Fire Protection

IAMC Toolkit

Innovative Approaches for the Sound Management of Chemicals and Chemical Waste

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Introduction

The presentation explains the basics of fire ignition process and the objectives of the fire protection concept.

The reader will familiarize with the subject trough the illustration of construction, organization, technical and specific measures to be applied to reduce fire related risks.

Hazard Management

1. Risk Identification and safety	2. Transport and storage	3. Fire and explosion protection	4. Emergency response
1.1 Chemical classification and labelling	**2.1 Internal transport of chemicals**	3.1 Fire protection	4.1 Emergency response plan
1.2 Risk assessment	2.2 Internal pedestrian routes	3.2 Fire protection in welding and cutting operations	
1.3 Safety rules	2.3 Storage	3.3 Explosion protection	
1.4 Personal protective equipment		3.4 Container cleaning	
1.5 Skin protection			
1.6 Emergency escape routes			
1.7 Solvents, acids, bases handling			
1.8 Safety in gas tank handling			

Checklists

Contents

Introduction

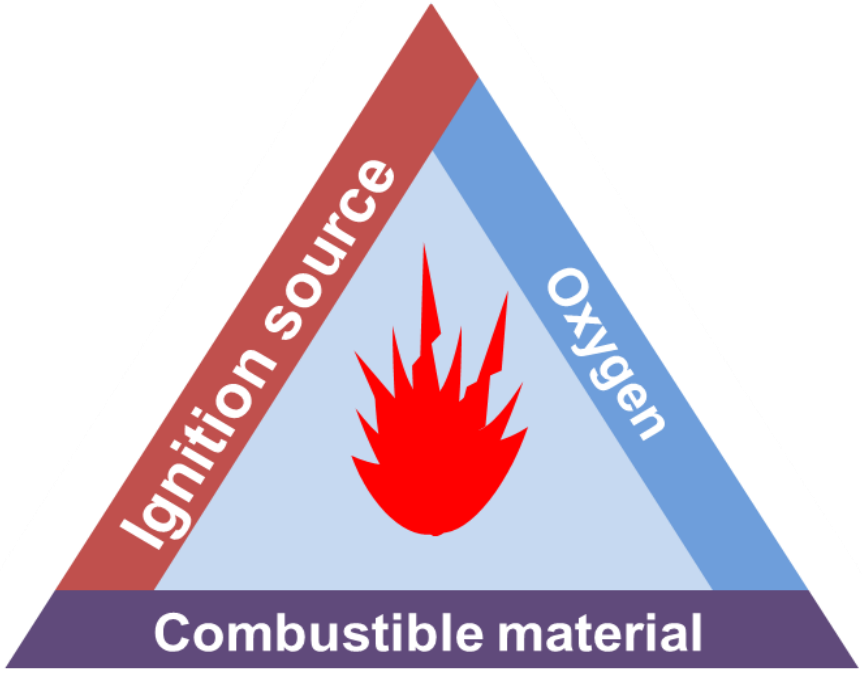
Fire Hazard Concepts – Fire, Smoke, Heat

When talking about fires and fire prevention, the smoke and heat induced by the fire also have to be considered.

Source: Londoño G.

Fire Hazard Concepts – Fire Triangle

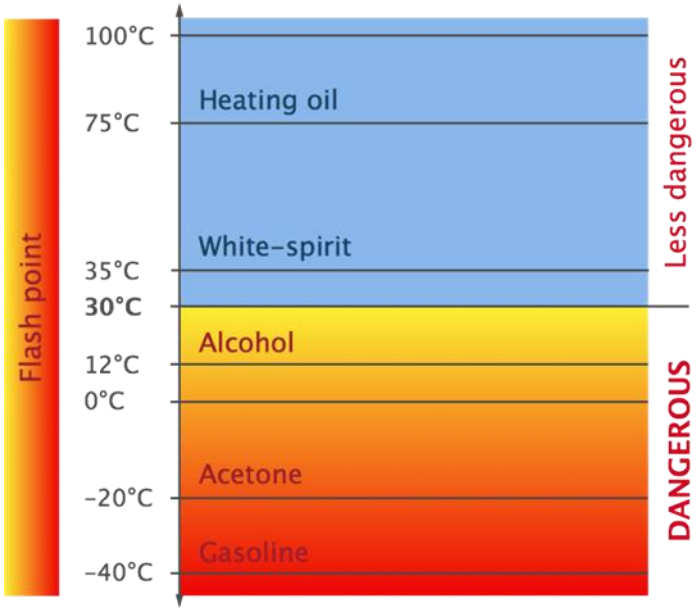
- The three elements a fire needs to ignite:



Source: based on ECA

Fire Hazard Concepts – Flash Point

- Flash point
  - The flash point is the lowest temperature at which a liquid releases enough vapours to form a potentially explosive atmosphere at the surface. With the presence of an ignition source, the mixture ignites. After ignition, the flame dies.



Source: based on FOEN

Objectives of Fire Protection

- Prevent fire appearance and fire/smoke propagation
- Protect property (movable and immovable) and the environment
- In case of a detected fire, allow an effective response
- Provide health protection to persons, rescue teams and animals through safe escape routes

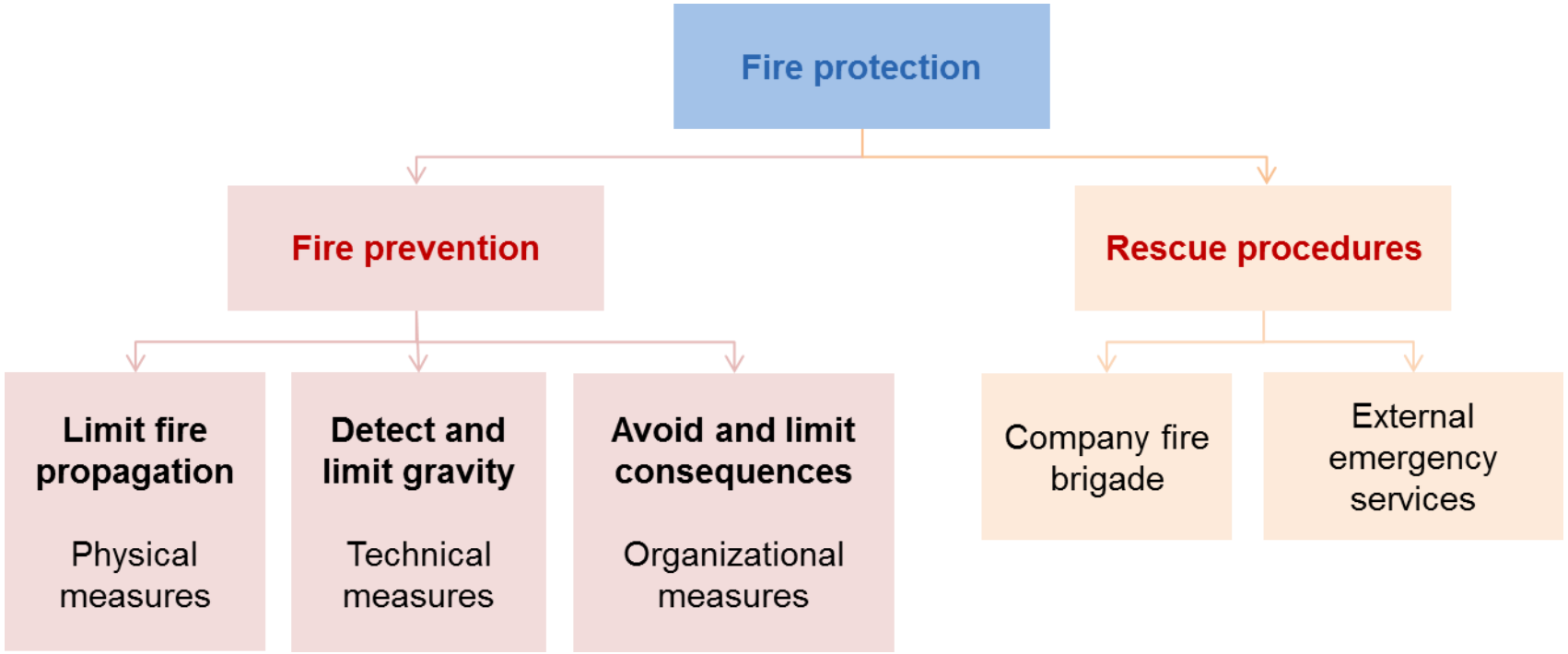
➢ Chain of fire protection measures (in order of priority)

1. Prevent **2. Detect** **3. Fight** **4. Learn**

Fire Protection Concept

Fire Protection Organization

- Must comply with national and regional legislation
- Fire protection includes two main aspects: fire prevention and rescue procedures



Fire Protection Concept (FPC)

- **What is a fire protection concept?**
  - "A basis for all measures aiming at improving fire protection" *Siemens, Fire Safety Guide*
  - It is the result of a methodological procedure where a range of essential protection measures (structural, technological, process-based, organizational) are planned taking into account the current situation, the identified hazards and the protection objectives.

Recommended for every company or industry

Mandatory for industries storing or processing any kind of flammable substances

Fire Protection Concept

Source: CSD

Hazard Inventory and Fire Risk Assessment

Hazard Inventory – Hazardous Materials

- First step of the FPC – Inventory of flammable, explosive and oxidizing materials (including gases under pressure) used in the company:
- Materials
- Quantities
- Storage conditions
- Handling
- Processing
- Disposal

Source: UN GHS 2013

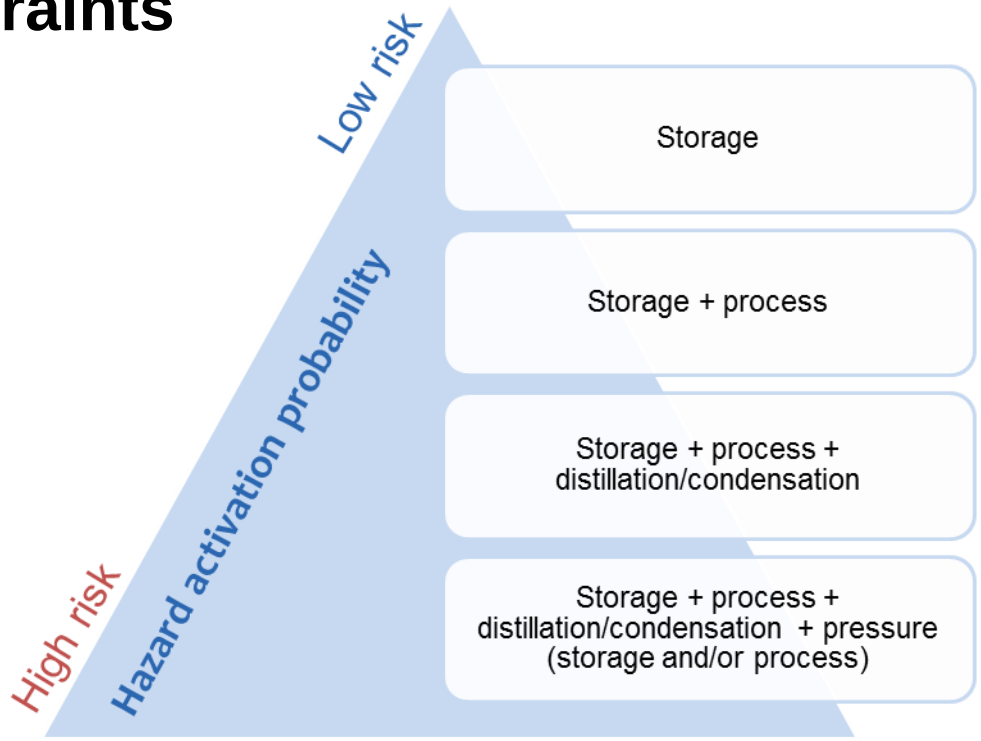
Hazard Inventory – Hazardous Materials

Hazard class	GHS[2] pictogram	Hazard statement codes
Explosive		H200 – Unstable explosive H201 – Explosive ; mass explosion hazard H202 – Explosive ; severe projection hazard H203 – Explosions ; fire, blast or projection hazard H204 – Fire or projection hazard
Flammable gases		H220 – Extremely flammable gas
Aerosols		H222 – Extremely flammable aerosol H223 – Flammable aerosol H229 – Pressurized container : may burst if heated
Oxidizing gases		H270 – May cause or intensify fire ; oxidizer
Gas under pressure		H280 – Contains gas under pressure ; may explode if heated
Flammable liquids		H224 – Extremely flammable liquid and vapor H225 – Highly flammable liquid and vapor H226 – Flammable liquid and vapor
Flammable solids		H228 – Flammable solid
Substances and mixtures which in contact with water emit flammable gases		H260 – In contact with water releases flammable gases which may ignite spontaneously H261 - In contact with water releases flammable gases
Oxidizing liquids or solids		H271 – May cause fire or explosion ; strong oxidizer H272 – May intensify fire, oxidizer

Source: based on ECA

Hazard Inventory – Ignition Hazard

- **Ignition Hazard : Probability of hazard realization based on the environmental context and related physical constraints**



Source: CSD

Hazard Inventory – Hazard Ignition

- The following internal and external causes can increase the probability of hazard ignition:

Internal	External
- Ignition sources - Shortage of facilities and missing or damaged fire safety equipment - Lack of organization - Lack of ability to respond to an emergency (lack of training)	- Arson - Natural disasters - Proximity of neighbouring buildings

Fire Risk Evaluation

- Based on the information gathered through the hazard inventory, the fire risk can be assessed.

Constraints	Largest Individual Quantity, LIQ (t), Total Quantity, TQ (t)							
	<0.5 LIQ	<1 TQ	0.5 - 1 LIQ	1-10 TQ	1 - 5 LIQ	10-30 TQ	5-10 LIQ	>30 TQ
Stored in tank, receiver, bulk containers, drums								
The above and processed in reactors								
The above and distilling, condensing								
The above and/or processing under pressure								
Category 1: Basic fire risk	Basic fire protection measures adequate							
Category 2: Medium fire risk	Additional fire protection measures are required							
Category 3: High fire risk	Additional fire protection measures are mandatory							

Source: based on CFPA Europe

Matrix valid for solvents with a maximum boiling point of 150°C

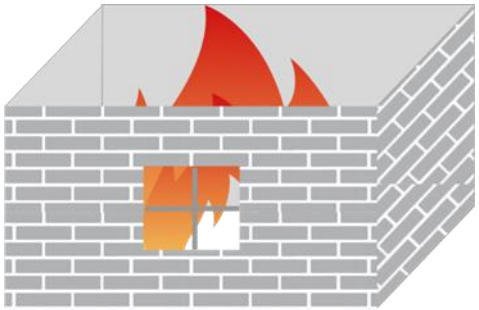
- The risk category will then be used to define the level of protection measures to be applied.

Risk Reduction Measures

- Construction Measures
- Technical Measures
- Specific Technical Measures
- Organizational Measures

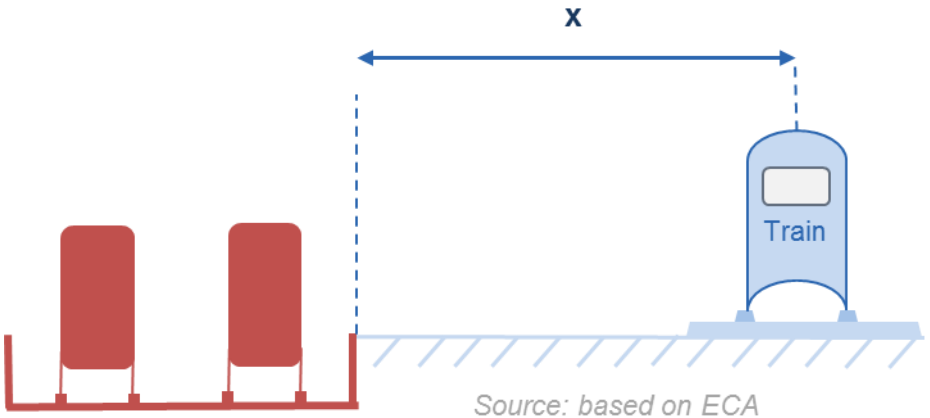
Risk Reduction Measures – Construction Measures

- The global purpose is to limit fire propagation by:
  - Using suitable construction materials
  - Following safety construction rules:
    - Safety distances between buildings/infrastructure/roads
    - Non-alignment of windows, etc.



Fire compartment

Source: CSD



Source: based on ECA

Construction Measures

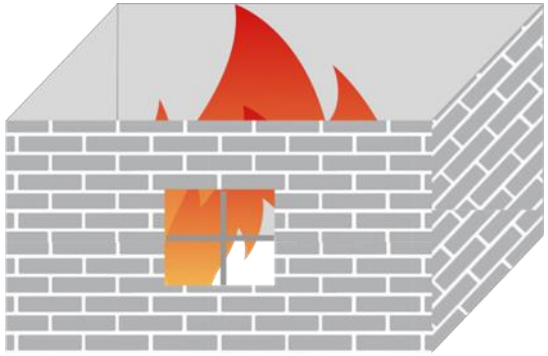
Physical measures	Fire risk		
	Basic	Medium	High
Respect security distances with other buildings (2,5 meters), especially for hazardous products storage rooms	X	X	X
Use non-combustible materials for building, especially for support structure and exterior walls	X	X	X
Separate the different kinds of activities in separate fire-compartments (administration, storage, production)	X	X	X
Limit the size of the fire-compartments, especially those with high fire hazard	X	X	X
Adapt the fire resistance of the compartments to the amount of flammable/ explosive products and the activation hazard	X	X	X
Provide enough secure escape routes	X	X	X
Install drainage and spill control systems designed to contain leakages and firefighting water	X	X	X

Source: based on CFPA Europe

Construction Measures – Fire-Proof Walls

- Fire-proof walls are barriers used to prevent the spread of a fire through premises and buildings.

- Depending on the type of protection wanted, fire-proof walls with a specific fire resistance period can be used.



Fire-proof walls

Source: CSD

Construction Measures – Fire-Proof Walls

Description	Resistance period
Separation between storage areas and vulnerable or important parts of the building used for non-warehousing activities	180 min
Separation between compartments inside a high-rack warehouse	180-120 min
Separation between compartments inside a warehouse	90 min
Self-supporting walls of a building, walls of escape routes and elevators	90 min
Exterior walls of a warehouse (if D ≤ 7m*)	90 min
Ceilings of storage compartments (vertical separation from other rooms)	90 min
Exterior walls of a warehouse (if D = 7-10 m*)	60 min
Roof constructions	≥30 min
Exterior walls of a warehouse (if D =10-20 m)	30 min
Segregation inside fire compartments	30 min

Source: based on SWISSI Process Safety Ltd.

** D corresponds to the distance between the exterior walls of a warehouse and the closest building.*

Construction Measures – Pillars/Beams

- To increase the fire resistance of a building's structure, pillars and beams can be protected.

Unprotected steel beam

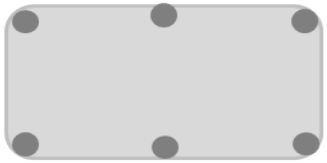
Fire resistance: 30 min

Coated steel beam (with 4 cm of gypsum)

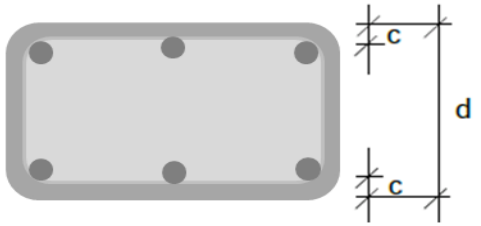
Fire resistance: 60 min

Source: CSD

Unprotected reinforced concrete beam



Coated reinforced concrete beam (with c = 3 cm of gypsum, d =24 cm)

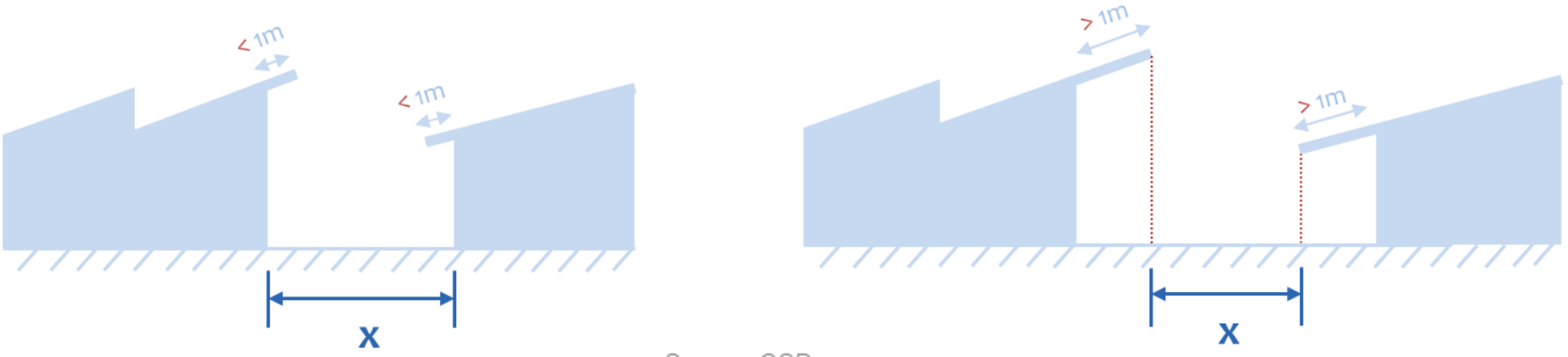


Fire resistance: 90 min

Construction Measures – Safety Distances

- The safety distance between two independent buildings depends on :the nature of the façades

- Two incombustible façades: x = 5 m
- An incombustible façade and a combustible façade: x = 7.5 m
- Two combustible façades: x = 10 m



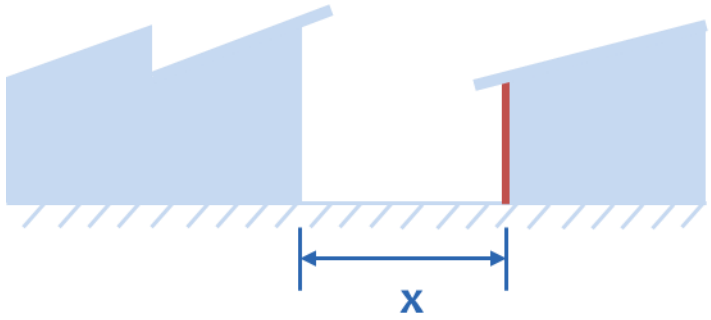
Source: CSD

Construction Measures – Safety Distances

- If the safety distances are not observed, compensation measures should be taken:

1.Treatment of exterior walls

- Build at least one fire resistant façade
- Create surfaces without openings in masonry (e.g. brick up a window)

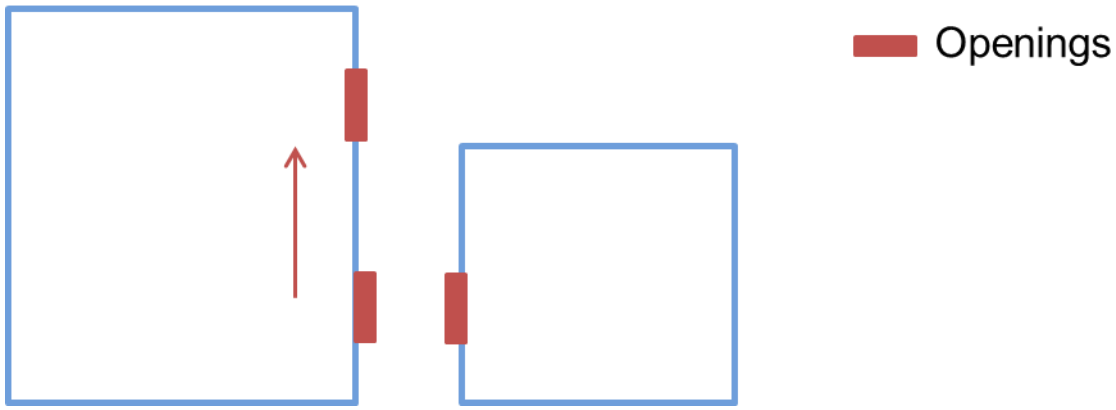


Source: CSD

Construction Measures – Safety Distances

2.Treatment of the roof undersides

Apply a fire resistant coating to the eaves

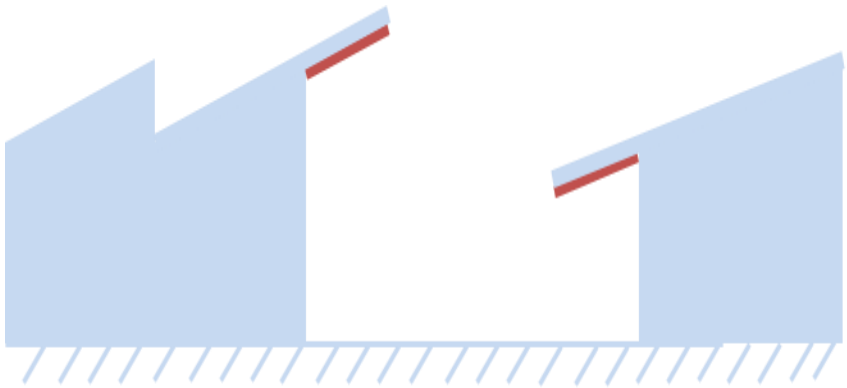


Source: based on ECA

Construction Measures – Safety Distances

3. Treatment of the roof undersides

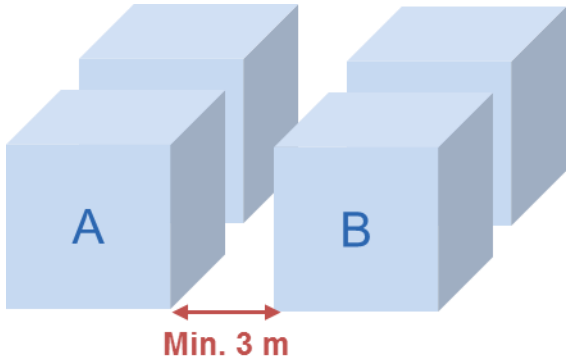
- Apply a fire resistant coating to the eaves



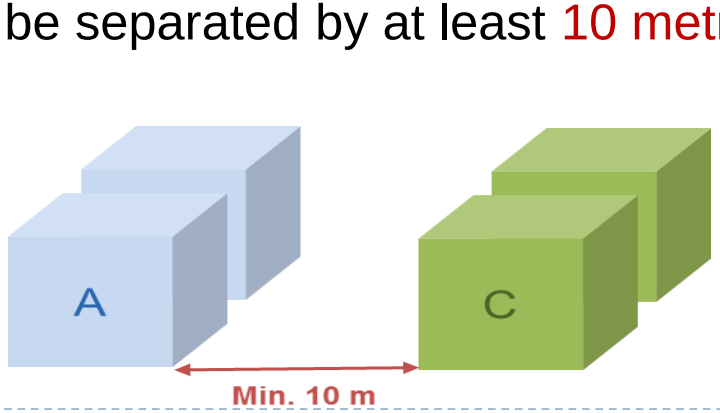
Source: based on ECA

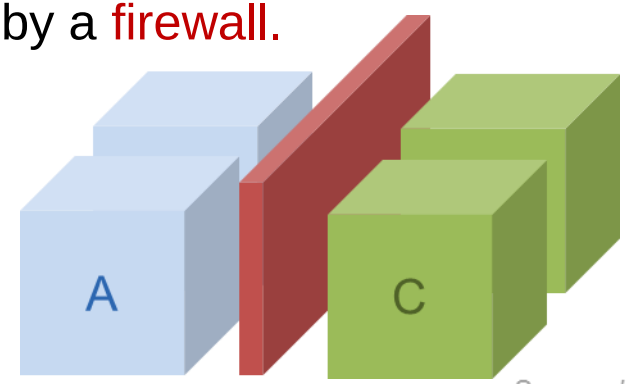
Construction Measures – Storage of Hazardous Material

- For compatible substances (A and B), storage compartments should be divided into storage subareas separated by at least 3 metres.



- For incompatible substances (A and C), storage compartments should be separated by at least 10 metres or by a firewall.





Source: based on ECA

Construction Measures – Flammable Liquids: Danger Classes

Danger classes	Description	Examples
F1	Liquids with a **maximum flash point of 21°C**	Gasoline, acetone, cellulose thinner
F2	Liquids with a **flash point higher than 21°C and lower than 55°C**	Petroleum, mineral oil
F3	Liquids with a **flash point higher than 55°C and lower than 100°C**	Extra-light fuel oil, diesel
F4	Liquids with a **flash point higher than 100°C**	Lubricating oils, vegetable oils
F5	Liquids with **low flammability**	Halogenated hydrocarbons
F6	**Incombustible** liquids	Water

Construction Measures – Storage of Flammable Liquids

- The safety distance between outdoor storage areas (tanks, tank farms, etc.) or warehouses containing dangerous liquids and neighbouring buildings depends on several factors.

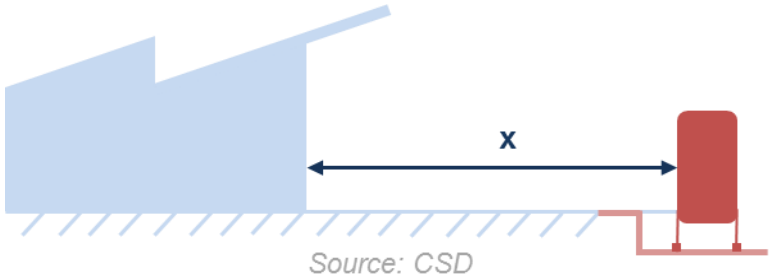
Construction type	Neighbourhood building activity		
	Low risk(1)	Medium risk(2)	High risk(3)
Construction at least fire-resistant for 1 hour and closest wall without openings	Low	Low	Low
At least incombustible	Low	Medium	High
Combustible	Medium	High	High

Examples:
(1) Production, treatment and storage of incombustible substances
(2) Engineering workshops, offices, apartments
(3) Storage and treatment of dangerous substances, corporate accommodation, buildings with many occupants

Construction Measures – Storage of Flammable Liquids

- Safety distance between unburied tanks containing flammable liquids and neighbouring buildings/installations:

Neighbouring risk	Safety distance (in metres) between unburied tanks and neighbouring buildings/installations					
	Danger classes **F1 and F2**			Danger classes **F3 to F5**		
	Tanks resistant to overpressure	Vertical tanks		Tanks resistant to overpressure	Vertical tanks	
		Up to 500 m^3	Over 500 m^3		Up to 500 m^3	Over 500 m^3
Low	12 m	20 m	30 m	6 m	10 m	15 m
Medium	16 m	25 m	35 m	8 m	12 m	18 m
High	20 m	30 m	40 m	10 m	15 m	20 m

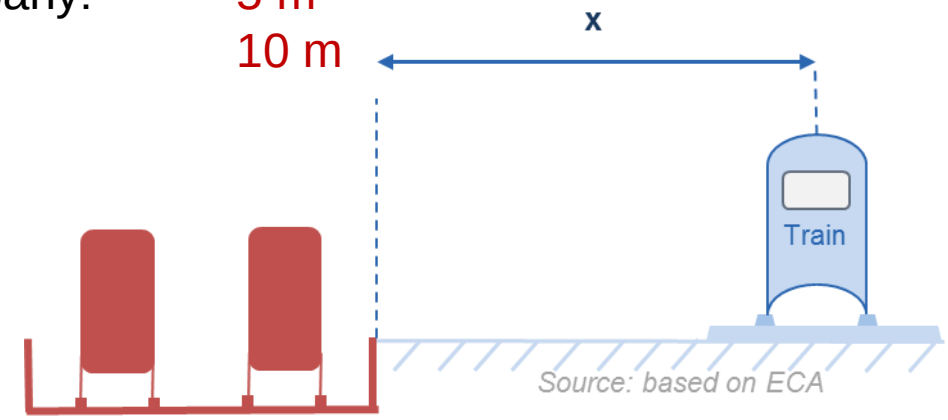


Source: CSD

Construction Measures – Storage of Flammable Liquids

- Safety distance between the edge of the retention basin and roads, high voltage lines, railways or dispensers of liquid fuels:

Public roads:	10 m
High voltage lines:	10 m
Railways	
Main routes:	15 m
Secondary routes:	10 m
Route owned by the company:	5 m
Dispenser of liquid fuels:	10 m



Source: based on ECA

Construction Measures – Liquefied Petroleum Gas Installations

- Safety distances (metres):

Neighbouring risks	Liquefied gas installations			
	Fixed tanks, above ground level*	Bottle storage	Transfer station	Filling/distribution station
	Content (m^3): up to 15	Content (kg): 50-500		
Low	1 m	--	--	--
Medium	5 m	5 m**	10 m	5 m
High	10 m	10 m	10 m	10 m

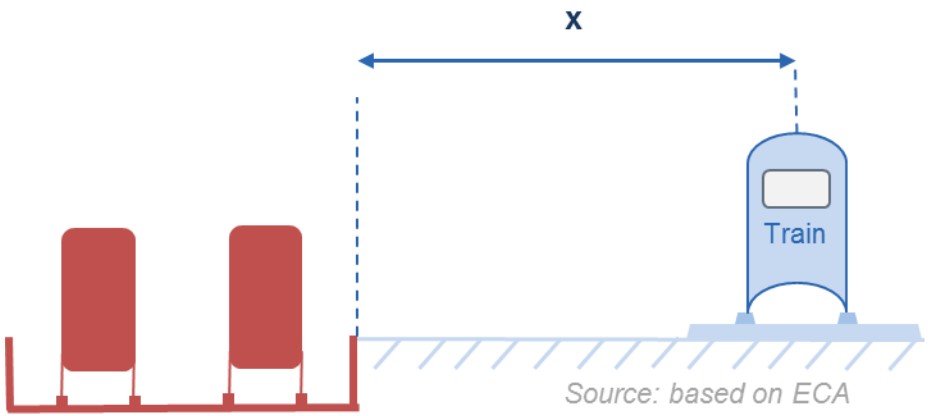
Notes:

* For tanks covered by earth but with an exposed portion, the safety distance should be calculated from the exposed part. If the tank is completely covered, the distance between the tank wall and any other object should be at least 1 metre.

** For quantities below 250 kg, there is no required minimum distance, provided that the exterior wall is incombustible and does not present any openings in the storage zone. For the storage of composite plastic bottles, the exterior wall of the storage area should be able to resist fire for 1 hour.

Construction Measures – Liquefied Petroleum Gas Installations

- In principle, outdoor installations of liquefied gas should observe the following safety distances:
  - Public roads: 5 m
  - High voltage lines: 10 m
  - Railways
    - Main routes: 15 m
    - Secondary routes: 10 m
    - Route owned by the company: 5 m
  - Dispenser of other liquid fuels: 10 m



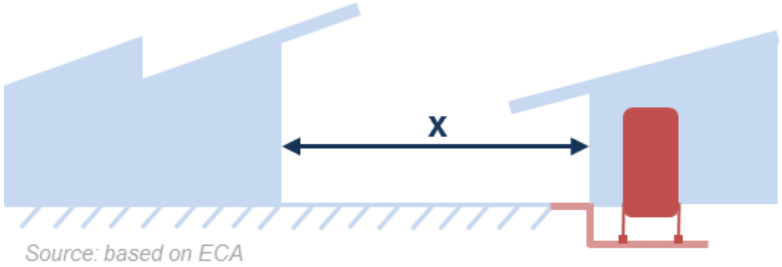
Source: based on ECA

Construction Measures – Exercise

What physical measures can you take to limit the propagation of a fire?

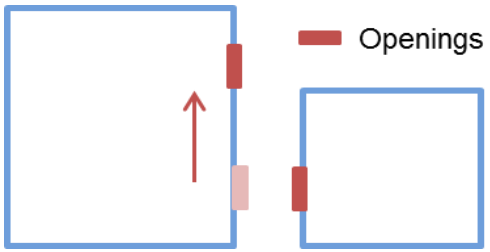
Construction Measures – Exercise

Safety distances



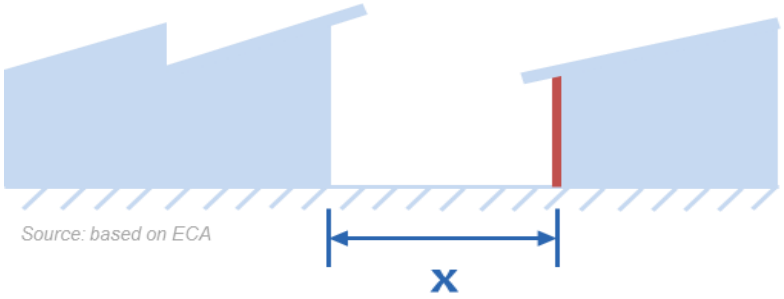
Source: based on ECA

Openings



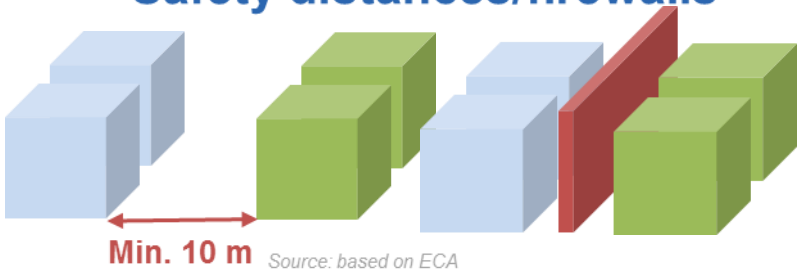
Source: based on ECA

Treatment of exterior walls



Source: based on ECA

Safety distances/firewalls



Source: based on ECA

Risk Reduction Measures

- Construction Measures
- Technical Measures
- Specific Technical Measures
- Organizational Measures

Risk Reduction Measures – Technical Measures

- The global purpose is to detect the fire, alert the persons in danger and activate fire protection equipment by:
  - Using alarms, fire or gas detection devices
  - Using water, extinguishers or sprinkler systems

Fire alarm
Source: CSD

Extinguisher
Source: CSD

Sprinkler
Source: CSD

Technical Measures

Technical measures	Fire risk		
	Basic	Medium	High
Provide air handling and smoke exhausting systems (automatic + manual)	X	X	X
Provide manual firefighting equipment in adequate numbers (internal fire hydrants, fire extinguishers, etc.)	X	X	X
Provide manual alarm points	X	X	X
Provide an automatic fire detection system		X	X
Provide an automatic fire extinction system (with adequate extinguishing agents)			X
Provide a gas detection system			X
Install a lightning rod for all production building with significant amount of flammable/explosive products	X	X	X
Install a security lighting system	X	X	X
Provide a sufficient fire water capacity	X	X	X

Source: based on CFPA Europe

Risk Reduction Measures – Technical Measures

Sprinkler examples

Source: ECA

Technical Measures – Surveillance Area

1. Fire

- For a total surveillance, the fire detection installations should cover the entirety of buildings and installations and should be designed according to the following factors:
  - Number of occupants
  - Number of storeys
  - Type of construction
  - Location
  - Area and its allocation
- Partial surveillance should at least cover the escape routes and other critical premises/installations.

When installing sprinklers in storage premises, the type of storage, the height of stacks and the packaging mode have to be taken into account for effective sprinkler operation.

Source: Londoño G.

Technical Measures – Surveillance Area

2.Gas

- Gas detectors should ensure the surveillance of a room if the location and the number of potential gas leak points are not predictable.

- If gas leak points can be clearly located, monitoring the objects is sufficient.

Technical Measures – **Control and Signalling Panels**

Fire and gas

- The fire and gas detection installations should be equipped with a standardized control panel.
- The warning light of the fire and gas detection installations should be located in the vicinity of the control panel.
- The fire and gas detection installations should be well-maintained to ensure their functioning at all times and should also be periodically checked (responsibility of the owners and operators).

Control panel

Source: ECA

Technical Measures – **Alarms**

Fire

- Any reaction from the fire detection installations should trigger an internal and external alarm. The external fire alarm should be directly transmitted to the official fire alarm centre.

- The operators of installations should develop an alarm response plan to ensure that the persons at risk are alerted.

Fire alarm

Source: CSD

Technical Measures – **Alarms**

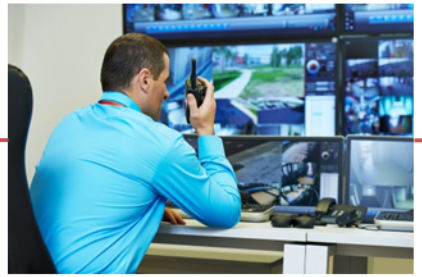
Fire

Manual or automatic fire detector

Source: CSD

Internal alarm

Source: Shutterstock



External alarm

Source: Shutterstock

Source: UNIDO

Technical Measures – **Alarms**

Gas

- Any reaction of a gas detector should trigger an internal alarm (clearly identifiable as a gas alarm: sound and light), and alert a permanently occupied office.

- Company management should develop an alarm response plan to ensure that every person in danger is alerted.

Gas detector

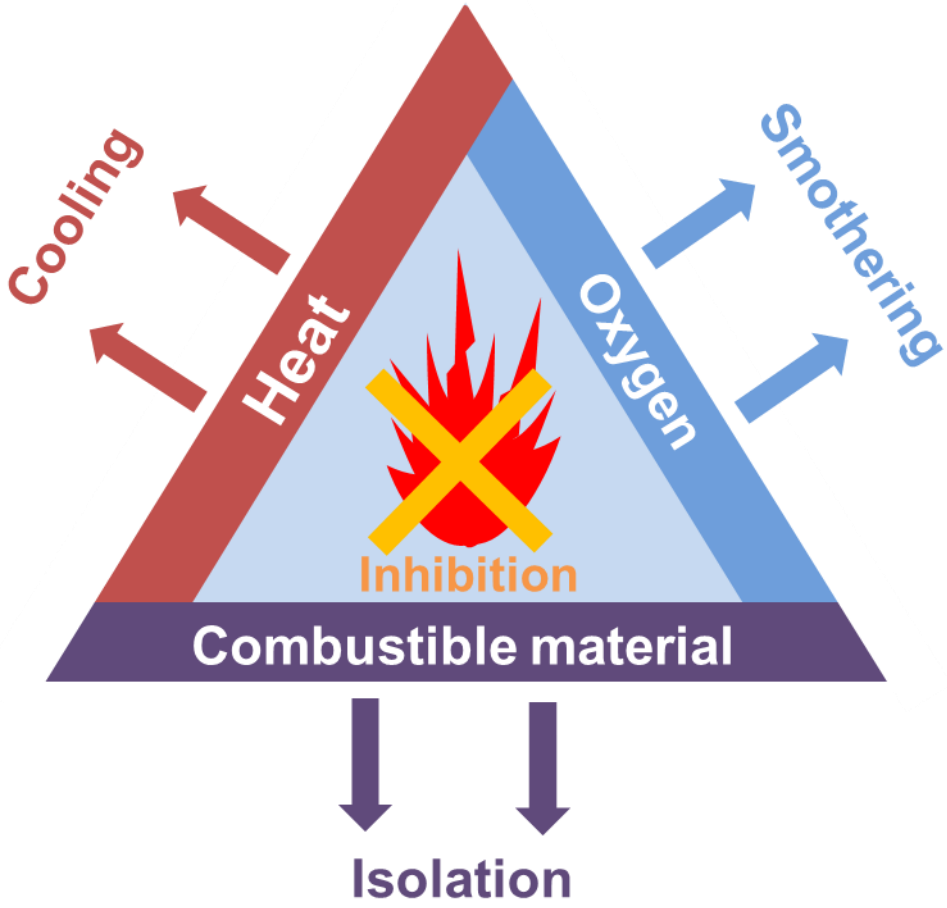
Source: UNIDO

Internal alarm

Source: Shutterstock

Internal organization

Technical Measures – Extinction Procedures



Source: based on ECA

Fire Classes

Fire classes	Combustible material	Aspect	Examples
A	Solid substances that do not melt	Embers and flames	Wood, paper, textiles, coal, synthetic materials that do not melt
B	Liquids, solid substances than can melt	Flames	Solvents, hydrocarbons, wax, synthetic materials that can melt
C	Gas	Flames	Propane, butane, acetylene, natural gas, methane, hydrogen
D	Metals	Embers	Sodium, magnesium, aluminium

Technical Measures – Extinguishing Agents

Extinguishing agent	Fire class			
	A	B	C	D
Water (full jet)	++	-	-	---
Water (spray)	++	±	-	---
Water with a wetting agent	++	±	-	---
Foam	+	+	-	---
ABC Powder	+	+	+	---
BC Powder	-	++	++	---
D Powder	-	-	-	++
Carbon dioxide (CO_2)	-	+	±	-

++ very good
+ good
± relatively good
- bad
--- DANGEROUS

Technical Measures – Portable Fire Extinguishers

Extinguisher agent

User instructions

Weight

Precautions

Supplier name

Product ID

Type

Revision date

Fire class

Local authority certification, if any

Source: ECA

Technical Measures – Portable Fire Extinguishers

- Chose the correct extinguishing agent considering the expected fire class
- Define the required number of portable fire extinguishers based on the following table (Swiss recommendation, AEAI):

	One extinguisher for every	Max. distance between any point of the location and the closest extinguisher
Buildings with low fire risk (administration, offices, schools, houses)	600 m^2	40 m
Buildings with medium fire risk (e.g. machine construction factories, malls, plastic industry, paper manufacture plants)	300 m^2	30 m
Buildings with high fire risk (activities with fire or explosion risks: e.g. wood works, cotton mills, paint industry)	200 m^2	20 m

Technical Measures – Fire Hoses

- The hose must be made of rubber, resist a service pressure of 18 bars and its length must not exceed 40 metres.
- The coating of the pipes that feed the hose must be made of non-flammable material.
- The embedded pipes must be coated with a material capable of resisting fire for 30 minutes (EI 30 (icb), European standard).
- The static pressure upstream of the hose must be 3 bars. The minimum water flow must be 16 l/min.
- The pump system must be independent.
- The hoses should be located in the escape routes, close to the emergency exits.

Source: ECA

Technical Measures – Sprinkler Station

- The sprinkler station should be located on the ground floor or in the first basement in separated premises. They should be able to resist fire for at least 1 hour.
- The water quantity and pressure depend on the characteristics of the sprinklers. Water supply should be guaranteed at all times to ensure an adequate response in case of a fire.
- In terms of water quantity, the sprinkler system should be able to provide water continuously at an appropriate pressure for a minimum of 1 hour in case of a fire.
- The sprinklers should be connected to the public water distribution system and, if available, to a company-owned reservoir.
- The access path to the sprinkler station should be indicated, protected. and safely accessible

Source: ECA

Technical Measures – Sprinkler Station

Exercise

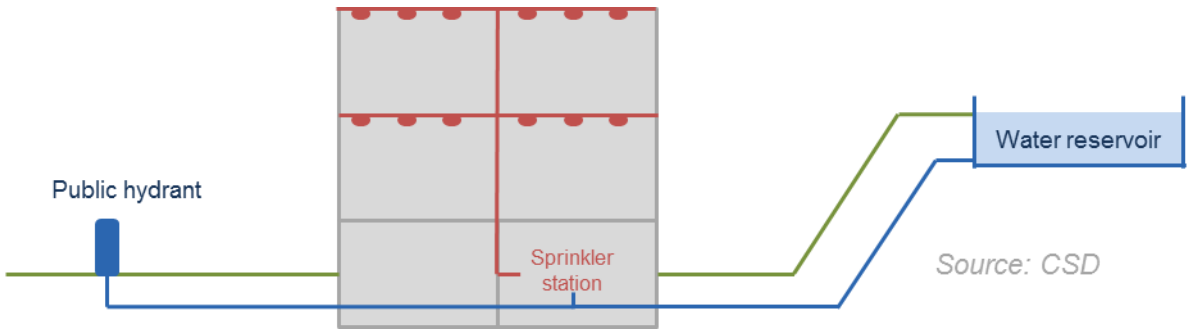
The public water distribution system can provide water at a pressure of 2.5 bars with a flow rate of 16 l/min.
The design of your sprinkler system indicates that you need to provide hydrants with a 20 l/min water flow at a pressure of 2.5 bars to ensure a proper response in case of a fire.

Can the public water distribution system provide enough water?
If not, what are the possible solutions to meet the requirements of your sprinkler system?

Technical Measures – Sprinkler Station

The water flow of the public hydrants is lower than required for the sprinkler system.
This implies that, in case of a fire, there will **not be enough water** available if only the public hydrants are used.

Solution: The company should build a water reservoir to meet its water needs.



Technical Measures – Smoke and Heat Extraction

Source: Londoño G.

Technical Measures – Smoke and Heat Extraction

What does the smoke consist of?

- Combustion gases (CO_2, H_2O, CO, NO_x, HCN, etc.)
- Unburned particles (soot)
- Incombustibles (ashes)

Source: Londoño G.

Why should we extract smoke?

- Smoke represents a danger for persons (visibility, intoxication, burns) and for **buildings and goods** (damage, fire propagation).

Technical Measures – Smoke and Heat Extraction

What are the objectives of smoke and heat extraction?

- Evacuating smoke and heat out of the buildings in a controlled way
- Allowing occupants to reach a safe place by using the escape routes
- Facilitating the work of the rescue teams (rescue of persons at risk, firefighters)
- Limiting the thermal stress on infrastructure and goods
- Reducing the damage resulting from the fire gases and thermal combustion products

Technical Measures – Smoke and Heat Extraction

Where should smoke and heat be extracted?

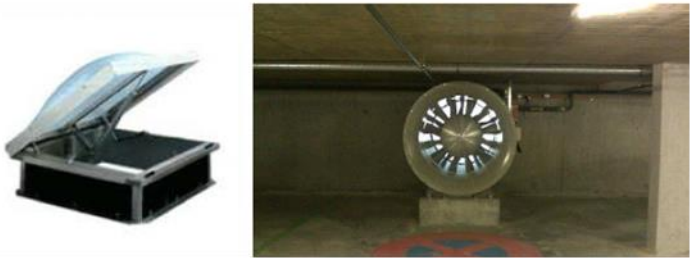
- In every building, installation and fire-proof compartment

- In staircases:
  - Always if the building accommodates persons or includes premises suited for a large number of occupants
  - Optional for administrative/industrial buildings depending on the configuration of the building: Staircases should be equipped if they connect more than three storeys and if the smoke and heat vents are not large enough on each storey.

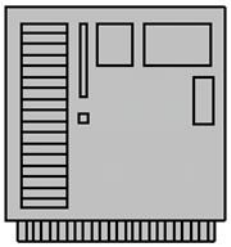
Technical Measures – Smoke and Heat Extraction

Components of smoke and heat extraction systems

Smoke exhaust ducts



Smoke extraction (outlets, ventilators)



Safety power supply

Air duct (door, opening)

Smoke alarm
(connection to fire brigade)

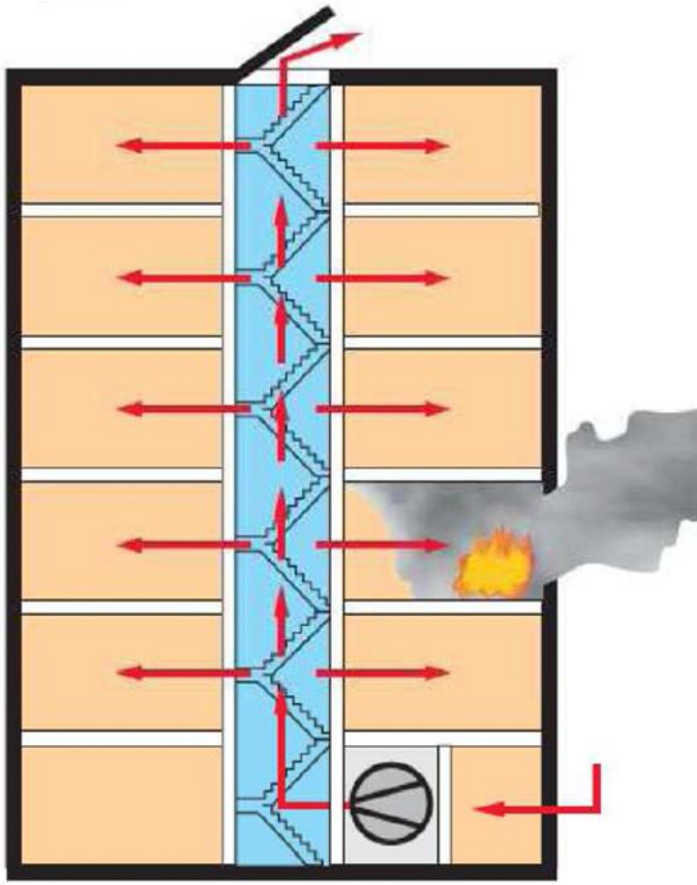
Source: ECA

Technical Measures – Smoke and Heat Extraction

Mechanical installation for smoke and heat extraction

Source: ECA

Booster fan installation



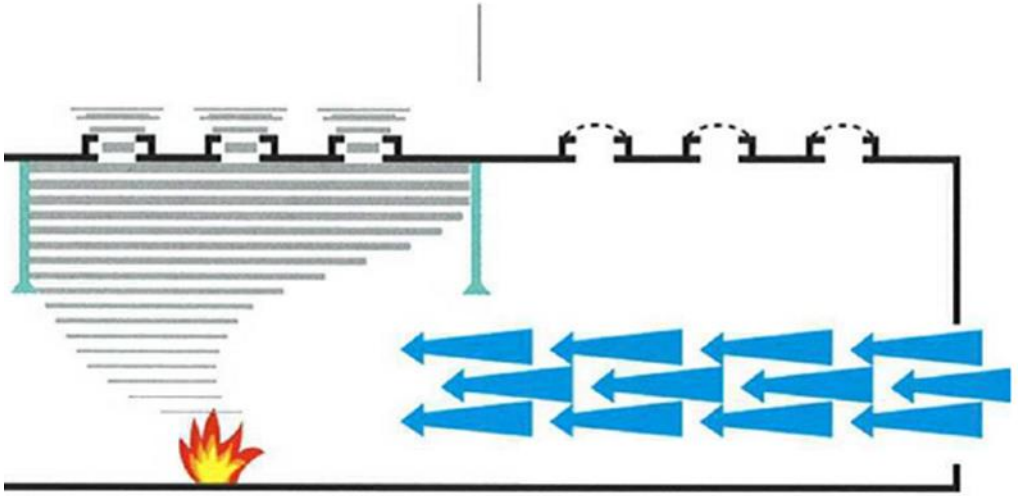
Source: ECA

Technical Measures – Smoke and Heat Extraction

Natural ventilation

Source: ECA

Smoke curtains

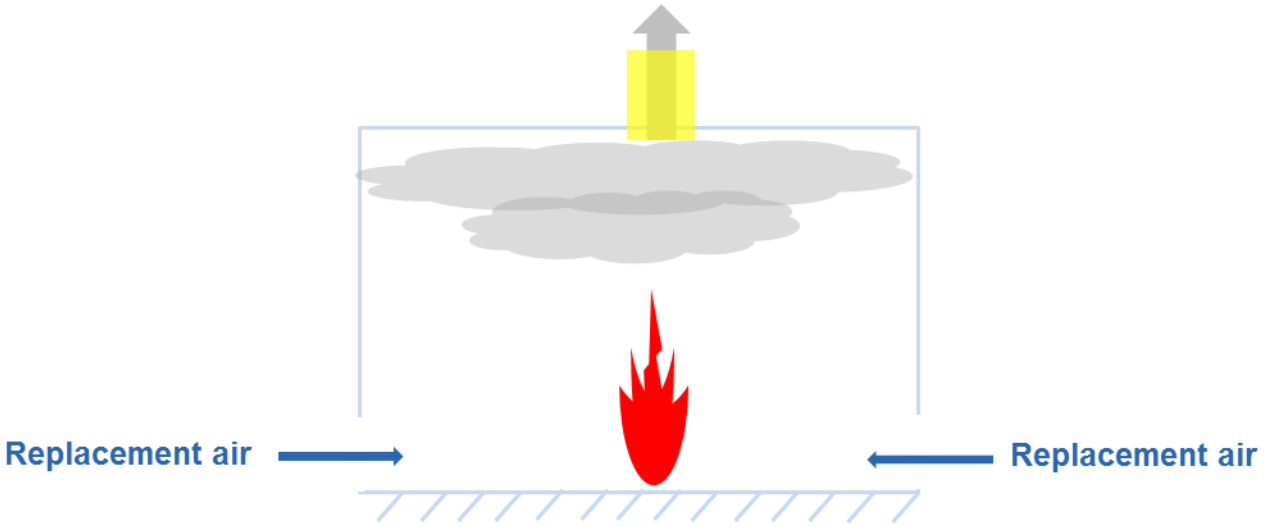


Source: ECA

Technical Measures – Smoke and Heat Extraction

Air replacement

The openings allowing the entry of replacement air (openings in doors, walls and windows) should be located near the ground. Their dimensions should be at least equal to the extraction openings.



Source: based on ECA

Risk Reduction Measures

- Construction Measures
- Technical Measures
- Specific Technical Measures
- Organizational Measures

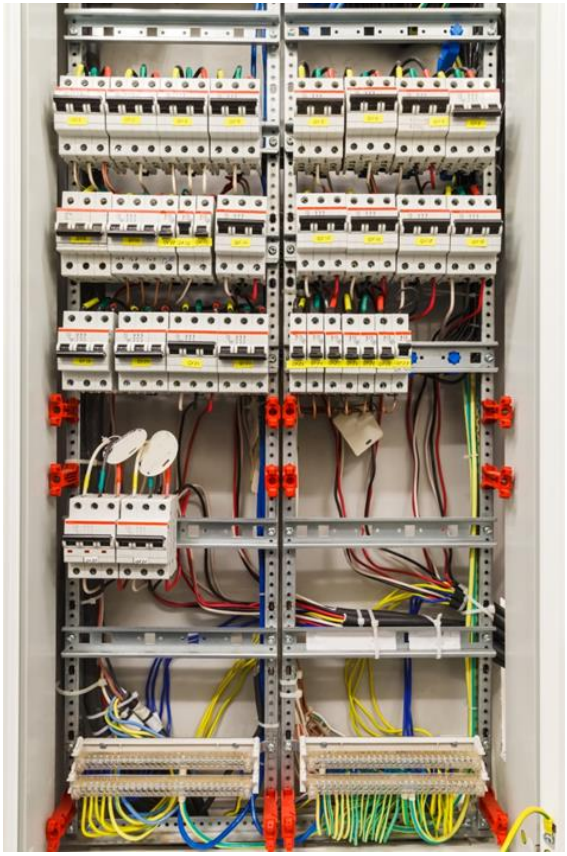
Risk Reduction Measures – Open Fire

- What are the recommendations for **open fires?**
  - Danger for persons and goods must be excluded.
  - No flammable substances should be used or stored in the vicinity of an open fire.
  - Every open fire should be supervised until it is completely extinct.
  - A fire may only be lit with flammable substances if there is no danger of fire propagation and explosion.
  - Do not spray liquids presenting a fire hazard into the fire or on incandescent materials.
  - Candles should be fixed in appropriate and incombustible supports.

Source: Suva

Risk Reduction Measures – Electrical Installations

- What are the recommendations for **electrical installations?**
  - Resistance to thermal, chemical and mechanical stress.
  - Use of materials that do not generate harmful fire by-products (no PVC)
  - Transforming equipment: risk of failure (electrical breakdown, generation of toxic products)



Source: Shutterstock

Risk Reduction Measures – Electrical Equipment

- What are the recommendations for **electrical equipment?**
  - Electrical equipment should be installed, used and maintained in such a way to prevent disturbances (thermal phenomena, electric arcs, etc.).
  - Electrical equipment presenting defects should not be used nor switched on.
  - Soldering irons and similar equipment should be placed on incombustible supports.

Source: Shutterstock

Risk Reduction Measures – Electrical Devices

- What are the recommendations for **electrical devices?**
- Electrical devices:
  - Should not be able to over-heat or set fire to objects/goods
  - Should not be used for other purposes than the ones they were conceived for
  - Can only be used in zones exposed to a fire/explosion risk if they are suited for such a use and if they are placed in an appropriate way

Risk Reduction Measures – Hazardous Substances

- What are the recommendations for hazardous substances?
  - It is forbidden to handle substances presenting a fire/explosion hazard next to:
    - Open fires
    - Thermal installations
    - Electrical heating appliances
    - Spark-producing installations
  - Oil, grease and similar substances must not be heated without supervision.
  -
  - Paraffin wax, furniture polish and similar substances should be heated in a water bath to avoid any fire hazard.

Risk Reduction Measures – Smoking

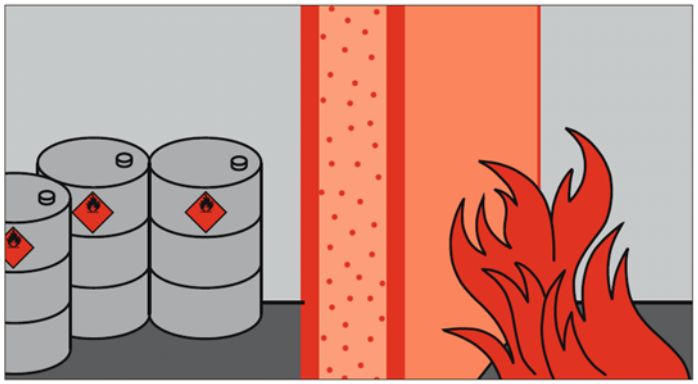
- Smoking is prohibited in areas where substances presenting a fire/explosion hazard are stored, sold, handled and in areas where, for other reasons, the fire hazard is significant.
- Company management should clearly indicate the areas where smoking is prohibited.
- In buildings and installations open to the public, as well as in industrial and crafts enterprises, appropriate cigarette-end receptacles should be placed in areas where smoking is permitted and near smoke-free zones.

Risk Reduction Measures – Storage and Waste Disposal

- Flammable liquids and containers holding flammable gases should be kept away from heating systems, cookers and similar electrical installations.
- Combustible materials should not be placed on top of energy-consuming appliances such as drying/heating systems, cooking systems, lamps, etc.
- Combustible waste should be removed from working areas and stored in separate fire-proof premises, silos or outdoors in appropriate locations.

Risk Reduction Measures – Storage and Waste Disposal

- It is forbidden to store easily flammable substances in the vicinity of electrical control systems, safety systems and similar installations.
- They should be stored outdoors at an appropriate distance from the buildings and installations or indoors with an effective ventilation system in fire-resistant compartments.
- Unauthorized staff should not be allowed to access the fire-proof compartments



Source: Suva

Risk Reduction Measures

- Construction Measures
- Technical Measures
- Specific Technical Measures
- Organizational Measures

Risk Reduction Measures – Organizational Measures

Organizational measures	Fire risk		
	Basic	Medium	High
Provide a preventive maintenance program for all equipment, including fire protection equipment	X	X	X
Name a trained security responsible	X	X	X
Organize an employee training program		X	X
Organize a visitors training program			X
Provide an escape and emergency plan		X	X
Organize escape exercises with local emergency services		X	X

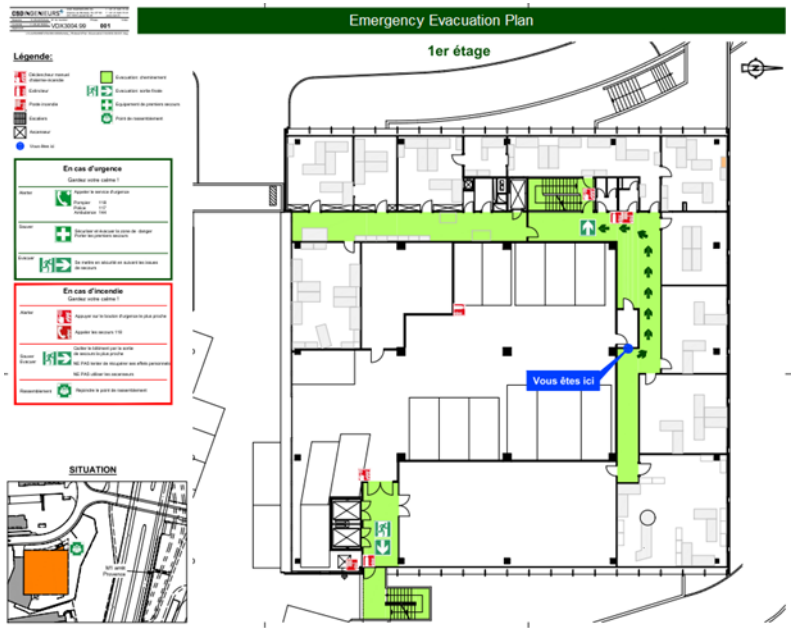
Source: based on CFPA Europe

Risk Reduction Measures – Organizational Measures

- The global purpose is to avoid and limit the consequences of a fire by:
  - Guaranteeing the safety of persons and goods
  - Keeping escape routes free of obstacles
  - Providing training to employees and disseminating the guidelines to be followed in case of a fire
  - Ensuring that the fire detection equipment is always operational
  - Providing areas of refuge
  - Conducting periodic inspections of the installations
  - Remedying defects

Risk Reduction Measures – Organizational Measures

- Principles:
  - Any person in charge of employees should make sure that they are trained and act with the required precaution.
  - Any person discovering a fire or a critical situation that might lead to a fire should immediately alert the fire brigade and the persons at risk.

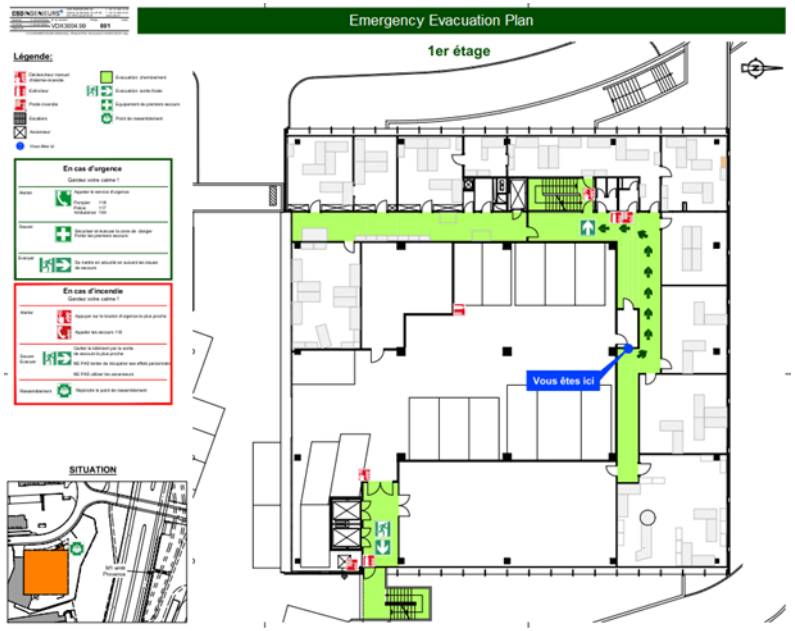


Source: CSD

Organize evacuation drills to practise the coordination of the protection measures.

Risk Reduction Measures – Emergency Plan

- The emergency plan should include information about:
  - Allocation of tasks
  - Particular fire hazards
  - Escape routes
  - Access ways for firefighters
  - Fire resistance of the supporting structures, fire compartments and fire protection equipment



Source: CSD

Risk Reduction Measures – Training and Practice

- Regular training of staff should be organized to address the following items:
  - Fire risk reduction measures taken by the company
  - Roles and responsibilities of the employees in terms of prevention of fire hazards
  - Emergency plan, etc.
  -
- Fire drills should be organized together with the local rescue services to practise the evacuation of the premises in case of an accident.

Risk Reduction Measures – Safety Managers

- If the fire hazards, the number of employees, the type or dimensions of the buildings/installations require it, safety managers should be designated and trained.

- They are responsible for fire safety and should ensure that:
  - Fire protection measures are observed (emergency plan, buildings, installations and operations)
  - Fire detection systems are operating properly
  - Maintenance is carried out to correct the defects

Organizational Measures – Exercise

What to do in case of a fire?

Sort your actions by order of priority.

Source: Londoño G.

Organizational Measures - What to Do in Case of a Fire?

1. Call the fire brigade (Who – Where – What)

2. Evacuate the premises

3. Close doors and windows

4. Fight the fire (extinguisher + cover)

5. Guide and inform the firefighters as soon as they arrive

Key messages

- The three elements a fire needs to ignite: oxygen, combustion material and an ignition source.
- Chain of fire protection measures is composed by the sequential actions : prevent, detect, fight, learn.
- To avoid and limit the consequences of a fire risk Reduction Measures should be implemented : they can be constructive, technical and organizational.

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- D5_2_Checklist Fire Prevention, Switzerland, 2015

Images

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