

FLASH OVER

OBJECTIVES:

1. To provide training to the firefighter to recognize the signs of the phenomena of FLASHOVER.
2. To enable the firefighter to better understand the phenomena of FLASHOVER.
3. To provide the firefighter with survival techniques.

Time: One Hour Lecture, 45 minutes in the Flashover container, 1 hour which will include set up , medical monitoring, SCBA training, rotation and clean up .

Location: Approved live burn training academy with water source. Secured location with flat ground in a paved area.

GOALS OF FLASHOVER SURVIVAL TRAINING.

1. To provide the fire services with a safe and secure system of Flashover training.
2. To teach firefighters to recognize the signs of Flashover.
3. To provide firefighters with techniques to possibly give them time to escape a Flashover.
4. To save firefighters from injury and death from Flashover

A. PREPARATIONS/INSTRUCTOR & STUDENT REQUIREMENT

1. Motivation:
 - a. Container and training program developed by the Swedish National Rescue Services Board in 1986.
 - b. The County Police and Fire Academy acquired the program on September 23, 1994.
 - c. Representative from the Swede Survival System certified nine BCFA Instructors as Flashover Survival Training Instructors.
 - d. This is a lifesaving program of recognition and survival of the phenomena of Flashover.
 - e. From 1990 to 1999, 455 firefighters were killed in structure fires in the United States. Of these, 44 died as a result of rapid-fire development (Flashover).

In addition, 7 firefighters were killed in similar circumstances during live fire training.

2. SAFETY GUIDELINES & PRECAUTIONS

- a. Good hydration is imperative because of the heat, and body fluid loss that you will experience while training.

Drink plenty of fluids, starting the day before the exercise and continue to replace your body losses throughout the day of training. Water will be available during the Flashover training.

b. In addition to staying well hydrated, your health should be very good. If you are suffering from a cold or other infection, such as the flu, do not enter the container. These minor discomforts of everyday life can be very dangerous when your body is put under the additional heat stress. It has been shown that a respiratory infection can lead to heart damage or worse, if ignored.

c. Because it is difficult to talk and be understood while using SCBA, talking should be kept to a minimum so that everyone will be able to hear the Instructor.

Should anyone need to leave the container during the exercise, it is imperative that one of the Instructors be notified.

When exiting the container, you must remain low to the ground. You will not be allowed to stand upright during life fire training.

Discipline is imperative and essential to the training and to prevent injuries.

d. Students will be confined to the Flashover container for approximately 20 to 30 minutes. During this time several Flashovers will occur and the student will be subjected to intense radiant heat.

All of your protective clothing must be in good condition. Shorts and sleeveless shirts will not be permitted.

Nomex or PBI Protective hoods are mandatory. NOTE: Cold weather hoods and earflaps attached to helmets do not provide adequate protection. No one will be allowed in the container without FULL protective clothing.

The Safety Officer will inspect everyone entering the Flashover Container. No bare skin should be showing when you enter the Flashover Container.

e. Breathing apparatus shall be worn at all times during the burn.

It is also important that the firefighter on the back-up line be in full protective clothing, including SCBA with face piece donned, regulator does not have to be connected, since this individual will be outside the Container. There are two reasons for this. First, this individual must be ready if rapid entry is needed; and second, it will protect the respiratory tract from stray smoke.

f. During training, the nozzle and hose should always be kept clear.

Be sure that no one is standing on or blocking free movement of the nozzle and hose line.

All lines must be charged and purged of air before starting the exercise. A back-up line is mandatory, attached to a separate water source.

g. After Flashover training it is important that you wash before eating. Ingestion is a common route into the body for contaminants.

h. After completion of Flashover training, you need to wash the under garments you have been wearing.

This will help keep your skin absorption of any contaminants to a minimum.

- i. All Live Fire Training Procedure and N.F.P.A. 1403 Live Fire Training Procedures will be strictly enforced and adhered to at all time during training.
3. The designated Safety Officer will check each participant for all of the following prior to entering the Flashover container:
 - a. All protective clothing properly donned.
 - b. Neck strap on protective coat fastened.
 - c. Protective hood on outside of SCBA face pieces.
 - d. All straps must be secure.
 - e. SCBA cylinder valve “fully open” and cylinder “Fully charged”.

NO ONE WILL ENTER THE FLASHOVER CONTAINER FOR TRAINING WITHOUT BEING CHECKED BY THE SAFETY OFFICER!

B. PURPOSE OF THE FLASHOVER CONTAINER

- a. To demonstrate the various fire stages as they occur in confined areas.
- b. To provide students with an opportunity to become familiar with various firefighting techniques that may possibly delay a Flashover and give the firefighter time to leave the structure.
- c. It must be clearly understood by all students that the Flashover container is a training aide only.
- d. The Instructors will cause the fire to produce several Flashovers during the training inside the container, so that everyone will have an opportunity to observe and participate in the evolution.
- e. It is imperative that all students realize that during actual emergency fire conditions, the techniques that will be demonstrated are to be used one time to provide firefighters additional escape time.

C. INDIVIDUAL OBSERVATIONS

- a. Provides an opportunity for the firefighter to recognize his/her personal limitations prior to a thermal collapse.
 1. Individual responses to heat stress.
- b. Provides an opportunity for the fire fighter to test the limits of his/her protective clothing and equipment prior to a thermal collapse.

D. DEFINITION OF FLASHOVER

- a. As per the IFSTA 200 manual Definition

The stages of a fire at which all surfaces and objects are heated to their ignition temperature and flame breaks out almost at once over the entire surface. It was originally believed that combustible gases released during the early stages of the fire caused Flashover. The belief was that these gasses collected

at the ceiling level and mixed with air until they reached their flammable range, then suddenly ignited, causing Flashover.

Current thought is that combustible gases mixed with air precede Flashover.

The cause of Flashover is attributed to the excessive buildup of heat from the fire itself. As the fire continues to burn, all the contents of the fire area are gradually heated to their ignition temperatures. When they reach this point, simultaneous ignition occurs and the area becomes fully involved in fire.

b. National fire Academy Definition

The ignition of combustibles in an area heated by convection and radiation, or a combination of the two.

The combustible substances in a room re-heated to their ignition point and almost simultaneous combustion of the material occurs.

c. Vincent Dunn's Definition

The sudden full room involvement in flame. Flashover is caused by thermal radiation feedback. During a fire in a room, the heat is absorbed into the ceiling and walls and re-radiated downward, gradually heating the combustible gases and contents to their ignition temperatures and the room and its contents simultaneously ignite.

1. Thermal radiation feedback theory.

2. Time temperature course of a fire.

E. BACK DRAFT - Definition

The explosion or rapid burning of heated a gas that occurs when oxygen is introduced into a building that has not been properly ventilated. At the latter stages of the fire, the building will have a depleted supply of oxygen with a high level of heat.

F. FIREFIGHTING DIFFICULTIES' ASSOCIATED WITH FLASHOVER

1. With the threat of Flashover present, firefighting problems increase. Firefighting becomes more dangerous and it becomes increasingly more difficult to extinguish the fire.

2. Attempts at search and rescue become increasingly more hazardous. After a Flashover, search and rescue SHOULD NOT BE ATTEMPTED without the protection of a hose line.

3. Occupants CANNOT SURVIVE the environment – anyone in the room would have been killed.

4. Flashover signals that beginning of the Collapse State of the fire. Collapse potential increased during the fully developed state and becomes even greater in the decay stage.

5. NO ONE CAN ACCURATELY PREDICT WHEN A FLASHOVER WILL OCCUR!

G. FIRE SCIENCE RELATIVE TO FLASHOVER

1. Combustion occurs within the area of the flammable range. Within this range, the concentration of gases is ideal to burn (ideal mixture)

2. Lower Limit of the Flammable Range

The minimum points that the fire gases will burn. Below this point, the concentration of gases is too lean to burn (lean mixture: too much air, too little fuel).

3. Upper Limit of the Flammable Range

The maximum point that fire gases will burn. Above this point the concentration of the fire gases is too rich to burn. (Rich mixture; too little air, too much fuel).

4. Generally with the progressive addition of heat to the substances, the lower limit of the flammability range decreases.

a. In the Flashover container, there will be gases from fibrous materials:

1. Before heat is introduced, the approximate flammable range will be:

- a. Lower Limit 50%
- b. Ideal Mixture 70%
- c. Upper Limit 80% to 90%

2. After the product is sufficiently heated:

- a. The lower limit falls to 0%
- b. The thermal ignition point is low

H. FIRE BEHAVIOR

1. The distribution of fuel in a room or space affects the behavior of the fire.

a. When the source of fuel is compact and is spent in the primary fire, it will generally remain intact and die without doing any harm.

b. When fuel is distributed throughout the room, the fire will generally emit unburned fire gases and spread as the heat rises.

2. FIRE GAS FORMATION

a. Formation of emission of fire gases from walls and ceilings begins as the temperature in a room rises. The higher the temperature, the more fire gases are produced.

b. The gases will gather under the ceiling and as the concentration and temperature rises, the fire and gases will come close to the lower limit of the flammable range.

c. The flames will struggle upwards and become longer and longer until they ignite the fire gas pillow that formed from the accumulating gases (lean Flashover).

d. When the flames have expired, the temperature falls – but it is still sufficiently high (approximately 500 to 1500 degrees Fahrenheit) to continue to produce a build-up of fire gases. The glowing fire produces carbon monoxide. Burning wood will produce carbon monoxide between 392 and 536 degrees Fahrenheit).

e. The production of fire gases will exceed the upper limit of the flammable range without additional oxygen. There is still an ignition source present, so a major fire can be started with the introduction of oxygen into the environment.

I. TYPES OF FLASHOVER

1. When fire has continuous supply of oxygen, fire progresses from incipient up through free burning to Flashover with rapid heat buildup.

2. When unburned gasses that have collected high in a structure ignite rapidly (example: along the ceiling) and radiate downward.

3. When the gases from both pyrolysis and combustion are initially too rich to burn, are mixed with enough oxygen to make an explosive combustible mixture, they will vigorously ignite (the gases can be from pyrolysis, incomplete combustion or both).

4. The 4th occurs when the accumulated gases in a room that have been given off by the fire (carbon dioxide) rises over 1200 degrees Fahrenheit, break down to form carbon monoxide.

Also large amounts of water vapor given off by the fire will unite with carbon to form hydrogen and more carbon monoxide make copious amount of two highly combustible gases which ignite in an explosive fire ball.

5. Traveling Flashover

The rapidly expanding gases leaving the room raveling with great speed flash out doorways, windows, down halls and up stairs.

6. FLASHOVER SAFETY

a. Recognize the warning signs of a Flashover

b. Assess the situation

c. Test the atmosphere for heat

d. Search or suppress – If Flashover warning signs are observed use delay tactics and,

e. GET OUT

7. VARIABLES OF FLASHOVER

a. Room Size

A small room will flash before a large one.

b. Size and number of openings within a room or space

- c. The rate and amount of heat released
- d. The insulation qualities of the structure itself
- e. Ceiling height

Ceilings 15 to 20 feet can result in dangerously misleading Flashover size-up information

Residential fire experience cannot always be transferred to commercial buildings, especially buildings with large open spaces and high ceilings.

8. KNOW THE POINT OF NO RETURN

a. A firefighter can reach a point of no return should a Flashover occur. Beyond this point he/she will not be able to escape to safety.

- 1. Without a hose line, a firefighter can travel, on average, 2-1/2 feet per second in full protective gear.
- 2. He/she has approximately 2 SECONDS to exit when a Flashover occurs.
- 3. There is a possibility of escape if a firefighter is 5 feet or less from the door.

NOTE: THIS IS NOT TO SAY A FIREFIGHTER IS NOT GOING TO GET BURNED, BUT THERE IS A CHANCE OF GETTING OUT ALIVE

9. FLASHOVER SURVIVAL TACTICS

- a. Understanding fire behavior is of CRITICAL importance to all fire fighters.
- b. Flammable gases from combustion and pyrolysis play a major role in rapid fire development and Flashover
- c. Look out for flammable gases accumulating in voids, above dropped ceilings, and in cocklofts and other concealed areas.
- d. "Routine" fires have resulted in fatal Flashovers, always expect rapid-fire development.
- e. Turnout gear is so insulating that you may not detect high heat levels. A reliable warning sign of Flashover, before it happens. We must train to visually recognize the warning signs.
- f. Post Flashover, our turnout gear will be saturated with heat, and we will be burned. Skin burns at 124 degrees Fahrenheit. Flashover temperature will approach 200 degrees Fahrenheit.
- g. Quick recognition of potential Flashover conditions and instant egress will mean the difference between life and death for firefighters.
- h. Raid, immediate escape is a key survival tactic.
- i. Adequate ventilation will generally increase the odds
- j. Water kills Flashover.

10. THE TECHNIQUE OF AGGRESSIVE COOLING in conjunction with penciling is to be used to possibly delay a Flashover long enough to allow all firefighters to immediately exit the structure.

1. The techniques are only designed to buy the firefighter a few extra seconds to exit the structure.
2. Flashover is imminent and if the firefighter remains in the unsafe atmosphere, he/she will be caught in a Flashover
3. Heavy residue buildup will obscure the color and the reflective and identification markings.
4. Hydrocarbon deposits conduct electricity.

J. WATER AS AN EXTINGUISHING AGENT

1) Scientific tests tell us that the extinguishing ability of water is optimal when the size of the droplets is one tenth of an inch (.1) in diameter.

- a. In a constant flow from the nozzle, succeeding droplets will follow those before them, resulting in an inefficient extinguishing effect.
- b. During firefighting, in order to provide the most efficient extinguishing effect possible from the water, the firefighter should move the nozzle in a circular motion.

This will result in more surface area of the water being discharged to be exposed to the heated atmosphere.

2) BTU'S of Heat Generated for 1 pound of material

- a. Wood or paper = 7,000 to 8,000 BTUs
- b. Polyurethane = 12,000 BTUs
- c. Plastic = 18,000 BTUs

3) WARNING SIGNS OF FLASHOVER

a. Heat Build-up in a smoke-filled room

Very hot smoke that forces a firefighter to crouch down when entering a building, signals a Flashover danger. The lower you are forced to crouch down, the greater the change of a Flashover.

b. Rollover

Sporadic small flashes of flames (sometimes called "snakes") mixed with smoke seen just before the Flashover occurs.

Before entering a smoke-filled room, firefighters should check the smoke coming out of the door or windows for signs of rollover.

c. Thick Dark Smoke

Large amount of fire gases being produced and heated by redirect heat

d. Free Burning

Open flame production, which heats the material and contents and allows the production of fire gases.

Authors: Fl. J. Berchtold