

# Fire Prevention

## According to OSHA Statistics

- Every year in the United States, fires cause huge losses
- Every year in the United States, fires cause huge losses:
- Every year in the US there are 1 million fires in buildings and other structures
- Every year in the US there are 8,000 death attributed to fires
- Each year in the US the total annual property loss = \$7 billion dollars

**Workplace fires and explosions kill 200 and injure more than 5,000 workers each year**



**Many if not most of these fires are preventable. The focus of this training is to look at how to prevent and protect against workplace fires**

**There are 3 items that must be present for a fire to exist**

**The definition of fire: Fire is a very rapid chemical reaction between oxygen and a combustible material, which results in the release of heat, light, flames and smoke**

### **1. For fire to exist, the following must be present at the same time**

- Enough oxygen to sustain combustion
  - Sources of oxygen are air, compressed air, liquid or solid oxygen and other chemicals

### **2. Some kind of fuel or combustible material:**

- Paper, wood, cloth and other ordinary combustible as well as flammable liquids and gaseous fuels. Fuels can even be solids like metals.

### **3. Enough heat or energy to raise the material to its ignition temperature**

- Heat sources include sparks, arcs, hot surfaces and open flames

- Once a fire starts and there are sufficient amounts of the three components, it will continue
- When some external source, such as a flame, spark, ember or heat causes ignition, the process is called piloted ignition
- When there is no external source, the process is called auto-ignition, spontaneous ignition or spontaneous combustion

## Causes of fire

### Household

- Household fires are typically caused by:
- Cigarettes and other tobacco products - 35%
- Heating and cooking equipment - 7 %
- Matches, lighters and candles - 5%
- Car crashes - 4%



### Industrial

- Electrical hazards cause 23% of all industrial fires. Examples of electrical hazards include faulty wiring, improperly functioning motors and poorly maintained electrical equipment
- Tobacco - The misuse of smoking materials - cigarettes, cigars, pipes, etc are behind 18% of industrial fires
- Friction and overheated Materials - Friction accounts for 10% of the total. Examples include faulty bearings and jammed machines - Overheated materials cause 8% of industrial fires
- Miscellaneous - There are many causes of industrial fires in addition to electrical hazards, tobacco, and friction and overload materials. For example, malfunctioning open-flame equipment, boilers and furnaces account for 7% of industrial blazes. Less frequent causes include combustion sparks, cutting and welding, arson, lightning and molten substances.

### Fire Codes and Standards

- Fire codes and standards help us prevent and protect against fires in the workplace

- In the US today, there are many fire codes:
  - Most cities have their own which are incorporated into building codes, zoning and other ordinances
  - Most states have similar codes that apply when local governments have not adopted their own standards
  - Most governments adopt codes developed and maintained by standards organizations
- **The National Fire Protection Association (NFPA)** publishes and maintains a wide range of standards for many aspects of fire protection, protection, engineering and extinguishment, including standards for the design of buildings and other facilities.
- This collection of standards is called the National Fire Code
  - Each element of the collection has an identifying number
  - For example, NFPA 101 is the Life Safety Code, which addresses safety of occupants and safe egress
- Certain OSHA standards require the creation of a fire protection plan
- The purpose of the Fire protection plan is to prevent a fire from occurring in a workplace
- **At a minimum, the 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 or fires
  - The name or job title of employees responsible for the control of fuel source hazards

## **Fire Prevention**

**Fire Prevention Planning is critical to protection employees and ensuring continued operations.**

- Fire prevention includes all activities directed towards preventing a fire from starting
  - Inspections
  - Training
  - Communication
  - Specific practices designed to reduce the risk of fire

## Inspections

- Periodic fire inspections are an important first step in fire prevention
- Some buildings, operations and processes require daily inspection, while others can be inspected weekly, monthly or at other intervals
- Inspections can be conducted by insurance companies, fire departments and Fire Marshalls
- Organizations should conduct self inspections to check for proper placement and operation of fire protection equipment and to correct common causes of fire such as poor housekeeping, improper storage of flammable materials, smoking violations and excessive accumulations of dust or flammable material
- Inspection of fire equipment should cover hydrants, fire pumps, hose houses, sprinkler system water supplies, sprinkler systems, portable fire extinguishers, fire doors, aisles and exits, special hazards and operations, detectors, alarms and communication systems and routines, and the methods of communication to the fire department and other emergency responders



## Housekeeping

- Poor housekeeping in a building or facility is a factor that contributes to industrial fires
- Make sure that combustibles are properly collected and stored, rubbish is disposed of, and that locker rooms are well maintained
- Keep passageways and exits free from and waste
- Promptly remove waste paper, packaging, old rags and other fire hazards
- Designate employees to ensure that appliances in break rooms, etc. are turned off.
- Make sure that fire and smoke doors that should be kept shut are not propped open
- Make sure that fire exits and escapes are not blocked or locked



## Holiday Decorations

- Holiday decorations such as trees and lighting are a significant fire hazard
- Only use artificial trees, wreaths, garland, boughs, or greenery labeled as fire resistant or flame retardant and that are UL listed or classified
- Before use, light strings should be carefully inspected to ensure there are no loose sockets and that the wires are not frayed or damaged
- Every electric light set used must bear the Underwriters Laboratories (UL) or Factory Mutual (FM) label and be identified for indoor use.
- Light strings can generate enough heat to ignite paper or cardboard and should not come into contact with paper, packages, cloth or other combustible items



## Combustibles

- Many workplace fires are the result of accumulations of oil-soaked or paint-soaked clothing, rags or waste
- Make sure that rags, etc. are deposited in noncombustible containers with self-closing covers that are removed daily
- Clean waste is not as dangerous as oil-soaked waste, but it is still readily combustible and must be kept in metal cans or bins with self-closing covers
- If large quantities are on hand, store them in fire-resistant rooms with fire doors and automatic sprinklers

- Make sure there is a schedule for the collection of all combustible waste and rubbish
- Never burn combustible wastes in the open, allow them to evaporate or flush them into the sewer
- Exhaust systems can be used to remove combustible gases, vapors and dusts from the atmosphere
- Dust accumulations on overhead beams, pipes and machines should be cleared regularly
- Keep roofs and floors clear of sawdust, wood shavings and other combustible materials
- Keep combustibles a safe distance away from sources of heat, ignition and other combustibles
- See the OSHA standard on flammables and combustibles, 29 CFR 1910.106 for more information

### **Flammable Liquids**

- Flammable liquids need to be stored appropriately to prevent fires
- A flammable liquid storage cabinet is an approved cabinet that has been designed and constructed to protect the contents from external fires.
- Storage cabinets must also be conspicuously labeled "FLAMMABLE - KEEP FIRE AWAY"
- WHEN flammables are transferred from storage drums to small containers or when there are transfers of large quantities of flammables, the containers involved must be connected to each other (bonded) by an electrical conductor or both must be connected to a grounding rod or line to prevent static electricity sparks
- Do not transfer flammable liquids from a metal to a plastic container since the plastic cannot be bonded and grounded effectively



### **Electrical Equipment**

- The largest number of workplace fires is caused by electrical faults
- Overheating of electrical equipment and electrical arcs from short circuits in poorly installed or maintained electrical equipment are two leading causes of building fires

- Install and maintain electrical equipment to conform to NFPA National Electric Code (NEC)
- All electrical equipment must be grounded or double insulated
- Use only UL or FM approved equipment where flammable gases or vapors may be present
- Temporary or makeshift wiring is a very common cause of electrical fires. Do not use it.
- Portable electric tools and extension cords need to be inspected frequently and repaired promptly
- Make sure that any cracked, frayed or broken electrical cord or plug is replaced immediately
- Use waterproof cords and sockets in damp places and explosion proof fixtures and lamps where flammable gases are vapors may be present
- Do not run electrical cords across doors or walkways, or pinch them behind furniture or equipment.
- Do not overload outlets or extension cords. Surge protectors must be used wherever possible
- If an appliance or piece of equipment begins to smell or give off smoke, it should be turned off immediately, unplugged and checked by a qualified electrician.
- Train all employees in the correct use of electrical equipment
- Make sure they understand never to tamper with equipment, block circuit breakers, bypass fuses or install equipment without authorization
- Make sure the electrical installations and equipment are inspected regularly



## Smoking

- Carelessly discarded smoking materials are another major cause of fire
- Prohibit smoking in the workplace, especially in places where flammable or combustibles are made, stored or used
- Designate specific smoking areas in locations away from flammables and combustibles
- Mark no smoking areas with conspicuous signs

- Make sure smokers dispose of their cigarettes, matches and other smoking materials in designated, approved containers only



### Friction

- Excessive heat caused by friction causes a high percentage of industrial fires
- Preventative maintenance on machinery and equipment can ensure that sources of friction, such as inadequate lubrication or misaligned bearings, are minimized
- Inspect bearings and shafting in buildings such as grain elevators, mills, plastic and metalworking plants, to make sure that they are kept well oiled and do not run hot
- Keep flammable dust or lint accumulation on or around machinery to a minimum
- Provide drip pans below bearings and clean them frequently to prevent oil accumulation
- Jammed working materials during production can create enough friction to cause ignition. Make sure that the tension adjustment on belt-driven machinery is correct - not too tight and not too loose



### Open Flames

- Open flames account for a significant percentage of fires
- Heating equipment, torches and welding and cutting equipment are most often to blame
- Portable heaters should be kept at least three feet away from any combustibles



- They should also be equipped with a tip-over safety shut off device, which will automatically extinguish the flame if the heater is knocked over
- If gasoline, kerosene, LPG, acetylene or alcohol torches are used, keep the flames at least 18 inches from wood surfaces
- Do not use them around flammable liquids, paper or other combustibles
- Provide overhead clearance of at least 4 feet for portable furnaces and blow torches. Remove or protect overhead combustibles
- When welding or cutting, keep in mind that sparks and hot particles can travel as far as 50 feet and can ignite flammables and combustibles within that range
- For this reason, welding or cutting should take place in special fire safe rooms or rooms with concrete or metal plate floors - floors must be clean and debris free
- Do not allow welding or cutting in or near rooms containing flammable liquids, vapors or dusts
- When welding cannot be performed in a safe location, use a fire watch to monitor the area for sparks and extinguish them
- Handle welding fuel and oxygen carefully to prevent leaks that can lead to flame ups and explosions

### **Hot Work Permits**

- Many industrial firms have hot work permit programs
- Hot work is any kind of welding, cutting, burning or activity that involves or generates sparks or an open flame
- Any hot work - except that in normal operations or processes - is subject to the hot permit program
- Hot work programs usually have the following requirements
  - Inspect the area where work is to be done and see how close combustible materials are to the work area
  - Establish fire watches if necessary. A fire watch should stay on duty for 30 minutes after all spark-producing equipment has been shut down
  - Provide fire-extinguishing equipment, usually staffed by a standby employee
  - Communicate with and coordinate the activities of all departments concerned with fire protection
  - Isolate Combustible materials from sources of ignition
  - Limit unauthorized use of flame or spark producing equipment

### **Fire Protection**

- Fire Protection - Ways of controlling and extinguishing fires once started
- Devices can be used to detect smoke, flame and heat, all of which are signs of combustion
- Warnings are needed to let people know to take action to save lives and property

- The action taken may include exiting or getting to a safe place and fighting the fire
- Devices may also trigger automatic fire fighting equipment, such as sprinkler systems



**Detectors and Alarms**

- There are many kinds of equipment used for detecting and warning people of fires
- Some devices are activated by people; others activate automatically
- They usually have two main functions:
- Human observers make good fire detectors because they are able to take immediate action based upon the actual circumstances of a fire
- However, it is not usually possible or practical to have people stationed around a building 24/7 to detect the signs of a fire
- Detectors are available for heat, smoke, flames and gas
- The workplace conditions determine which type is best



## **Detectors**

### **Heat detectors include:**

- Fixed temperature detectors, which operate when a preset temperature is reached
- Rate of rise detectors, which respond to sudden and rapid temperature increases
- Rate compensation detectors, which also respond to present temperatures, but do so more quickly than fixed temperature detectors
- Some detectors have multiple elements that respond to both rapidly and slowly developing fires
- Flame detectors are sensitive to the flow from flames or embers
- Gas Sensors sense the presence of gases produced by combustion in most fires
- Smoke detectors usually detect fire before heat detectors because in many fires, smoke is present before there is a significant buildup of heat or flame

## **Alarm Systems**

**Alarm systems are designed to alert everyone in a building or structure that there is a fire and they need to evacuate**

### **There are many different types of alarm systems, but they must:**

- Be clearly and immediately distinguishable from other signals and alarms used
- Be located so that they can be heard by every person in the building or structure (and provisions must be made to alert hearing-impaired workers)
- Conform to NFPA standards and be listed by Underwriters Laboratories (UL)
- Be maintained in good working order and tested on at least a monthly basis
- Every person on a work site needs to know whom to contact in the event that a fire alarm sounds and what other action they must take

## **Sprinkler Systems**

There are many types of sprinklers and water spray systems for extinguishing fires  
The type used will depend on the building, the type of work done there and the materials stored there

Properly installed and maintained automatic fire sprinklers systems help save lives  
Because fire sprinkler systems react so quickly, they can dramatically reduce the heat, flames and smoke produced in a fire

Fixed extinguishing systems throughout the workplace are among the most reliable fire fighting tools

These systems detect fires, sound an alarm, and send water to the fire and heat

Inspect and test sprinkler systems and their water supplies regularly

## **Fire Extinguisher**

### **The three most common types of fire extinguishers are:**

1. Air pressurized water and foam extinguishers

2. CO2 (carbon dioxide) Extinguishers
3. Dry chemical Extinguishers, sometimes called Multi-Purpose Extinguishers

**Other types include:**

- Wet chemical
- Clean Agent
- Dry powder
- Water mist
  
- Employers are not required to provide fire extinguishers, but if they do, they must establish an educational program to familiarize workers with the general principles of fire extinguisher use
- Workers must receive additional training on fire extinguishers before being allowed to use an extinguisher to fight a fire
- All portable fire extinguishers must be approved by a nationally recognized testing laboratory such as Underwriters Laboratory (UL)
- All fire extinguishers should be inspected every 30 days and the inspection should be logged on the inspection log

**Fire extinguishers should be:**

- Easily visible and readily accessible. Don't stack materials in front of extinguishers
- The Right CLASS of extinguisher for the materials in the area
- In good working condition with no signs of rust, damage, or leakage with a legible label and operations instructions
- Fully pressurized and equipped with an intact seal

**Fire Extinguishers**

- Extinguishers must be maintained on a regular basis to ensure proper operational readiness
- Thorough inspection and maintenance should be done at least annually by a fire service professional
- Never remount a used extinguisher
- Used extinguishers should be placed out of service and replaced immediately with a fully charged and operationally recharged extinguisher



## Fire Exits

### Considerations include:

- The type of structure
- The number of persons exposed
- The fire protection available
- The types of industry involved
- The height and type of construction of the building or structure
- In addition, fire doors must not be blocked or locked when employees are inside
- Delayed opening of fire doors, however, is permitted when an approved alarm system is integrated into the fire door design
- Exit routes from buildings must be free of obstructions and properly marked with exit signs



**Not Compliant**

## Evacuation

- Evacuation is an important element of fire protection
- When preparing your emergency action plans, designate primary and secondary evacuation routes and exits

### Ensure that evacuation routes and emergency exits are:

- Wide enough to accommodate the number of evacuation personnel
- Unobstructed and clear of debris at all times
- Unlikely to expose evacuating personnel to additional hazards

## Evacuation

- If you prepare drawings that show evacuation routes and exits, post them prominently for all employees to see
- Accounting for all employees following an evacuation is critical
- Confusion in the assembly areas can lead to delays in rescuing anyone trapped in the building, or unnecessary and dangerous search-and-rescue operations
- To ensure the fastest, most accurate accountability of your employees, you may want to consider including these steps in your emergency plan:
  - Designate assembly areas where employees should gather after evacuating
  - Take a head count after the evacuation. Identify the names and last known locations of anyone not accounted for and pass the names to the official in charge
  - Establish a method for accounting for non-employees such as suppliers, subcontracted personnel, and customers



## Fire Drills

Fire protection is not effective unless people understand how it will work in the event of real fire

For this reason, it is important to plan and conduct regular fire drills

Drills remind employees of fire prevention and protection practices and also test the adequacy and condition of fire protection systems

Any problems discovered during a fire drill should be corrected immediately

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## Overview:

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### The three items that must be present for fire to exist

#### 1. For fire to exist, the following must be present at the same time

- Enough oxygen to sustain combustion
  - Sources of oxygen are air, compressed air, liquid or solid oxygen and other chemicals

#### 2. Some kind of fuel or combustible material:

- Paper, wood, cloth and other ordinary combustibles as well as flammable liquids and gaseous fuels. Fuels can even be solids like metals.

#### 3. Enough heat or energy to raise the material to its ignition temperature

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### The leading cause of fires in the workplace

- Household fires are typically caused by:
  - Cigarettes and other tobacco products - 35%
  - Heating and cooking equipment - 7%
  - Matches, lighters and candles - 5%
  - Car crashes - 4%
  - Electrical hazards cause 23% of all industrial fires. Examples of electrical hazards include faulty wiring, improperly functioning motors and poorly maintained electrical equipment
  - Tobacco - The misuse of smoking materials - cigarettes, cigars, pipes, etc are behind 18% of industrial fires
  - Friction and overheated materials - Friction accounts for 10% of the total. Examples include faulty bearings and jammed machines - Overheated materials cause 8% of industrial fires
  - Miscellaneous - There are many causes of industrial fires in addition to electrical hazards, tobacco, and friction and overload materials. For example, malfunctioning open-flame equipment, boilers and furnaces account for 7% of industrial fires. Less frequent causes include combustion sparks, cutting and welding, arson, lightning and molten substances.
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### Common workplace fire prevention practices

Fire Prevention Planning is critical to protecting employees and ensuring continued operations.

- Fire prevention includes all activities directed towards preventing a fire from starting
  - Inspections
  - Training
  - Communication

Specific practices designed to reduce the risk of fire

## **FIRE PREVENTION PLAN**

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### **The requirements of a hot work permit program**

- Many industrial firms have hot work permit programs
- Hot work is any kind of welding, cutting, burning or activity that involves or generates sparks or an open flame
- Any hot work - except that in normal operations or processes - is subject to the hot permit program
- Hot work programs usually have the following requirements
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  - Communicate with and coordinate the activities of all departments concerned with fire protection
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### **Fire protection tools and practices used in the workplace**

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#### **Fire Codes and Standards**

- **The National Fire Protection Association (NFPA)** publishes and maintains a wide range of standards for many aspects of fire protection, protection, engineering and extinguishment, including standards for the design of buildings and other facilities.
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Certain OSHA standards require the creation of a fire protection plan

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- Specific practices designed to reduce the risk of fire

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## **The typical procedures for fire drills and evacuations**

### **Fire Drills**

Fire protection is not effective unless people understand how it will work in the event of real fire

For this reason, it is important to plan and conduct regular fire drills

Drills remind employees of fire prevention and protection practices and also test the adequacy and condition of fire protection systems

Any problems discovered during a fire drill should be corrected immediately

### **Ensure that evacuation routes and emergency exits are:**

- Wide enough to accommodate the number of evacuation personnel
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