FIRE PREVENTION

PURPOSE

CF is committed to having a fire prevention plan in each workplace to assist workers and the public to respond to an emergency relating to fire.

If ignition is not presented, there will be no fire. This, then is the line of first defense against fire in buildings, Although the National Building code (NBC) contains few restrictions regarding ignition of the building materials, the National Fire Code (NFC) does place limitations on the placement of textiles such as carpets, furniture, and drapery materials. Flammable liquids and gases are special cases and there are provisions for controlling their location. In general, however, it is difficult to predict where combustible materials might be located, particularly in large buildings.

Even buildings constructed of non-combustible materials will almost without exception contain materials that burn under certain circumstances. On the other hand, materials that are designated combustible according to tests may be out negligible significance in fires.

Wood is a good example of a common material for which fire performance is difficult to predict. It ignites if its surface reaches about 300C in the presence of a flame or perhaps 400-500 deg C in its absence, it may also ignite, however, at much lower temperatures if the time of exposure to heat is longer. Charring, a much above 100 C Table 1 defines the terms that are commonly used to describe the ignition process and its various aspects.

DEFINITIONS

Ignition
The initiation of sustained combustion.

Combustibility
Combustibility is a measure of how easily a substance will ignite due to fire or combustion.

Flammable and Combustible: What is the difference?
The distinction between flammable and combustible liquids is determined by how easily they ignite--in other words, their "flash point."

The flash point of a flammable or combustible liquid is the lowest temperature at which it gives off enough vapor to form an ignitable mixture with air and produce a flame when a source of ignition is present:
Flammable liquids have flash points below 100°F and a vapor pressure at or below 40 pounds per square inch at 100°F

Combustible liquids have flash points at or above 100°F. Flammable liquids ignite more readily than combustible ones. Flammable liquids also have the ability to vaporize and form flammable mixtures when exposed to air.

Ignitability

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The ease with which a material can reach the pint of combustion in a specified test regime. The relative ignitability of one material to that of other has meaning only for specified test condition and is not applicable to all test conditions or even to real fire.

Ignition Temperature

The lowest temperature at which a sample of material will ignite spontaneously without a spark or flame. This value is often used to assess whether a material could have been a source of ignition. For liquids and gases it is reasonably well established characteristic of a substance, but it is less well defined for solids.

Flash Point

The temperature at which a liquid or solid ignites and sustains combustion when a small flame is brought near the sample surface. There are several methods of measuring flash point, but they are not generally reliable enough to give the same results for the same material. Flash point is used most commonly to describe the hazard associated with storage of liquids; a flash pint of 0deg C, for example, indicates that the material will ignite in the presence of a small flame even when the temperature of the liquid is 0 deg C.

Lower Explosive Limit (LEL)

The minimum concentration of gas in air at which explosion or flame propagation occurs when a heat source such as a spark is applied. This term is employed in the NFC in relation to ventilation systems in which combustible gases are expected to be a problem; for example, in paint spraying booths, dip tanks for finishing operations, and other special processes involving flammable liquids with substantial vapour pressures.

Cause of Ignition

Flammable materials may ignite in many ways, some less so. Knowledge of the most important ignition scenarios is essential for designers seeking to reduce the likelihood of fire buildings. The common element is heat transfer. Heat may be transferred by radiation through space, by conduction, upon direct contact with a heat source, or by convection (where air, or other heated fluid, moves to carry heat from source to sample). All ignitions are caused by a version of heat transfer, although other factors may influence them.

Flames

The most common ignition source is flame. A match flame transfers heat primarily by convection and may be simply represented in laboratory testing. Larger flames, 0.5m high or more, transfer heat primarily by radiative transfer and may ignite objects without coming into direct contact with them. The larger the flame the more probable radiative ignition becomes.

Hot Surface

Hot surface can also cause fire. A heated metal block can transfer sufficient heat (by conduction) to raise the temperature of some materials above their ignition temperature. The most common case of ignition by this means is probably the kitchen fire in which towel is ignited by contact with a cooking element.

Sparks

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Sparks generate very high temperatures in a very small space, but except when flammable gas mixtures are involved it is rare that a spar will cause ignition in the absence of other factors.

Exposure Time
This can be critical. An intense heat source may cause a fire in a very short time, but so may a much less intense heat source over a longer period. Thus, fire in a waste paper basket may ignite a sofa very quickly, but a carelessly dropped cigarette may also cause ignition given more time.

Configuration
It is difficult to ignite a sample in intimate contact with an efficient heat sink such as the metal hull of a ship in contact with the sea. At the other extreme is an insulated material that may not be able to dissipate heat sufficiently fast to prevent a temperature rise high enough to cause ignition. Thus, spontaneous combustion can occur by mild self- heating caused by very slow oxidation (as in coal dust) or the effects of biochemical attack (as in damp hay).

Secondary Ignition
The propagation of fire beyond the site of primary ignition will almost inevitably involve secondary ignition of surrounding materials. Now the ignition source is most often larger than before and may present an exposure different from the original. A lit match may not set a room on fire, but if it ignites the contents of a waste paper basket the room may become vulnerable.

When a fire has generated sufficient heat to make the upper reaches of a room very hot, there can eventually be sufficient radiation from this hot layer to ignite essentially all of the remaining un-burnt materials in the area. This is termed flashover. Survival in the room would now not be possible.

Measurement of Ignition
The results of tests related to other fire properties can provide useful information about the tendency of a material to ignite. In Canada, the surface flame spread test, or tunnel test, is designed to rate materials by their propensity to spread flame or generate smoke. This test also gives information on ignitability. A material with a high flame- spread rating by this test is often easy to ignite. No assurance can be given, however, that the relationship will always hold. The tunnel test results should therefore be used with considerable caution in predicting the ignition behaviour of materials.

Consider, for example, how to rate a large wall hanging of textile fabric. A tunnel test may be of little value se the test uses long, thin samples (7.0 m by 0.66 m) attached horizontally to the roof of a test tunnel. A large flame is applied and the time taken for it to pass down the tunnel is measured. The conditions of burning are most unlike those to be expected of a textile hanging on a wall and probably represent a far less severe condition than the most likely fire scenario.

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Laboratory versus Scenario Testing

The majority of tests are tied to the definitions of ignition-related characteristics (for example, combustibility, flash point, and lower explosive limit, Table 1). Often it is not possible to identify all the factors involved in practical ignitions. Regulators rely mainly on the results of test procedures that simulate the actual application. These demonstrations, however, can be far more expressive than the more controlled, laboratory test procedures and they are often less informative.

Fire behaviour is influenced by so many uncontrolled variables that prediction is extremely difficult. A useful technique is the worst case scenario. As serious a set of circumstances as can be envisaged is selected and material performance is probability that the material will perform well in less severe fire conditions. The technique, however, encourages expensive overdesign that results in unnecessary use of highly fire-resistant materials.

Alternative Strategies

In addition to controlling ignition by material selection, the designer may use active or passive fire protection measures, or both.

Active Fire Protection

Active techniques sense a primary ignition either manually or by automatic means to evoke a response. Automatic sprinkler systems are the most common. Where they are not desirable, substances that quench flames chemically may be used, for example, halon gases or dry powders. Carbon dioxide is also effective, displacing the oxygen necessary to sustain fire.

Passive Fire Protection

Passive techniques rely on built-in fire protection measures and do not require activation. Fire-resistant compart-mentation of rooms, for example, is an important element of the fire protection of buildings.

Protective Coatings

A very simple technique for protecting combustible material from unwanted ignition is to cover the surface with a non-combustible protection. Metal sheathing is used to protect some combustible insulation products. The wall closest to a wood stove installation should be protected from thermal radiation by a suitable non-combustible cover sheet. A similar form of protection is available for a wide variety of surfaces by applying a chemical coating (intumescent coating) like a paint; it has the useful property of expanding and hardening when exposed to heat, thus presenting a fire-resistant and heat-insulating barrier. This technique is used to protect combustible walls and to afford useful fire resistance to structural columns and non-combustible surfaces made of steel.

Fire Retardants

The addition of chemicals to combustible materials can control fire behaviour. Fire retardants may simply absorb heat, often by causing the liberation of steam from chemicals that contain water; alumina is often used in this way. Others may form a char through which heat has difficulty passing; many fire retardants containing phosphorus work in this manner. They may enhance melting at a low temperature, thus causing a material to flow away from a heat source; many additives to synthetic polymers have this effect. They may evolve a flame-inhibiting gas; poly (vinyl chloride) is a polymer containing chlorine that on heating liberates hydrogen chloride, a gas that inhibits

combustion. Lastly, on heating they may assist the transformation of the material to a less flammable material, usually by cross-linking the polymer chains (from which many materials are made) into a hard, thermally resistant solid.

Material Location

Unwanted ignitions are more than an engineering problem. Their control is a social problem too. Attitudes towards fire differ widely from one country to another. Canada, with one of the world's worst fire loss records, could with advantage adopt some of the principles of fire protection used in other countries. Responsibility for the location of combustible materials is properly that of the building occupants, owners and users, se they are the prime risk takers. In some countries this responsibility is a civic duty, and any dereliction is a punishable offence; the owner of a building that suffers a fire may be prosecuted.

Conclusion

Ignition prevention remains the primary means of avoiding fires. While no single method of evaluating materials is specifically directed to ignitability, the common fire test methods often provide useful indication of successful ignition control.

The damage caused by unwanted ignition can be minimized by appropriate choice and use of materials. Where caution outweighs cost, protection against the worst of all conceivable potential ignition cases should be considered. If material choice has been exhausted as a method of control, active and passive fire protection measures must be considered. The avoidance of fire is a social responsibility, and the cooperation of building occupants is the most powerful asset.

The following is a description of the three degrees of fire loading within the occupancy.
Light (Low) Fire Load: An Occupancy in which Class A combustible materials including furniture, window treatments and its contents is of minor quantity. Small amounts of Class B flammable liquids such as duplicating and cleaning solvents are included provided that they are kept in closed containers and stored properly.

Ordinary (Moderate) Fire Load: An occupancy in which Class A combustibles, Class B flammable liquids and Class C energized electrical equipment are in greater amounts than expected under a low hazard. These locations include dining areas, storage areas, parking garages and assembly halls.

Extra (High) Fire Load: an occupancy in which the total amount of Class A combustibles, Class B flammable liquids and Class C energized electrical equipment present is over and above those classified as moderate hazard. These occupancies and areas includes laboratories, cooking areas, trade shops and warehouses.

24.4 Fire Tetrahedron

In order to understand how fire extinguishers work, you first need to know a little bit about fire.
Four things must be present at the same time in order to produce fire:

1. Enough oxygen to sustain combustion,
2. Enough heat to raise the material to its ignition temperature,

3. Some sort of fuel or combustible material, and
4. The chemical, exothermic reaction that is fire.

For many years the concept of fire was symbolized by the Triangle of Combustion and represented, fuel, heat, and oxygen. The fire triangle was changed to a fire tetrahedron to reflect this fourth element. A tetrahedron can be described as a pyramid which is a solid having four plane faces. Essentially all four elements must be present for fire to occur, fuel, heat, oxygen, and a chemical chain reaction. Removal of any one of these essential elements will result in the fire being extinguished.
The four elements are oxygen to sustain combustion, sufficient heat to raise the material to its ignition temperature, fuel or combustible material and subsequently an exothermic chemical chain reaction in the material. Each of the four sides of the fire tetrahedron symbolizes the Fuel, Heat, Oxygen and Chemical Chain Reaction.
Theoretically, fire extinguishers put out fire by taking away one or more elements of the fire tetrahedron
Fire safety, at its most basic, is based upon the principle of keeping fuel sources and ignition sources separate.

Take a look at the following Diagram, called the “Fire Tetrahedron”

Oxygen, heat, and fuel are frequently referred to as the “fire triangle.” Add in the fourth element, the chemical reaction, and you actually have a fire “tetrahedron.” The important thing to remember is:

- Take any of these four things away, and you will not have a fire or the fire will be extinguished.
- Essentially, fire extinguishers put out fire by taking away one or more elements of the fire triangle/tetrahedron.
- Fire safety, at its most basic, is based upon the principle of keeping fuel sources and ignition sources separate.

PROCEDURE

Fire Emergency Procedure

1. If You Discover a Fire
2. Stop all work. Alert everyone in the area.
3. Designate someone to call 911 or the applicable Fire Department phone number.
4. Only attempt to extinguish the fire if it is safe to do so, or as a means of escape from the fire area.
5. Leave the fire area, closing all doors behind you, (if possible). Always using the nearest safe exit.
6. Notify a Supervisor.
7. Stand By to assist the Fire Department.

Evacuating Work Areas (Buildings, Trailers, Site)

When being requested to evacuate a work area:

- Stop all Work
- Shut down all equipment (if possible)
- DO NOT return to pick up your belongings
- Use stairs - Do not use elevator

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Procedure after Evacuation

The Supervisor is responsible for ensuring that all workers are accounted for. Workers are to assemble at pre-planned staging area.

A roll-call will take place when all workers are assembled. This will determine if there are any missing person(s). Procedure for Calling the Fire Dept.

1. Go to the nearest safe phone and call "911" or the applicable emergency phone number.
2. Ask for the Fire Dept. and give them the following information:

a. Name First and Last.
b. The company's name.
c. The location of the site.
d. Details regarding the fire.
e. Wait for further instruction if it is safe to do so.

Controlling and Identifying a Fire Hazard

All workers are responsible for reporting, controlling, or identifying a fire hazard on all CF workplaces. Consider the following:

- No smoking around flammable liquids.
- Do not obstruct access or egress roads. (Safe evacuation routes are to be clear).
- Do not block fire cabinets or fire suppression equipment.
- Return spent fire extinguishers to your Supervisor for recharging.
- Reports are to be directed to Supervision for review.

Access for/to Fire Fighting Equipment and Vehicles

In order to provide a safe and unobstructed Fire Department access to the construction site, vehicles or equipment shall not be parked in fire routes or near fire hydrants unless approved by the Supervisor.

In all offices, industrial settings and construction projects:

- Ensure that all exits are clear of material and easily accessible.
- Ensure that all Fire hose cabinets, stand pipes & wall mounted extinguishers are easily accessible and not blocked with material or machinery (clear within 1 m. around and clear path to device).
- Ensure annual inspections of fire extinguishers.
- Ensure all equipment has a minimum 5lb abc mounted on equipment in an accessible location.

The National Fire Protection Association (NFPA) classifies fires into five general categories (U.S.):

1. Class A fires are ordinary materials like burning paper, lumber, cardboard, plastics etc.
2. Class B fires involve flammable or combustible liquids such as gasoline, kerosene, and common organic solvents used in the laboratory.

3. Class C fires involve energized electrical equipment, such as appliances, switches, panel boxes, power tools, hot plates and stirrers. Water can be dangerous extinguishing medium for class C fires because of the risk of electrical stock unless a specialized water mist extinguisher is used.
4. Class D fires involve combustible metals, such as magnesium, titanium, potassium and sodium as well as pyrophoric organometallic reagents such as alkyllithiums, Grignards and diethylz. These materials burn at high temperatures and will react violently with water; air, and/or other chemicals. Handle with care!!
5. Class K fires are kitchen fires; this class was added to the NFPA portable extinguisher Standard 10 in 1998. Kitchen extinguishers installed before June 30, 1998 are "grandfather" into the standard. This extinguisher is a wet chemical class.

Fire Extinguishers

A worker is not required to fight a fire. Only if his/her life is in danger should he/she proceed to try and extinguish a fire.

There are two points to remember before using a fire extinguisher to put out a fire:

- Know what is burning.
- Know the class of fire extinguisher that is required.

Fire Extinguishing Equipment

Standard

All workers shall be familiar with the use of fire extinguishing equipment in the work area.

Procedure

- Placement of Extinguishers
  - Class A
    - one 2 lb extinguisher for every 300 m2 (3,000 ft2) of building area
  - Class B
    - One 10 lb extinguisher stored within 15 m (50') of more than 5 gallons of flammable liquid (including paint)
    - One 20 lb extinguisher stored within 3 m (10') or more than 270 litres (60 gallons) of flammable liquid (including paint)
  - Class C
    - One 10 pound C02 extinguisher near major electrical installations
    - Fixed Carbon Dioxide systems in computer rooms, generating stations, etc.
  - Class D
    - System must be suitable dry powder for specific combustible metal found in the workplace.
  - Class ABC
    - Class B criteria to be followed where ABC extinguishers are needed
- It is most common to place fire extinguishers just inside the entrance to a room or area.
- Extinguishers of the Class B type shall be 7.5 m to 15 m (25' to 50') from gasoline and diesel fueling areas.

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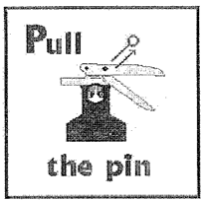
- Extinguishers shall be found within 15 m (50') of welding and burning operations.
- Extinguishers shall be mounted no more than 1.5 m (5') above floor in buildings with clear access and shall be clearly marked.
- Fire extinguishers shall be visually inspected monthly.
- Once an extinguisher is used or the pressure falls, it shall be recharged.

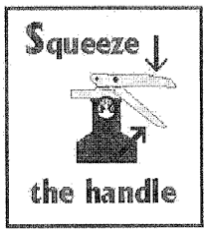
How to Use a Fire Extinguisher

It's easy to remember how to use a fire extinguisher if you can remember the acronym PASS, which stands for Pull, Aim, Squeeze, and Sweep.



Pull the pin.
This will allow you to discharge the extinguisher.

Aim at the base of the fire.
If you aim at the flames (which is frequently temptation), the extinguishing agent will fly right through and do no good. You want to hit the fuel.



Squeeze the tip handle or lever.
This depresses a button that releases the pressurized extinguishing agent in extinguisher.

Sweep from side to side until the fire is completely out. Start using the extinguisher form a safe distance away then move forward. Once the fire is out, keep an eye on the area in case it re-ignites.

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CLASSES OF FIRES	TYPES OF FIRES	PICTURE SYMBOL
A	Wood, paper, cloth, trash & other ordinary materials.	
B	Gasoline, oil, paint and other flammable liquids.	
C	May be used on fires involving live electrical equipment without danger to the operator.	
D	Combustible metals and combustible metal alloys.	
K	Cooking media (Vegetable or Animal Oils and Fats)	

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Portable Fire Extinguisher Inspection and Maintenance Procedure

Standard

To establish standard procedures for the inspection and maintenance of portable fire extinguishers.

Policy

Portable fire extinguishers will be inspected and maintained to ensure that they are properly located and operational in accordance with NFPA standards.

Procedure

Portable fire extinguishers will be inspected monthly. The inspection should include the following:

- Extinguishers are located in their designated location, are secured properly and are the proper type.
- Extinguishers are not obstructed with respect to access or visibility.
- Extinguishers are examined for obvious physical damage, corrosion, leakage, or clogged nozzles.
- Legible operating instructions are on the extinguisher nameplate facing outward.
- Seals and tamper indicators are not broken or missing.
- Pressure-gauge readings or indicators are in operable ranges.

Annual maintenance will involve a thorough examination of the fire extinguisher shell and its external mechanical parts. The maintenance will include the following:

- All monthly inspection items.
- Inspection of the hose and nozzle for cracks, blockages, or other damage.
- Inspection of extinguisher shell for corrosion, dents, or other damage.
- Carbon dioxide extinguishers are weighed to ensure no weight deviation greater than 10%.

When inspection or maintenance of any extinguisher reveals a deficiency in operating condition, the following corrective actions are to be taken immediately.

- A spare extinguisher of the same type and equal or greater rating shall replace the extinguisher.
- Defective extinguishers are to be marked as such and placed in an appropriate place until repair and/or recharging is performed. A defective tag to identify problems will be attached.

Documentation of inspection and maintenance will be provided by maintaining the following records:

- A fire extinguisher inspection record tag is attached to each extinguisher and provides the following information.
- The date the extinguisher was inspected.
- The condition of the extinguisher.
- The initials of the person performing the inspection.

The fire extinguisher inspection record must indicate the date of the last charge; recharge and the last date of hydrostatic testing must be recorded.

If inspections and maintenance procedures are performed by outside vendors under contracts, an CF Rep will obtain a copy of the annual inspection and maintenance report from the vendor and submit a copy of this report to the Safety Advisor by the end of contract and fiscal year to ensure compliance.

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Temporary Heat

Standard

Temporary heat shall be arranged so that no danger of uncontrolled fire exists.

Procedure

• Combustibles such as tarpaulins, wood and flammable liquids will be positioned no closer than 3 m (10'). If combustibles are in the direct flow of heat, no closer than 6 m (20').
• Safety features on the heaters must be operating properly. Contact the manufacturer/supplier for further information.
• Heaters cannot be set on combustible materials and must be protected from damage due to overturning.
• The temptation is great to locate heaters near a means of access/egress because fresh air is available for combustion. It is against the law to restrict access/egress with a portable heater.
• Fuel lines must be guarded to prevent accidental damage.
• When open flame heaters are operating continuously, a designated person will be assigned to inspect it periodically.
• A viable means of extinguishing a fire must be readily available.
• Familiarize yourself with the fuel source emergency shutoff.
• Any temporary heating system requiring the use of propane requires special training in propane handling (Where legislated) Please contact your H&S Department for further details.
• Open flame heaters shall not be used as temporary heat in an occupied building.

Note: Temporary heat must be by means of an approved heating device. Equipment such as hand held torches etc. are not an acceptable means for providing temporary heat.

Smoking Near Flammables

Smoking near or during the dispensing of any flammable materials can have a devastating effect to a worker and your work place. It is imperative for workers who smoke to adhere to the following requirements.
1. Site specific or client Workplace Smoking Policy.
2. Smoking Policy.
3. No Smoking in all Identified areas. This includes all buildings, offices, site trailers,
4. building roofs, storage containers and any vehicle/equipment rented or owned with a cab.
5. Never smoke during a refueling operation or within 10 feet of a Fuel Storage area. Examples; Compressed Gas storage, bulk storage.

Burning and Forest Fire Prevention

Burning of construction refuse including but not restricted to trees, branches, waste wood, or construction materials shall only be undertaken in accordance with the conditions and requirements of a burning permit issued by the applicable authorities and shall, in all cases, comply with the requirements of applicable forest fire prevention practices.

Any burning shall comply with applicable fire codes for the area.