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BASIC FIRE FIGHTING

E-learning Learner Handbook

Unit Standard 12484

Level 2 Credits 3

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MODULE 1: FIRE ANATOMY

Specific outcomes:

- Ability to define a fire.
- Ability to explain the fire triangle and the chemistry of fire.
- Understanding of sources of fire in the workplace.
- Understanding of classes of fire.

INTRODUCTION

Although fires are not the major cause of death in South Africa, its devastating effects are being felt across the country. Every month we hear of cases of fire damage in the media. Fires are a danger to human survival and as a result they must be managed. Prevention is better than cure, a common statement by HIV/AIDS activists is also a popular song in fire management.

Definition of fire

Fire is the rapid oxidation of a material in the chemical process of combustion, releasing heat, light, and various reaction products. Slower oxidative processes like rusting or digestion are not considered to be part of this process..

The flame is the visible portion of the fire and consists of glowing hot gases. If hot enough, the gases may become ionized to produce plasma. Depending on the substances alight, and any impurities outside, the colour of the flame and the fire's intensity might vary. Fire in its most common form can result in conflagration, which has the potential to cause physical damage through burning.

1.1 INGREDIENTS NECESSARY FOR A FIRE

For us to understand the ingredients which are necessary for a fire to start we shall look at the Fire Triangle and Fire Tetrahedron models.

a) Fire Triangle

The fire triangle or combustion triangle is a simple model, from the science of firefighting, for understanding the ingredients necessary for most fires it has largely been replaced in the industry by the fire tetrahedron, which provides a more complete model, which is described below:

The triangle illustrates the rule that in order to ignite and burn, a fire requires three elements:

- Heat,
- Fuel, and
- An oxidizing agent, usually oxygen.

The fire is prevented or extinguished by removing any one of the elements. A fire naturally occurs when the elements are combined in the right mixture (e.g., more heat is needed for igniting some fuels, unless there is concentrated oxygen).

Fuel

Fuel is anything that burns at any temperature. Some fuel burn at a low temperature, some examples are petrol, paraffin, benzene, paper plastic alcohol and spirits. Without fuel, a fire will stop. Fuel can be removed naturally, as where the fire has consumed all the burnable fuel, or manually, by mechanically or chemically removing the fuel from the fire. Fuel separation is an important factor in wildland fire suppression, and is the basis for most major tactics. Other fuels may also

be chemically altered to prevent them from burning at ordinary temperatures, perhaps as part of a fire-prevention measure.

Heat

Heat is also a source of ignition. The following are possible sources of heat, electricity sparks, smoking, flame and hot surfaces. Without sufficient heat, a fire cannot begin, and it cannot continue. Heat can be removed by dousing some types of fire with water; the water turns to steam, taking the heat with it. Note that water will actually increase or spread some types of fires. Separating burning fuels from each other can also be an effective way to reduce the heat. In forest fires, burning logs are separated and placed into safe areas where there is no other fuel. Scraping embers from a burning structure also removes the heat source. Turning off the electricity in an electrical fire removes the heat source, although other fuels may have caught fire and continue burning until the firefighter extinguishes the fire.

Oxygen

Oxygen is the air that is found in the atmosphere and is important for breathing of animals. The fire requires the same oxygen to burn. We do not really need to add and remove oxygen like we do for other elements like heat and fuel because oxygen is all around us. Without sufficient Oxygen, a fire cannot begin, and it cannot continue. The fire needs about 19.5% in the atmosphere for it to burn, anything less than that the fire will not burn. Oxygen may be removed from a fire by smothering it with an aqueous foam, or some inert gas (e.g., carbon dioxide) or dry chemicals, or by enclosing it where the fire will quickly use up all of the available oxygen. A candle snuffer uses this principle. Oxygen for the fire may also be instantly consumed, if only for a moment, by more sophisticated means such as using explosives to 'snuff' an oil well gas fire. Once the gas fire is out, it is not hot enough to start again, but workers must be extremely careful not to create sparks.

b) Fire Tetrahedron

The fire triangle is a useful teaching tool, but fails to identify the fourth essential element of fire: the sustaining chemical reaction.

This has led to development of the fire tetrahedron: a triangular pyramid having four sides (including the bottom). Some fire suppression agents do not remove or reduce any of the three necessary components, but rather interfere with their chemical combination, such as Halon. In most fires, it does not matter which element gets removed; the fire fails to ignite, or it goes out. However, there are certain chemical fires where knowing only the “fire triangle” is not good enough.

Combustion is the chemical reaction that feeds a fire more heat and allows it to continue. With most types of fires, the old fire triangle model works well enough, but when the fire involves burning metals (known as a class-D fire in the fire classifications, involving metals like lithium, magnesium, etc.), it becomes useful to consider the chemistry of combustion. Putting water on such a fire could result in the fire getting hotter (or even exploding) because such metals can react with water in an exothermic reaction to produce flammable hydrogen gas. Therefore, other specialized chemicals must typically be used to break the chain reaction of metallic combustion and stop the fire.

1.2 CHARACTERISTICS OF FIRE

Below are some simple facts that explain the particular characteristics of fire.

I. Fire is FAST!

There is little time!

In less than 30 seconds a small flame can get completely out of control and turn into a major fire. It only takes minutes for thick black smoke to fill a house. In minutes, a house can be engulfed in flames. Most fires occur in the home when people are asleep. If you wake up to a fire, you won't have time to grab valuables because fire spreads too quickly and the smoke is too thick. There is only time to escape.

II. Fire is HOT!

Heat is more threatening than flames.

A fire's heat alone can kill. Room temperatures in a fire can be 100 degrees at floor level and rise to 600 degrees at eye level. Inhaling this super-hot air will scorch your lungs. This heat can melt clothes to your skin. In five minutes, a room can get so hot that everything in it ignites at once: this is called flashover.

III. Fire is DARK!

Fire isn't bright, it's pitches black.

Fire starts bright, but quickly produces black smoke and complete darkness. If you wake up to a fire you may be blinded, disoriented and unable to find your way around the home you've lived in for years.

IV. Fire is DEADLY!

Smoke and toxic gases kill more people than flames do.

Fire uses up the oxygen you need and produces smoke and poisonous gases that kills. Breathing even small amounts of smoke and toxic gases can make you drowsy, disoriented and short of breath. The odourless, colourless fumes can lull you into a deep sleep before the flames reach your door. You may not wake up in time to escape.

key question for review

What are the implications of the above characteristics of fire?

1.3 FIRE CLASSIFICATION

Fires can be divided into broad classifications for ease of extinguishing them. This will assist in selecting the best extinguishing agent to be used, on the most appropriate type of fire. Let's now look at the classes.

Class A

Class A fires involve ordinary combustible materials: wood, paper, trash, plastic and cloth. Class A fires are usually relatively slow in their initial development and growth, and because these materials are solids, they are somewhat easier to contain. Class A fires leave an ash after the material has been consumed.

Class B

Class B fires involve flammable and combustible liquids and flammable gases such as Gasoline, Fuel, oil, Paint, Butane and Propane. These fires usually develop and grow very rapidly. Class B materials are fluid in nature, which allows them to flow and move. This makes dealing with them somewhat more difficult than Class A materials. These materials are common in many settings. These fires typically do not leave an ash.

Class C

Class C fires involve energized electrical equipment such as motors, appliances, and machinery. This is the only classification of the fire that is not directly related to the type of fuel. The fact that a live electrical circuit is involved is the determining factor. Remove the power and the burning materials may actually fall into one or more of the four other classes. If the electric power is disconnected, the fire is no longer considered class C. Whether the device being considered is turned on or not is unimportant in this classification. Power to the device makes it Class C even if the device is turned off.

Class D

Class D fires involve combustible metals such as Potassium, Sodium, Magnesium, Aluminium, Titanium, and Zirconium. These materials are usually difficult to ignite but create intense fires once started. Class D fires are very difficult to extinguish, but, fortunately, they are relatively uncommon in most industries.

Class K

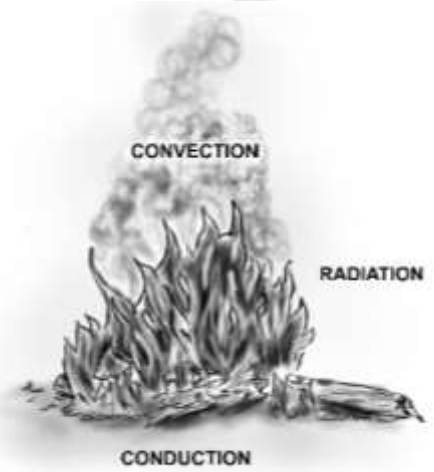
Class K fires involve cooking oils and greases such as animal fats and vegetable fats. This is the newest of the fire classes. This class is normally found in the canteens and kitchens where cooking takes place and oils and fats are used. Though such fires are technically a subclass of the flammable liquid/gas class, the special characteristics of these types of fires, namely the higher flash point, are considered important enough to recognize separately. A special class K extinguisher will safely smother the fire by turning the oil into a foam. A water mist can also be used to extinguish such fires. As with Class B fires, a solid stream of water should never be used to extinguish this type because it can cause the fuel to scatter, spreading the flames.

Question for consideration during the learning process

Why is it important for fire fighters to understand the different classifications of fires?

1.4 METHODS OF FIRE TRANSMISSION

To reduce the risk to persons if there is a fire, it is necessary to consider how to control or restrict the spread of fire and smoke. The majority of people who die in fires are overcome by the smoke and gases. To evaluate the risk to people in premises requires a basic appreciation of the way fires grow and how smoke and poisonous gases can spread through a building. A fire in a building can generate smoke that is thick and black, obscures vision, causes great difficulty in breathing, and can block the escape routes. Smoke is a serious threat to life which should not be underestimated.



Fire is spread by three methods:

- Convection;
- Conduction; and
- Radiation.

1.4.1 Fire Spreads through Radiation

One way a structure starts on fire is through radiation. Radiation is caused from the heat from the flame itself. The amount of heat produced depends on:

- The size of the flame. Generally, larger flames release more heat.

- The amount of surface area on the structure exposed to the radiant heat. The larger the piece of surface that is exposed, the greater the chance of ignition.
- Duration of exposure. The more time the structure is exposed the greater the likelihood of ignition.
- The distance between the flames and the structure. The closer the flames are to the structure, the greater the chance of ignition.

1.4.2 Fire Spreads through Conduction

A second way a structure may start on fire is through conduction. Conduction is caused by direct contact between the flame and the structure. Firebrands, which are small pieces of burning material often carried by wind, can start new fires, and are a common form of conduction. Minimizing the chance of loss due to firebrand-started ignitions includes:

- Using non-flammable building materials in the construction of your home. This is especially important when considering the type of roof to install.
- Planting appropriate vegetation around structures.

1.4.3 Fire Spreads through Convection

Convection is a third way fire spread. Convection is caused by the superheated air that rises from the fires and pre-heats the fuels above it. Convection is most often associated with steep slopes and the "Chimney Effect". The best way to minimize loss due to convective heating include:

- Build all structures back away from steep slopes. The edge of these steep slopes often provides the best view but can also make the home extremely difficult to protect during a wildland fire.
- Avoid building your home at the top of steep canyons.

If a structure is properly insulated from all these types of spreading, the chances of the structure being lost or damaged to a wildfire will be minimized.

1.5 FIRE PHENOMENA

Fire Development is a function of many factors including: fuel properties, fuel quantity, ventilation (natural or mechanical), compartment geometry (volume and ceiling height), location of fire, and ambient conditions (temperature, wind, etc).

a) Traditional Fire Development

The Traditional Fire Development curve shows the time history of a fuel limited fire. In other words, the fire growth is not limited by a lack of oxygen. As more fuel becomes involved in the fire, the energy level continues to increase until all of the fuel available is burning (fully developed). Then as the fuel is burned away, the energy level begins to decay. The key is that oxygen is available to mix with the heated gases (fuel) to enable the completion of the fire triangle and the generation of energy.

IGNITION

GROWTH

FLASHOVER

FULLY DEVELOPED

DECAY

b) Fire Behaviour in a Structure

The Fire Behaviour in a Structure curve demonstrates the time history of a ventilation limited fire. In this case the fire starts in a structure which has the doors and windows closed. Early in the fire growth stage there is adequate oxygen to mix with the heated gases, which results in flaming combustion. As the oxygen level within the structure is depleted, the fire decays, the heat release from the fire decreases and as a result the temperature decreases.

When a vent is opened, such as when the fire department enters a door, oxygen is introduced. The oxygen mixes with the heated gases in the structure and the energy level begins to increase. This change in ventilation can result in a rapid increase in fire growth potentially leading to a flashover (fully developed compartment fire) condition.

Flashover is the transition phase in the development of a contained fire in which surfaces exposed to the thermal radiation, from fire gases in excess of 600° C, reach ignition temperature more or less simultaneously and fire spreads rapidly through the space. This is the most dangerous stage of fire development.

Activity

Why is it important to understand the behaviour of a fire as a fire fighter?

1.6 IDENTIFYING FIRE RISKS IN THE WORKPLACE

As explained earlier in this module, for a fire to start, three things are needed:

- a source of ignition;
- fuel; and
- Oxygen.

If any one of these is missing, a fire cannot start. Taking measures to avoid the three coming together will therefore reduce the chances of a fire occurring. Now we will look at how we can identify potential ignition sources, the material that might fuel a fire and the oxygen supplies that will help it burn.

1.6.1 Identify sources of ignition

You can identify the potential ignition sources in your premises by looking for possible sources of heat, which could get hot enough to ignite material found in your premises. These sources could include:

- Smokers' material, e.g. Cigarettes, matches and lighters;
- Naked flames, e.g. Candles or gas or liquid-fuelled open-flame equipment;
- Electrical, gas or oil-fired heaters;
- Hot processes, e.g. Welding by contractors or shrink wrapping;
- Cooking equipment;
- Faulty or misused electrical equipment;
- Lighting equipment, e.g. Halogen lamps or display lighting too close to stored products;
- Hot surfaces and obstruction of equipment ventilation, e.g. Office equipment; and arson.

Indications of 'near-misses', such as scorch marks on furniture or fittings, discoloured or charred electrical plugs and sockets, cigarette burns etc., can help you identify hazards which you may not otherwise notice.

1.7.2 Identifying fuel.

Anything that burns is fuel for a fire. You need to look for the things that will burn reasonably easily and are in enough quantity to provide fuel for a fire or cause it to spread to another fuel source. Some of the most common 'fuels' found in offices and shops are:

- Flammable-liquid-based products, such as paints, varnishes, thinners and adhesives.
- Flammable liquids and solvents, such as white spirit, cooking oils and disposable cigarette lighters.
- Flammable chemicals, such as certain cleaning products, photocopier chemicals and dry cleaning that uses hydrocarbon solvents;
- Packaging materials, stationery, advertising material and decorations;
  plastics and rubber, such as video tapes, foam-filled furniture and polystyrene-based display materials;
- Textiles and soft furnishings, such as hanging curtains and clothing displays;
- Waste products, particularly finely divided items such as shredded paper and wood shavings, off cuts, and dust;
- Flammable gases such As Liquid Petroleum Gas (LPG).

You should also consider the materials used to line walls and ceilings, e.g. polystyrene or carpet tiles, the fixtures and fittings, and how they might contribute to the spread of fire.

1.7.3 Identify sources of oxygen

The main source of oxygen for a fire is in the air around us. In an enclosed building this is provided by the ventilation system in use. This generally falls into one of two categories: natural airflow through doors, windows and other openings; or mechanical air conditioning systems and air handling systems. In many buildings there will be a combination of systems, which will be capable of introducing/extracting air to and from the building.

Additional sources of oxygen can sometimes be found in materials used or stored at premises such as some chemicals (oxidising materials), which can provide a fire with additional oxygen and so help it burn. These chemicals should be identified on their container by the manufacturer or supplier who can advise as to their safe use and storage.

Key Learning points:

- Fire is defined based on the three elements which are oxygen, fuel and heat.
- Within the fire triangle one can kill the fire by taking out one of the elements through smothering, cooling or starvation.
- Fire is classified according to the type of burning material into the following classes:
    - Class A – papers and wood.
    - Class B- flammable material.
    - Class C- Electrical appliances
    - Class D- potassium and sodium
    - Class K – Cooking oils and animal fats
- There are three ways in which fire spreads which is Radiation, Conduction and Convection.
- Fire development takes a four-stage process and these are:
    - Ignition
    - Development stage(early)
    - Mature or full development
    - decline stage
- It is important to understand these key issues before taking any measures to stop or fight a fire.
- The common cause of fire is smoking in a non-designated area, leaving naked flames unattended, poor housekeeping etc.
- Fire will always pose different risk to property, environment and also to people.

MODULE 2: FIRE FIGHTING PROCEDURES AND TECHNIQUES

Specific Outcome

On completion of this module you will be able to discuss and explain procedures for dealing with fires in the workplace.

Assessment Criteria

- An understanding of procedures for dealing with fires in the workplace is demonstrated
  (SO 1, AC 1)
- Reports on status of fire and equipment are completed.

Assessment criterion notes

- Hazards are isolated.
- Fire is approached according to procedures.
- Selection of firefighting procedures for particular fires are identified.

INTRODUCTION

Firefighting is one of the world's most honoured but hazardous operations. By becoming fire-fighters, people join an organization rich in heritage of dedication, unselfish sacrifice and inspired human action. The job of a fire-fighter is not comfortable or easy. It is one that requires a high sense of personal dedication, a genuine desire to help people and a devotion to a profession that requires a high level of skill. It is also a profession that exposes an individual to a high level of personal danger.

Whenever there is an emergency, the fire department is one of the first called to the scene. Because it is an emergency, the conditions will not always be favourable. There will be hard, fast work that will drain energy and test endurance. The situation will not always involve fire. There will be cave-ins, building collapses, auto accidents, aircraft crashes, tornadoes, dangerous-goods incidents, civil disturbances, rescue operations, explosions, water incidents and medical emergencies. The emergency list is unlimited.

All fire-fighters use the same tactics and strategies to combat a fire. The strategies are simple-fight this fire offensively or defensively. Regardless, the goal is to extinguish the fire. Urban firefighting deals with structural

firefighting. It includes dealing with hazardous goods, water and ice, as well as high-angle rescue and emergency medicine. Fire service personnel must respond day and night to emergencies.

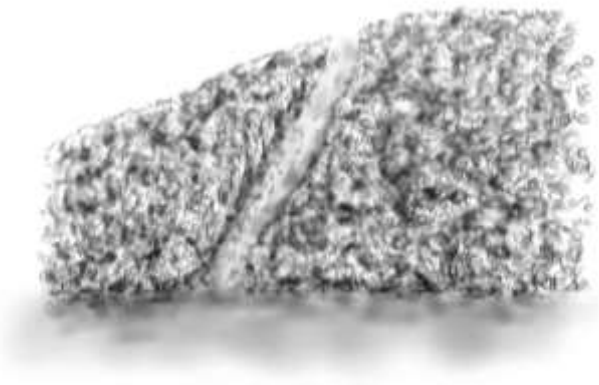
Reasons for fire fighting

Fire Fighting is about bringing the fire under control and/or putting the fires out. This must be done in two ways:

- The first step is to stop the fire from spreading by containing it to some boundaries.
- The second step involves putting the fire out completely by mopping up all the hot spots and continuously patrolling the edges to ensure that nothing is missed.

The illustrations below show the two critical steps in firefighting/ Stopping the fire from spreading by:

Putting water on it.



Make a firebreak around the fire.

2.1 Basic rules of firefighting.

Fire attack is a constant source of debate in the fire service. This debate usually focuses on which nozzle, pressure, and pattern are best to attack a fire. At the heart of the discussion are three basic rules that all sides do agree upon.

Rule Number One: **Fire attack must be properly supported.**

Fire attack does not exist in a vacuum. There are a number of important supporting operations that must be performed to allow for a safe and effective fire attack. These operations include size-up, command, water supply, stretching the attack line, stretching the back-up line, and initiating early ventilation. Without these operations, fire attack success will be decreased while the danger to firefighters will vastly increase.

Rule Number Two: **There must be adequate flow to knock down the fire.**

Fire attack is a simple matter of physics. There must be enough water hitting the fire to eliminate the heat that is being produced. If the attack line does not have adequate flow, the fire will continue to burn while water

supplies are being depleted. It is absolutely critical that the attack line flows enough water to achieve knockdown quickly. ***Remember! A lot of water real fast beats a little bit of water over a long period of time!***

Rule Number Three: **The water must hit the seat of the fire.**

In order for any amount of water to have any effect, it must reach the seat of the fire. It will not matter how much the attack line is flowing, if the water is wasted, only the water level lights on the engine will go out. This rule requires the attack line to be properly positioned and then repositioned as necessary so that the water is always hitting the fire. Another important consideration here is the penetration ability of the attack stream. There must be adequate flow and pressure available so that the water can penetrate the super-heated gases and actually reach the seat of the fire.

NOTE:
These three core rules are beautiful in their simplicity and when considered, much of the fire attack debate becomes academic. This is because there is more than one way to accomplish each rule and the correct method is based on the situation, departmental necessities, and departmental preference. What is important is that firefighters be able to determine which tactics are best for any given situation. These tactics are based on the basic elements of fire attack that include attack pattern, direction, and type.

2.2 FIRE ATTACKING DIRECTION

There are two basic fire attack directions and they include attacking from the unburned side or attacking from the burning side.

1. **Attacking from the unburned side**.

   This means that firefighters are entering the structure and positioning the attack line between the fire and the uninvolved portions of the structure. This is the preferred attack direction because it contains the fire, protects occupants, and pushes heat and gases out of the structure if ventilation has been performed. However, attacking from the unburned side is the most dangerous and is not always practical based on fire location, intensity, and building construction. When this is the case, another option is necessary.

2. Attacking from the burning side.

This means that firefighters are attacking the fire from the side that is burning and are not positioned between the fire and uninvolved areas. This attack direction is often the most practical and sometimes the only choice based on the situation such as when entry is not safe or obstacles make it impossible to attack from the unburned side. When this attack direction is selected, firefighters must remember that the fire can be pushed into other areas of the structure and onto any trapped occupants.

The attack direction plays an important role in determining the attack pattern. When attacking from the unburned side firefighters will need to maintain a tenable work environment. In this case they should limit steam production by using a straight stream or medium fog as ventilation levels allow. If firefighters are attacking from the burning side then it may become necessary to limit the spread of the fire by using a straight stream.

2.3 FIRE FIGHTING ATTACK PATTERN.

There are three basic attack patterns that firefighters can choose from. These patterns are a wide fog, a medium fog, or a straight stream. Each pattern has advantages and disadvantages that determine when they should and should not be used. Refer to the chart below for more information.

Pattern	Reach	Heat Absorption	Steam Production	Push Potential
Wide Fog	Lowest	Highest	Highest	Highest
Medium Fog	Medium	Medium	Medium	Medium
Straight Stream	Highest	Lowest	Lowest	Lowest

The above information makes it clear that firefighters should select the pattern that will meet the demands of the current situation. A smooth bore is not listed on the chart because there is little difference between a smooth bore and a straight stream from a fog nozzle. *Remember! Equal flows and pressures produce equal streams!*

2.4 TYPES OF FIRE ATTACK

There are three basic fire attack types that include indirect, direct, and combination attacks. Each is classified based on where firefighters direct the water.

2.4.1 Indirect Attack

The theory behind the indirect attack is to aim the stream of water (30 degree or less pattern) at the ceiling and allow the droplets of water to rain down on the fire. When this method is employed two things happen;

- The water cools the ceiling upsetting the thermal balance some of the water will vaporize into steam
- The rest of the water will fall like rain to the main body of fire below to extinguish the fire.

There are things the fire fighters must consider before using this type of attack.
Are there any trapped occupants in the fire? Remember steam can kill a trapped occupant just as fast as smoke or fire.

- Steam can also burn us. Remember if you open the nozzle and it is on a pattern wider than 30 degrees you could be in for a world of hurt, especially if the fire has not vented. Remember the steam has to go somewhere.

- Well in a hot fire if you upset the thermal layer by rapidly cooling the ceiling you will drop the thermal layer down to where you are, that means you could be in for trouble.

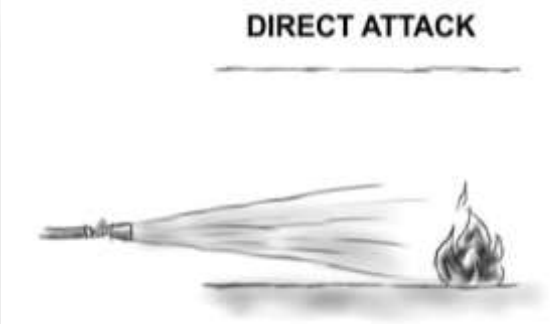
There are times to use the indirect attack.

- If the fire has vented in the room of origin you will be able to push the heat and smoke and steam out the vent hole, because the fire products are exiting the vent hole you will reduce the risk of burn to you as well any trapped occupants.
- Another time that the indirect method will work for you is to control roll over or to cool the area ahead of you to prevent possible flashover. You are not putting the fire out you are cooling the gasses that could ignite behind you.

Remember if you are moving towards the fire and the area gets hot do not hesitate to direct a straight stream at the ceiling ahead of you. In doing so you will reduce the risk of flashover.

2.4.2 Direct Attack

The theory behind the direct attack is to put water directly on the base of the fire and not to disturb the thermal layer at the ceiling. This type of attack is best used with a straight tip nozzle or a straight stream (size depends on your organisation's policy on the minimum GPM to attack a fire) If the fire has not vented and you apply water to the base of the fire you will have rapid extinguishment of the fire and reduced steam thus reducing the risk of steam burns. The thermal layer will cool slowly and not drop down to where you or any trapped occupants are. Once the fire has been knocked use the stream of water to break out windows to relieve the remaining heat in the room of origin. In today's fires the smoke you will encounter will be thick and dark. There will be times you will not see the fire until you are right next to it. This can be a very dangerous situation firefighters can be burned if they get too close to the fire, this is due to the high BTU's that the fires of today produce.



If you are in the room of origin and you cannot see the fire, the best tactic is to open the nozzle and aim it about chest high 3 to 4 feet from the floor (chest high when you are on your knees) and sweep the room. This will ensure you will hit the base of the fire. Think about your typical living room or bedroom. Get on your knees and look. What is the highest piece of furniture? The bed or the couch. if you sweep the room at chest high you will hit the base of the fire. The rules still apply if you are making your way towards the fire and you encounter high heat conditions you can aim the stream of water at the ceiling ahead of you and cool the area down, use short bursts of water and hit the 2 walls and the ceiling. Also use the nozzle to control roll over.

2.4.3 Combination Attack

When a combination attack is performed, firefighters apply water on the heated gases and on the seat of the fire. This is the most common attack method and usually takes the form of a circle that starts at the ceiling and then rotates clockwise to the floor and back to the ceiling.

NOTE:

There are number of important things to remember about the different attack types.

1. Each of the attack types have times when they are appropriate – There are times when each attack type is necessary. Indirect attacks are good to cool heated gases to prevent flashover. Combination attacks are the best option for interior attacks while direct attacks are the best choice when blitzing a large fire with a high flow hand line.
2. Any attack pattern can be used with any attack type – Any of the three attack patterns can be used to implement any of the attack types. Firefighters need to use the pattern characteristics, fire conditions, and attack direction to determine which is most appropriate.
3. The defining lines between the attack types become blurred in reality – This occurs because when a room or area of a structure becomes fully involved, the seat of the fire is the entire room. The ceilings, walls, floors, and everything in between are burning and the need to identify the heated gases from the seat of the fire is meaningless. What is important is that water reaches the fire.

Firefighters have many options when preparing for fire attack. They should choose an attack direction and then pick a pattern that will meet the needs of the current situation. When this is done properly firefighters will meet the core rules of fire attack and successfully accomplish many priorities of the incident.

2.5 PROCEDURES FOR DEALING WITH FIRE IN THE WORKPLACE

It is vital to have a fire plan in the workplace that ensures all employees can get out of the building safely. Whether you are the employee or the employer, there are a number of things you need to make sure are known to be prepared for, and properly deal with a fire at work. There is no use with only having a 'hazy idea' of what evacuation procedures and firefighting steps that should be taken.

1. Fighting the fire

Workers should be warned not to attempt to deal with a fire unless they have been trained to do so. If you have been given permission to deal with a fire, consider these steps:

a) Extinguishing a person engulfed in flames:

- If a person's clothing is on fire, he/she must not be allowed to run, as this will fan the flames and cause a more serious burn. **Remember! STOP, DROP and ROLL.** Clothing fires must be extinguished immediately, before anything else is done, in order to minimize skin burns. Try not to use your hands for they will also burn

- Roll the person on the floor if necessary.
- Wrap him/her in a fire blanket; coat or whatever is available to smother the flames. Put the person under a shower or use an extinguisher, or whatever is available to smother the flames.
- After calling the emergency numbers, place clean, wet, ice-packed cloths on small burned areas. Wrap the person warmly to avoid shock, and secure medical assistance.

b) Fire-fighting Procedures for Controllable Fires

- For all fires, the fire alarm must be transmitted immediately to ensure Fire Department response.
- The decision of whether to fight the fire oneself or to wait for fire-fighting help must be made according to the type and size of the fire, its location and the circumstances of the fire. A small fire in a container may be easily snuffed out by the placement of a non-flammable cover across the container opening. A small fire in an area free of other fuels can be extinguished with appropriate available extinguishers before calling for help. When extinguishing a burning solid, direct the extinguisher discharge at the base of the flame; in the case of burning liquids, direct it at the leading edge. Larger or rapidly growing fires are best left to the Fire Department.
- To extinguish a minor fire with an extinguisher:

Remember! PASS

Pull Pin

Aim nozzle at base of fire

Squeeze handle

Sweep from side to side

Remember! – If you *pull the pin, call it in!*

c) Evacuation Procedures for Uncontrollable Fires

- Leave the area of danger.
- **DO NOT** stay to fight a large fire.
- Rescue anyone in immediate danger.
- On your way out, if it can be done safely, turn off equipment and move any explosive or flammable materials away from possible contact with hot surfaces or other sources of ignition.
- Using the laboratory circuit breaker or Emergency Power Off switch (EPO) is often the quickest and most effective way to turn off all laboratory electrical equipment simultaneously.
- For this reason, the circuit breaker or EPO must always be readily accessible.
- Your safe exit, however, must be given the highest priority.

- Transmit the fire alarm by pulling the alarm box in the hallway, notify personnel on the floor and call the Safety Officer.
- Leave by means of one of the predetermined evacuation routes for your laboratory area. If possible, confine the fire by closing doors as you leave. Evacuate promptly and meet outside the building away from the entrance at a pre-determined place. Conduct an attendance/person count of workers and make sure all are accounted for. If not, notify the Fire Department immediately.

Remember! RACE
Rescue
Alarm
Contain
Extinguish

2. Discovering a Fire

If you ever discover a fire follow these steps:

1. Remain calm.

2. Sound the fire alarm and/or alert all the occupants to evacuate.

3. Alert the fire brigade by dialling 10177 (or your Security Staff – depending on what procedures are currently in place).

4. Leave the building immediately via the closest escape route. Never use the lift (elevator).

5. Assemble with other staff at the evacuation assembly point.

6. Upon their arrival, inform the firefighters of the situation.

3. Evacuating the Building

Upon being told to evacuate, or hearing the fire alarm, follow these steps:

1. Stop what you are doing. Leave the building immediately via the closest escape route. Never use the lift (elevator).
2. Walk briskly, and never turn back.
3. Never take anything with you.
4. Always follow the Fire Warden's instructions.
5. Before opening any door feel the door and door handle. Never open a warm door as there could be a fire behind it.
6. If the door is hot when you feel it then take another route. A window might be an option.
7. If you encounter smoke during your evacuation, drop to the floor and crawl.
8. Close all doors behind you and all windows along the way, as fresh air feeds fire.
9. Assemble and remain at the evacuation assembly point. Do NOT return to the building until you are told by either the fire brigade or your immediate supervisor that it is safe to do so.
10. Notify someone of any injuries you have sustained, as soon as possible.
11. Never cancel a fire alarm. Fire alarms should only be reset by those directed to do so.

If for some reason you are unable to get out of the building.

1. Alert others of your presence – via a phone, standing at a window, or by opening the window and hanging a sheet or something to alert fire fighters of your presence.
2. Keep a wet cloth over your mouth.
3. Stay as close to the ground as possible. Not only will you be able to see better, there is more oxygen.
4. Keep the door closed to stop smoke getting into the room.
5. Block up the cracks around the doors, if possible, with wet cloths, to stop smoke getting in.
6. If there is a lot of smoke, keep your hand against the wall to guide you if you need to move about.
7. If your clothes catch fire, immediately drop to the floor and roll around. This will help to extinguish the flames.

2.6 HAZARDS CAUSED BY FIRE

The primary risk to people in a fire are not the flames themselves, but rather smoke inhalation, which, contrary to popular belief, is the most common cause of death in a fire. The risks of smoke include:

- Suffocation due to the fire consuming or displacing all of the oxygen from the air.
- Poisonous gases produced by the fire as products of combustion.
- Aspirating heated smoke that can burn the inside of the lungs and damage their ability to exchange gases during respiration.

To combat these potential effects, firefighters carry Self-Contained Breathing Apparatus (SCBA; an open-circuit positive pressure compressed air system) to prevent smoke inhalation. These are not oxygen tanks; they carry compressed air. SCBA usually hold 30 to 45 minutes of air, depending upon the size of the tank and the rate of consumption during strenuous activities.

Obvious risks are associated with the immense heat. Even without direct contact with the flames (direct flame impingement), conductive heat can create serious burns from a great distance. There are a number of comparably serious heat-related risks: burns from radiated heat, contact with a hot object, hot gases (e.g., air), steam and hot and/or toxic smoke. Firefighters must be equipped with personal protective equipment (PPE) that includes fire-resistant clothing (Nomex or polybenzimidazole fibre (PBI)) and helmets that limit the transmission of heat towards the body. No PPE, however, can completely protect the user from the effects of *all* fire conditions.

Heat can make flammable liquid tanks violently explode, producing what is called a BLEVE (Boiling Liquid Expanding Vapor Explosion). Some chemical products such as ammonium nitrate fertilizers can also explode. Explosions can cause physical trauma or potentially serious blast or shrapnel injuries.

Heat causes human flesh to burn as fuel, causing potentially severe medical problems. Depending upon the heat of the fire, burns can occur in a fraction of a second.

Activity

With the help of your facilitator, demonstrate the various firefighting methods and techniques that can be used in the workplace.

2.7 MONITORING AND RESPONDING TO CHANGE IN FIRE.

During a fire it is important to monitor and craft a correct response mechanism to changes in fire behaviour, direction and intensity.

Factors that cause a fire to change;

1. Wind direction: Wind change matters to fire fighters. It can change fire activity in a moment, shifting the flank of the fire to the fire front, suddenly putting fire fighters and communities at risk. A change in wind can also

change the rate of fire spread, increase the quantity, distance and direction of downstream spotting, and change the safety status of residents and townships in a flash.

2. Backdraft: A backdraft is a situation which can occur when a fire's product-gases are starved of oxygen; consequently, combustion slows (due to the lack of oxygen) but the combustible fuel gases (primarily carbon monoxide) and smoke (primarily hydrocarbon free radicals and particulate matter) remain at a temperature above the ignition-point of the fuel gases. If oxygen is re-introduced to the fire, e.g. by opening a door (or window) to a closed room, combustion will restart, often resulting in an explosive effect as the gases are heated by the combustion and expand rapidly because of the rapidly increasing temperature.

If firefighters discover a room pulling air into itself, for example through a crack, they generally evacuate immediately, because this is a strong indication that a backdraft is imminent. Due to pressure differences, these puffs of smoke are sometimes *sucked* back into the enclosed space from which they emanate, which is where the term *backdraft* originates.

Backdrafts are very dangerous situations, often surprising firefighters, regardless of their level of experience. The most common tactic used by firefighters in defusing a potential backdraft is to ventilate from the highest point, allowing the heat and smoke to escape without igniting explosively.

3. Hazardous substances

The sudden introduction of hazardous substances can also change the direction and nature of a fire.
Hazardous chemical as any liquid, solid, or gas that could present a physical or health hazard to an employee. Examples of hazardous chemicals include cleaning agents, degreasers, flammables, greases, paints, pesticides, aerosols and compressed gases.

Activity

Discuss how the following factors can result in either the change in the direction or nature of a fire.

- Radiation.
- Incorrect application of firefighting procedures.

Monitoring a fire

When observing a fire, the following must be taken into account;

- Status of the fire i.e. change in direction and nature; amount of smoke.
- Status of firefighting equipment's i.e. are they still effective in containing the fire. With the use of equipment like fire extinguishers runout of water and carbon dioxide.
- Structural damage and equipment i.e. how bad is the fire causing damage to equipment and the structures.
- Firefighting casualties i.e. those who have been injured as a result of firefighting efforts.

Monitoring fire is important because it helps the fire fighters to;

- Know when to back off.
- Know when to call for back-up.
- Know when to change the firefighting strategy.
- Give the necessary information when handing over the fire to superior teams.

NOTE:

Each observation must include the date and time at which it was taken. Be very careful to record the observation date and time for the data collection period; a common mistake is to record the date and time at which the monitor is filling out the final report.

2.8 FIRE HANDOVER

As a fire fighter never risk your life. If the fire gets out of hand, it is important to call the fire department. Upon their arrival, the fire marshals, controller, volunteers must handover the fight to the fire department. The following information must be reported to the fire department or a superior firefighting team;

1. Fire Cause (Origin), and Ignition Point.

Source of the ignition and describe the type of material ignited (e.g., a red fir snag). It is important to locate the origin and document the probable mechanism of ignition.

2. Fire Location and Size.

Report on the precise location of the fire. You can use an office layout plan. Appropriate map coordinates, i.e., Universe Transverse Mercator (UTM), latitude and longitude, legal description or other local descriptor can be used for bush fires.

3. Logistical Information.

Document routes, conditions and directions for travel to and from the fire.

4. Fire name and number.

The fire name and number assigned by your dispatcher in accordance.

5. Current and Predicted Fire Behaviour.

Describe fire behaviour relative to the vegetation and the fire environment using adjective classes such as smouldering, creeping, running, torching, spotting, or crowning. In addition, include descriptions of flame length, rate of spread and spread direction.

6. Potential for Further Spread.

Assess the fire's potential for further spread based on surrounding fuel types, forecasted weather, fuel moisture, and natural or artificial barriers. Record the directions of fastest present rates of spread on a fire map, and then predict them for the next burn period.

7. Resource or Safety Threats and Constraints.

Consider the potential for the fire to leave a designated management zone, impact adjacent owners, threaten human safety and property, impact cultural resources, affect air quality, or threaten special environmental resources such as threatened, endangered or sensitive species.

8. Smoke Volume and Movement

Report on the smoke volume, direction of movement and dispersal. Identify areas that are or may be impacted by smoke.

Key competency question for assessment preparation

Describe the procedure of retreating and handing over a fire to the fire brigade or a superior firefighting team.

Key Learning points:

- There are a number of procedures and techniques required for a fire fighter to understand and know their application when handling workplace fires.
- These measures range form the ability to identify the fire, select the right equipment and conducting the process of killing the fire safely.
- Fire can be attacked from unburned or burned side with consideration for safety precautions.
- There are generic rules when attacking the fire and are listed below:
    - Be properly supported.
    - Have adequate flow of knocking down the fire.
    - Hit from the seat of the fire.
- Only a competent fire-fighter can extinguish the fire.
- Do a risk assessment before attacking the fire looking at the following points:
    - Fire Classifications and stages of development.
    - Material burring in terms of quantity and flammability and other specific building conditions that might influence the development of that specific fire.
    - Equipment needed and method of using such equipment to extinguish the fire safely.
- When a person is engulfed in flame, consider the stop, drop and roll method to extinguish the fire.
- Do a safety inspection on the extinguisher before using it.
- Evacuation must be done according to the company emergency respond procedure.
- Remember to call for help before attending a fire, in case the situation gets out of control.

MODULE 3: FIRE FIGHTING AND SAFETY EQUIPMENT

• Specific Outcome

- Identify, select and check appropriate firefighting safety equipment.
- Identify risks associated with certain firefighting equipment and come up with control measures.
- Identify the right equipment and use it safely to extinguish a fire.

Assessment Criteria

- ❖ Fires are extinguished and or contained. (SO, 3, AC 2)
- ❖ Fire safety signs in the workplace.

Assessment criterion notes & Essential Embedded Knowledge

- ❖ Attributes, descriptions, characteristics and properties.
- ❖ Ideal condition of firefighting equipment.
- ❖ Relationship between the nature and context of a fire and the firefighting technique applied.

INTRODUCTION

Fire fighters are without a doubt some of the most needed service people in the world. Every year, they help save thousands of lives and possessions internationally. Although fighting fires has always been a dangerous job, thanks to modern day firefighting equipment, firemen are now safer than ever.

Types of firefighting equipment vary by fire organisations, but generally most fire fighters use the same basic apparatus grouped into categories like:

- Clothing,
- Safety equipment, and
- Fire extinguishing tools,

A breakdown of what fire fighters use makes it easy to appreciate the efforts of firemen internationally.

Importance of firefighting equipment.

Firefighting equipment protects people and businesses during fire accidents. It keeps people safe wherever they live and work. Regular inspection and servicing of the equipment meant for the safety of the occupants to the relevant standards is very crucial. Daily, weekly, monthly, quarterly and annual inspections are done to ensure the equipment's functionality, and maintain all other aspects of fire safety management.

Trained personnel need to involve in the checking of firefighting equipment, which is usually provided by the installer, or the installer's agent, or even by a servicing organization.

In this module, we shall cover in detail fire extinguishers, hose reels, and fire blankets. Other equipment that can be used fire detection and alarm systems; emergency and escape lighting systems; sprinkler systems; fire door automatic release mechanisms; portable fire extinguishers; gaseous; smoke control systems including systems using pressure differentials; evacuation lifts for persons with disabilities; fire hydrants; fire mains and fire doors.

3.1 FIRE EXTINGUISHER

A fire extinguisher, flame extinguisher, or simply an extinguisher, is an active fire protection device used to extinguish or control small fires, often in emergency situations. It is not intended for use on an out-of-control fire, such as one which has reached the ceiling, endangers the user (i.e., no escape route, smoke, explosion hazard, etc.), or otherwise requires the expertise of a fire department.

3.1.1. Types of Fire Extinguishers

Each fire extinguisher has its own symbolic notation that is a special geometric symbol to make it easier to identify the extinguisher type. They also have some additional information necessary for the identification of different classes of fire.

Fire Extinguisher Chart

Extinguisher		Type of Fire				
Colour	Type	Solids (wood, paper, cloth, etc)	Flammable Liquids	Flammable Gasses	Electrical Equipment	Cooking Oils & Fats
	Water	✓ Yes	✗ No	✗ No	✗ No	✗ No
	Foam	✓ Yes	✓ Yes	✗ No	✗ No	✓ Yes
	Dry Powder	✓ Yes	✓ Yes	✓ Yes	✓ Yes	✗ No
	Carbon Dioxide (CO_2)	✗ No	✓ Yes	✗ No	✓ Yes	✓ Yes

- **Class A fire extinguishers**, for example, symbolized by a a green triangle and also the special numerical rating, showing the quantity of water this extinguisher, it holds and the class of fire it is able to extinguish.
- **Class B fire extinguishers** are marked with the red square and have the numerical rating indicating the approximate area of fire (in square feet) it is able to extinguish.
- **Class C fire extinguishers** are marked with the blue circle, but they don't have any numerical rating. As a rule, they contain the non-conductive extinguishing agent, because they are often used for electrical fire fighting.
- **Class D fire extinguishers** have the yellow decagon on them and are mostly regarded as the part of chemical laboratory firefighting equipment. They also don't have any numerical rating on them. There are also class K fire extinguishers, marked with the black hexagon. They are intended for the fighting the fire caused by any cooking oils, fats or trans-fats combustion and are highly recommended for restaurant or cafeteria kitchens.

There is also another fire extinguishers classification based on their content nature. According to this classification there are water, foam, dry-powder and CO2 fire extinguishers.

a) Water or APW (Air Pressurized Water) fire extinguishers

As a rule, recommended for class A fire fighting and are effective in case of wood, paper or plastic ignition. Their operation principle is based on the reducing the temperature of the burning materials below their ignition temperature. The APW units, available in the USA, as a rule, are made of stainless steel and contain 2.5 gallons (9 litres) of water, but for us in South Africa it is replaced by the fire hose

Their main advantage is their price and their harmlessness. On the other hand, their disadvantages is that they cannot be used in class B fires or electrical fires, and mostly are recommended for the class A firefighting only.

There are also Water Mist fire extinguishers, very popular in hospitals. These harmless and non-contaminant fire extinguishers contain 1.75 or 2.5 gallons (11.3 litres) of water and can be used both for class A and class C fires.

b) Foam fire extinguishers

These fire extinguishers are as a rule used in class B fires. The foam, contained in them, reduces the oxygen around the fire. They are able to progressively put out the fire without any flashback. Depending on their contents there are AFFF (Aqueous Film Forming Foam), AR-AFFF (Alcohol-Resistant Aqueous Film Forming Foams), FFFP (Film Forming Fluoroprotein), CAFS (Compressed Air Foam System), Arctic Fire and FireAde fire extinguishers. AFFF units are portable foam extinguishers, used for class A and class B fires fighting as

well as for vapor suppression. AR-AFFF units are used when fuel, having caused the fire, contains alcohol, and are able to create the alcohol-resistant foam blanket. FFFP fire extinguishers are very at hand in case of alcohol-based liquids ignition, as they are able to create the heat resistant foam blanket and thus effectively put out the class C fire. CAFS, containing the special foam solution at high air pressure, are mostly used for water supply extension or (in case of A class fire or, if with the very dry foam contents, in case of B class fire) for vapor suppression. Arctic Fire extinguishers are very interesting and effective firefighting equipment solution, as they contain the special agent, able to cool and emulsify the heated and ignited materials faster than any water or foam fire extinguisher does. They are highly recommended for use in class A, B or D fires. FireAde extinguishers have something in common with Arctic Fire units, as they operate on the same principle, turning the ignited liquids into non-flammable ones thanks to their special temperature reducing agent. But unlike Arctic Fire units, these ones are recommended for use in class A or class B fire only.

c) Dry Chemical Powder fire extinguishers (DCP)

As a rule, they contain some powder-based agent, able to break the chemical chain reaction, sustaining the fire. There are monoammonium phosphate ("tri-class" or "multipurpose") units, belonging to this group, that are recommended for use in case of class A, B, and C fires, sodium bicarbonate fire extinguishers, that prevent the oxygen reaching to the fire, discharging the carbon dioxide and are used on class B and C fires, or potassium bicarbonate (also famous as aka Purple-K) extinguishers, popular in oil and gas industry for their powerful effect in class B or C fires. The dry powder fire extinguishers also include Potassium bicarbonate & Urea Complex units, effective on Class B and C fires thanks to their agents ability for decrepitation and inhibition of fire sustaining free-radicals production on large surface areas, then Potassium Chloride, or Super-K units, containing protein-foam compatible dry chemical, very effective in case of class B or C fires, or Foam-Compatible units, containing sodium bicarbonate based dry chemical, effective on class B or C fires and using silicone as a waterproofing agent, which makes them compatible with most of synthetic foam fire extinguishers. One of the most special dry powder fire extinguishers kinds is the MET-L-KYL / PYROKYL units, contains silica gel particles, preventing the unburned fuel contact with air. It makes this type of fire extinguishers irreplaceable in case of pyrophoric liquid fires, as well as in case of any other class B fires. The dry-powder fire extinguishers are very effective and popular in many industries as the reliable fire equipment, but the disadvantage of some of them is that some of the agents they contain turn to be rather corrosive and thus must be quickly removed from the surface.

d) Carbon dioxide (CO_2) and other clean agents containing fire extinguishers

They operate almost on the same principle that the dry-powder extinguishers do. They inhibit the chemical chain reaction, sustaining the fire, but have one great advantage here – they don't leave any residue after the discharge, that makes them invaluable as the part of firefighting equipment for offices. The fire extinguishers of this type contain halon (a gaseous agent, inhibiting the chemical reaction of fire and

effective in case of class B or C fires) or CO2, able to reduce the oxygen around the fire area. They can also contain the mixtures of inert gases, like Inergen and Argonite. There are Novec 1230 fluid units, containing fluorinated ketone. These ones are able to cool the surfaces and objects on fire very fast and effectively.

3.1.2 How fire extinguishers work

At the top of the cylinder, there is a smaller cylinder filled with compressed gas. A release valve acts as a locking mechanism and prevents this gas from escaping. When you pull the safety pin and squeeze the lever, the lever pushes on an actuating rod which presses the valve down to open a passage to the nozzle. The compressed gas is released, applying a downward pressure on the fire-extinguishing material. This pushes the material out the nozzle with high amounts of pressure.

Although the temptation is to aim the extinguisher at the flames, the proper way to use the extinguisher is to aim it directly at the fuel.

1. Water Extinguishers

Water extinguishers are filled with regular tap water and are typically pressurized with air. The best way to remove heat is to dump water on the fire but, depending on the type of fire, this is not always the best option.

2. Dry Chemical Extinguishers

Dry chemical extinguishers are filled with either foam or powder, usually sodium bicarbonate (baking soda) or potassium bicarbonate, and pressurized with nitrogen. Baking soda is effective because it decomposes at 70 degree Celsius and releases carbon dioxide (which smothers oxygen) once it decomposes. Dry chemical extinguishers interrupt the chemical reaction of the fire by coating the fuel with a thin layer of powder or foam, separating the fuel from the surrounding oxygen.

Depending on what type of flammable metals you are dealing with will decide which type D fire extinguisher you will require.

- Copper extinguishing medium should be used when you are dealing with lithium and lithium alloy metals.
- Sodium chloride extinguisher should be used when you are dealing with magnesium, sodium, potassium, uranium and powdered aluminium.

3. Carbon Dioxide (CO2) extinguishers

CO2 extinguishers contain carbon dioxide, a non-flammable gas, and are highly pressurized. The pressure is so great that it is not uncommon for bits of dry ice to shoot out. CO2 is heavier than oxygen so these extinguishers work by displacing or taking away oxygen from the surrounding area. CO2 is also very cold so it also works by cooling the fuel.

3.1.3 Procedure for using a fire extinguisher

Before using your fire extinguisher, be sure to read the instructions beforehand. Although there are many different types of fire extinguishers, all of them operate in a similar manner.

The PASS extinguisher operating procedure.

The following are the steps in using a fire extinguisher;

1. **Pull the Pin** at the top of the extinguisher. The pin releases a locking mechanism and will allow you to discharge the extinguisher.
2. **Aim at the base of the fire,** not the flames. This is important - in order to put out the fire, you must extinguish the fuel.
3. **Squeeze the lever slowly.** This will release the extinguishing agent in the extinguisher. If the handle is released, the discharge will stop.
4. **Sweep from side to side.** Using a sweeping motion, move the fire extinguisher back and forth until the fire is completely out. Operate the extinguisher from a safe distance, several meters away, and then move towards the fire once it starts to diminish. Be sure to read the instructions on your fire extinguisher - different fire extinguishers recommend operating them from different distances. Remember: Aim at the base of the fire, not at the flames!!!!

REMEMBER:

The following steps should be followed when responding to incipient stage fire:

- Sound the fire alarm and call the fire department, if appropriate.
- Identify a safe evacuation path before approaching the fire. Do not allow the fire, heat, or smoke to come between you and your evacuation path.
- Select the appropriate type of fire extinguisher.
- Discharge the extinguisher within its effective range using the P.A.S.S. technique (pull, aim, squeeze, and sweep).
- Back away from an extinguished fire in case it flames up again.
- Evacuate immediately if the extinguisher is empty and the fire is not out.

- Evacuate immediately if the fire progresses beyond the incipient stage.

3.1.4 Care and maintenance

Inspect fire extinguishers at least once a month (more often in severe environments).

Fire extinguisher maintenance is important for everyone's safety.

You must ensure that:

- The extinguisher is not blocked by equipment, coats or other objects that could interfere with access in an emergency.
- The pressure is at the recommended level. On extinguishers equipped with a gauge, the needle should be in the green zone - not too high and not too low.
- The nozzle or other parts are not hindered in any way.
- The pin and tamper seal (if it have one) are intact.
- There are no dents, leaks, rust, chemical deposits and/or other signs of abuse/wear. Wipe off any corrosive chemicals, oil, gunk etc. that may have deposited on the extinguisher.

Some manufacturers recommend shaking your dry chemical extinguishers once a month to prevent the powder from settling/packing.

Fire extinguishers should be pressure tested (a process called hydrostatic testing) once a year to ensure that the cylinder is safe to use.

If the extinguisher is damaged or needs recharging, replace it immediately!

IMPORTANT:

Recharge all extinguishers immediately after use regardless of how much they were used.

What is the difference between a fire extinguisher inspection and fire extinguisher maintenance?

3.1.5 Inspection

An inspection is a "quick check" to give reasonable assurance that a fire extinguisher is available, fully charged and operable. The value of an inspection lies in the frequency, regularity, and thoroughness with which it is conducted. The frequency will vary from hourly to monthly, based on the needs of the situation. Inspections should always be conducted when extinguishers are initially placed in service and thereafter at approximately 30-day intervals.

Maintenance

Fire extinguishers should be maintained at regular intervals (at least once a year), or when specifically indicated by an inspection. Maintenance is a "thorough check" of the extinguisher. It is intended to give maximum assurance that an extinguisher will operate effectively and safely. It includes a thorough examination and any necessary repair, recharging or replacement. It will normally reveal the need for hydrostatic testing of an extinguisher.

Activity

With the help of your facilitator, demonstrate how to contain a fire using a fire extinguisher.

3.2 FIRE BLANKET

It is a safety device designed to extinguish small incipient fires. It consists of a sheet of fire-retardant material which is placed over a fire in order to smother it. Newer household fire blankets are usually made of materials like fiberglass or aramid fibres. These materials are synthetic, but will not melt or drip and of course, do not burn. They will not stick even to fire-damaged skin. Most fire blankets are still effective up to temperatures as high as 900 degrees celsius, making them one of the most effective as well as simplest fire safety solutions.

3.2.1 Types of fire blankets

- They are *small fire* blankets mainly used in the kitchen and around the home, usually made of fibre glass.
- Larger *fire blankets* are usually used in labs and industrial situations. They are often made of wool that has been treated with a flame-retardant fluid.

3.2.2 How a fire blanket works.

Fire blankets are useful in many other areas of the home or office, not just the kitchen. You may want to keep one near your electrical equipment, in the garage and anywhere that an oil or grease fire may occur. The newer fire blankets perform better than the old wool fire blankets, with no scorching. Some large wool fire blankets are still in use in labs.

A fire blanket works by cutting off the supply of oxygen to a fire. Wrapping something which is burning in a blanket smother the flames. You should keep your fire blankets where they can be easily reached in the event of a fire. To get the benefits of your fire blanket, you must use it properly. Read the instructions and follow them carefully.

NOTE

It is vital to protect your hands from the fire while using a fire blanket. Wrap them in the top edge of the blanket as you put the blanket on the flame - you can also use fire resistant gloves while doing this. If you still can't put out the fire with the blanket, call the fire department right away.

After use, fire blankets should be allowed to cool for at least 30 minutes. They require no maintenance or service other than this. A fire blanket is always ready to go and will already have been tested to ensure that it will work for you. Keep several of these devices around your home. They can be folded into a small container, so they take up almost no room in your home. The container quickly releases the blanket for use.

3.2.3 Procedure for using a fire blanket

The following are procedures for using a fire blanket;

1. Choose the right type of fire blanket for the situation.
    - Small fire blankets, often made of fire-treated synthetic materials, are best for home use.
    - Larger fire blankets made of fire-retardant wool are often used in industrial situations, although most fire blanket manufacturing is moving to synthetic materials for greater fire safety.
2. Review fire blanket instructions before you need to use it for fire safety reasons.
3. Make certain the fire blanket is stored in an easily accessible quick-release container.
    - Store fire blankets in the kitchen, as this is where most home fires break out.
    - The sooner you can get to, and use, a fire blanket, the better the chances are of containing the fire.
4. Use the non-flammable blanket as a shield as you approach the fire.
5. Place the non-flammable blanket over the fire.
    - Do not throw a fire blanket over a fire. The chances are high that you will miss the fire, but be unable to retrieve the fire blanket.
6. Turn off any heat source, such as a stove burner.
    - You will most likely see smoke moving through the blanket. This is normal.
7. Leave the blanket in place until it's cool to the touch.
8. Call the fire department immediately from a safe location if the fire blanket is unsuccessful at putting out the fire.

Remember:

It is vital to protect your hands from the fire while using a fire blanket. Wrap them in the top edge of the blanket as you put the blanket on the flame - you can also use fire resistant gloves while doing this. If you still can't put out the fire with the blanket, call the fire department right away.

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3.3 HOSE REELS

A fire hose is a high-pressure hose used to carry water or other fire retardant (such as foam) to a fire to extinguish it. Outdoors, it is attached either to a fire engine or a fire hydrant. Indoors, it can be permanently attached to a building's standpipe or plumbing system.

Fire hose reels are located to provide a reasonably accessible and controlled supply of water to combat a fire. The length of a fully extended fire hose is normally between 30 and 36 metres. These appliances are designed to deliver a minimum of 20 litres of water per minute. A control nozzle attached to the end of the hose enables the operator to control the direction and flow of water to the fire.

3.3.1 **Types of Hoses**

There are several types of hose designed specifically for the fire service. Those designed to operate under positive pressure are called discharge hoses. They include attack hose, supply hose, relay hose, forestry hose, and booster hose. Those designed to operate under negative pressure are called suction hoses.

Types	
Name	**Definition**
Attack	Hose is a fabric-covered, flexible hose used to bring water from the fire pumper to the nozzle. This hose ranges in nominal inside diameter from 1.5 to 3 in (38 to 76 mm) and is designed to operate at pressures up to about 400 psi (2,760 kPa). The standard length is 50 ft (15.24 m).
Supply and relay hoses	Are large-diameter, fabric-covered, flexible hoses used to bring water from a distant hydrant to the fire pumper or to relay water from one pumper to another over a long distance. These hoses range in nominal inside diameter from 3.5 to 5.0 in (89 to 127 mm). They are designed to operate at pressures up to about 300 psi (2,070 kPa) for the smaller diameters and up to 200 psi (1,380 kPa) for the larger diameters. The standard length is 100 ft (30.48 m).

Forestry hose	Is a fabric-covered, flexible hose used to fight fires in grass, brush, and trees where a lightweight hose is needed in order to manoeuvre it over steep or rough terrain? Forestry hose comes in 1.0 and 1.5 in (25 and 38 mm) nominal inside diameters and is designed to operate at pressures up to about 450 psi (3,100 kPa). The standard length is 100 ft (30.48 m).
Booster hose	Is a rubber-covered, thick-walled, flexible hose used to fight small fires? It retains its round cross-section when it is not under pressure and is usually carried on a reel on the fire pumper, rather than being stored flat. Booster hose comes in 0.75 and 1.0 in (19 and 25 mm) nominal inside diameters and is designed to operate at pressures up to 800 psi (5,520 kPa). The standard length is 100 ft (30.48 m).
Suction hose	Sometimes called hard suction, is usually a rubber-covered, semi-rigid hose with internal metal reinforcements. It is used to suck water out of unpressurized sources, such as ponds or rivers, by means of a vacuum. Suction hose ranges in nominal inside diameter from 2.5 to 6.0 in (64 to 152 mm). The standard length is 10 ft (3.05 m).

3.3.2 Using Fire Hose Reels

1. Turn on the stop valve.
2. Run out the length of the hose as required.
3. Turn on the water at the nozzle, direct the stream at base of fire.
4. Ensure you leave a direct egress path between you and the nearest exit door/ egress route.

Activity

With the help of your facilitator, demonstrate how to use a hose reel and fire blanket to contain a fire.

3.4 SAFETY EQUIPMENT

Depending on your needs and your goals for fire safety equipment, you may need some of these pieces of equipment:

- Emergency Lights.

- Eye Protection.
- Exit Signs.
- Eyewash.
- Fall Protection.
- Fire Safety Literature.
- First Aid.
- Flashlights.
- Foot Protection.
- Gloves.
- Head Protection.
- Hearing Protection.
- Heat Stress.
- Mirrors.
- Protective Clothing.
- Respiratory.
- Safety Air Guns.
- Safety Cans.
- Safety Storage.
- Signs.
- Sorbents.
- Traffic Control.

Many of these items will be provided to those who are in the fire safety field, but they can also be purchased online or at stores specifically dedicated to fire safety.

The Way Equipment Protects You.

What you might not realize at first is that fire safety equipment protects in a few different ways.

- Prevention of burns – When you're wearing certain pieces of fire safety equipment, it will be resistant to heat, so you will not become burned, assuming you don't stay in the direct flame for a long period of time.
- Management of heat – In other cases, the fire equipment is not meant to be in the fire directly, but it will keep you from getting too hot while you find your way out or you perform a certain task for a short period of time.
- Reduction of fire – Other fire safety equipment is designed to help you put out the flames or to make them less pervasive until another fire truck can arrive.

Activity

1. Discuss the implications of using defective firefighting equipment
2. Identify and explain the implications of failing to correctly detect the nature and context of the fire.

3.5 FIRE SAFETY SIGNS

Legislation states that everyone in the workplace must be provided with relevant fire safety information. With regards to fire safety signs, this means that everyone must be aware of the location of fire alarms and emergency equipment, as well as understand where the fire exits are located and how to access them safely, though not everyone should have access expect those who have been trained to do so.

The individual requirements for your premises' fire safety signs will be determined by your business' individual risk assessment, – however, this guide to fire safety signs introduces the main signage available and shows you in which situations they should be displayed.

3.5.1 The Rules on Fire Safety Signs

- The signs should always be clear and definite.
- Escape routes and door must be labelled and displayed along the exit route.
- Signs must have direction indicating the quickest route to safety.
- It is recommended that the signs must be in pictures, to accommodate all levels of literacy.
- Signs should be positioned at an appropriate height.
    - Fire extinguisher 1,7m approximately from the floor.
- Fire-fighting equipment must be identified with signs.
- All employees should know the location of the nearest fire alarm and what to do in an emergency.
-

3.5.2 Fire safety signs needed for fire-fighting equipment

Sign	Description
	Fire Extinguisher sign - displayed next to all fire extinguishers to easily identify the location of the nearest extinguisher.
	Fire Alarm Call Point sign - located at all fire alarms.
	Fire Hose Reel sign – located at all fire hose points.
	Fire Blanket sign - located at all fire blanked locations
	In Case of Fire, Do Not Use the Lift sign - displayed at all lifts alongside the 'Use Stairs' sign to indicate safe escape route.

3.5.3 Safety Signs are Needed for Emergency Exits

Sign	Description
	Progress forward from here (indicating direction of travel) Progress forward and through from here; when sign is sited above a door (indicating direction of travel) Progress forward and up from here (indicating change of level)
	Progress down from here (indicating change of level)
	Progress to the right from here (indicating direction of travel)
	Progress to the left from here (indicating direction of travel)
	Progress down to the left (indicate change of level) Progress forward and across to the left from here when suspended within an open area
	Progress up to the right (indicate change of level) Progress forward and across to the right from here when suspended within an open area
	Progress down to the left (indicating change of level)
	Progress up to the left (indicating change of level) Progress forward and across to the left from here when suspended within an open area

Sign	Description
	Fire Door Keep Shut sign - displayed on each side of all fire doors to ensure safety.
	Fire Exit sign - displayed along all designated fire escape routes (with arrows) and above all emergency exits (without arrows).
	Fire Assembly Point - a pictogram or written sign displayed at the outside point of assembly where people must gather after evacuation.
	In Case of Fire, Use Stairs sign - an information sign displayed next to lifts and at the top of staircases so people know not to use the lift for safety reasons.

Key Learning points:

- One of the effective ways of working as a fire fighter is to know your equipment
- A fire fighter must know that different companies have different equipment for firefighting based on existing fire risks
- The most common workplace firefighting equipment are the following:
  - Portable fire extinguishers mainly DCP and CO2.
  - Fire blanket.
  - Fire beaters.
  - Fire bucket.
  - Hose reels.
  - Fire hydrants.
- There is a technique used to operate all firefighting equipment when they are used and they are appropriate for a particular type of fire.
- All firefighting equipment require proper maintenance, inspection and use.
- Some firefighting equipment can only be used by advanced fire fighters for example the fire hydrant.
- The rest of the firefighting equipment can be used by any fire fighter.
- When attacking a fire, the key rule to remember is to follow the laid-out procedure.

MODULE 4: FIRE PREVENTION

Specific Outcome

- Ability to apply principles of fire safety in a company's emergency management plan.
- Ability to help in all possible fire prevention measures.
- Ability to identify fire hazards and mitigate potential l risks.
- Ability to stop fires when they happen without exposing yourself and others to risks.

Assessment Criteria

❖ Fires are extinguished and or contained. (SO, 3, AC 2)

Assessment criterion notes & Essential Embedded Knowledge

❖ Prevention of fires.

❖ Applicable organisational policies and procedures.

INTRODUCTION

Fire can create huge destructions in the workplace. There are a range of work injuries that can occur as a result of a fire. Burn injuries and smoke inhalation are the most common types, with the latter accounting for 50% of all fire fatalities. Noxious fumes such as cyanide (from the burning of woollen materials) and carbon monoxide are often produced by fires and play a significant role in health effects and deaths.

Fire-related injuries caused when people are trying to flee a burning building are also frequently seen by the fire services. Fall injuries from people who leapt out of windows and injuries from falling debris result in a considerable number of casualties each year.

The fire prevention plan

It is a plan which provides employees with information and guidelines that will assist them in recognizing, reporting, and controlling fire hazards. This Fire Prevention Plan serves to reduce the risk of fires at your workplace in the following ways:

1. The FPP identifies materials that are potential fire hazards and their proper handling and storage procedures.
2. It distinguishes potential ignition sources and the proper control procedures of those materials.
3. The plan describes fire protection equipment and/or systems used to control fire hazards.

4. It identifies persons responsible for maintaining the equipment and systems installed to prevent or control ignition of fires.
5. The FPP identifies persons responsible for the control and accumulation of flammable or combustible material.
6. It describes good housekeeping procedures necessary to ensure the control of accumulated flammable and combustible waste material and residues to avoid a fire emergency.
7. The plan provides training to employees with regard to fire hazards to which they may be exposed.

A fire prevention plan must be in writing, be kept in the workplace, and be made available to employees for review. However, according to OSHA, if you have 10 or fewer employees you may communicate the plan orally to employees.

At a minimum, your fire prevention plan must include:

- A list of all major fire hazards, proper handling and storage procedures for hazardous materials, potential ignition sources and their control, and the type of fire protection equipment necessary to control each major hazard.
- Procedures to control accumulations of flammable and combustible waste materials.
- Procedures for regular maintenance of safeguards installed on heat-producing equipment to prevent the accidental ignition of combustible materials.
- The name or job title of employees responsible for maintaining equipment to prevent or control sources of ignition of fires
- The name or job title of employees responsible for the control of fuel source hazards.

4.1 COMMON FIRE HAZARDS AND THEIR CONTROL

A. **Heating Equipment**- Improperly installed, operated, or maintained furnaces and other heating equipment can lead to a fire.

- Heating equipment should be installed and serviced annually by a licensed technician.
- Every furnace or heater has required minimum clearance distances on all four sides and above. Material and building components must be kept out of this area.
- Combustible material must never be stored in furnace rooms. Some furnace malfunctions can cause sparks and embers. FURNACE ROOMS ARE NOT STORAGE ROOMS.

- Temporary heating units should generally not be used in public buildings. If they must be used, they should be UL listed, equipped with tip-over protection and the manufacturer's recommendations for use strictly followed- especially clearances around the unit! Electric heaters can easily overload electrical branch circuits, causing another fire hazard. An electrician should be consulted to ensure that current amperage limits are not being exceeded.

B. **Electrical**

Misused, overloaded, damaged, or improperly maintained electrical equipment is a very common cause of workplace fires.

1. Extension cords should only be used for temporary power to "in hand" equipment that is in use by someone "NOW". They should never be used:
    a) To power equipment on a semi-permanent basis, in lieu of plugging the equipment directly into a proper outlet.
    b) Run through walls, above ceilings etc.
    c) Attached to building surfaces.
    d) Where subject to crushing or pinching.

2. Cords should never be left coiled up while plugged in. This can cause inductive heating that will damage the insulation and can cause fires.

3. Multiple outlet strips should be used only where equipped with a surge suppressor and used to power only computer equipment. They must never be used to power appliances or other electric equipment. Doing so can overload outlets and branch circuits.

Extension cord and multiple outlet strip misuse is the most common cause of office fires!

4. Circuits must not be overloaded. Warm or hot circuit breakers indicate an overloaded circuit and a serious fire hazard.
5. Romex type wiring must be properly secured and supported. It should never be used as flexible temporary wiring. damaged conduit, wires, junction boxes, outlets and switches must be de-energized and repaired by a qualified electrician immediately.
6. Air vents on electrical and electronic equipment must never be blocked and should be kept clear of dust and lint.

7. Circuit breakers should be "exercised" every six months, by turning them off and on, to ensure proper function.

C. Conventional Cooking-

Microwave ovens, coffee makers and stoves used for food warming can cause fires if misused.

1. NEVER leave cooking unattended.
2. All break/kitchen rooms should be equipped with smoke detectors.
3. Combustible material must be kept away from stovetops.
4. Follow microwave container recommendations and popcorn instructions carefully.

D. Mechanical Friction-

Improperly maintained or cleaned mechanical equipment can lead to fires.

1. Bearings on ventilation equipment and conveyors should be kept properly lubricated and aligned.
2. Conveyors and mobile equipment such as loaders and forklifts should be kept cleaned and free of accumulations of combustible material.

E. Housekeeping-

Poor housekeeping can lead to fires and increase the severity of fires from other causes.

1. Excessive storage of boxes and other combustible material increases fuel loading that can increase fire severity and decrease the time occupants have to leave the building in the event of a fire.
2. Stored material must not obstruct exits, walkways, electrical panels, or emergency equipment.
3. Combustibles should not be stored close to heat sources.
4. Stored material must not be within 18” (45.72 cm) of the level of sprinkler heads.

F. Proximity Hazards

Hazards outside of buildings can expose them to the risk of fire.

1. Other buildings within 100’’ (254 cm) pose a risk and should be evaluated for fire risk and considered in emergency plans.
2. Fuel tanks near buildings should be installed to current codes and protected from vehicle collisions by barricades.
3. Dumpsters should be at least 30’’ (76.2 cm) from buildings to prevent dumpster fires from exposing to a structure.
4. Weeds/grass/brush should be kept mowed back at least 30 feet (9.144 m) from buildings to avoid fire exposure during the spring wildfire season.

G. **Smoking**-

Unauthorized smoking or poor setup of smoking areas can cause fires.

1. Smoking is prohibited in all office buildings. Unauthorized smoking in buildings must be addressed and stopped if it exists.
2. Outside smoking areas must be kept away from fuel tanks, landscaping that has chips or mulch, dumpsters and building air intakes.
3. **Butt cans should be of the self-extinguishing type.**

4.2 PREVENTING ARSON

Arson is a serious threat to homes, shops, offices, storage buildings, factories, hotels, hospitals, churches and schools. All buildings are at risk. Much of the arson is associated with vandalism and burglaries.

If small fires have been started on your own or neighbouring premises, they could be a warning of worse to come – inform the police and the fire brigade.

1. Security

- Keep the number of entry points to the minimum compatible with safe means of escape in case of fire;

- Perimeter fences, walls and gates need to be strong and high enough to keep out intruders;
- Doors and windows must be in good repair and locked when not in use;
- Locks and padlocks must be of good quality;
- Keys must be distributed only to a restricted number of people;
- Gaps under doors must be kept small;
- Letter boxes should have metal containers fitted on the inside;
- Stored material of any kind should be kept away from perimeter walls or fences where it could be set alight.

2. Employees

- Warn staff about the threat from arson;
- They should challenge anyone who should not be on the premises and report any suspicious activities;
- Vet new employees;
- Keep an eye on contractors.

3. Visitors

- Control the access and movement of visitors.
- Fire protection.
- Fixed and portable fire-fighting equipment must be regularly maintained and protected against sabotage attempts.

4. End-of-day checks

Ensure that:

- The building is secured by an individual at the end of each working day;
- Doors and windows are secure;
- No combustible material is left lying around;
- No unauthorised people are on the premises;
- Alarms are switched on;
- External lighting is switched on;
- Flammable liquids are locked in the proper store.

4.3 FIRE DETECTION

Fire detectors sense one or more of the products or phenomena resulting from fire, such as smoke, heat, infrared and/or ultraviolet light radiation, or gas.

In dwellings, smoke detectors are often stand-alone devices. In non-domestic buildings, fire detection will typically take the form of a fire alarm system, incorporating one or more of the following automatic devices:

- **Heat detector**

A **heat detector** is a fire alarm device designed to respond when the converted thermal energy of a fire increases the temperature of a heat sensitive element. The thermal mass and conductivity of the element regulate the rate flow of heat into the element. All heat detectors have this thermal lag. Heat detectors have two main classifications of operation, "rate-of-rise" and "fixed temperature". The heat detector is used to help in the reduction of property damage. It is triggered when temperature increases.

- **Smoke detector**

A **smoke detector** is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as **smoke alarms**, generally issue a local audible or visual alarm from the detector itself or several detectors if there are multiple smoke detectors interlinked.

- **Flame detector**

A **flame detector** is a sensor designed to detect and respond to the presence of a flame or fire. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is working properly; it can be used to turn off the ignition system though in many cases they take no direct action beyond notifying the operator or control system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.

- **Fire gas detector**

A carbon monoxide detector or CO detector is a device that detects the presence of carbon monoxide gas to prevent carbon monoxide poisoning. The CO is a colorless, tasteless and odorless gas produced by incomplete combustion of carbon- containing materials. It is often referred to as the ''silent killer'' because it is virtually undetectable by humans. Some system-connected detectors also alert a monitoring service that can dispatch emergency services if necessary.

Carbon monoxide detector connected to an electrical outlet

4.4 SPECIAL FIRE HAZARDS

"Special" fire hazards are special because of the severe risk of fire loss that they present, the special or unusual safety controls required to effectively prevent severe fires from them, and the fact that they *usually* are not common in office or residential occupancies.

A. Cutting/Welding and other "Hot Work"- Lack of proper safety equipment and safety procedures during work that produces flames, slag or sparks, such as welding, burning or grinding, can lead to serious fires with high injury risk.

1. Hot work should be restricted to two types of areas approved by supervision:
    a. Permanent hot work areas, such as shops, which are kept free of combustible material and posted as approved hot work areas.
    b. Locations that have been inspected and have a written "hot work permit" issued.
3. All combustible material within 35' (10.668 m) of hot work must be removed or protected with fire resistant coverings. Special attention should be given to floor openings that slag and sparks can fall into.
4. An individual should stand "fire watch" for 30 minutes after "hot work" is done.
5. Welding leads must be frequently inspected and free from damage. Do not repair leads with electrical tape.
6. All torches should be equipped with flashback arresters and the hoses inspected frequently.
    c. Cylinders should be shut off and the system bled down when not in use.

7. Oxygen and fuel gas cylinders in storage (not on a torch cart) should be properly secured, capped and separated by 20' (6.069 m) or a ½ hour fire barrier, such as a cement block wall, at least 5 feet(1.524 m) high. Torch cylinders should be capped at all times when regulators are not attached.

B. Flammable Liquid Storage and Handling - Improper handling and storage of flammable liquids, such as gasoline and solvents, can lead to dangerous "flash" fires.

1. Flammable liquids should not be used or stored inside buildings unless it is absolutely necessary for operations. If it is necessary to store flammable liquids inside buildings, the quantity should be limited to the minimum necessary.
2. DO NOT store flammable liquids in furnace/boiler rooms.
3. If 25 gallons (94.64 litres) or more of flammable liquids must be stored in one building, a UL listed flammable liquid cabinet should be used. An alternative is a separate storage shed at least 30 feet (9.144 m) from the main building.
4. Gasoline should only be stored in UL Type I or Type II safety cans.
5. If flammable liquids are dispensed from drums or portable tanks, proper bonding and grounding techniques must be used. Always set portable containers on the ground before filling.
6. Parts washer covers must rest on their fusible link when open.

C. Spontaneous Combustion- Improper storage of oily rags, chemicals, hay, straw, leaves, or coal can result in a fire.

1. Oily rags should be disposed of in an airtight metal container, which is regularly emptied to an outside container at least 30 feet (9.144 m) from buildings. Plant based oils such as linseed oil and wood stains are the most hazardous.
2. Oxidizers, such as pool treatments, tile cleaners, and disinfection/fluoridation chemicals should not be stored near combustible or flammable liquids. If they mix, a fire can result.
3. Damp hay, straw, or leaves can spontaneously ignite. Store only in outside structures at least 30 feet (9.144 m) from main buildings. Never allow hay/straw bales as decorations inside buildings.

D. **Commercial Cooking Equipment**- Commercial cooking, especially that which generates grease laden vapours, is a serious fire loss hazard.

1. Fryers, griddles and other equipment generating grease laden vapours must have a hood and ventilation system meeting the requirements of Standard.
2. Grease baffles must be properly installed when the equipment is in use.
3. Grease baffles must be washed frequently. Ductwork must be cleaned periodically.
4. Grease vents must not discharge horizontally through a combustible wall.
5. Open flame equipment, such as char broilers and gas stove burners, must be separated from the grease surface by 8" (20.32 cm), horizontally, vertically, or by use of an 8" (20.32 cm) high metal divider.

6. Fryers, griddles and other equipment generating grease laden vapours must have a Class K wet agent automatic fire extinguishing system that meets the performance requirements of UL 300. DRY CHEMICAL extinguishing systems are not effective against modern vegetable-based oils!

E. LPG ("Propane") and Natural Gas- Improper use of portable gas fuelled equipment and inadequate maintenance of piped in gas equipment and systems can lead to serious fires and facility threatening explosions.

1. Only gas fired portable equipment that is approved for indoor use should be used indoors. The use of portable gas fired equipment indoors should be limited to essential operations only.
2. All gas fired equipment and fuel systems should be serviced annually by a qualified technician.
3. Regulators must be kept clear of ice, spider webs etc.
4. Inside storage or gas cylinders should be kept to a minimum needed. An approved cabinet or storage room should be used. Gas cylinders must never be stored within 50' (15.24 m) of exits.
5. Our emergency plan should clearly require immediate evacuation in the event of a suspected leak. All evacuated personnel should be moved at least 100' (30.48 m) from the building ASAP.

Activity

1. What are the leading causes of workplace fires?

a. Smoking in non-designated areas.

b. Electrical system failures and equipment misuse.

c. Microwave and other kitchen fires.

d. Fires in waste cans and dumpsters.

2. Which of the following is required when using portable heaters in the workplace?

a. Must be certified by the supervisor.

b. Manual shut off switch in front and back of unit.

c. A thermal index of at least 5 in the on position.

d. Adequate clearance between the heater and combustibles.

3. Fires in offices have become more likely because of _____.

a. Use of cell phone causing battery fires.

b. Higher voltages being used.

c. Increased use of electrical equipment.

d. More employees smoking in the building.

4. Type ____ combustibles can act as a fuel and are found in areas such as offices.

a. A

b. B

c. C

d. D

5. Type ____ include flammable and combustible liquids, flammable gases, and flammable aerosols.

a. A

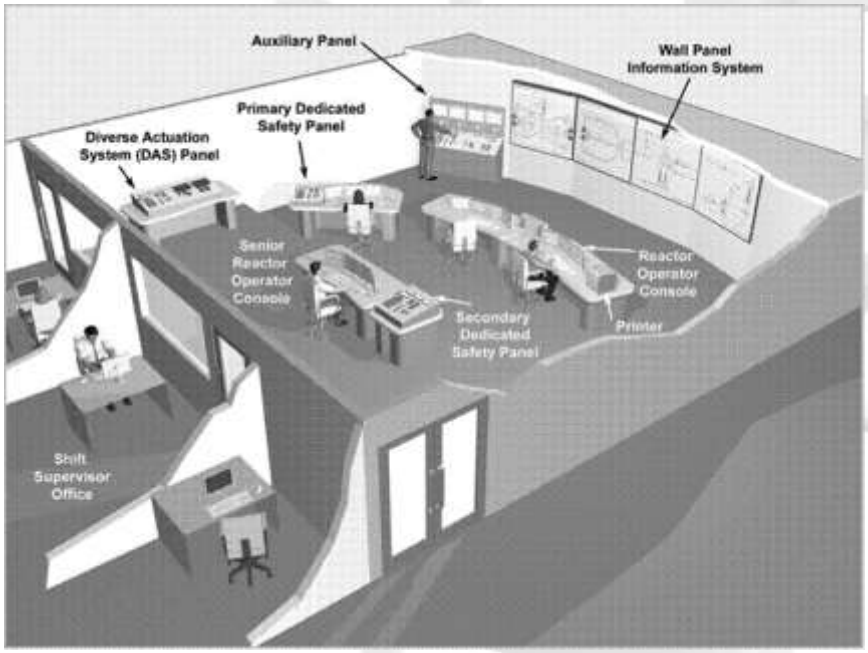
b. B

c. C

d. D

EMERGENCY CONTROL ROOM

An **emergency control centre** or **emergency communications centre** (**ECC**) is a building or room where control room operators receive incoming telephone calls from members of the public in need of assistance. Callers make initial contact through the emergency telephone service, where their calls are answered at an operator assistance centre (OAC). From here the telephone company's operator directs the call to the relevant ECC.



The purpose of an Emergency Control Centre (ECC) is to prioritise, deploy and track critical resources which enhances decision making, communication, collaboration and coordination during an emergency.

In old policing ECC's were basic and consisted of a telephone's, maps and radios. Over time as technology has advanced more equipment is used in dealing with calls. Nowadays technology is used to pinpoint the location of the caller, advanced logging systems are used to record conversations and events, should they be needed as evidence, and live records are kept of the locations of all units on patrol to co-ordinate effective responses to tasks.

Control room operators usually work in teams on variable shift patterns, with shifts lasting many hours. Emergency control centres work twenty-four hours day, all year round, and are usually busiest on Friday and Saturday night. Being staffed twenty-four hours a day requires that roughly 80 operators to work standard shifts to keep the control centre running, based on a standard sized jurisdiction.

Many big organisations or skyscraper buildings, Eskom mainly at power station and mines also have control rooms. These control rooms are used for the day-to-day operations and maintenance of the building or premises and are then also used in emergency.

Functions of an emergency control room

- ✓ When an emergency situation occurs, the Emergency Control Center (ECC) provides a centralized location where key staff members can monitor, track and make decisions that are critical to the continuing operation of the enterprise as well as the health and safety issues of its employees.

- ✓ The Emergency Control Center provides the means for the organization to communicate with emergency services, vendors, clients and employees during and after the emergency.
- ✓ The location of the Emergency Control Center (ECC) should be preplanned. It is too late to begin looking for a place to meet after the disaster or attack has occurred.
- ✓ Having an Emergency Control Center (ECC) facility in place and dedicated to the management of the emergency promotes prompt and responsible reactions during the emergency.

Emergency control center is one of the most special rooms in companies such as Eskom, as it serves as a main key communication between stakeholder and other relevant parties. It is also important to follow the procedure of who must contact the ECC department during an emergency, and what actions must be maintained after that.

Key Learning points

- In this basic firefighting programme, you have been able to learn the following key issues from principles to practical application skills for managing fires in the workplace.
- Fire is the rapid oxidation of a material in the chemical process of combustion, releasing heat, light, and various reaction products.
- For a Fire to start it needs a heat, fuel and Oxygen.

To extinguish a fire, you need to remove one of the three elements Fire can be classified into several classes based on the material that is burning(fuel).

the following are the classes of fire and their examples:

- ➢ Class A- Non-flammable material (paper, wood).
- ➢ Class B- flammable material (gasoline, petrol).
- ➢ Class C – Electrical equipment (TV, Machines).
- ➢ Class k- Cooking oil and greases.

Fire goes through four or more stages of its development and these are key in any decision to attack a fire.

The stages are, ignition, early development, flashover and full development and as well as decline stage

- Always attack a fire from a safe direction approximately 1.5 meters from the fire.
- When extinguishing afire, it is always recommended that you aim at its base.
- There are types of extinguishers which can be used to fight the fire, remember it is important to choose the correct extinguisher based on the fire classifications.
- Equipment for firefighting range from portable fire extinguishers containing different extinguishing materials and other hand held equipment such as fire beaters and fire blankets. they all serve one purpose which is to extinguish a fire.
- When using a portable fire extinguisher always follow the PASS principle which is: P-pull the pin, A- aim Nozzle at the base of the fire, S- squeeze handle, and S- sweep side to side
- If a person is engulfed in fire, ask them to stop, drop to the group and roll or you may cover them in a fire blanket.
- Remember the RACE principle for evacuating people from controllable fire

Remember! RACE

Rescue

Alarm

Contain

Extinguish

Fire detectors are used to sense one or more of the products or phenomena resulting from fire, such as smoke, heat, infrared and/or ultraviolet light radiation, or gas.

- It is always recommended that every building must have fire safety signs which are clear and accommodate every level of literacy.
- Fire can be prevented by maintenance, inspection and a good housekeeping principle on all work stations.
- Fire prevention plan provides employees with information and guidelines that will assist them in recognizing, reporting, and controlling fire hazards.
- This document must cater for all the material that might have the potential of causing fire.
- It is important for the company to have devices that will detect fire and respond immediately**.**