
- **Inadequate fire detection system.** Automatic fire alarm systems which directly alert fire services can make a huge difference. Without them, fire crews often arrive after the fire has already spread too far to be contained without extreme difficulty.
- **Employees failed to control the initial outbreak.** Depending on the warehouse type, its layout and size, it may not even be possible for employees to attempt to tackle an outbreak (e.g., if a fire started in high-bay racking or block storage areas).
- **Human error or wilful/grossly negligent conduct.** This includes arson, smoking in non-smoking areas, performing hot work, faulty installation of electrical equipment, careless handling of fuel and electrically operated equipment, and even incorrect storage (e.g., chemicals or products that tend to self-ignite, such as grain in bulk storage warehouses).

Further study of the reports shows that warehouses were often not divided into fire zones, or their firewalls had significant shortcomings (e.g., non-fire-resistant/insufficiently protected openings, or walls that stop short of the roof), allowing fire to spread quickly throughout the facility. Another issue is that stored goods need to be destroyed totally after a loss as they cannot be sold any longer after a fire due to contamination by smoke. This is standard practice in food and pharmaceutical warehouses, where affected goods are no longer permitted to be sold due to their high temperature sensitivity or quality and/or hygiene requirements.

Conventional fire control measures

In an ideal world, warehouses would be built from scratch allowing suitable fire control measures to be factored in from the start – from construction materials and layout to provisions for inspections, servicing, and testing.

However, this is a rare luxury and retrofitting existing warehouses with automatic fire extinguishing and fire alarm systems usually involve significant financial expenditure. The same applies to buildings that add complex partitions to divide the building into fire zones.



Regardless of the age of the facility, any change to the structure, the goods being stored, or the type of storage being used must be carefully assessed concerning their impact on fire risk. Existing fire control measures should be tested to ensure they are still effective, and if not, adapted to the new risk situation as a matter of priority.

Key recommendations

In many countries, insurers have written guidelines with recommended fire control measures for warehouses, where they describe their experiences with claims and the fire control measures that are proven to be effective (e.g., in Germany by the GDV,⁶ and in the US by the NFPA⁷/FM⁸).

From our experiences, we've seen these as effective measures:

- Installation of automatic extinguishing systems suitable for the goods being stored (and their packaging)
- Division of storage rooms using complex partitions with a fire-resistance duration of at least 90 minutes or more, with any openings in the walls appropriately protected to prevent smoke damage and the spread of fire
- Warehouse buildings situated at least 20 m away from others and the gaps between kept free of flammable materials and vehicles
- Smoke/heat extraction systems fitted to help firefighters fight outbreaks indoors
- Waste collection containers kept a safe distance from the warehouse, and waste removed (at least) at the end of each working day
- Storage blocks in large warehouses (e.g., every 300 m²) with at least 5 m between them, to prevent a fire spreading rapidly between blocks
- For goods sensitive to water or moisture, automatic detection systems fitted to provide a warning before sprinkler systems are triggered
- Critical/flammable goods and aerosols/gases stored in separate fire-resistant rooms. The same applies to battery chargers or fuel for forklift trucks
- Electrical installations and heating systems installed in accordance with up-to-date guidelines
- Order and cleanliness maintained throughout the warehouse
- Automatic alarm or extinguishing systems linked directly to a first responder unit, e.g., the local fire brigade, to allow intervention asap
- Maximum storage heights stipulated for fire extinguishing systems followed to preserve their extinguishing capability and goods kept clear to avoid obstructing the water spray
- No production processes taking place within storage areas
- Appropriate drainage provisions made to prevent uncontrolled flow of extinguishing water and environmental damage
- A welding permit process in place, along with a strict smoking ban in storage areas
- Employees appropriately trained on how to respond in the event of an emergency
- A contingency plan/business continuity plan (BCP) created so action can be taken as quickly as possible and operations maintained after a fire
- Data and programs required for smooth warehouse operations backed-up regularly (and copies stored in a separate location)
- Guarantee of a bypass option and creation of fire brigade set up areas to provide optimal deployment options
- Regular testing of extinguishing water supply
- Cooperation with the local fire brigade to improve firefighters' knowledge of the location
- If photovoltaic systems are installed, making the main shutdown facility easily accessible to enable the power to be disconnected

Notes for Underwriters

Assessing the risks presented by storage facilities can be daunting and the checklist included at the end of this article is intended to act as a solid starting point for underwriters faced with this task. Below, we discuss some of the key considerations in more detail.

Inspection reports are naturally a vital source of information and should ideally never be more than two-to-three years old. Goods, packaging, and storage equipment change over time and it's vital that warehouse configurations and fire control measures are updated in line with the new risk profile. Fire prevention measures that were once adequate, but no longer effective, can lead to significantly greater damage.

If customers cannot provide enough information, it is best to be cautious with pricing and capacity considerations. Likewise, maximum damage estimates should be kept on the conservative side if there are no physical or structural complex partitions, or these are insufficient. In case of doubt, the potential maximum damage should be set at 100%.

At a minimum, inspection reports should contain:

- The structure of the warehouse and the construction materials and components used
- The goods, packaging materials, and storage equipment used
- Type of storage (e.g., bulk, block, high-bay racking)
- Storage area layout (size and height)
- Machinery used for storage and retrieval (e.g., industrial trucks, forklift trucks) and other technical equipment
- Fire control measures such as sprinklers, alarms, fire zone partitions, water supply, and information on organisational safety measures
- Statements on the adequacy and reliability of these safety measures including:
 - > Have the systems been installed in accordance with local regulations (e.g., Germany: VdS; UK: LPC; U.S.: NFPA, FM; France: Apsad)?
 - > Are they serviced regularly and independently tested?
 - > Is at least one fire zone completely protected by the fire extinguishing system? (Partially installed systems do not constitute real protection)
 - > Are the systems free from obstructions?

- The turnover timeframe for the stored goods and possibility of reordering
- Access options for the fire brigade, an estimate of their response time, and information on any access restrictions

Further considerations

Classified areas

Dividing storage facilities into classes based on their risk exposure has proven very effective. For example:

- Very low fire risk (e.g., storage of non-flammable materials, packaging and storage equipment)
- Low fire risk (e.g., essentially non-flammable products generally packed in non-flammable materials and storage equipment made of non-flammable materials)
- Medium fire risk (e.g., products with a low fire load, not packed or with edge guards only, and using wooden racks or pallets as storage equipment)
- High fire risk (e.g., products packed with wood, cardboard, paper, films, non-foam plastics, flame-resistant foam plastics or edge guards made of foam plastics and using wooden racks or pallets as storage equipment)
- Very high fire risk (e.g., products with a significant amount of foam plastics as external or internal packaging or use of plastic pallets and boxes as storage equipment)
- Chilled and deep-freeze storage
- Special storage (e.g., peat, plastic foams, explosives, upholstered furniture, aerosol products)

Unused storage equipment

Unused storage equipment such as pallets can constitute a significant risk due to their significant fire load. Such equipment is usually grouped in blocks at the outer wall of warehouses (making them an easy target for arsonists) or stored inside the building. The intensity of the fire when pallets burn is so high and the spread so rapid, that (even adequately installed) fire extinguishing systems can quickly be defeated. Empty pallets should, therefore, be stored at a safe distance (at least 20 m) from the outer walls of warehouse buildings, or in a separate fire zone within the warehouse.

New technology

In order to become more efficient and save costs, warehouses are increasingly using automated storage and retrieval systems, such as paternoster lifts, carousel systems, shelving systems/vertical lift storage or fully automatic "autostore" systems. This can have a big impact on the fire risk assessment due to the following:

- Increased value per m² of storage areas
- Integration of storage areas directly into production areas without effective fire zoning
- Difficulty of installing previously tried-and-tested fire control measures (e.g., due to the high storage density, the installation of a sprinkler system is no longer possible)
- Increased difficulty for fire-fighters to identifying the source of a fire and fight it in a targeted way (e.g., when rack systems are surrounded)
- Increased specialisation of warehouses making it hard to source suitable replacement equipment quickly, potentially interrupting operations

Contract storage

In addition to warehouses operated by the insured company itself, warehouses may be operated by special logistics contractors and shipping companies, who take care of the storage, warehouse handling and distribution of goods for a fee. In this case, it's important to clarify how the insurance of the stored goods is governed contractually, and whether the goods are insured by the owner of the goods or the operator of the warehouse.

The goods logistics contractors store frequently change and it shouldn't be assumed that fire control measures

are adapted each time. It's, therefore, a good idea to agree that the insurer must be informed immediately if the type of goods changes as part of the insurance contract.

Furthermore, it's important to find out whether the warehouse owner has warehouse liability insurance which offers insurance cover in the event of wilful or grossly negligent conduct on the part of the warehouse operator. Checking the contract between the two companies may clarify these questions.

Shared use

It's also not uncommon for warehouses to be used by other parties/tenants. Depending on their activities, this may indicate a higher fire risk.

Business interruption

Once-upon-a-time business interruption (BI) following the loss of a warehouse was considered negligible because goods could be reproduced relatively quickly. Today, globalisation means business interruption is increasingly coming into focus.

Frequently, parts needed for production are no longer manufactured on-site, but rather ordered from specialist suppliers and stored in intermediate warehouses. If such a warehouse experiences a fire, it can be very difficult to find adequate replacements quickly, bringing production grinding to a halt.

To estimate BI risk successfully, the following questions should be asked:

- What is the calculation basis for the insurance value of the stored goods (e.g., is it the manufacturing cost or the end consumer's sale price (including the gross profit), or something else)?
- What liability period is the insurance contract based on? Since the value of stored goods may change over the course of the year (due to depreciation of assets, changes in exchange rates, fluctuations in procurement prices, market availability, and purchasing behaviour), it can be difficult to determine the actual values during the contractual term.
- What alternative/replacement options are available to the company to minimise the potential damage of a business interruption after a fire? How realistic is this option (e.g., direct delivery to the customer from the manufacturer, leasing of a replacement warehouse, delivery to the customer through other sites)? Can lost goods still be reordered and if so, within what time frame? And, how much would the failure of one or more seasons affect the company?
- What additional costs and provisions/initial risk items are agreed in the insurance contract and may come to bear in the event of a claim?
- How much time would be needed to re-establish a destroyed warehouse building and procure replacement systems?



Seasonal goods

Seasonal goods, such as textiles, are sometimes produced up to a year prior to being released for sale, and then stored in distribution warehouses until they are purchased. They are particularly vulnerable to business interruption; should the distribution warehouse be the victim of a fire, it's unlikely the lost goods could be replaced in time, meaning the seller's entire season is marked by the financial losses. Products that only appear at certain times on the global market in the required quantity and quality, such as raw tobacco or coffee, pose a similar risk.

Special risks

Warehouses which store products under specially controlled conditions constitute special risks. They require extensive technical systems to maintain the requisite conditions for storage. It should be discussed whether the spoiling of goods (e.g., due to the failure of refrigeration systems), is to be included in the existing insurance contract.

Normally the spoiling of goods is covered by separate specialist insurance policies, but more frequently they are being included in additional clauses in conventional fire/all-risk insurance policies, even though they represent a different kind of exposure and are subject to completely different underwriting considerations.

Important considerations include: the sensitivity of the goods to spoiling, the affected technical measures for maintaining storage conditions, alarms alerting the failure of important technical systems, the availability of specialist personnel to carry out repairs as soon as possible, and the retention of important replacement parts for faulty systems.

A fire in a state-of-the-art robot distribution centre at the U.K. online food retailer quickly turned into a major fire as employees turned off the sprinkler system.

A distribution centre for the online food retailer where more than 30,000 orders were processed each week, burned for four days in February 2019. According to a news release,⁹ the fire was triggered by the malfunction of a loading unit for robots. The fire alarm system is said not to have worked, so the fire was only discovered by an engineer more than half an hour later. The employees first tried to extinguish the fire themselves and turned off the sprinkler system. Only when they realised that the fire was spreading further, did they start it again and alert the fire brigade. An earlier intervention of the fire brigade might have prevented a major fire. According to press reports, the fire caused damage in excess of GBP 100 million.¹⁰

Beyond fire risks

In addition to fire risks, warehouses may also be exposed to other insured risks that similarly can result in major damage or total loss. Examples include natural risks (e.g., flooding, heavy rain, wind, earthquakes) as well as damage caused by burst water pipes, theft, burglary or even confiscation. Which risks are included in the scope of cover of the insurance policy must be clarified. Depending on what's agreed, further questions for the final risk assessment could arise.

Summary

Warehouses of all types have the potential to cause major losses. Key factors for this are:

- High fire load (due to the stored material and/or the packaging)
- Type of storage, storage area size and height, and layout
- Lack of complex partitions and fire zones
- Lack of fire extinguishing systems
- Use of flammable construction materials in the building structure
- Significant business interruption risk

The risks can be insured, but careful underwriting is required to ensure the exposure is fully understood and is considered carefully. Of critical importance are:

- The contractual terms on which the insurance policy is based, including any additionally agreed special conditions (clauses)
- The agreed sum insured corresponds to the actual/effective value of the warehouse, and any additional initial risk items that have been agreed are factored into the definition of the potential maximum damage and the insurance premium calculation
- Knowledge of preventative fire control measures and their suitability to the risk exposure
- Whether any other insurance contracts for the insurance object in question exist (accumulative situation)

Warehouse risk underwriting checklist

Type of storage

- ✓ Racking, block storage, bulk storage, mixed storage, suspended storage, refrigerated building, high-bay racking, storage in galleries, hazardous goods storage?
- ✓ Products stored, packaging material and storage equipment used?
- ✓ Storage process: automated, manual?
- ✓ Continuous storage, intermediate storage, distribution warehouse?
- ✓ Warehouse dimensions (m², height) and location?
- ✓ Construction materials and components used?
- ✓ Presence of photovoltaic system on the roof?
- ✓ Refrigerated buildings: compressor room, coolant used (e.g., ammonia)?

Assets

- ✓ Value of the building and building equipment as well as storage facilities?
- ✓ Value of the stored products (annual average value, maximum value)?
- ✓ Seasonal considerations?
- ✓ Indemnification basis for stock: sale price, wholesale price, manufacturing costs, fixed price/agreed price, including or excluding tax?

Turnover cycle of warehouse inventory

- ✓ Annual, monthly, weekly?
- ✓ Constant, sporadic delivery to customers?
- ✓ Suppliers and customers?

Storage conditions

- ✓ Degree of packaging of goods?
- ✓ Packaging material and storage equipment used (e.g., pallets, cardboard boxes, plastics, etc.)?
- ✓ Sensitivity of goods to smoke, fire, moisture, water, heat, etc.?

Warehouse IT

- ✓ Purpose of IT?
- ✓ Required replacement time in the event of a claim?

- ✓ Backup procedures (e.g., hourly, daily, weekly)?
- ✓ Storage of backups?

Prevention/safety and security measures

- ✓ Structural measures (e.g., firewalls, distance to other buildings, fire-protected rooms, fire protection of openings, flooding protection, structural break-in protection measures, type of construction)?
- ✓ Technical measures (e.g., automatic fire alarm, automatic fire extinguishing system, smoke protection, burglar alarm system, alarm forwarding)?
- ✓ Operational protective measures (e.g., BCP, maintenance, order and cleanliness, smoking, plant security, fencing, employee training, etc.)?
- ✓ Defensive fire control measures (e.g., company/plant fire brigade, public fire brigade, hydrants, water supply, etc.)?
- ✓ Miscellaneous (e.g., the procurement period for buildings, contents, warehouse inventory, financial and order situation, expected downtimes after a loss, expected effects on customers/markets)?

Insurance exposure

- ✓ Maximum Foreseeable Loss (divided into PD and BI, costs and wages/wages)?
- ✓ Seasonality (worst case, best case, when, how long, description of observed scenario)?
- ✓ Maximum loss definition/scenario used by the inspector/broker/insurer versus the company's own?

Wording/insurance contract

- ✓ Standard wording or manuscript wording?
- ✓ Scope of insurance?
- ✓ Warehouse liability cover, all-risk cover, machine breakdown, ICOW/AICOW, unexplainable disappearance of warehouse inventory/inventory discrepancies/missing stock, stock put-through policy, spoiling of goods, theft/burglary?

- ✓ Agreed maximum loss limits, excess, waiting time, sublimits?
- ✓ Agreed costs/initial risk items?

Insured risks

- ✓ Named risks
- ✓ All-risk cover
- ✓ Sectoral cover
- ✓ Agreed additional cover

Business interruption

- ✓ Understanding of warehouse and distribution processes of the insured party?
- ✓ Existing bottlenecks and potential alternatives/replacement options (e.g., IT, transport/storage systems), delivery times for important systems?
- ✓ Stored goods (constant availability on the market, replacement procurement – constant or very limited possibility), re-procurement times?
- ✓ Turnover speed of stored goods over the course of a year?
- ✓ Seasonal peaks/distribution of warehouse inventory over the course of the year?
- ✓ Alternative storage options (e.g., own warehouses, third party providers, direct delivery from the producer to the consumer)?
- ✓ Consequences/effects to be expected in the event of a claim (delivery capability, financial impacts, additional expenses)?
- ✓ BCP/contingency plans available (up-to-date, regularly tested)?

Miscellaneous

- ✓ Claims history?
- ✓ Insurance accumulation (e.g., in harbours)?
- ✓ Natural risk exposure (e.g., flooding, earthquakes, storm)?
- ✓ Appeal of stored goods (in terms of likelihood of theft, exposure to burglary)?
- ✓ Subjective risk of the policyholder?
- ✓ Risk of arson?

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Endnotes

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