SAFETY AND RISK MANAGEMENT

3rd Stage

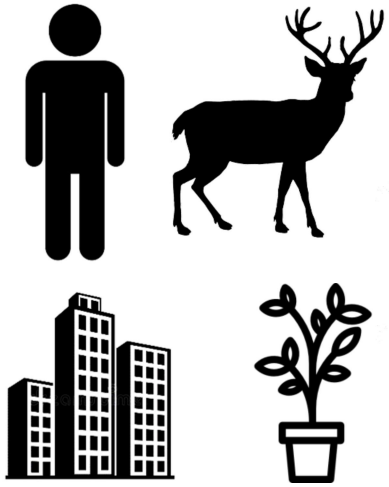
Polymers and Petrochemicals Engineering Dept.

By: MSc. Ismaeil R. Alnaab

Safety and risk management Course Topics	
Week No.	**Subject**
Week 1	Concepts of Hazard, Exposure, Risk, Accident and Safety
Week 2	Hazard area classifications, zones, identification and control
Week 3	Hazardous Area Classification Drawing
Week 4	Ingress Protection (IP) and impact resistance rating (IK)
Week 5	Explosion protection concepts
Week 6	Explosion protection codes and examples
Week 7	Personal Protective Equipment (PPE), and Hat classifications
Week 8	Safety in Automobile, In vehicle Monitoring System (IVMS)
Week 9	First aids and extinguisher classifications
Week 10	Safety in handling and storage of chemicals
Week 11	RISK Management

Week 1

Concepts of Hazard, Exposure, Risk, Accident and Safety

HAZARD	EXPOSURE	RISK	ACCIDENT
			

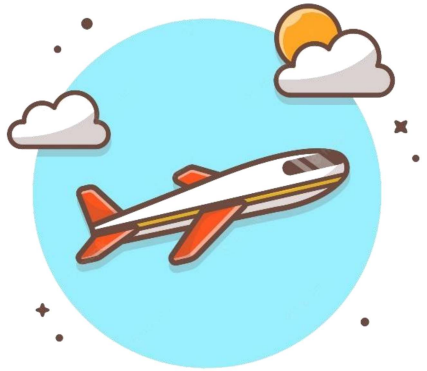
At Home

On Road

During Sports

At Work

HAZARD



Transportation

Hazard: Anything with the potential to cause harm.

Exposure: Any object that hazard is occurred on (an object that is exposed to hazard) e.g. Human, Animal, Plant, Building and Environment.

Risk: The degree of chance (likelihood) that the hazard will cause harm to someone.

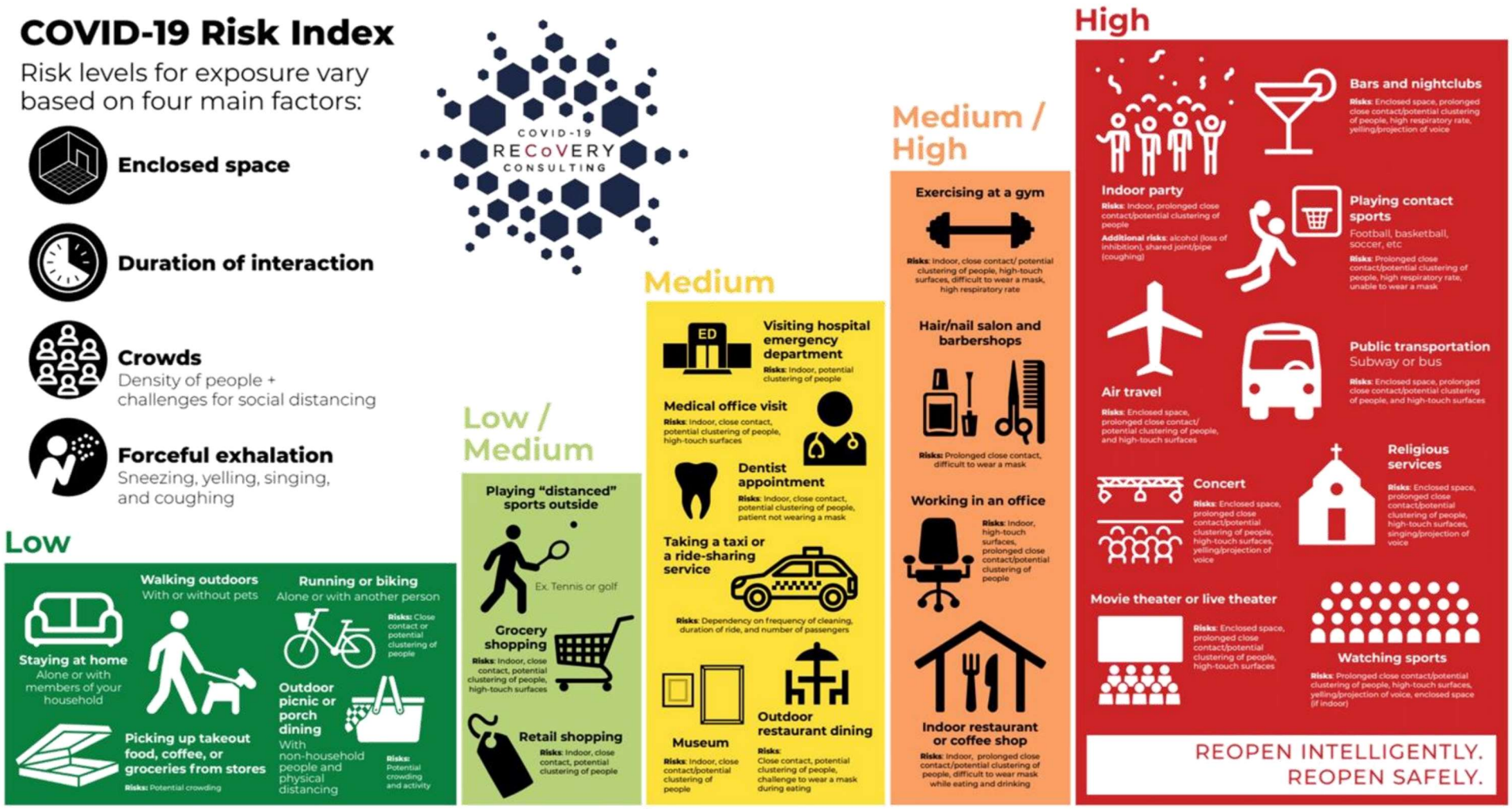
Accident: An unplanned unexpected events that results in personal injury or property damage.

Definition of Safety: a state in which or a place where you are safe and not in danger or at risk.

Safety is the state of being "safe", the condition of being protected from harm or other danger. **Safety** can also refer to the control of recognized hazards in order to achieve an acceptable level of risk.

It is important to realize that safety is relative. Eliminating all risk, if even possible, would be extremely difficult and very expensive. A safe situation is one where risks of injury or property damage are low and manageable.

Safety: is any way of protection against harm to avoid accident by limiting the sources of hazards or insulating from being exposed to that hazard.


COVID-19 Risk Index
Risk levels for exposure vary based on four main factors:
Enclosed space
Duration of interaction
Crowds
Density of people + challenges for social distancing
Forceful exhalation
Sneezing, yelling, singing, and coughing
COVID-19 RECoVERY CONSULTING
Low
Staying at home
Alone or with members of your household
Walking outdoors
With or without pets
Running or biking
Alone or with another person
Risks: Close contact or potential clustering of people
Outdoor picnic or porch dining
With non-household people and physical distancing
Risks: Potential crowding and activity
Picking up takeout food, coffee, or groceries from stores
Risks: Potential crowding
Low / Medium
Playing "distanced" sports outside
Ex. Tennis or golf
Grocery shopping
Risks: Indoor, close contact, potential clustering of people, high-touch surfaces
Retail shopping
Risks: Indoor, close contact, potential clustering of people
Medium
Visiting hospital emergency department
Risks: Indoor, potential clustering of people
Medical office visit
Risks: Indoor, close contact, potential clustering of people, high-touch surfaces
Dentist appointment
Risks: Indoor, close contact, potential clustering of people, patient not wearing a mask
Taking a taxi or a ride-sharing service
Risks: Dependency on frequency of cleaning, duration of ride, and number of passengers
Museum
Risks: Indoor, close contact/potential clustering of people
Outdoor restaurant dining
Risks: Close contact, potential clustering of people, challenge to wear a mask during eating
Medium / High
Exercising at a gym
Risks: Indoor, close contact/ potential clustering of people, high-touch surfaces, difficult to wear a mask, high respiratory rate
Hair/nail salon and barbershops
Risks: Prolonged close contact, difficult to wear a mask
Working in an office
Risks: Indoor, high-touch surfaces, prolonged close contact/potential clustering of people
Indoor restaurant or coffee shop
Risks: Indoor, prolonged close contact/potential clustering of people, difficult to wear mask while eating and drinking
High
Bars and nightclubs
Risks: Enclosed space, prolonged close contact/potential clustering of people, high respiratory rate, yelling/projection of voice
Indoor party
Risks: Indoor, prolonged close contact/potential clustering of people
Additional risks: alcohol (loss of inhibition), shared joint/pipe (coughing)
Playing contact sports
Football, basketball, soccer, etc
Risks: Prolonged close contact/potential clustering of people, high respiratory rate, unable to wear a mask
Air travel
Risks: Enclosed space, prolonged close contact/ potential clustering of people, and high-touch surfaces
Public transportation
Subway or bus
Risks: Enclosed space, prolonged close contact/potential clustering of people, and high-touch surfaces
Concert
Risks: Enclosed space, prolonged close contact/potential clustering of people, high-touch surfaces, yelling/projection of voice
Religious services
Risks: Enclosed space, prolonged close contact/potential clustering of people, high-touch surfaces, singing/projection of voice
Movie theater or live theater
Risks: Enclosed space, prolonged close contact/potential clustering of people, high-touch surfaces
Watching sports
Risks: Prolonged close contact/potential clustering of people, high-touch surfaces, yelling/projection of voice, enclosed space (if indoor)
REOPEN INTELLIGENTLY.
REOPEN SAFELY.

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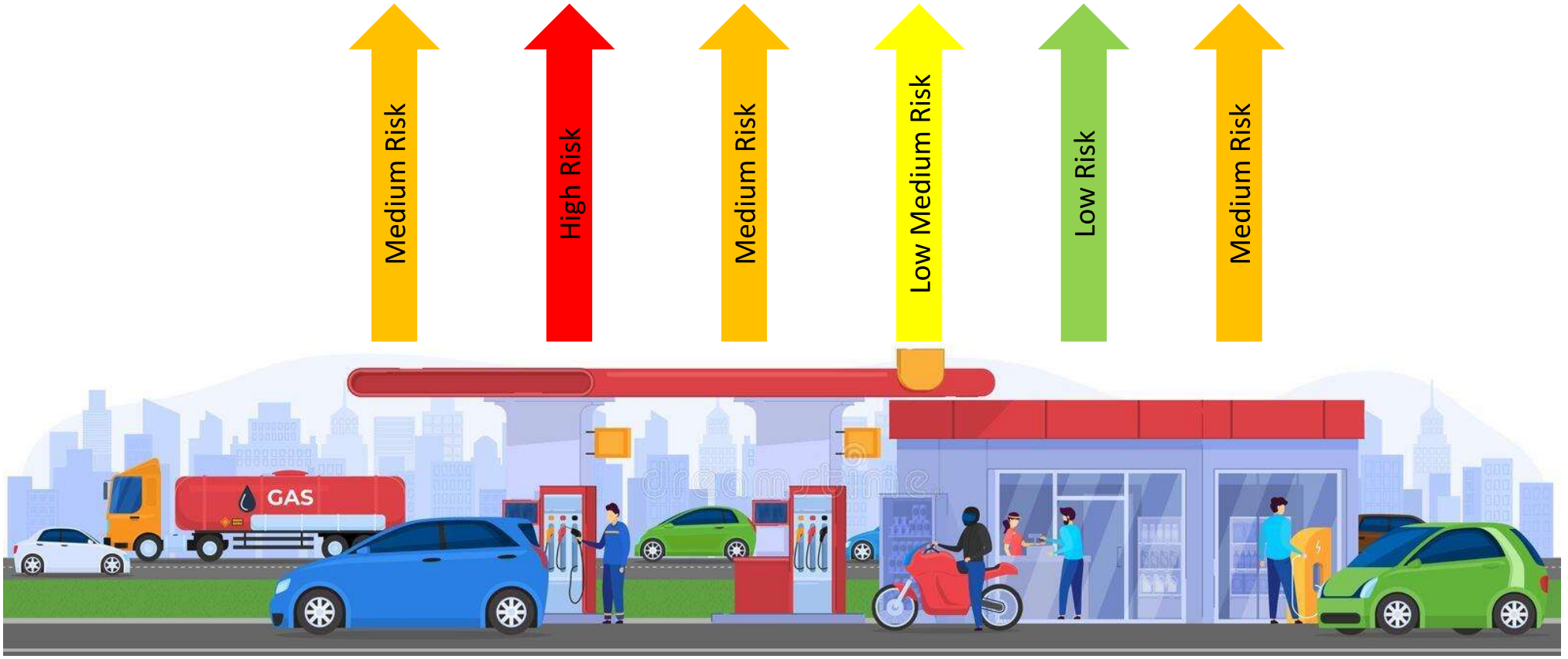

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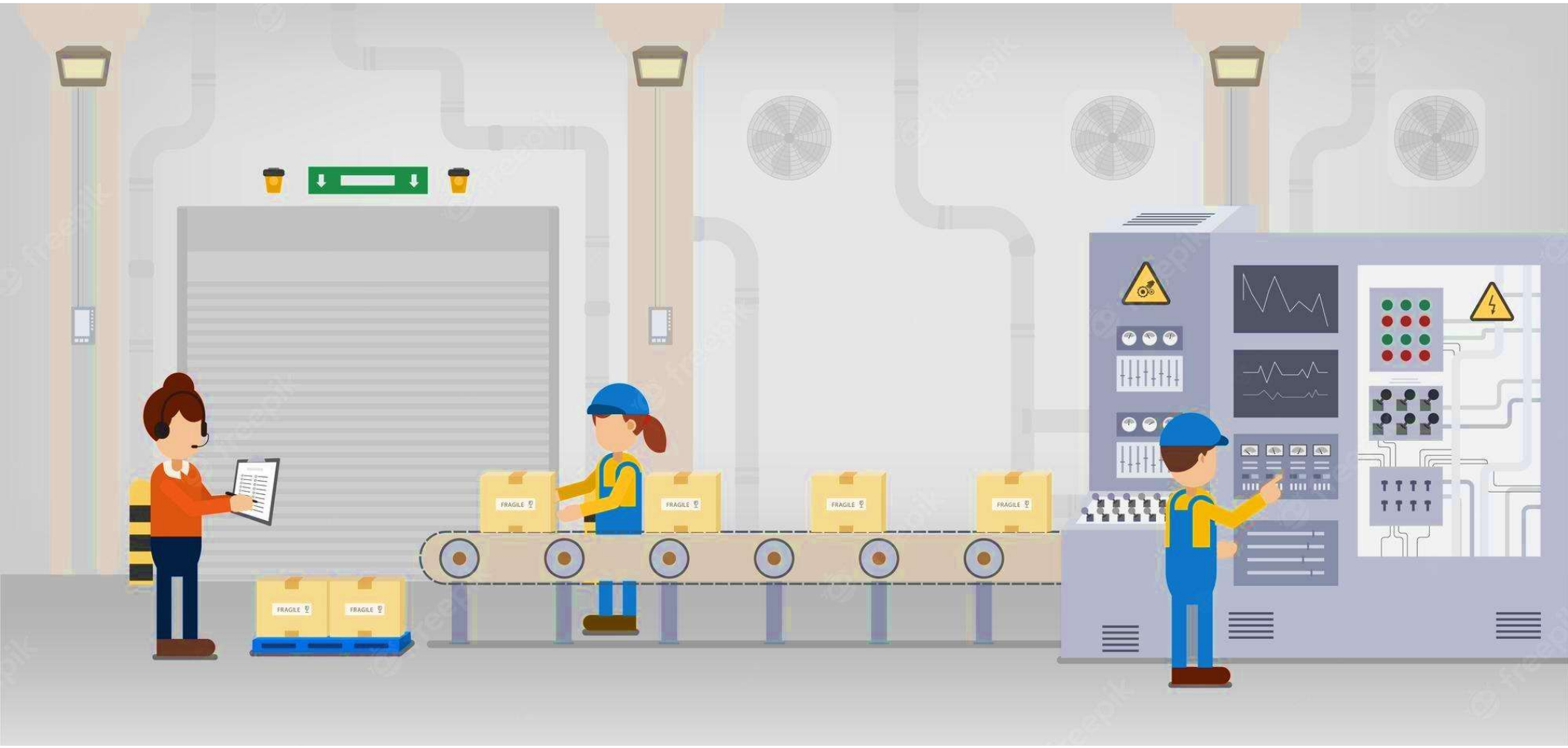

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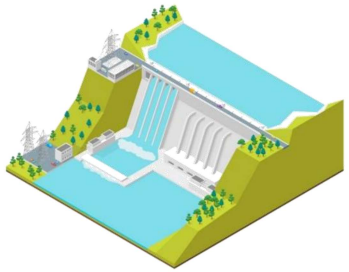
Use Safety to Minimize

Minimize HAZARD by using



Dams
Extinguishers
Fire resistant doors
Enclosures (encapsulation)

Minimize EXPOSURE by using

Caution Signs

PPE

Assembly point

Week 2

Hazard area classifications, zones, identification and control

Hazard Classification

- Chemical hazards
- Fire and Explosion
- Oxygen deficiency
- Biological Hazards
- Health Hazards
- Site and Equipment Hazards
- Electrical Hazards
- Environmental Hazards
- Radiological Hazards

In electrical and safety engineering, hazardous locations are places where fire or explosion hazards may exist. Sources of such hazards include gases, vapors, dust, fibers, and flying, which are combustible or flammable.

Standards and regulations exist to identify such locations, classify the hazards, and design equipment for safe use in such locations.

In an industrial plant, such as a refinery or chemical plant, handling of large quantities of flammable liquids and gases creates a risk of exposure. Coal mines, grain mills, elevators, and similar facilities likewise present the risk of a clouds of dust. In some cases, the hazardous atmosphere is present all the time, or for long periods. In other cases, the atmosphere is normally non-hazardous, but a dangerous concentration can be reasonably foreseen—such as operator error or equipment failure. Locations are thus classified by type and risk of release of gas, vapor, or dust. Various regulations use terms such as Class, Division, Zone, and Group to differentiate the various hazards.

The classification process requires the participation of operations, maintenance, safety, electrical and instrumentation professionals; and the use of process diagrams, material flows, safety data sheets, and other pertinent documents.

Area classification documentations are reviewed and updated to reflect process changes.

Hazardous areas are classified into zones based on an assessment of the frequency of the occurrence and duration of an explosive gas atmosphere, as follows:

- Zone 0: An area in which an explosive gas atmosphere is present continuously or for long periods;
- Zone 1: An area in which an explosive gas atmosphere is likely to occur in normal operation;
- Zone 2: An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it occurs, will only exist for a short time.

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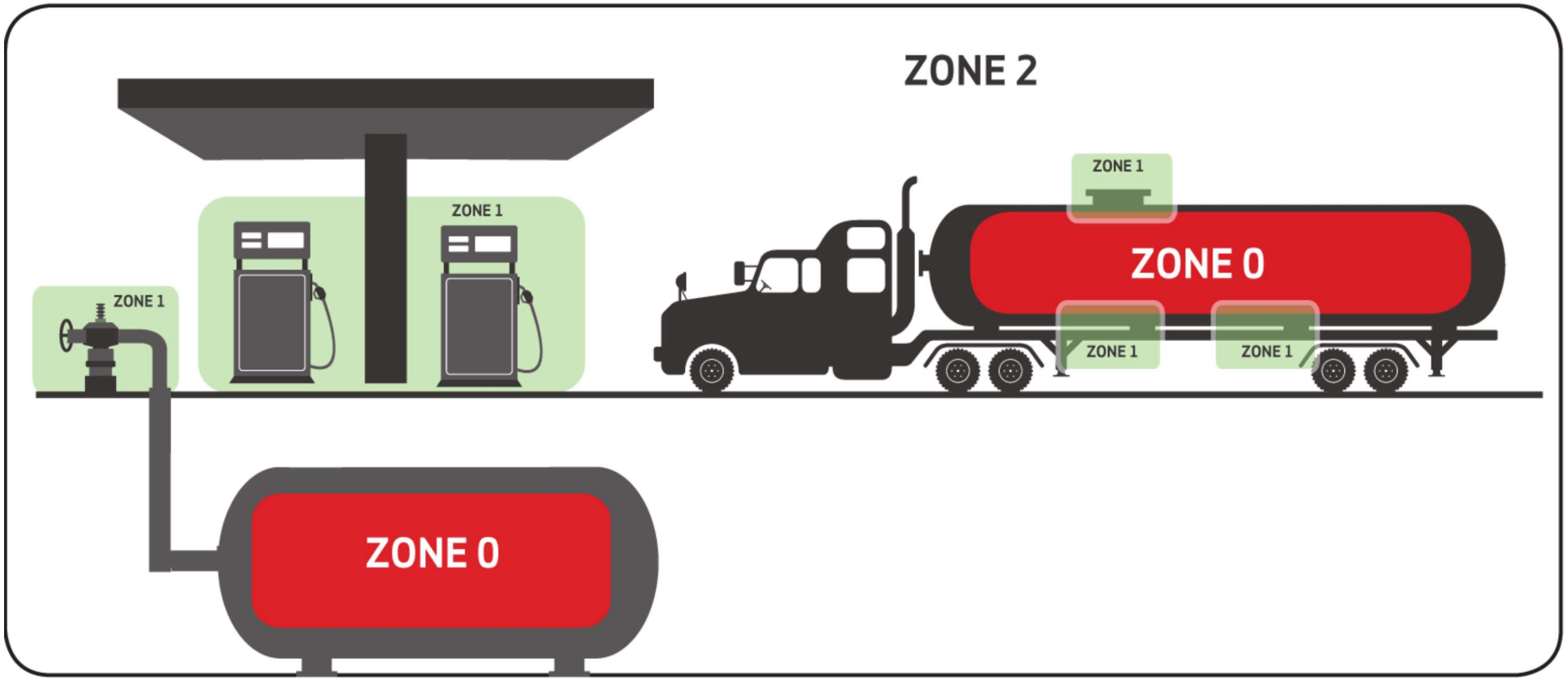

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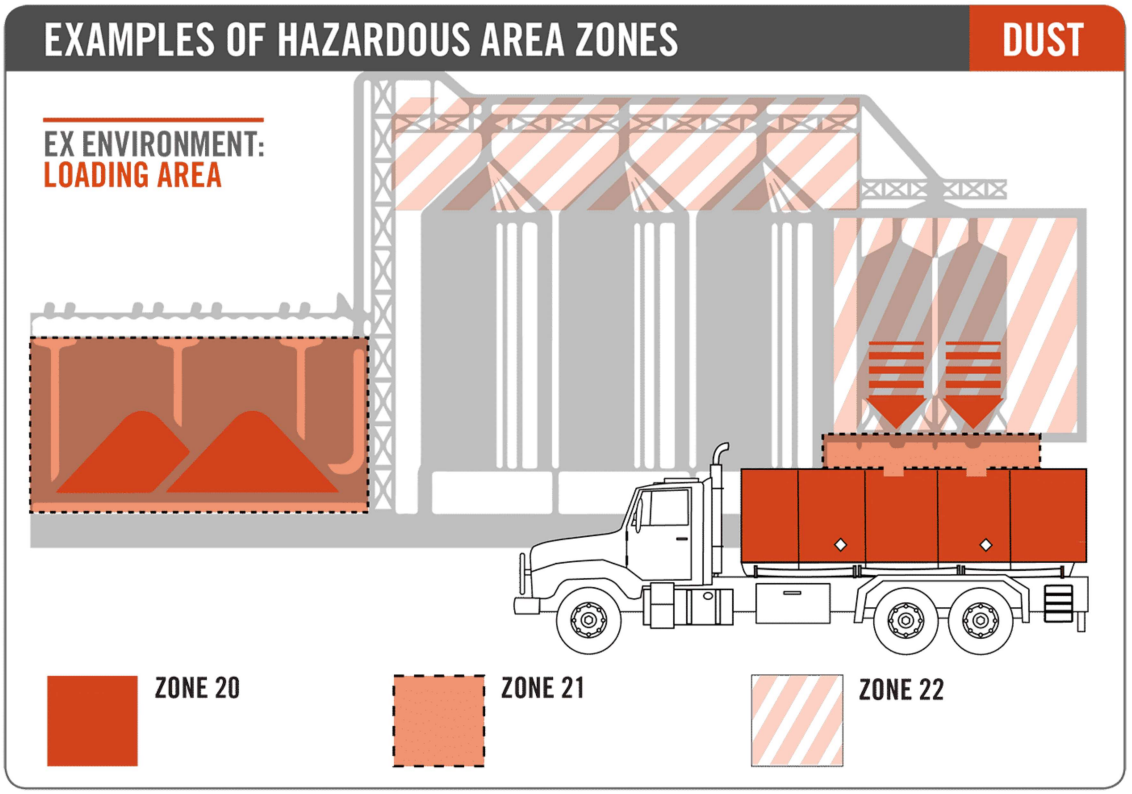
Various sources have tried to place time limits on to these zones, but none have been officially adopted. The most common values used are:

- Zone 0: Explosive atmosphere for more than 1000h/yr.
- Zone 1: Explosive atmosphere for more than 10, but less than 1000 h/yr.
- Zone 2: Explosive atmosphere for less than 10h/yr, but still sufficiently likely as to require controls over ignition sources.

Classification of dusts relating to auto-ignition and minimum ignition current is undertaken similarly to gases/ vapors, but involves additional complications.

The explicability of dusts is dependent upon a number of factors:

- chemical composition;
- particle size;
- oxygen concentration;



Equipment group classification

- Group I equipment applies to equipment used in underground operations, such as mines.

- Group II equipment applies to surface-processing industries. The petrochemical, chemical, pharmaceutical as well as food industries are typical processing industries.


Zone 1
Division 1
Zone 2
Division 2
Zone 0
Division 1
Zone 0 or 1
Division 1
Equipment Group I
Mining
Equipment Group II
Above Surface Industry

Temperature Classification	Maximum Surface Temperature, °C	Ignition Temperature of gas or vapour, °C
T1	450	>450
T2	300	>300
T3	200	>200
T4	135	>135
T5	100	>100
T6	85	>85

Deployability of the operating material	List of gases and vapours						
	Explosion subgroup II for ignition protection type d, i, n	Gases and vapours					
	IIA	Ammonia, methane, ethane, propane	Ethyl alcohol, cyclohexane, n-butane	Benzene gen. jet fuels, n-hexane	Acetaldehyde		
	IIB	Acrylonitrile, city gas	Ethylene, ethylene oxide	Ethylene glycol, hydrogen sulphide	Ethyl ether		
	IIC	Hydrogen	Acetylene Ethin				Carbon disulphide

Temperature class: Classification of gases, vapours and mists acc. to ignition temperature					
T1 Max. 450°C	**T2** Max. 300°C	**T3** Max. 200°C	**T4** Max. 135°C	**T5** Max. 100°C	**T6** Max. 85°C

Deployability of the operating material

------ >T1

---------- >T2

---------- >T3

---------- >T4

---------- >T5

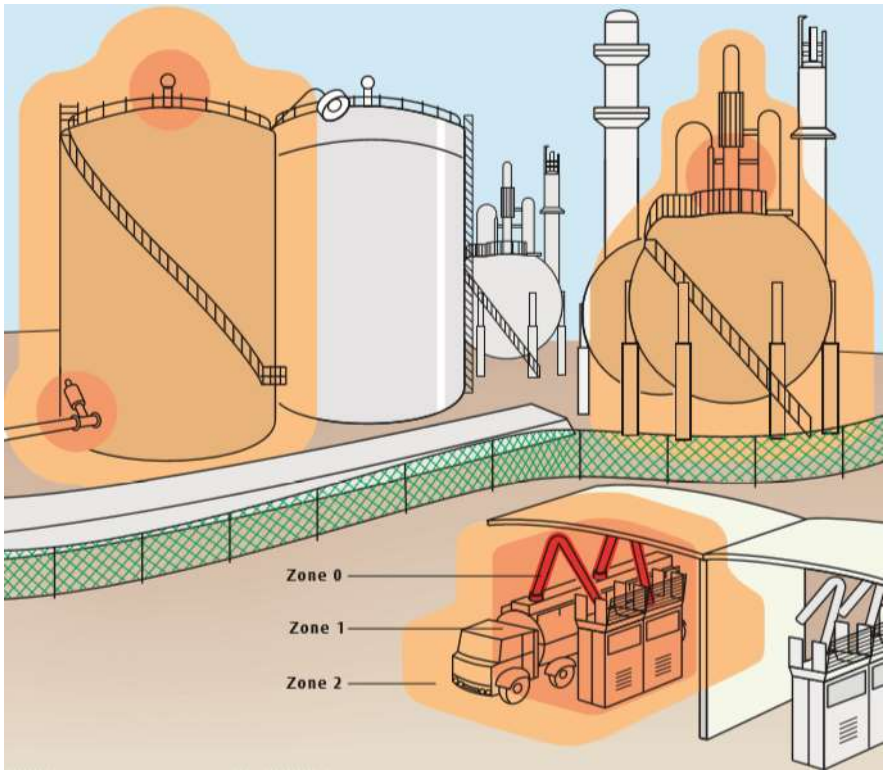
---------- >T6

Explosion group	Type of group	Characteristics of group
Gas explosion group	IIC	Easily ignitable (e.g. hydrogen, acetylene)
	IIB	Ignitable (e.g. coalgas, ethylene, ethylene glycol)
	IIA	Less ignitable (e.g. acetone, benzene, toluene)
Dust explosion group	IIIC	Conductive dusts (resistivity $\leq 10^3 \Omega m$)
	IIIB	Non-conductive dusts (resistivity $>10^3 \Omega m$)
	IIIA	Flammable fibers (length >50-0μm)

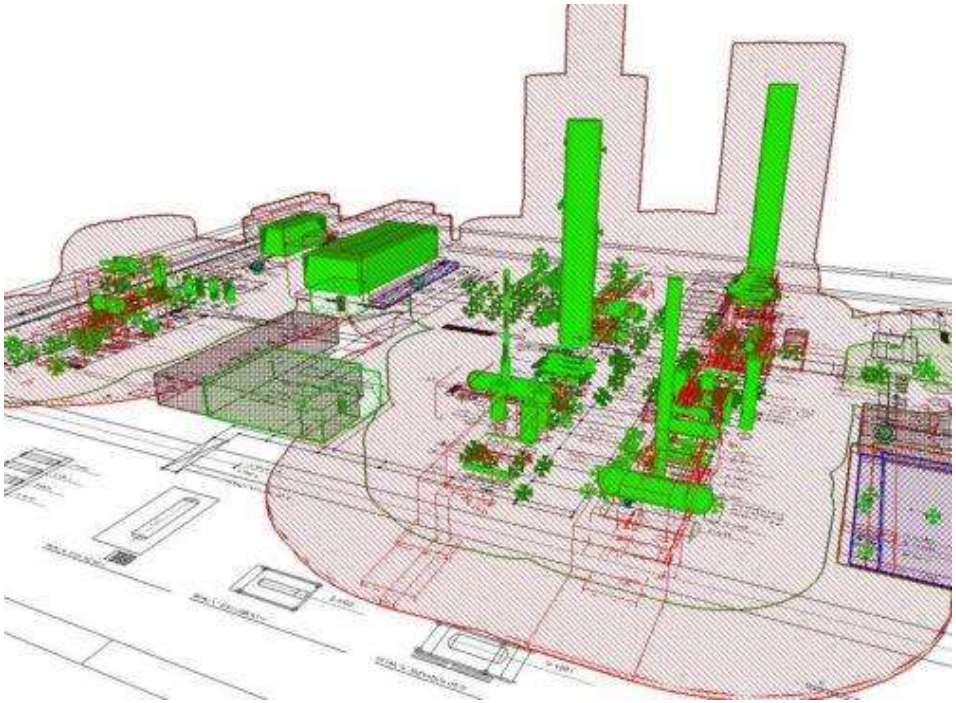
Week 3

Hazardous Area Classification Drawing

Hazardous area classification drawing outlines the classifications of areas where flammable liquids, gasses or vapors are handed, processed or stored. It is created based on input from the Process Flow Diagrams, Piping & Instrumentation Diagrams and the Equipment Location Plan.

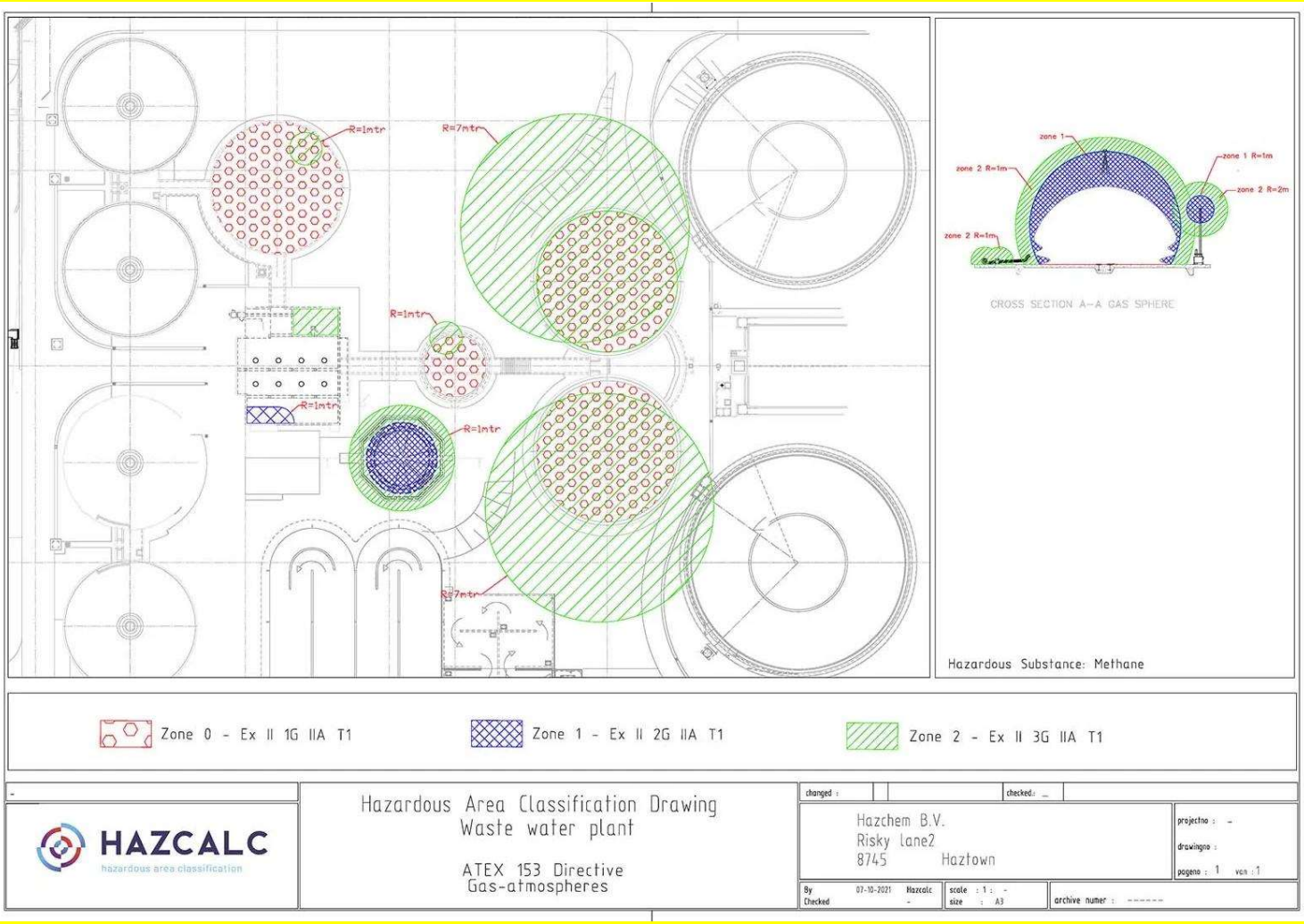


After performing hazardous area classification assessments the results must be presented and communicated to staff, personnel, co-workers, contractors and other third parties in a Hazardous Area Classification Drawing. The nature of the zones and the extent of the zones must be presented in a clear way. This is an essential part of the Hazardous Classification (HAC) process.



The easiest way to create Hazardous Area Classification Drawings (HAC Drawings) is to use some kind of AutoCAD program, but it is certainly not essential. But, in CAD programs, the base drawings of a plant of factory can mostly be imported, so it is an easy way of working. Even pdf files or jpg and png files can be loaded into CAD. By creating an additional layer, the HAC zones can be drawn. It is a good practice to scale the zones correctly with the base-drawings.

Level of Protection	Description Hazardous Area	Explosive atmosphere	Zone	ATEX 114 Directive		IECEx standards		Symbol in HAC drawing
				Group	Category	Group	EPL	
Very high: 2 independent faults shall not lead to ignition.	Area in which an explosive gas atmosphere is present continuously, or for long periods, or frequently (more than 10% of the time)	Mining	-	I	M1	I	Ma	
		Gas	Zone 0	II	1G	II	Ga	
		Dust	Zone 20	III	1D	III	Da	
High: a single faults shall not lead to ignition.	Area in which an explosive gas atmosphere is likely to occur occasionally in normal operation. (between 0,1 and 10% of the time).	Mining	-	I	M2	I	Mb	
		Gas	Zone 1	II	2G	II	Gb	
		Dust	Zone 21	III	2D	III	Db	
Normal: normal functioning shall not lead to ignition	Area in which an explosive gas atmosphere is not likely to occur in normal operation, but, if it does occur, will exist for a short period only (less than 0,1% of the time).	Gas	Zone 2	II	3G	II	Gc	
		Dust	Zone 22	III	3D	II	Dc	


R=1mtr
R=7mtr
R=1mtr
R=1mtr
R=1mtr
R=7mtr
zone 1
zone 2 R=1m
zone 1 R=1m
zone 2 R=2m
zone 2 R=1m
CROSS SECTION A-A GAS SPHERE
Hazardous Substance: Methane
Zone 0 - Ex II 1G IIA T1
Zone 1 - Ex II 2G IIA T1
Zone 2 - Ex II 3G IIA T1
HAZCALC
hazardous area classification
Hazardous Area Classification Drawing
Waste water plant
ATEX 153 Directive
Gas-atmospheres
changed :
checked :
Hazchem B.V.
Risky Lane2
8745 Haztown
projectno :
drawingno :
pageno : 1 van : 1
By 07-10-2021 Hazcalc
Checked -
scale : 1 : -
size : A3
archive numer :

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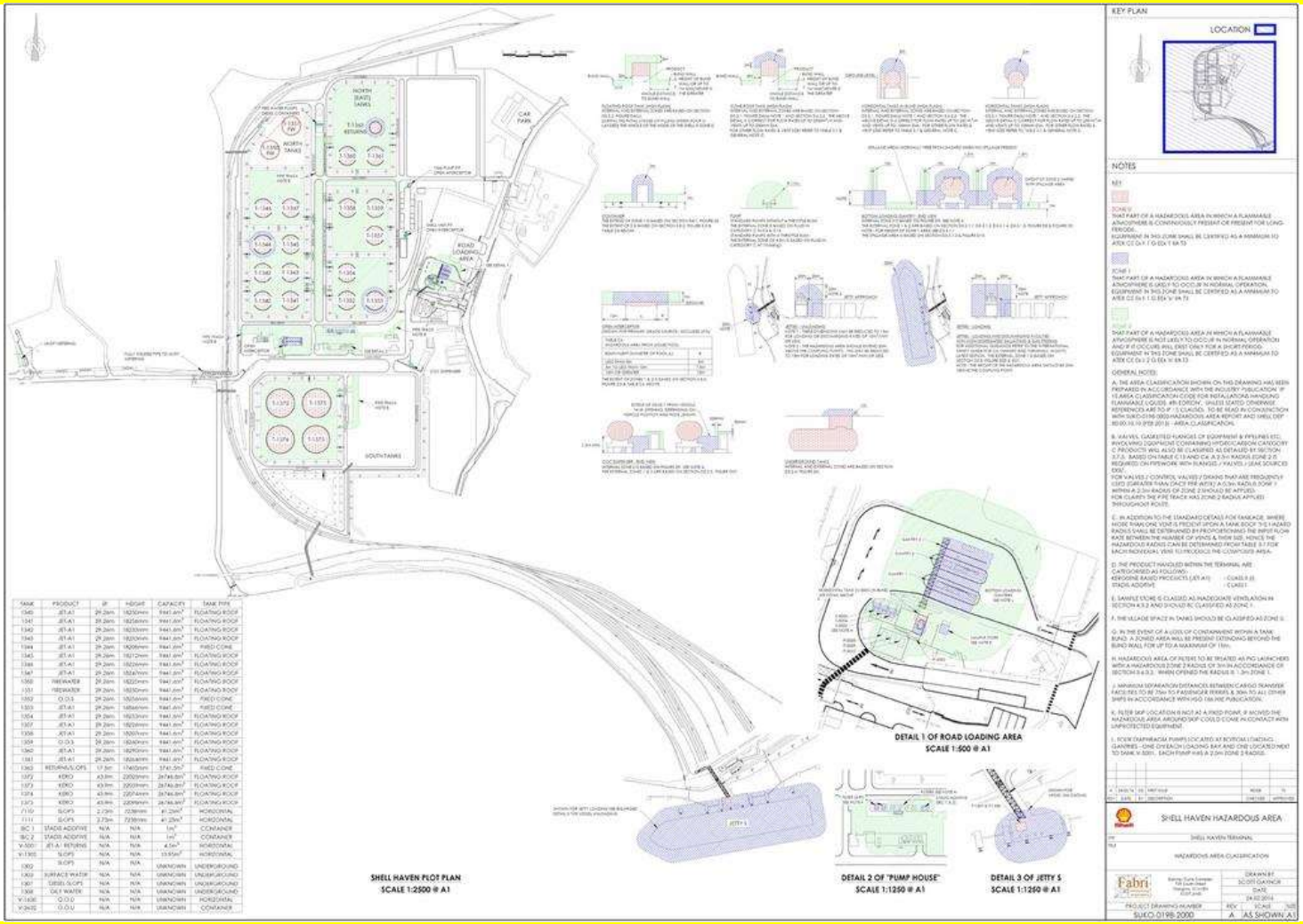

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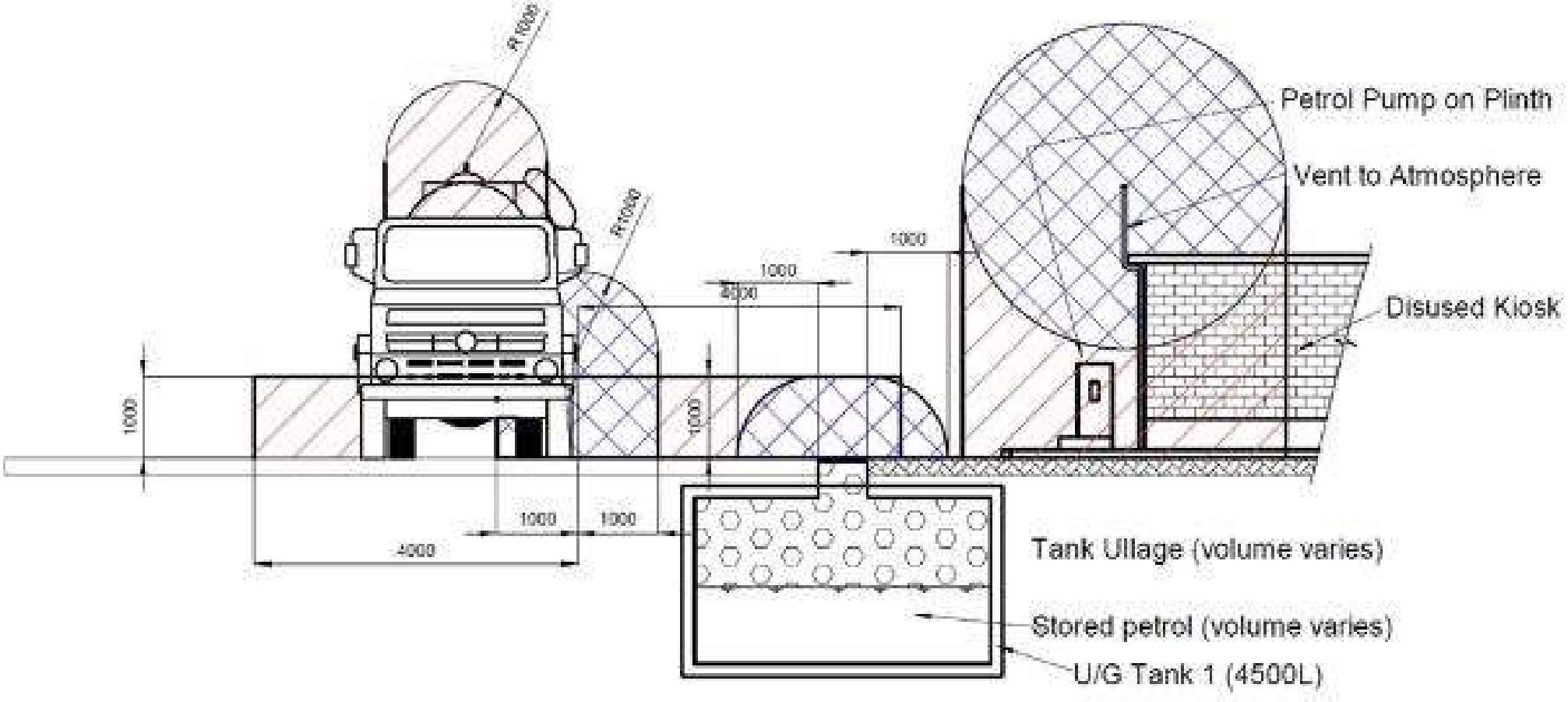

Side Elevation – Cross Section

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The intent of the drawing is to communicate to engineers, operators and contractors information on the hazardous material that may be present and the probability that it is in the atmosphere. This knowledge allows for engineers and designers to select the right equipment and for contractors to know how to properly install the equipment.

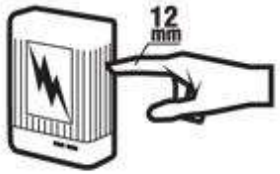
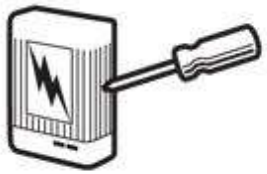
Week 4

Ingress Protection (IP) and impact resistance rating (IK)

Ingress Protection

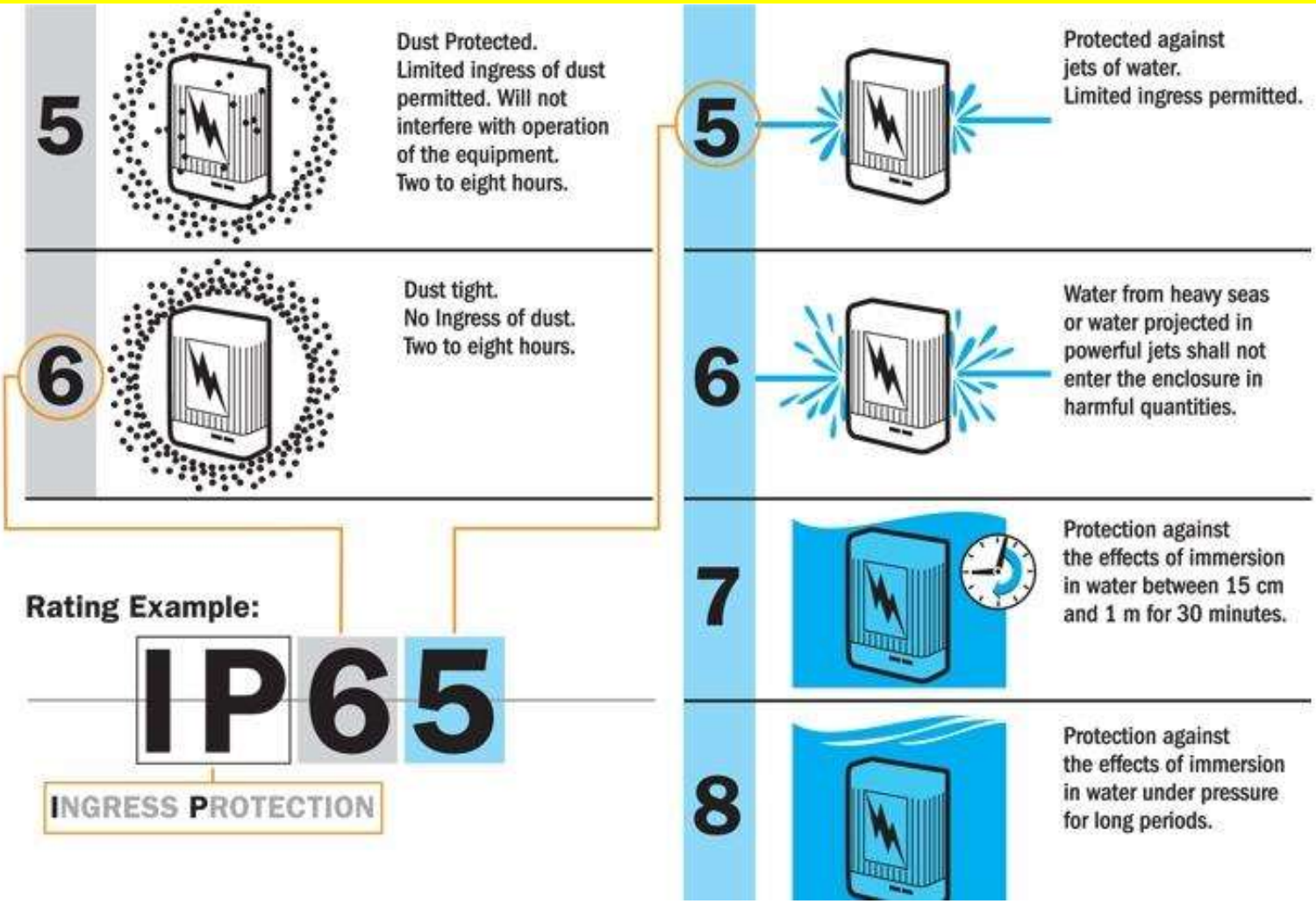
Another consideration in the protection of equipment in hazardous areas is the safeguarding against the ingress of solid foreign objects and water. This is known as the degree of ingress protection and is commonly referred to as the IP Code.

SOLIDS

1		Protected against a solid object greater than 50 mm such as a hand.
2		Protected against a solid object greater than 12.5 mm such as a finger.
3		Protected against a solid object greater than 2.5 mm such as a screwdriver.
4		Protected against a solid object greater than 1 mm such as a wire.

WATER

1		Protected against vertically falling drops of water. Limited ingress permitted.
2		Protected against vertically falling drops of water with enclosure tilted up to 15 degrees from the vertical. Limited ingress permitted.
3		Protected against sprays of water up to 60 degrees from the vertical. Limited ingress permitted for three minutes.
4		Protected against water splashed from all directions. Limited ingress permitted.


5
Dust Protected.
Limited ingress of dust permitted. Will not interfere with operation of the equipment.
Two to eight hours.
6
Dust tight.
No Ingress of dust.
Two to eight hours.
Rating Example:
IP65
INGRESS PROTECTION
5
Protected against jets of water.
Limited ingress permitted.
6
Water from heavy seas or water projected in powerful jets shall not enter the enclosure in harmful quantities.
7
Protection against the effects of immersion in water between 15 cm and 1 m for 30 minutes.
8
Protection against the effects of immersion in water under pressure for long periods.

IP69K

Protected from total dust ingress.

Protected from steam-jet cleaning.

The IP69K rating means a piece of equipment can withstand intensive cleaning with high-pressure, high-temperature jets. IP69K products are ideal for industries where sanitation is a primary concern, such as food processing and pharmaceutical applications.

IP69K is currently the highest rating on the ingress protection (IP) scale. The IP scale is an international system that gives products a rating based on their ability to withstand the intrusion of solids and liquids.

The first number of the rating indicates how dustproof a product is, ranging from 0 to 6. The second number indicates how watertight a product is, ranging from 0 to 9. The addition of a 'K' after the second digit signifies specific protection from high-pressure jets. These ratings allow a company to choose equipment with the right level of protection for a given environment.

IP69K means a product is completely dustproof and can withstand washdown at pressures of 80 to 100 bar/1,160 to 1,450 PSI, in phases of 14 to 16 l/min, and at temperatures up to 176°F/80°C.

In practice, that means high-pressure jets blasting hot water at a piece of industrial equipment with no negative consequences — an impressive achievement!
IP69K products, like KPI screen enclosures, are ideal for facilities that use intensive wash-down procedures to meet strict sanitation standards:

- Food and beverage processing
- Pharmaceutical applications
- Chemical manufacturing
- Petrochemical plants
- Waste treatment

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WHAT IS THE IK IMPACT RESISTANCE RATING?

IK Ratings are an international numeric classification to indicate the degrees of protection provided by enclosures for electrical equipment against external mechanical impacts. It provides a means of specifying the capacity of an enclosure to protect its contents from external impacts.

IK00 - No Protection

IK01 - Protected against 0.14 joules of impact (the equivalent to the impact of a 0.25kg mass dropped from 56mm above the impacted surface)

IK02 - Protected against 0.2 joules of impact (the equivalent to the impact of a 0.25kg mass dropped from 80mm above the impacted surface)

IK03 - Protected against 0.35 joules of impact (the equivalent to the impact of a 0.2kg mass dropped from 140mm above the impacted surface)

IK04 - Protected against 0.5 joules of impact (the equivalent to the impact of a 0.25kg mass dropped from 200mm above the impacted surface)

IK05 - Protected against 0.7 joules of impact (the equivalent to the impact of a 0.25kg mass dropped from 280mm above the impacted surface)

IK06 - Protected against 1 joules of impact (the equivalent to the impact of a 0.25kg mass dropped from 400mm above the impacted surface)

IK07 - Protected against 2 joules of impact (the equivalent to the impact of a 0.5kg mass dropped from 400mm above the impacted surface)

IK08 - Protected against 5 joules of impact (the equivalent to the impact of a 1.7kg mass dropped from 300mm above the impacted surface)

IK09 - Protected against 10 joules of impact (the equivalent to the impact of a 5kg mass dropped from 200mm above the impacted surface)

IK10 - Protected against 20 joules of impact (the equivalent to the impact of a 5kg mass dropped from 400mm above the impacted surface)

Mobile phones are not intrinsically safe, meaning that they have the potential to produce a spark of such intensity that it could ignite a vapor air mix. In oil refineries, although every effort is made to avoid having flammable vapor air mixtures present, accidents do happen, so it makes sense to keep potential sources of ignition away from these areas.

Mobile phones are radio transmitters - the radio frequency energy from a phone, although tiny, still has the potential to induce a spark in nearby metallic objects if the conditions are right, and ignite petroleum or other explosive vapors. That's why it's forbidden to use them at filling stations.

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The explosion-proof antenna
explosion-proof antenna to enable full Wi-Fi coverage in hazardous areas. Here are some of the key features of this smart safety solution:

- Suitable for use in ATEX zones 2 and 22
- Combined with a special HF-barrier, it can even be placed in Zones 0 and 20
- Optimized for steel and concrete environments (with reflections)
- Suitable for indoor and outdoor use — thanks to rugged design
- You can connect WiFi antenna on with a coaxial cable up to 25 meters…the access point will not have to meet additional requirements
- Available in 2.4GHz or 5GHz-execution

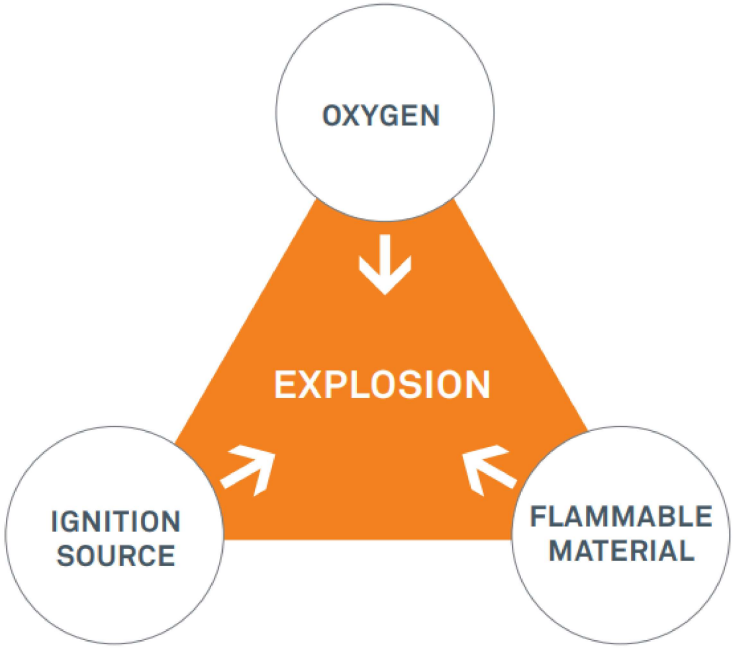
IP Rating: https://www.youtube.com/watch?v=z935clBMJYU
IK Rating: https://www.youtube.com/watch?v=GkxbCZOoYi8

Week 5

Explosion protection concepts

For explosions to happen in atmospheric air, three factors have to be present at the same time

- Flammable material
- Oxygen (air)
- Source of ignition



Flash point, Fire point, Auto Ignition, Surface Temp.

The flash point of a material is the "lowest liquid temperature at which, under certain standardized conditions, a liquid gives off vapours in a quantity such as to be capable of forming an ignitable vapour/air mixture“.

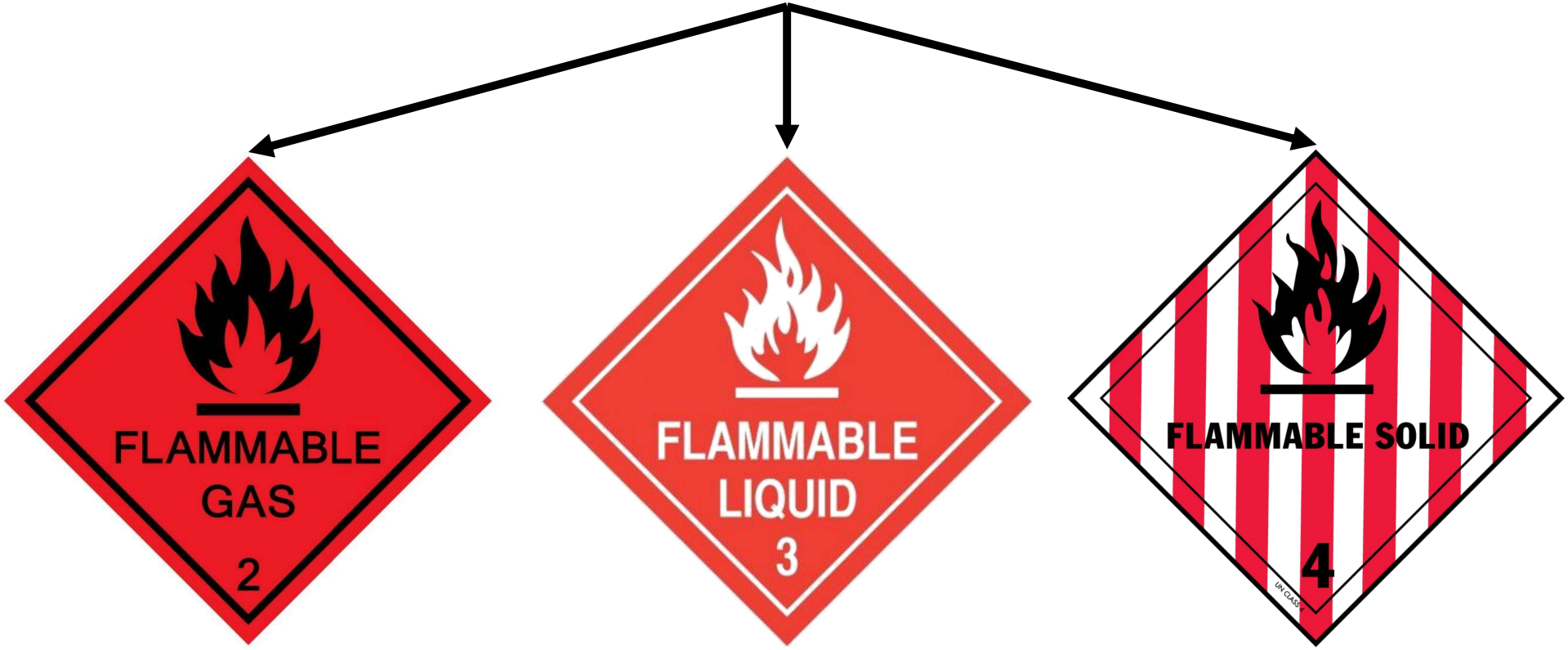
The fire point is the lowest temperature at which the vapors keep burning after the ignition source is removed. It is higher than the flash point, because at the flash point vapor may not be produced fast enough to sustain combustion.

Flash point, Fire point, Auto Ignition, Surface Temp.

The autoignition temperature or kindling point of a substance is the lowest temperature in which it spontaneously ignites in a normal atmosphere without an external source of ignition.

Surface temperature or radiant heat is the infrared energy emitted by surfaces warmer than the surroundings.

Flammable material



Flammable gases

A flammable gas may be an element such as hydrogen which can be made to react with oxygen with very little additional energy. Flammable gases are often compounds of carbon and hydrogen. These flammable gases and vapours require only small amounts of energy to react with atmospheric oxygen.

Flammable liquids (actually the vapor only)

Flammable liquids are often hydrocarbon compounds such as ether, acetone or petroleum spirit. Even at room temperature, sufficient quantities of these can change into the vapour phase so that an explosive atmosphere forms near their surface. Other liquids form such an atmosphere near their surface only at increased temperatures. Under atmospheric conditions this process is strongly influenced by the temperature of the liquid. For this reason the flash point, or rather the flash point temperature, is an important factor when dealing with flammable liquids.

Flammable solids (actually dust only)

Flammable solids in the form of dust or flyings can react with atmospheric oxygen and produce disastrous explosions. Normally more energy is required for activating the explosion in air than with gases and vapours. However, once combustion starts, the energy released by the reaction produces high temperatures and pressures. In addition to the chemical properties of the solid itself, the fineness of the particles and the overall surface area, which increases with increasing fineness, play an important role.

Oxygen

The quantity of oxygen available in the air can only oxidise/burn a certain quantity of the flammable material. The ratio can be determined theoretically, it is called the stoichiometric mixture. When the quantity of the flammable material and the available atmospheric oxygen are near to the optimum (most ideal) ratio, the effect of the explosion - temperature and pressure increase - is most violent. If the quantity of flammable material is too small, combustion will only spread with difficulty or will cease altogether. The situation is similar when the quantity of flammable material is too great for the amount of oxygen available in the air.

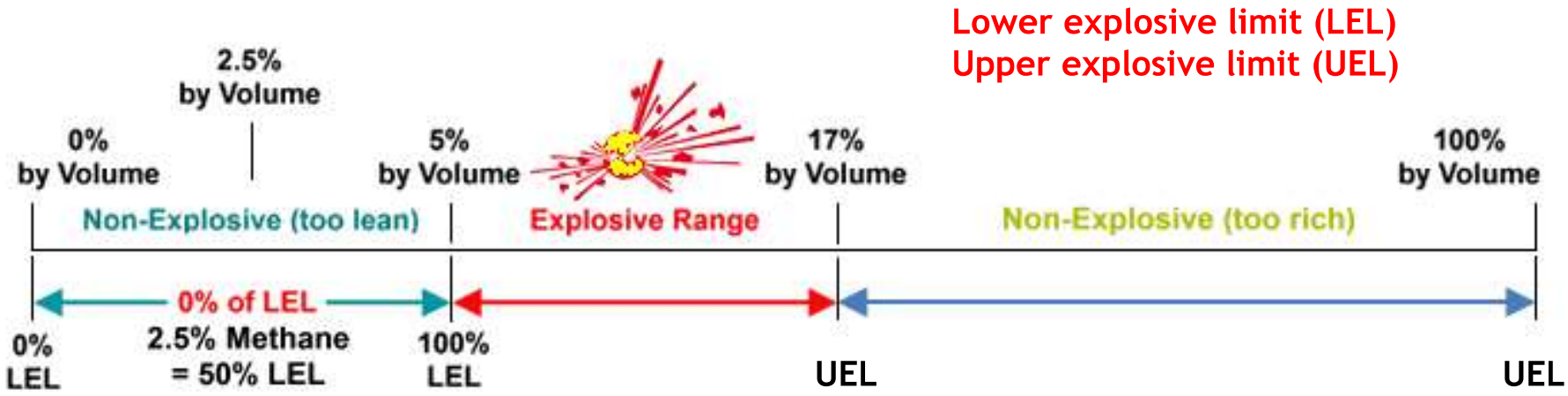
O_2

Sources of ignition

- Hot surfaces
- Flames and hot gases (including hot particles)
- Electrical equipment and components
- Mechanically generated sparks
- Stray electric currents, cathodic corrosion protection
- Radio frequency
- Electro-magnetic radiation - radio RF waves
- Electro-magnetic radiation - IR, visible and UV light
- Ionising radiation - röntgen (X-rays) and gamma
- Ultrasonic
- Adiabatic compression and shock waves
- Exothermic reactions

Explosion Range (limits)

Combustible materials mixed with air have a lower and an upper flammable limit and the explosive range lies between these limits. When considering the safety of the workplace, the lower flammable limit is the more important value. In many cases, a possible concentration ≤ 10 % of this value is considered to be safe.



Explosion Protection

Explosion protection is used to protect all sorts of buildings and civil engineering infrastructure against internal and external explosions or deflagrations.

The term explosion proof describes electrical and non-electrical fixtures that can prevent explosions from occurring, and withstand explosions when they occur.

Primary explosion protection

Primary explosion protection aims at either substituting or reducing the quantity of the flammable substances or the atmospheric oxygen to a level where there is no danger of an explosive mixture forming. Increased air supply air flushing through ventilation can be achieved by structural measures; for example the open layout of filling stations where the potentially explosive atmosphere is very small.

Secondary explosion protection

If, despite primary explosion protection measures, it is possible for a hazardous, potentially explosive atmosphere to form (to a degree that requires measures to protect employees against explosion hazards), the ignition of this hazardous, potentially explosive atmosphere must be effectively prevented. All possible sources of ignition are evaluated, and the appropriate protective measures applied.

Tertiary explosion protection

If the primary and secondary explosion protection measures are not enough, additional protective measures shall be taken. The purpose of these is to limit the impact of an explosion and/or to reduce it to an occupational health and environmental safe level.

Week 6

Explosion protection codes and examples

Type of Explosion Protection Method	Equipment Code	Description	International Standard	Suitable for Zones
Intended to prevent a potential ignition arising	Ex e	Increased safety	IEC 60079-7	2 ,1
	Ex nA	Type -n protection	IEC 60079-15	2
Intended to limit the ignition energy of the equipment	Ex ia	Intrinsic safety 'ia'	IEC 60079-11	2 ,1 ,0
	Ex ib	Intrinsic safety 'ib'	IEC 60079-11	2 ,1
	Ex ic	Intrinsic Safety 'ic'	IEC 60079-11	2
	Ex nL	Type -n protection	IEC 60079-15	2
Intended to prevent an ignition from escaping outside the equipment	Ex d	Flameproof protection	IEC 60079-1	2 ,1
	Ex q	Sand / powder (quartz) fi lling	IEC 60079-5	2 ,1
	Ex nC	Type -n protection	IEC 60079-15	2

Type of Explosion Protection Method	Equipment Code	Description	International Standard	Suitable for Zones
Special	Ex s	Special protection	See IEC 60079-0	2 ,1 ,0
Intended to prevent the explosive atmosphere contacting the ignition source	Ex px	Purge/pressurized protection ‘px’	IEC 60079-2	2 ,1
	Ex py	Purge/pressurized protection ‘py’	IEC 60079-2	2 ,1
	Ex pz	Purge/pressurized protection ‘pz’	IEC 60079-2	2
	Ex m	Encapsulation	IEC 60079-18	2 ,1
	Ex ma	Encapsulation	IEC 60079-18	2 ,1 ,0
	Ex mb	Encapsulation	IEC 60079-18	2 ,1
	Ex o	Oil immersion	IEC 60079-18	2 ,1
	Ex nR	Type -n protection	IEC 60079-15	2

Ex i Intrinsic Safety is an explosion protection concept in which the electrical energy within the equipment is restricted to a level which is below that what may cause an ignition or to limit the heating of the surface of the hazardous area equipment. There are two main sub types to Ex i protection, these being “ia” and “ib”. Type “ia” protection allows for the occurrence of two faults during operation Type “ib” explosion protection allows for the occurrence of one fault during operation.

Ex d Flameproof The equipment that may cause an explosion is contained within an enclosure which can withstand the force of an explosion and prevent transmission to the outside hazardous atmosphere. The Ex d flameproof method of explosion protection also prevents the hazardous atmosphere from entering the enclosure and coming into contact with equipment.

Ex m Encapsulation is an explosion protection concept where by equipment that could potentially cause an ignition is encapsulated within a compound or resin so as to prevent contact with the explosive atmosphere. The concept also limits the surface temperature of the equipment under normal operating conditions.

Ex e Increased Safety is an explosion protection concept applied to the installation to ensure increased security against the possibility of excessive temperatures and sparks from hazardous area electrical equipment. Equipment that normally causes sparks is excluded from use within this method of protection.

Ex p Pressurized One process ensures that the pressure inside an Ex p enclosure is sufficient to prevent the entrance of a flammable gas, vapor, dust, or fiber and prevent a possible ignition. Another process maintains a constant flow of air (or an inert gas) to dilute to take away any potentially explosive atmosphere.

Ex o Oil Immersion All equipment that has the potential to arc and potentially cause an ignition is immersed in a protective liquid or oil. The oil provides an insulating method to prevent ignition.

Ex q Powder Filling All equipment that has the potential to arc is contained within an enclosure filled with quartz or glass powder particles. The powder filling prevents the possibility of an ignition.

Ex n Non-Sparking A type of explosion protection where precautions are taken so that hazardous area electrical equipment that has the potential to arc is not capable of igniting a surrounding explosive atmosphere. This can be further categorized as follows:

Ex nA -Where components used in construction are non-sparking.
Ex nC -Where components used in construction are non- incentive (Sparkling electrical equipment).
Ex nR – Where components used are tightly enclosed to restrict the breathing and prevent ignition.
Ex nL -Where components used in construction do not contain enough energy to cause an ignition.
EX np - Where components used in construction are simplified pressurization equipment

Ex s Special This method of explosion protection, as its name indicates, has no specific parameters or construction rules. In essence it is any method of explosion protection which can provide a pre-determined level of safety to ensure that there is no potential for an ignition. As such it does not fall under any specific protection method and may in fact be a combination of more than one.

WOLFLITE HANDLAMP H-4DCA

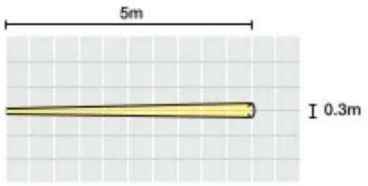
Primary Cell Safety Handlamp

- ATEX Approved for Zones 1 and 2 gas and Zones 21 and 22 dust explosive atmospheres
- T4 temperature class
- Halogen bulb
- Up to 20 hours from primary cells
- Robust anti-static thermoplastic lamp enclosure
- Lloyd's Register Type Approved

Ref	H-4DCA
Ex	II 2 GD Ex e ib IIC T4 Gb – Ex tD A21 IP66* T135°C Db *IECEx certified for IP65
	BAS00ATEX2203 – IECEx TSA 05.0017X
G	Zones 1 & 2
D	Zones 21 & 22
kg +	1.45kg
	130 x 140 x 185mm
	4 x LR20 (D)
	2.4W Halogen
	≈20hrs
	IP66 / IECEx IP65

H-4DCA

960 lux (3.5°) @ 5m



WOLF MIDI TORCH

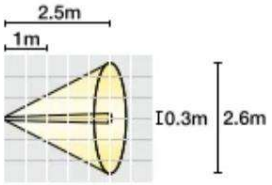
Primary Cell Midi Safety Torch

- ATEX and IECEx Approved for Zones 1 and 2 gas explosive atmospheres
- 189 lumen high output LED light source
- T3/T4 temperature class
- IIB Gas Group
- Midi compact size
- Compact and robust ergonomic design
- Single handed switch with protection shroud
- Ingress protection to IP67
- Group I M2 Mining Approval
- Supplied with a wrist strap and T4 approved cells

Ref	M-80
Ex	IM2/II2G Ex ib I Mb/IIB T3/T4 Gb IP67
	Baseefa11ATEX0236 – IECEx BAS 11.0116
G	Zones 1 & 2, Gas Groups IIA, IIB
	0.190 kg
	45 x 170mm
	4 x LR6 (AA)
	High Power LED 189lm
	~7hrs
	IP67

M-80

6500 lux (7°) @ 1m
1233 lux (7°) @ 2.5m



CE 1180 Ex IECEx

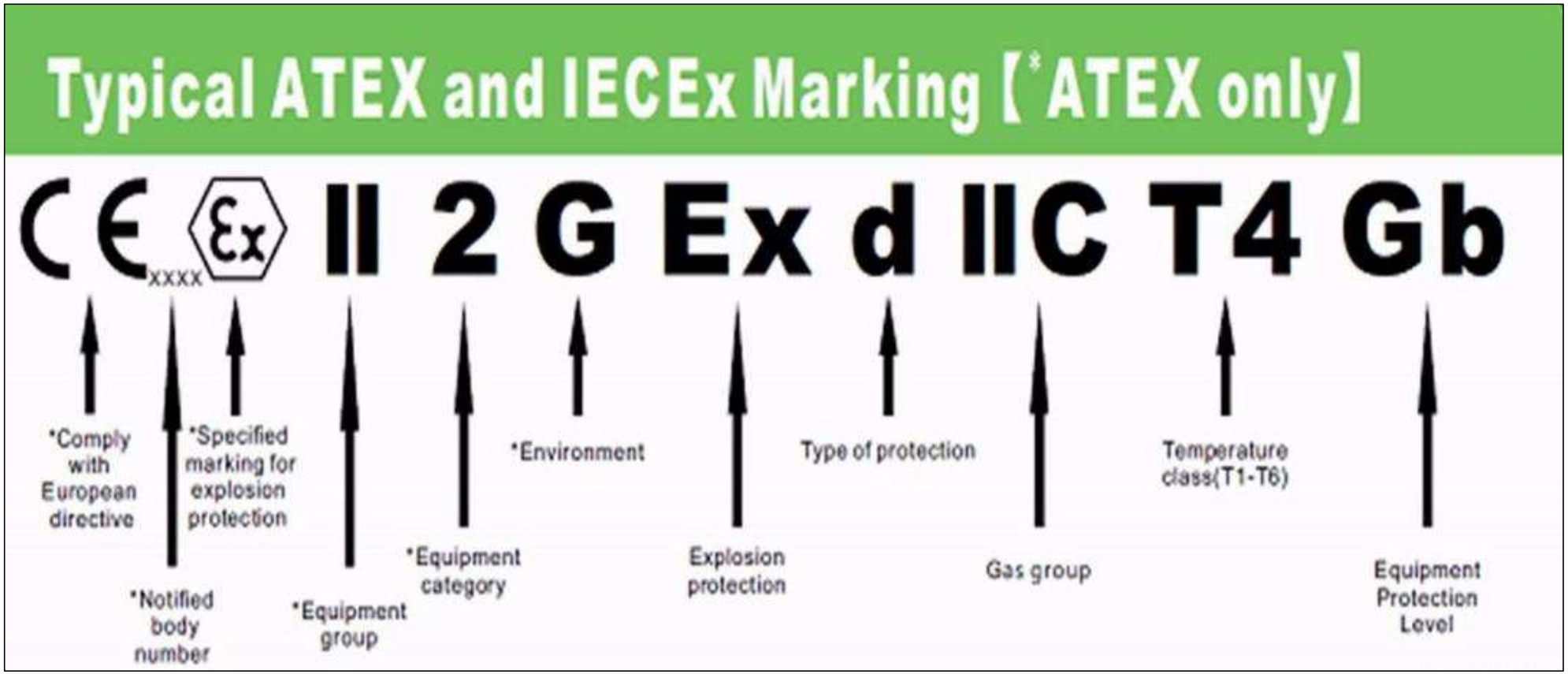
WOLF ATEX CABLE REEL

30m Cable Extension Reel

- ATEX Approved for Zones 1 and 2 gas explosive atmospheres
- Compact and solid hard rubber reel body with flat steel frame
- Internal brake which does not produce friction on reel body
- Fitted with ATX or CEAG plugs and sockets with 30m HOFR cable
- 110V or 230V input voltage available

Ref	LL-300
Ex	II 2 G Ex de IIC* T6
	PTB03ATEX1186
G	Zones 1 & 2
Kg	≈12Kg (inc cable)
	412 x 314 x 319mm
	110V or 230V
	IP54

CE 0158 Ex


Typical ATEX and IECEx Marking [*ATEX only]
CE XXXX Ex II 2 G Ex d IIC T4 Gb
*Comply with European directive
*Notified body number
*Specified marking for explosion protection
*Equipment group
*Equipment category
*Environment
Explosion protection
Type of protection
Gas group
Temperature class(T1-T6)
Equipment Protection Level