

CDI 6 – Fire Technology and Arson Investigation

I. Science of Fire

Definition

FIRE

- It is the product of chemical reaction in which combustible materials burn at sufficient temperature and sustained by oxidizing chemicals.
- An active chemical reaction that takes place between fuel, heat and oxygen in the form of light of noticeable heat.
- Is the manifestation of rapid chemical reaction occurring between fuel and an oxidizer- typically the oxygen in the air. Such rapid chemical reaction releases energy in the form of heat and light.
- In simplest definition, it is a product of combustion or burning.

TECHNOLOGY

- The branch of knowledge that deals with industrial arts and sciences.
- It is the application of such knowledge that is used to produce the material necessity of society.

FIRE TECHNOLOGY

- It deals with the science and study of the chemistry of fire and mechanics of combustion, to include the principles and fundamentals of fire protection.

Elements of Fire

There are three elements of fire or also known as the TRIANGLE OF FIRE, namely:

1. FUEL

- It is the combustible matter that is consumed by fire.
- Anything that will burn when heated with sufficient oxygen.
- It is recognized as the most vital element of fire.

2. HEAT

- It is the thermal agitation of matter or increase of temperature at kindling point/ignition point.
- It is a form of energy and initiator of fire.
- It is the source of ignition.

3. OXYGEN

- It is the element that sustains the fire.
- A tasteless, odourless and colorless gas which a common **oxidizing agent**.
- It comes from the atmosphere we breathe.
 - Atmosphere contains: 21% Oxygen, 78% Nitrogen and 1% impurities.

OXYGEN REQUIREMENTS:

1. 12% - No Fire
2. 14% - Flash Point
3. 21% - Fire Point

Over the years, the Triangle of Fire was taught as the elements of fire not until an emerging idea came up namely the FIRE TETRAHEDRON.

FIRE TETRAHEDRON

- Is a geometric representation of what is required for fire to exist, namely, fuel, an oxidizing agent, heat, and an uninhibited chemical reaction.
- The fire tetrahedron is composed of the following:
 - Oxygen (Oxidizing Agent)
 - Fuel
 - Heat
 - Self-sustained chemical reaction/Uninhibited chemical reaction
 - A chain reaction is a series of reactions that occur in sequence with the result of each individual reaction being added to the rest.

Combustion, Ignition and Oxidation

COMBUSTION

- Is a complex reaction that requires a fuel (in the gaseous or vapor state), an oxidizer, and heat energy to come together in a very specific way. Once flaming combustion or fire occurs, it can only continue when enough heat energy is produced to cause the continued development of fuel vapors or gases. Scientists call this type of reaction a “chain reaction”.
- It is the self-sustaining chemical reaction producing energy or products that cause more reaction of the same kind.

Mode of Combustion

1. Flameless Type – it is the type of fire that does not produce incandescent gas.
2. Flaming Type – it is the type of fire that produces incandescent gas called flames.

Phase of Combustion

1. Condensed Phase (Glowing Combustion) – it is the combustion that does not produce incandescent gas due to less intensity of heat.
2. Gas Phase (Flame) – it is the combustion that produces incandescent gas.
3. Explosion – a combustion in which that process is confined to produce appreciable pressure.
4. Detonation – it is the combustion that occurs if the pressure reach a supersonic speed producing shockwave.

IGNITION

- It is literally means the start of fire.
- Ignition will occur once the combustible matter will start to burn once it reaches its certain temperature to produce fire called Ignition Temperature.

OXIDATION

- It is a chemical change or reaction that takes place upon introduction of oxygen.
- A chemical change in which combustible material and an oxidizing material react.

Forms of Oxidation

1. Slow Oxidation

- Decaying – rotting or decomposing through the action of bacteria and fungi.
- Aging – is accompanied by accumulation of damaged DNA, misfolded proteins, and oxidized proteins (124, 143, 148). The accumulation of oxidized proteins is limited in proliferating cells due to the fact that permanent cell divisions lead to a dilution of damaged molecules.
- Rusting - process of rusting is a combustion reaction, similar to fire. Left in contact with oxygen, iron will react with the oxygen to form rust.

2. Rapid Oxidation

- **Fire**
- **Explosion**

Dangerous Behavior of Fire

This is the behavior of fire that fire-fighters should be aware of, it is also called as the other forms of combustion.

FLASH OVER

- Is the sudden and dramatic simultaneous combustion of all solid materials in a room, this occurs in pre-burning phase.
- It is the sudden burning of free radicals, which is initiated by a spark or flash produced when temperature rises until flash point is reached.
- It is the sudden ignition of accumulated radical gases produced when there is incomplete combustion of fuels.

ROLL OVER

- It is the combustion of accumulated combustible gases in a room.

BACKDRAFT

- It is the sudden combustion that occurs upon the immediate introduction of oxygen.
- It is the rapid and violent burning of heated gas in a confined area that occurs in the form of explosion. This may occur as a result of inadequate ventilation.

FLASH FIRE

- This is also known as Dust Explosion.
- This occurs when the metal post that is completely covered with dust going to be hit by lightning.

FIRE STORM

- It is an intense fire during which rising air creates vacuum beneath surroundings air rushes to fill the gap and forms extremely strong winds and propagate the fire.

BITE BACK

- A fatal condition that takes place when the fire resists extinguishment operations and become stronger and bigger instead.

CONFLAGRATION

- An extremely large fire that consumes a quarter or a half of a city or municipality.

Heat Sources

ELECTRICAL HEAT

- It is the product of arcing, shorting or other electrical malfunction.
- Poor wire connections, too much resistance, a loose ground, and too much current flowing through an improperly sized wire are other sources of electrical heat.

MECHANICAL HEAT

- It is the product of friction – the rubbing of two sticks together to generate enough heat is an example.
- Overheating of machines and compression of gas are other sources of mechanical heat.

CHEMICAL HEAT

- It is the result of rapid oxidation.
- There are four chemical heat energy, namely:
 - Heat of Combustion – the amount of heat generated by the combustion (oxidation) process.
 - Heat of Decomposition – the release of heat from decomposing compounds. These compounds may be unstable and release their heat very quickly or they may detonate. (separation of chemicals)
 - Heat of Solution – the heat released by the mixture of matter in a liquid. Some acids, when dissolved, give off sufficient heat to pose exposure problems to nearby combustibles. (combination of chemicals)
 - Spontaneous Heating – the heating of an organic substance without the addition of external heat. This occurs most frequently where sufficient air is not present to dissipate the heat produced. The speed of heating reaction doubles with each 180 F (80C) temperature increase.

NUCLEAR HEAT

- It is the product of the splitting or fusing of atomic particles.
- There are two ways of nuclear heat, namely:
 - Nuclear Fission –splitting or separation proton, electrons and neutrons to create energy.
 - Nuclear Fusion – combination of proton, electrons and neutrons to create energy.

Propagation of Fire

It means the manner or way on how the fire spreads or transfers. These are called, Conduction, Convection, and Radiation.

CONDUCTION

- It is the heat transfer that occurs in solids in which it transfers from molecules to molecules.
- This type of heat transfer happens by direct contact or through a conductor.

CONVECTION

- It is the heat transfer that occurs in fluids – liquid and gases, in which it transfers from molecules to molecules.
- This type of heat transfer is through the movement of hot gases or liquids and the main responsible for the spread of fire in buildings and other infrastructures.

RADIATION

- It is the heat transfer that occurs in vacuum (place without matter) in which heat travels in the form of heat wave.

Phases of Fire

INITIAL PHASE

- It is the phase in which the fire starts, temperature rises and small flames are produced.
- The base area of the fire has a temperature of 400 to 800 degrees Fahrenheit.
- This phase of fire can be easily controlled and extinguished.

FREE BURNING PHASE

- It is the phase in which all materials are burning, flashover occurs at this phase and serves as the phase where intensity is at its peak.
- The acceleration of pyrolysis happens.
- The base temperature of the fire is around 800 to 1,000 degrees Fahrenheit and ceiling temperature is up to 1,600 degrees Fahrenheit

SMOLDERING PHASE

- It is the phase in which all materials are consumed by fire oxygen and heat are released that yields to reduction of heat until such time it does not burn at all.
- Flames are not visible but a large amount of carbon monoxide is produced.
- The sudden introduction of oxygen with superheated fuel under pressure can cause an explosion.

Magnitude and Intensity

MAGNITUDE

- It is the size of fire usually indicated by height of flames and span of damage. These two are proportionate with each other.

INTENSITY

- It means the rate of fire's temperature or how hot the fire is.
- It is the rate of burning that varies in different conditions.
- In simplest understanding, it is the strength, energy and temperature of fire.

Factors that affect the rate of Intensity of Heat

1. Amount of materials available for burning

2. Calorific (amount of energy) value of burning
3. Oxygen supply available
4. Surface area of exposure
5. Flame length

Properties of Fire

Physical Properties

BOILING POINT

- The constant temperature at which the vapor pressure of the liquid is equal to the atmospheric pressure.

Vapor - diffused matter (such as smoke or fog) suspended floating in the air and impairing its transparency.

IGNITION POINT

- It is the temperature that must be reached by a matter in order to start the fire.
- This is also called as the KINDLING POINT.

FLASH POINT

- It is the minimum temperature that must be reached by a liquid in order to release vapors that supports combustion.

FIRE POINT

- The temperature at which the liquid will release enough amounts of vapors for combustion.

To burn a fuel (combustible material), its temperature must be raised until ignition point is reached. Thus, before a fuel start to burn or before it can be ignited, it has to be exposed to a certain degree of temperature. When the temperature of a certain substance is very high, it releases highly combustible vapors known as FREE RADICALS (combustible vapors such as hydrogen gas, carbon monoxide, carbon dioxide, and nitrogen).

- the fuel is heated until its temperature reaches its fire point,
- decomposition takes place – moisture in the fuel is converted to vapor,
- decomposition produces combustible vapors that rise to the surface of the fuel (free radicals)
- free radicals undergo combustion.

Chemical Properties

ENDOTHERMIC REACTION

- It is the chemical change that undergoes whereby a matter absorbs or adds energy/heat.

EXOTHERMIC REACTION

- It is a chemical reaction that takes place whereby a matter releases or give off energy/heat.

OXIDATION

- A type of exothermic reaction.
- It is the chemical change or reaction that takes place upon introduction of oxygen.

PYROLYSIS

- It is the chemical decomposition (scattering of molecules) of matter in reaction to heat.

Products and Effects of Fire

PRODUCTS	EFFECTS
<p>SMOKE – tiny solid particles produced by fire.</p>	<ul style="list-style-type: none"> ○ Panic ○ Low Visibility ○ Acute Respiratory Irritation <ul style="list-style-type: none"> • Cough • Sneeze
<p>FIRE GASES – gases that are produced by fire through pyrolysis.</p>	<ul style="list-style-type: none"> ○ Intoxication ○ Loss of Consciousness ○ Comatose ○ Death
<p>HEAT – thermal agitation of matter in which temperature rise at kindling point.</p> <p><i>Normal Heat – 35 – 37 degrees Celsius</i></p>	<ul style="list-style-type: none"> ○ Perspiration ○ Dehydration ○ Heat Shock (sudden exposure to fire) ○ Heat Stroke ○ Comatose ○ Hypothermia (due to high temperature of person)
<p>FLAMES – incandescent (very bright/glowing w/ intense heat) gases. It is a combustion product and a manifestation of fire when it is in its gas-phased combustion.</p> <p>Types of Flames</p> <p>a. Based on Color and Completeness of Combustibility Fuel</p> <ol style="list-style-type: none"> 1. Luminous Flame – is orange-red, deposit soot at the bottom of a vessel being heated due to incomplete combustion and has a low temperature. 2. Non-Luminous Flame – is blue, there is complete combustion of fuel and has relatively high temperature. <p>b. Based on Fuel and Air Mixture</p> <ol style="list-style-type: none"> 1. Premixed Flame – is exemplified by a 	<ul style="list-style-type: none"> ○ Burns – wounds cause by heat. <p>Types of Burns</p> <ol style="list-style-type: none"> 1. First Degree – blistering and red discoloration of the skin. 2. Second Degree – exposure of dermis without deep scarring. 3. Third Degree – charring of skin and deep scarring.

<p>Bunsen-type laboratory burner where hydrocarbon (any substance containing primarily carbon and hydrogen) is thoroughly mixed with air before reaching the flame zone.</p> <p>2. Diffusion Flame – is observed when gas (fuel) alone is forced through a nozzle into the atmosphere which diffuses in the surrounding atmosphere in order to form a flammable mixture. The candle flame is an example of diffusion flame governed by purely by molecular diffusion, and the flame of the oxyacetylene torch.</p> <p>c. Based on Smoothness</p> <p>1. Laminar Flame – when particle follows a smooth path through a gaseous flame.</p> <p>2. Turbulent Flame – are those having unsteady, irregular flows. As physical size, gas density or velocity is increased, all laminar gas flows tend to become turbulent.</p>	
---	--

Classification of Fire

Based on Cause

NATURAL/PROVIDENTIAL FIRE

- It is fire caused by natural cause or act of God such as humidity, sunrays, volcanic eruption, lightning, etc.

Spontaneous Heating

- The automatic chemical reaction that results to spontaneous combustion due to auto ignition of organic materials, the gradual rising of heat in a confined space until ignition temperature is reached.

Lightning

- A form of static electricity; a natural current with a great magnitude, producing tremendous amperage and voltage. Lightning usually strikes objects that are better electrical conductors than air.

Radiation of Sunlight

- When sunlight hits a concave mirror, concentrating the light on a combustible material thereby igniting it.

ACCIDENTAL FIRE

- It is the fire caused by human error, neglect or imprudence.
- Electrical accidents in the form of:
 - Short Circuit - unusual or accidental connections between two points at different potentials (charge) in an electrical circuit of relatively low resistance.
 - Arcing - the production of sustained luminous electrical discharge between separated electrodes; an electric hazard that results when electrical current crosses the gap between 2 electrical conductors.
 - Sparking - production of incandescent particles when two different potentials (charged conductors) come in contact; occurs during short circuits or welding operations.
 - Induced Current - induced line surge – increased electrical energy flow or power voltage; induced current; sudden increase of electrical current resulting to the burning of insulating materials, explosion of the fuse box, or burning of electrical appliances.
 - Overheating of electrical appliances - the increase or rising of amperage while electric current is flowing in a transmission line resulting to the damage or destruction of insulating materials, maybe gradual or rapid, internal or external.

INTENTIONAL/INCENDIARY CAUSES

- It is the fire caused by deliberate act of man or incendiarism.
- If preparations or traces of accelerant, plants, and trailers are evident in the fire scene, the cause of fire is intentional.
 - Accelerant - Highly flammable chemicals that are used to facilitate flame propagation.
 - Plant - The preparation and/or gathering of combustible materials needed to start a fire.
 - Trailer - The preparation of flammable substances in order to spread the fire.

Classes of Fire

CLASS A

- It is the fire in which burning fuels are composed of normal combustibles such as wood, paper, fiber, draperies and trash.
- Its extinguishing agent is water or water fog.

CLASS B

- It is the fire in which burning fuels are composed of flammable liquids such as gasoline, kerosene, cleaning fluids, grease and alcohol.
- This class of fire must be smothered to deprive them of oxygen hence, foam extinguishers and CO₂ may be utilized.

CLASS C

- It is the fire which starts with live electrical wires, equipment's and electrical appliances.
- It is commonly known as electrical fire.

- This class of fire can be extinguished by a non-conducting agent such as CO₂ and dry chemicals.

CLASS D

- This class of fire are rare and usually occurs in manufacturing facilities and composed of combustible metals.
- It can be extinguished by using dry powder, ABC chemical, baking soda or sand.

CLASS K

- Fires that are composed of kitchen products.

Building Materials and Combustible Content

Combustible Building Materials

WOODS – solid materials that came from tree.

PLASTICS – organic synthetic materials used to roofing, bathroom doors and other installation parts.

PAPERS – tiny wood based products used for wallpapers.

FIBERBOARD – used in walling and ceilings.

ASPHALT – black petroleum applied below the wooden foundation to avoid termite infestation.

Non Combustible Building Materials

STEEL – strengthened iron used for foundation and trusses.

MASONRY – prefabricated concrete such as bricks and hollow blocks used in walling and certain floorings.

CONCRETE – processed cement used in building foundation, pavements and certain walling.

GLASS – materials made up of silica and other compound used in windows and doors.

ASBESTOS – it is used in ceiling to repel heat of roof but prohibited due to adverse effects to occupant's health.

GYPSUM PLASTER – it is applied to protect the steel from melting.

Combustible Content

SOLID COMBUSTIBLES

- Wood
- Textiles
- Plastics

LIQUID COMBUSTIBLES

- Kerosene
- Gasoline

- Alcohol
- Liquefied Petroleum Gas (LPG)

Classification of Flammable Liquids

1. Class I-A – liquids with flashpoint below 22.8 degrees Celsius and boiling point below 37.8 degrees Celsius.
2. Class I-B – with flashpoint of 22.8 – 37.8 degrees Celsius.
3. Class I-C – 37.8 degrees Celsius and above.

COMBUSTIBLE GAS

Class According to Physical Properties

COMPRESSED GAS

- Gas that is present in the container that may produce pressure when heated.

LIQUEFIED GAS

- Gas that is in liquid form when confined in a container such as LPG.

CRYOGENIC GAS

- A gas that produces rapid drop of temperature when released in container.

Class According to Usage

FUEL GAS

- Gas that is use for burning.

INDUSTRIAL GAS

- Gas that is used for manufacturing products.

MEDICAL GAS

- Gas that is used in health care facilities in treating patients.

Properties and Chemicals

PROPERTIES

- These are characteristics of chemicals as their nature and how those react to various factors like temperature, environment and to other chemicals or matter.

Types of Chemical Properties

COMBUSTIBLE CHEMICALS

- Chemicals that can be consumed by fire and will likely to burn when heated.

OXIDIZING CHEMICALS

- Chemicals that can be yield oxygen to support combustion, certain types are classified too as combustibles.

UNSTABLE CHEMICALS

- Chemicals that react violently beyond anticipation even though the effects are established, its reaction takes place inconsistently.

AIR AND WATER REACTIVE CHEMICALS

- Chemicals that undergo chemical change and reaction when exposed to air or mixed with water.

TOXIC CHEMICALS

- Chemical that causes adverse effects to human body, the lethal property of chemicals vary on human capacity and amount of chemical inhaled or ingested by the person.

RADIOACTIVE

- Chemicals that emit radiation and has unstable nucleus that can be bombarded to produce enormous heat.

CORROSIVE CHEMICALS

- Chemicals that corrode metals, it also causes scalding when in contact with skin.

II. The Bureau of Fire Protection

BRIEF HISTORY

On August 7, 1901 the United States – Philippine Commission organized the Manila Fire Department, merely as part of the Department of Streets, Park, Fire and Sanitation, later it was separated from the former department. The first Filipino Fire Chief of Manila Fire Department has succeeded the line of Americans on October 19, 1935 in the person of Deputy Chief Jacinto Lorenzo.

Presidential Decree (PD) 975 was enacted on August 8, 1975 constituting the Integrated National Police (INP). It integrated all city and municipal police, fire and jail departments into the INP. These integrated forces were placed under the operational control of the Philippine Constabulary as its nucleus.

Republic Act 6975 otherwise known as the DILG Act of 1990 was enacted on December 13, 1990, the law has created the now Bureau of Fire Protection (BFP) and its present organization under the Department of Interior Local Government (DILG) and separated from the Police (PNP) and the Jail (BJMP).

On June 24, 2004, the congress enacted the RA 9263 otherwise known as the BFP Professionalization Act of 2004 which has professionalized and upgraded the qualification standards of appointment in the BFP and BJMP to make it in par with the Philippine National Police in accordance to RA 8551.

On May 8, 2009, RA 9592 an “Act extending the 5 years reglementary period for complying the minimum education qualification and appropriation eligibility in the appointment of the BFP and BJMP was enacted.

POWERS AND FUNCTIONS

Under the Section 54 of RA 6975, the BFP is responsible for the following:

The Fire Bureau shall be responsible for the prevention and suppression of all destructive fires on buildings, houses and other structures, forest, land transportation vehicles and equipment, ships or vessels docked at piers or wharves or anchored in major seaports, petroleum industry installations, plane crashes and other similar incidents, as well as the enforcement of the Fire Code and other related laws.

The Fire Bureau shall have the power to investigate all causes of fires and, if necessary, file the proper complaints with the city or provincial prosecutor who has jurisdiction over the case.

ORGANIZATION

The Fire Bureau shall be headed by a chief who shall be assisted by a deputy chief. It shall be composed of provincial offices, district offices and city or municipal stations.

At the provincial level, there shall be an office of the provincial fire marshall which shall implement the policies, plans and programs of the Department; and monitor, evaluate and coordinate the operations and activities of the fire service operating units at the city and municipal levels. In the case of large provinces, district offices may be established, to be headed by a district fire marshall.

At the city or municipal level, there shall be a fire station, each headed by a city or municipal fire marshall: Provided, That, in the case of large cities and municipalities, a district office with subordinate fire stations headed by a district fire marshall may be organized as necessary.

RANK CLASSIFICATIONS

COMMISSIONED OFFICER	NON-COMMISSIONED OFFICER
Director	Senior Fire Officer 4
Chief Superintendent	Senior Fire Officer 3
Senior Superintendent	Senior Fire Officer 2
Superintendent	Senior Fire Officer 1
Chief Inspector	Fire Officer 3
Senior Inspector	Fire Officer 2
Inspector	Fire Officer 1

KEY POSITIONS

KEY POSITIONS	MINIMUM RANK REQUIRED
Municipal Fire Marshal	Senior Inspector
City Fire Marshal	Chief or Senior Inspector
District Fire Marshal, Provincial Fire Marshal, Asst. RD for Operations, Asst. RD for Admin, Regional Chief for Directorial Staff	Superintendent
District Fire Marshal for NCR, Regional Director, Director of Directorate for NHQ	Senior Superintendent
Deputy Chief for Admin, Deputy Chief for Operation, Chief of Directorial Staff	Chief Superintendent
Chief of BFP	Director

QUALIFICATIONS FOR BFP PERSONNEL

- A citizen of the Republic of the Philippines;
- A person of good moral character;
- Must have passed the psychiatric/psychological, drug and physical test for the purpose of determining his/her physical and mental health;
- Must possess a baccalaureate degree from recognized institution of learning;
- Must possess the appropriate civil service eligibility;
- Must not have been dishonourably discharged of dismissal for cause from previous employment;
- Must not have been convicted by final judgement of an offense or crime involving moral turpitude;
- Must be at least one meter and sixty-two centimeters (1.62m) in height for male, and one meter and fifty-seven centimeters (1.57m) for female: Provided, that a waiver for height and age requirement/s shall be automatically granted to applicants belonging to the cultural communities; and
- Must weight not more or less than five kilograms (5kgs.) from the standard weight corresponding to his/her height, age and sex;
- New applicants must be less than twenty-one (21) nor more than thirty (30) years of age.

APPOINTMENT

RANK	MANNER OF APPOINTMENT
Non Commissioned Officers	Appointed by RD/Chief of BFP Attested by CSC
Inspector to Superintendent	Appointed by Chief of BFP Recommended by Immediate Supervisor Attested by CSC
Senior Superintendent	Appointed by Secretary of DILG Recommended by Chief of BFP Attested by CSC
Chief Superintended to Director	Appointed by President Recommended by Secretary of DILG Endorsement from Chairman of CSC

III. Fire Safety

FIRE SAFETY

- It is the totality of undertakings, process or systems that ensure persons and properties against the effects of destructive fires.

FIRE PREVENTION

- It pertains to means employed to avoid the possibility of fire to occur.

Certain measures to avoid fires

- Seclusion of heat source
- Use of non-combustible materials
- Use of fire alarms and extinguishers
- Proper storage and disposal
- Maintenance of electrical system

- Conducting fire drill
- Occupants awareness

FIRE SUPPRESSION

- It pertains to the undertakings or means employed to pacify the fire.

Methods of Suppression

- Cooling – it is the method employed to reduce the heat below the ignition temperature.
- Smothering – it is the method employed to separate or prevent the oxygen to interact and support the fire.
- Separation of Fuel – it is the means employed by separating combustible materials from fire.
- Inhibition of Chemical Reaction – it is the means employed to prevent the combustion process by simultaneously preventing the elements of fire to combine.

FIREFIGHTING

- It is an activity intended to save lives and property. It is one of the most important emergency services in a community. Fire fighters battle fires that break out in homes, factories, office buildings, shops, and other places. Fire fighters risk their lives to save people and protect property from fires.

Factors affecting Fire fighting

- Time of Day
 - Daytime provides visibility but can intensify the fire.
 - Night time reduce visibility but does not contribute to the intensity of fire.
- Weather
 - Rain can aid to suppress the fire.
 - Summer weather can aid the intensity of fire.

Things to evaluate at the Fire Scene

- Extent
- Location
- Type of Content
- Life Hazard
- Type of Construction
- Condition of Fire
- Occupancy

Fire fighting Tools and Equipment

- Fire Personal Protective Equipment
- Ladder Belt
- Gloves
- Flashlight
- Personal Alert and Safety System
- Thermal Vision System – measures heat intensity

- Two-way Radio
- Self-contained breathing apparatus
- Bolt cutter
- Battering ram
- Pike-fire break
- Axe
- Hose clamp
- Hose Jacket – for leak
- Nozzle
- Foam Nozzle Eductor (AFFF)
- Foam Mechanical ventilation
- Fan hanger
- Hydrant wrench – opening hydrant
- Spanner wrench
- Hose strap
- Tarpaulin – for salvaging
- Saw
- Deck gun – for 30ft distance from the fire scene

STRUCTURAL FIREFIGHTING

- Is the organized means of suppressing fire in various structures or buildings to ensure efficient extinguishments and efficient work output in fire suppression operation.

Strategies in Fire fighting

1. Locate the Fire – determination of location, size and speed of fire.
2. Confinement – it is the restriction of fire from spreading.
3. Extinguishments – it is the series of actual act of pacifying the fire.

FIRE EXTINGUISHERS/EXTINGUISHING AGENTS

- Is a mechanical device, usually made of metal, containing chemicals, fluids, or gasses for stopping fires, the means for application of its contents for the purpose of putting out fire (particularly small fire) before it propagates, and is capable of being readily moved from place to place.

Types of Fire Extinguishers

- Water Fire Extinguisher – extinguisher filled with water use of fight Class A and Class B fires except class C fires.
- Liquefied Fire Extinguisher – those extinguishers that contain Carbon Monoxide Gas use to fight class A, B, and C fires
- Dry Chemical Extinguisher – those that contain chemical powder intended to fight all classes of fires.
- Foam Extinguisher– contains sodium bicarbonate and a foam-stabilizing agent in a larger compartment and a solution of aluminum sulfate in an inner cylinder; reaction between the two solutions forms a stabilized foam of carbon dioxide bubbles.
- Soda-acid Fire Extinguisher – filled with sodium bicarbonate mixed with water; a small bottle of sulfuric acid is suspended inside (near the top) in such a way that when the extinguisher is turned up-side-down, the acid mixes with sodium bicarbonate;

- carbon dioxide is formed by the reaction which results to the building of pressure inside the extinguisher; this pressure forces the water solution out from the container through a hose.
- Vaporizing Liquid Fire Extinguisher – contains non-conducting liquid, generalization carbon tetrachloride or chlorobromethane; operation is by manual pumping or using a stored pressure; the stream of liquid that is expelled is vaporized by the heat of the fire and forms a smothering blanket. This type is usually used in fires involving flammable liquids or electrical equipment.
 - Carbon Dioxide Fire Extinguisher – effective against burning liquids and fires in live electrical equipment; used mainly to put out Class C fires.

VENTILATION

- It is the performed in order to free the building of smoke and fire gases.

Types

- Vertical Ventilation
- Cross Ventilation
- Mechanical Ventilation

EXPOSURES

- It is the condition of subjecting a person or property of fire.

Types

- Fire Exposure – the exposure of property to fire.
- Life Exposure – the exposure that endangers the life of persons.

Things to avoid/minimize Exposure

- Rescue – the act of removing the occupants from the building.
- Overhaul – the detailed check of installation to ensure the re-ignition will not occur.
- Salvage – it is the act of preventing properties to be damaged by smoke and water.

FIRE CONTROL

- It pertains to means employed to keep the fire to a minimum or manageable level for easy suppression.

Means of Fire Control

- Control of external spread
- Control of internal spread
- Choice of construction materials
- Proper use of fire fighting equipment
- Providing access to fire brigade
- Installation of fire alarms
- Proper use of rescue facilities
- Adoption of fire safe design
- Occupants' cooperation
- Maintenance of exceptional hazards

- Proper heating and ventilation
- Proper storage of goods
- Proper waste storage and disposal

FIRE INSPECTION

- It is the critical view of installation conducted by authorized personnel of Fire Department to determine the safety and hazards from fire and recommend necessary change if corrections should be made.

Reasons to Conduct Inspection

1. To ensure fire safety of installation and community.
2. Prevention of fire
3. Enforcement of Fire Code
4. Compliance of occupants to Fire Code.

Authority to Conduct Fire Inspection

The Bureau of Fire Protection (BFP) is mandated to enforce Fire Code and conduct of Fire Safety Inspection and Prevention of Fires. Such is in accordance to RA 6975 and RA 9514.

FIRE CODE OF THE PHILIPPINES

- The RA 9514 or the Fire Code of the Philippines was enacted on December 19, 2008 that repealed the old Fire Code, the PD 1185.
- The notable incident of Glorietta explosion became the precedence in the amendment. It was cited that the Makati Fire District has limited number of inspectors to cover numerous establishments in their AOR. It was also cited that the PD 1185 is not responsive to the trend of current times and requires amendment.

FIRE SAFETY ENFORCEMENT BRANCH

- The branch of BFP that is tasked to enforce Fire Code; it is composed of Fire Safety Enforcers.

FIRE SAFETY ENFORCERS

- These are the personnel of BFP tasked to enforce the fire code. The function of BFP is to enforce the Fire Code and conduct inspection is being performed by the Fire Safety Enforcement Section.

FIRE SAFETY INSPECTORS

- These are FSE that conduct inspection, recommends to Chief of FSES the approval of Fire Safety Inspection Certificate (FSIC) and/or Notice of Disapproval (NOD), correct deficiency of installation, keep records for inspection, testify to court on related cases and conduct fire safety lectures, seminars and drills.

Qualifications of Fire Safety Inspector

FOR UNIFORMED PERSONNEL

- Licensed Engineer (Civil, Electrical, Mechanical, Chemical, Sanitary and Electronic and Communication); or Architect with at least 1 year in the BFP service; or Graduate of Baccalaureate Degree Course with at least 3 years in the BFP service.
- Shall have completed the Fire Arson Investigation and Inspection Course (FAIIC); or have undergone at least 40 hours of relevant seminar/workshops on the Fire Code of the Philippines of 2008 and other relevant fire safety seminars/workshops; and
- Non-licensed and non-engineering graduate must pass the written fire safety inspection examination conducted by the BFP.

FOR NON-UNIFORMED PERSONNEL

- Appointed Engineer (Civil, Electrical, Mechanical, Chemical, Sanitary and Electronic and Communication); or Appointed as Electrical/Building Inspectors; and
- Shall have undergone at least 40 hours of relevant seminar/workshops on the Fire Code of the Philippines of 2008 and other relevant fire safety seminars/workshops.
- Electrical/Building Inspectors must pass the written examination conducted by the BFP, otherwise they can only conduct inspection relative to their appointment's duties and functions.

PLAN EVALUATORS

- These are FSE that review and evaluate building plans to determine its compliance to the fire code.
- It also conducts site verification to determine if the building under construction is in accordance to the approved plan.

Qualifications of Plan Evaluator

- Must be a licensed Architect or Engineer; and
- Shall have undergone at least 40 hours of relevant seminar/workshops on the Fire Code of the Philippines of 2008 and other relevant fire safety seminars/workshops.
- In cases where there is no licensed engineer or architect in a specific jurisdiction, a graduate of any baccalaureate degree with FAIIC training shall be designated as PLAN EVALUATOR.

INSPECTION PROCEDURE

1. Preparation for Inspection

- a. Determine the need for inspection
- b. Determine the things to be inspected
- c. Gather recording materials
- d. Secure a copy of Fire Code

2. Knowledge of Fire Code and its relevant provisions

3. Time Requirement

- a. Plan the period of time to be consumed during inspection

4. Inspection Frequency

- a. Inspection must be made twice a year but varies under existing conditions.
- b. Malls, Hospitals, School – 4x a year

5. Inspection Preliminaries

- a. Procure a copy of Inspection Order (IO)
- b. Review past records of the installation to be inspected (records, reports, IO, notices, etc.)

- c. Suggest the inquiry of former inspectors in case that the AOR is transferred to you.

6. Manner of Dress

- a. Suggest the use of uniform and ID.

PROCEDURES DURING INSPECTION

1. Identification and Permission to Inspect

- a. Identify yourself to occupants and show the IO.
- b. Court order is required in case the installation is a residential type (single detached).

2. Interview of Owner/Administrator

- a. Ask the owner about the previous inspection.

3. Inspection tour

- a. Always be accompanied by the owner/administrator
- b. Start on top to bottom
- c. Note exceptional hazards

4. Correcting Violations

- a. Record violations on your notebook and advice for remedies and correction.
- b. Correction may be done informally (verbal) or formal (letter or notice).

5. Discuss Findings with Escorts

- a. Discuss findings and suggested solution to escort.

6. Exit Interview

- a. Inquire certain issues that require clarification.

7. Prepare report

- a. The inspection report must be prepared and submitted to the Fire Marshal.

8. Issuance of Abatement Order

- a. In case of violation, abatement order shall be issued to owner.
- b. Notice of hazard must be displayed to the front of the installation.
- c. The owner must comply with the deadline set by law.

9. Re-inspection

- a. This shall be made after the abatement period.
- b. To speed up the process, check only the issues to be corrected, but thorough tour is suggested.

10. Issuance of Fire Safety Inspection Certificate or Notice of Disapproval

- a. Recommend to the Fire Marshal the Issuance of FSIC or OP to owner
- b. Issue FSIC and Occupancy Permit if the owner has complied.
- c. Issue Notice of Approval if in case that he did not comply.

11. Summary Abatement

- a. Failure to comply to abate will cause the government to conduct summary abatement.
- b. Upon the end of summary abatement, the owner must reimburse the government the sum of money that it used to abate the installation within 90 days after the completion.

12. Enforcement of Lien

- a. Failure to reimburse shall cause the government to confiscate the property and auction it.

Abatement - Any act that would remove or neutralize a fire hazard.

Summary abatement - is the abatement of a nuisance without any judicial proceeding.

Nuisance – anything that causes inconvenience or annoyance.

IV. Fire Investigation

FIRE INVESTIGATION

- It is the process of determining the cause of fire.

REASON TO INVESTIGATE FIRES

- To determine the cause.
- To prevent such fire to occur again.

FIRE INVESTIGATOR

- The personnel of BFP that investigates fire and determines its cause and must possess the following qualifications:
 - Must possess knowledge in Investigation.
 - Must possess insight in human behavior.
 - Must possess knowledge in the chemistry and behavior of fire.
 - Must be resourceful.

FIREMEN'S ROLE IN FIRE INVESTIGATION

Information that can be obtains from Firemen:

- Information attainable prior to the arrival at the scene.
 - Time of call
 - Name of caller
 - Time of alarm
 - Date
 - Time and place of occurrence
- Information available to firemen at the scene
 - Nature of occupancy
 - Number of casualties and wounded
 - House of origin
- Information available during overhaul
 - Identities of casualties
 - Possible cause of fire

MEANING OF THE COLOR OF SMOKE AND FLAME

- Black Smoke with Deep Red Flame – Petroleum, Tar, Rubber, Plastics, etc.
- Heavy Brown Smoke with Bright Red Flames – Nitrogen Products
- White Smoke with Bright White Flames – Magnesium
- Black Smoke with Red and Blue Green Flames – Asphalt shingles
- Purple, Violet or Lavander Flames – Potassium
- Greenish to Yellow Flames – Chlorine or Manganese
- Bright Reddish Yellow Flames – Calcium
- Changes of Smoke to Yellow or Greyish – Usual backdraft condition

EXAMINATION OF THE FIRE SCENE

- Exterior Openings – examine the doors, walls and windows.
- Locked doors may indicate the intent to delay fire fighters.
- Closed windows may indicate the arsonist’s intent to conceal the crime.
- Open windows may indicate the intent to speed up the conflagration.
- Preliminary Examination of the Scene
 - Equipment that may be used by the arsonist
 - Traces which may lead to perpetrators identity
 - Photographs – images during the fire may aid to look for perpetrators.
- Observation of the Spectator – pyromaniacs usually remains at the scene. At night the pyromaniac is fully clothed.

INVESTIGATION OF THE SCENE AFTER THE FIRE

- Safeguard the Scene
- Order of Searching
- Locating the Point of Origin
- Examination of Point of Origin
- Traces of Accelerants
- Altered Protective Devices
- The exterior of the structure must be examined to acquire idea on the location of the fire, manner of burning and heat transfer. Photographs and sketches are required.
- Pre-fire condition must be established.
- Condition of Utilities
- Condition of doors and windows
- Evidence of explosion manifested by the displacement of objects
- Fire Damages
- Fire spread scenario must be established to determine the origin and patterns.

CRIME SCENE INVESTIGATION TEAM

<ul style="list-style-type: none">○ LEADER○ ASSISTANT LEADER○ PHOTOGRAPHER○ RECORDER○ SKETCHER○ MEASURER○ EVIDENCE PERSONNEL RECOVERY○ EVIDENCE CUSTODIAN○ UTILITY MAN	<div>TECHNICIAN</div> <ul style="list-style-type: none">○ CHEMIST○ FORENSIC PATHOLOGIST○ FINGERPRINT TECHNICIAN○ DNA ANALYST○ TOOL MARK ANALYST○ FIREARM IDENTIFICATION OFFICER○ BOMB TECHNICIAN○ OTHERS
--	---

FIRE SCENE SEARCH

Purposes of Search

- To locate, identify, record, collect and preserve evidence.
- To determine the cause of fire.
- To provide evidence for the guilt of arsonist (in case of intentional fire)

STEPS IN SEARCHING

- Conduct outside survey – check doors, windows and outside appearances
- Conduct internal survey – check burn trails and arrangements
- Locate the Point of Origin
 - The source of ignition is definitely at the point of origin, some are recognizable some are not.
 - The competent ignition source must produce sufficient temperature in order to produce ignition it must reach the kindling temperature.
 - Ignition process involves generation, transmission and heating.
 - The competent ignition source must generate energy enough to raise the temperature of the matter and must transmit the energy to fuel.
 - The proximity of the source of ignition from fuel decreases the time how long the fuel will burn.

LEADING TRACE TO POINT OF ORIGIN

- Burn Patterns in Ceiling
- Alligatoring of Woods
- Deformed Appliances/Content
- Fallen Debris
- Inverted Cone Pattern
- Spalling
- Trailers

DETERMINE THE INTERIOR STRUCTURE

The following must be considered:

- Analyze and establish the materials used in building the structure including age and status.
- Determine the contents of the scene or structure preferably those combustible contents.
- Establish the arrangements of furniture preferably those that can cause or produce fire.
- Establish the wiring system of electricity; look for profile conditions of systems, defects and age of wire and repairs.
- Consider the alterations made during fire suppression stage to avoid misconceptions.
- Vital things stored/secured in the scene must be established documents etc.

RECORDING THE INVESTIGATION

- Photograph
- Sketch
- Evidence Log Sheet
- Departmental Notebook
- Report Forms

COLLECT THE FOLLOWING EVIDENCE

- Containers – cans, bottles that may look like or possible to contain accelerants.
- Ashes/Debris – examination of ashes may reveal the presence of accelerants.
- Fingerprints
- Incendiary Devices – fuse, candles, lighter

- Tools – such as crowbar used in forced entry might be left including blades, submit to this to lab for paint comparison.
- Documents

PROCEDURE IN COLLECTION

- Identified evidence must be photograph in place with date, measurement and nomenclature.
- Collect accordingly based on physical state.
- Coordinate the action to leader and sketcher.

TOOLS IN COLLECTING

- Debris Shifter
- Arson Scene Tool Kit
 - Box
 - Container
 - Drills
 - Mallet
 - Gloves
 - Shovel
- Electrical Tool Kit
- Liquid Sample Kit
- Solid Sample Kit
- Metal Detector

TOOLS USED IN PRESERVATION

- Canisters
- Vials and Tubes
- Re-Sealable Plastics
- Jars – for gases

PROCEDURE IN PRESERVATION

- Place the collected evidence in the proper container.
- The manner of placement must be photograph and recorded.
- Appropriate labelling and tagging must be made in the container.
- Endorse the preserved specimen to evidence custodian.

COLLECTION OF EVIDENCE

EVIDENCE STATE	MEANS OF COLLECTION	MEANS OF PRESERVATION
SOLIDS	Sawing, cutting, picking	Contained in sealable plastic container
LIQUIDS	Siphoning by using dropper	Contained in test tube/vials
GAS	Siphoning by using dropper	Contained in wide mouthed jar sealed w/ plastic and rubber band.

CAUSES OF FIRE

Providential Causes

- Lightning (Hot Bolt)
- Spontaneous Heating
- Rays of the Sun

Accidental Causes

- Smoking
- Electrical Fire Causes (short circuit, overloading etc.)
- Flammable Liquids
- Matches played by children
- Candles

Incendiary Fire

Things used by the Arsonist:

- Plants – physical arrangement of arsonist in setting up the fire.
- Trailers – these are the materials used by arsonists to spread the fire throughout the installation.
- Accelerants – these are chemicals used in speeding up the ignition.

V. Arson Investigation

ARSON

- It is the malicious destruction of property by fire.
- It is the concern of fire investigation to prove malicious intent of the offender. Intent must be proved, otherwise, no crime exist. The law presumes that a fire is accidental, hence criminal designs must be shown. Fire cause by accident or criminal design must be shown. Fire cause by accident or negligence does not constitute arson.

LAWS ON ARSON

- Art. 320 of the Revised Penal Code
- PD 1613 Law on Arson (as amended by PD 1744)

TYPES OF ARSON

DESTRUCTIVE ARSON (Art. 320 of RPC)

The penalty of reclusion temporal in its maximum period to death shall be imposed upon any person who shall burn:

1. One (1) or more buildings or edifices, consequent to one single act of burning or as a result of simultaneous burnings, or committed on several or different occasions;
2. Any building of public or private ownership, devoted to the public in general or where people usually gather or congregate for a definite purpose such as but not limited to official governmental function or business, private transaction, commerce, trade workshop, meetings and conferences, or merely incidental to a definite purpose such as but not limited to hotels, motels, transient dwellings, public conveyance or stops or terminals, regardless of whether the offender had knowledge that there are persons in said building or edifice at the time it is set on fire and regardless also of whether the building is actually inhabited or not.

3. Any train or locomotive, ship or vessel, airship or airplane, devoted to transportation or conveyance, or for public use, entertainment or leisure.
4. Any building, factory, warehouse installation and any appurtenances thereto, which are devoted to the service of public utilities.
5. Any building the burning of which is for the purpose of concealing or destroying evidence of another violation of law, or for the purpose of concealing bankruptcy or defrauding creditors or to collect from insurance.

OTHER CASES OF ARSON PD 1613

Section 1. Arson. Any person who burns or sets fire to the property of another shall be punished by Prison Mayor.

The same penalty shall be imposed when a person sets fire to his own property under circumstances which expose to danger the life or property of another.

Section 2. Destructive Arson. The penalty of Reclusion Temporal in its maximum period to Reclusion Perpetua shall be imposed if the property burned is any of the following:

1. Any ammunition factory and other establishment where explosives, inflammable or combustible materials are stored.
2. Any archive, museum, whether public or private, or any edifice devoted to culture, education or social services.
3. Any church or place of worship or other building where people usually assemble.
4. Any train, airplane or any aircraft, vessel or watercraft, or conveyance for transportation of persons or property
5. Any building where evidence is kept for use in any legislative, judicial, administrative or other official proceedings.
6. Any hospital, hotel, dormitory, lodging house, housing tenement, shopping center, public or private market, theater or movie house or any similar place or building.
7. Any building, whether used as a dwelling or not, situated in a populated or congested area.

Section 3. Other Cases of Arson. The penalty of Reclusion Temporal to Reclusion Perpetua shall be imposed if the property burned is any of the following:

1. Any building used as offices of the government or any of its agencies;
2. Any inhabited house or dwelling;
3. Any industrial establishment, shipyard, oil well or mine shaft, platform or tunnel;
4. Any plantation, farm, pastureland, growing crop, grain field, orchard, bamboo grove or forest;
5. Any rice mill, sugar mill, cane mill or mill central; and
6. Any railway or bus station, airport, wharf or warehouse.

Section 4. Special Aggravating Circumstances in Arson. The penalty in any case of arson shall be imposed in its maximum period;

1. If committed with intent to gain;
2. If committed for the benefit of another;
3. If the offender is motivated by spite or hatred towards the owner or occupant of the property burned;
4. If committed by a syndicate.

PRIMA FACIE EVIDENCE OF ARSON

- If the fire started simultaneously in more than one part of the building or establishment;
- If substantial amount of flammable substances or materials are stored within the building not necessary in the business of the offender nor for household use;
- If gasoline, kerosene, petroleum or other flammable or combustible substances or materials, or any mechanical, electrical, chemical or electronic devices designed to start a fire are found in the ruins or premises of the burned property;
- If the building or property is insured for substantially more than its actual value at the time of the issuance of the policy;
- If during the lifetime of the corresponding fire insurance policy, more than two fires have occurred in the same or other premises owned or under the control of the offender and/or insured;
- If shortly before the fire, a substantial portion of the effects insured and stored in a building had been withdrawn from the premises except in the ordinary course of business;
- If a demand for money or other valuable consideration was made was the fire in exchange for the desistance of the offender or for the safety of the person or property of the victim.

PENALTIES

- Destructive Arson – Reclusion Perpetua
- Arson (if committed by the owner who intentionally burned in his own property) – Prision Mayor
- Other Cases of Arson – Reclusion Temporal to Reclusion Perpetua
- Where Death result from Arson – Reclusion Perpetua
- Conspiracy to commit Arson – Prision Mayor

MOTIVES FOR ARSON

Motive is something that pushes someone to commit arson; the following are some of the common motives of arson:

- Incendiarism in Industry – commonly committed by employees and workers.
- Revenge and Spite – performed by person with grudge to owner/occupant.
- Desire to conceal crime – commonly known performed by burglars.
- Jealousy – commonly performed by lovers/jilted partners.
- Intimidation – commonly performed by persons with legal impediments with the owner/occupants.
- Juvenile Delinquency – commonly performed by minors involved in riots.
- Insanity – commonly performed by pyromaniacs.
- Sabotage – commonly performed by business rivals.

- Riots – in cases rioting gangs are present before the fire; it can be committed discriminately or indiscriminately.
- Radical Terrorism – commonly performed by terrorist to cause fear in public.
- Suicide – commonly performed by desperate persons.
- Insurance Fraud

TECHNIQUES IN ARSON

Fuels used in Arson

- Flammable Liquids
- Cloths and textiles
- Vegetation (in case of farm)

Chemical Igniters

- Chemicals reacting with calcium hypochloride (brake fluid, charcoal, glycerol, pine oil, turpentine, tobacco, grease and oil)
- Potassium chlorate and sugar (can be ignited by spark)
- Potassium chlorate/potassium permanganate mixed with acids
- Sodium/lithium mixed with water
- Glycerin and potassium permanganate

EXPLOSION

- It is the sudden combustion accompanied by light, heat, abrupt noise and pressure.

Types of Explosion

- Mechanical – caused by leak due to inability of the container to withstand internal pressure.
- Chemical – caused by chemical reaction of explosives.
- Nuclear – due to bombardment of sub-atomic particles of radioactive materials.

Results of Explosion

- Sudden release of energy with light, heat and energy
- Sudden rise in temperature
- Movement of materials

Classification of Explosion

According to Totality of Combustion	According to Generated Velocity
Low Order – not all particles were combusted.	Low Explosive (speed of deflagration) – the speed of pressure did not reach supersonic speed.
High Order – at all the particles of the materials were combusted.	High Explosive (speed of detonation) – the pressure reach supersonic speed.

Equipment used in Detecting Accelerants and Explosives

- Portable Hydrocarbon Detector – Hydrocarbon rate
- Gas Chromatogram – To determine what chemical is used
- Portable Ion Mobility Spectrometer – Sniffing of explosive gases
- Color Test
- Taggants – fingerprint of explosive device (disc-like)

INVESTIGATION OF FATAL FIRES

Purpose

- To identify the victims
- To determine the cause of death
- Determination of manner of death
- Determination of the approximate time of death

AUTOPSY

- The examination of dead body to determine the cause of death in relation to investigation.

MEANS OF IDENTIFYING THE VICTIMS

- Sex of the body
- Fingerprints
- Dental Features
- Skeletal Features
- Serologic Studies
- DNA
- Body marks – tattoos, scars, birth marks, moles, piercings, etc.

DETERMINATION OF CAUSE OF DEATH

NATURAL DEATH

- Absence of fire gases in respiratory tract
- Absence of foul play upon discovery

ACCIDENTAL DEATH

- Presence of fire gases in respiratory tract
 - Hyperthermia
 - CO2 Poisoned
- Absence of foul play upon discovery usually at fetal position

INTENTIONAL DEATH

- Indication of being hogtied or unusual appearance upon discovery.

DETERMINATION OF MANNER OF DEATH

INHALATION OF CARBON MONOXIDE

- Presence of carboxyhemoglobin in the blood vessel
- Presence of soot and fire gas in respiratory tract

HYPERTHERMIA AND BURNS

- Deep burn in the body
- Charring and deformity of the victim's body

SUGGESTED REFERENCES

1. Fires in the Philippine Setting by Paz Abis
2. Fire Behavior and Arson Investigation by Leo Bustria
3. NFPA 921 Guide for Fire and Explosion Investigations
4. Introduction to Fire Prevention, 4th Edition by James C. Robertson
5. Saferstein, Richard S. Criminalistics: An Introduction to Forensic Science, 9th Edition. 2007. Pearson Education Inc. Upper Saddle River, New Jersey USA
6. Chandler, Russell. Fire Investigation. 2009, Dekumar, Cengage Learning. New York, USA
7. Related Laws
 - Revised Penal Code
 - PD 1613
 - RA 6975
 - RA 9263
 - RA 9514 and its IRR
 - RA 9592