



## Swede Survival Systems Division

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### WAIVER OF LIABILITY AND HOLD HARMLESS AGREEMENT

1. In consideration being granted the valuable privilege of participating in Flashover Survival Training, including that part of the training conducted in the flashover container (collectively, "the Training"), I hereby release, waive, discharge and covenant not to sue Dräger Safety, Inc., and The City of \_\_\_\_\_, as well as each of their affiliated corporations, parents, indirect parents, subsidiaries, trustees, officers, agents, insurers, attorneys, and employees ("the Releasees") from any and all liability, claims, demands actions and causes of action whatsoever arising out of related to any loss, damage, or injury, including death, that may be sustained by me, or to any property belonging to me, while participating in the Training.
2. To the best of my knowledge and belief, I am in excellent physical health and I am not aware of any physical disability or health-related reason or problem that would preclude or restrict my participation in the Training.
3. I am fully aware of the risks and hazards connected with the Training. For example, **I KNOW THAT THE TRAINING IS EXTREMELY DANGEROUS AND COULD LEAD TO MY DEATH OR SERIOUS INJURY.** Regardless, I hereby elect to voluntarily and fully participate in the Training. I voluntarily and unconditionally assume full responsibility for any risks of loss, property damage, or personal injury, including death, that may be sustained by me or to my family, or any loss or damage, to property owned by me or my family, as a result of being engaged in the Training.
4. I warrant and represent that I have carefully read, and that I fully understand, the document entitled *Safety Rules and Guidelines*, a copy of which is attached hereto; and that I will carefully follow the heed all its advice, directives, cautions, and warnings.
5. I warrant that I have all necessary health insurance coverage to pay for any medical costs that may directly or indirectly result from my participation in this activity. I agree to indemnify and hold harmless the Releasees from any loss, liability, damage or costs, including court costs and attorneys' fees, that may be incurred due to my participation in the Training.

WAIVER OF LIABILITY AND HOLD HARMLESS AGREEMENT

6. It is my express intent that this Release and Hold Harmless Agreement (“Release”) shall a) bind me and my family, if I am alive; b) bind my heirs, assigns and personal representative, if I am deceased; and c) be deemed as a release, waiver, discharge and covenant not to sue the Releasees, regardless whether I am alive or dead.

**IN SIGNING THIS RELEASE I INTEND TO BE LEGALLY BOUND BY ALL ITS TERMS.**

I acknowledge and represent that I have carefully read and fully understand all the foregoing terms of this Release; that I sign it voluntarily; that no one has made any other representations, statements, or inducements, apart from the foregoing terms, to induce me to sign it; and that I am at last eighteen (18) years of age and fully competent to enter into this Agreement.

Organization	Address	Telephone
Signature	Printed Name	Date

# SAFETY RULES AND GUIDELINES

## WARNING!

BEFORE YOU TAKE THE FLASHOVER TRAINING COURSE, YOU MUST CAREFULLY READ, FULLY UNDERSTAND, AND STRICTLY FOLLOW THESE SAFETY RULES. FAILURE TO DO SO COULD LEAD TO YOUR DEATH OR SERIOUS BODILY INJURY!

The following rules and guidelines regarding your Flashover Survival Training, including that part of the training conducted in the flashover container (collectively, “the Training”) have been carefully thought out. They have a single purpose: **YOUR SAFETY AND WELL BEING**. You must take the time and effort to follow them carefully. The rules and guidelines are as follows:

1. You must be in very good physical condition to take the Training. **IF YOU ARE NOT IN VERY GOOD PHYSICAL CONDITION, YOU MAY NOT TAKE THE TRAINING.** For example, you may not take the Training if you have health problems such as heart conditions, high blood pressure, emphysema, or diabetes. If you have any question as to whether you are in very good physical condition, you must consult your physician and ask his or her advice before participating. The extreme heat and heavy clothing can cause high output cardiac failure.
2. Good hydration is imperative because of the body fluid loss that you will experience while training. Drink plenty of fluids starting the day before the exercise, and continue to replace your losses throughout the day. Mineral water is the liquid of choice.
3. Besides staying well hydrated, your health must be very good. For example, if you are suffering from a cold or other infection such as the flu, do **NOT** go into the container. These minor discomforts of every day life can be very dangerous when your body is put under the additional heat stress. For example, if you participate in the Training while suffering from a respiratory infection, it could cause heart damage or worse.
4. Because it is difficult to talk and be understood while using **SCBA**, keep talking to a minimum so that everyone will be able to hear. Should anyone need to leave, you must first notify the instructor.
5. When exiting the container, a low position must be maintained. **YOU MUST NEVER STAND ERECT DURING LIVE FIRE TRAINING.** Discipline is imperative and essential to prevent injuries.

## SAFETY RULES AND GUIDELINES

6. All of your safety clothing **MUST** be in good shape. Your safety clothing must fit comfortably and be big enough to allow for additional layers beneath your normal equipment. Allow for a T-shirt and long sleeve sweat shirt on top, and a pair of cotton long johns or sweat pants for your legs. To give extra protection to your feet, wear an extra pair of socks if possible. Flash Hoods are mandatory. No bare skin may be showing when you are ready to start. Helmet shields must be removed because they discolor and have a tendency to melt down. **NO POLYCARBONATE HELMETS MAY BE WORN INSIDE THE CONTAINER.**
7. Breathing apparatus must be worn at all times during a burn. The safety man on the back-up line must also be wearing and using his breathing apparatus. (Reason: to insure his ability to rapidly enter if needed, and to protect his respiratory tract from stray smoke.)
8. During training, the nozzle and hose must always be kept clear. Always make sure that no one is standing or blocking free movement of the nozzle and hose line. All lines must be charged and purged of air before starting the exercise. A backup line is mandatory, as is a separate water source for that line.
9. After a training exercise in the containers, you must wash up before eating. Ingestion is a common route into the body for contaminants.
10. After completing your daily Training drill, wash you're under garments. This will help keep your skin absorption of any contaminants to a minimum. At the end of the three-day session, wash your turnouts and all contaminated clothing. If you have areas of your gear that have especially heavy build up of grime, pre-treat area with Simple Green, 409 cleaner or equivalent. This also works well on your helmets and B/A bottles.

Good luck in your Flashover training and let us **keep it SAFE.**

By signing below, I acknowledge and attest that I have carefully read these SAFETY RULES AND GUIDELINES, that I fully understand them, and that I will strictly follow them, and that the instructors of the Flashover Survival Training have explained to me the crucial importance of complying with these SAFETY RULES AND GUIDELINES.

Print your name on top line, then sign and date below it.

**Print** \_\_\_\_\_  
**Sign** \_\_\_\_\_  
**Date** \_\_\_\_\_

**To: ALL FLASHOVER SURVIVAL TRAINING INSTRUCTORS**

**From: Swede Survival Systems**

**Subject: Class Schedule and Equipment**

Please read over the following information so that you will be familiar with how the training days will be structured.

DAY ONE - The morning will be devoted to theory, flashover recognition, and fire behavior. We will be devoting a significant amount of time to container operations, and safety issues involving container use

The afternoon session will be live fire training. You will need all of your turnout gear and SCBA. Flash hoods are mandatory. Also bring a sweat shirt and sweat pants for extra layering beneath your turnouts. We know that you are all senior firefighters and officers and have plenty of firefighting experience, but take our word for it, you will need the extra clothing under your turnouts. It does get hot! An extra pair of socks is a good idea if your boots are big enough.

A reminder to drink plenty of liquids starting the day before training starts. Additional liquids will be available at the drill ground. Being well hydrated during this training program is very important if you want to stay healthy. If you have a cold or other similar condition, please do not take this class. The live fire training puts a tremendous stress on your body therefore your health must be good. If you feel that you cannot participate, please let the Training Officer know so that someone else can take your place.

We sincerely hope that you enjoy your training as much as we enjoy sharing our program with you. Let us be safe and make this a program that will benefit us all.

### III. What is Flashover?

- A. I.F.S.T.A. definition: Stage of a fire at which all surfaces and objects within a space have been heated to their ignition temperature, and flame breaks out almost at once over the surface of all objects in the space. (Fire Service Orientation and Terminology, Third Edition)
1. It was originally believed that flashover was caused by combustible gases released during the early stages of the fire and these gasses collected at the ceiling level and mixed with air. When they reached their flammable range and suddenly ignited, flashover occurred.
  2. Current thought is that combustible gases mixing with air precede flashover
  3. The cause of flashover is attributed to the excessive build-up of heat from the fire itself.
- 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 are heated to their ignition point and almost simultaneous combustion of the material occurs.
- C. National Fire Protection Association (NFPA 921): As the fire continues to grow, the ceiling layer gas temperatures approach 900°F, increasing the intensity of the radiation on the exposed combustible contents in the room. The surface temperature of these combustible contents rises, and pyrolysis gases are produced and become heated to their ignition temperature. When the upper layer temperature reaches approximately 1100°F, pyrolysis gases from the combustible contents ignite along with the bottom of the ceiling layer. This is the phenomenon known as flashover.
1. Research has shown that time to flashover from open flame can be as short as 1.5 minutes in residential fire tests with contemporary furnishings, or it may never occur.
- D. Vincent Dunn 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.
- E. Backdraft: the explosion or rapid burning of heated gases 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.

### IV. Fire Science and Flashover

- A. Combustion occurs within the flammable range of a vapor (gas). Within this range the concentration of gases is ideal to burn.
1. Lower limit of the flammable range: the minimum concentration that gases will burn. Below this point the mixture of gas is too lean to burn – too much air and too little gas.
  2. Upper limit of the flammable range: the maximum concentration that gases will burn. Above this point, the mixture is too rich to burn – too little air and too much gas.

#### IV. Fire Science and Flashover- continued

3. Generally with the progressive addition of heat to substances, the lower limit of the flammable range decreases.
  - a. Before heat is introduced in the flashover container, the approximate flammable range for the gases from fibrous materials will be 50% to 90%.
  - b. After the materials are sufficiently heated the lower limits fall to 0% and the thermal ignition point is low.

##### B. Fire behavior in structures

1. The distribution of fuel in a room affects the behavior of fire.
  - a. When the fuel is compact and is spent primarily in the fire, it will generally remain intact and die without doing any harm.
  - b. When the fuel is distributed throughout the room, the fire will generally emit unburned fire gases and spread as the heat rises.

##### C. Fire gas formation

1. Formation and 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.
2. The gases will gather under the ceiling and as the concentration and temperature rises, the fire gases will come closer to the lower limit of the flammable range.
3. The flames will climb upward until they ignite the fire gas pillow that has formed.
4. When the flames die down, the temperature falls but it is still high enough to continue to produce a build-up of fire gases (approximately 500° to 1500° F).
5. The glowing fire produces carbon monoxide. (Flammable range: 12.5% to 74%, ignition temperature : 1128°F)

##### D. Water as an extinguishing agent

1. Scientific tests show that the extinguishing ability of water is optimal when the size of the droplets are one-tenth of an inch in diameter.
2. In a constant flow from a nozzle, succeeding droplets will follow those before them, resulting in an ineffective extinguishing effect.
3. During firefighting, in order to provide the most efficient extinguishing effect from water, the nozzle should be moved in a circular motion. This results in more surface area of water being discharged to be exposed to the heated atmosphere.

#### V. Warning Signs of Flashover

##### A. Heat build-up

1. Hot smoke that forces fire fighters to crouch down when entering a building signal a flashover danger.
2. The lower you are forced to crouch, the greater the chance of flashover.

#### V. Warning Signs of Flashover – continued

**B. Rollover**

1. Sporadic small flashes of flames (sometimes called “snakes”) mixed with smoke seen just before flashover occurs.
2. Before entering a room, fire fighters should check the smoke exiting for signs of rollover.

**C. Thick Dark Smoke**

1. Large amounts of fire gases being produced and heated by redirected heat

**D. Free Burning**

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

**VI. Variables of Flashover**

A. Room size- a small room will flash before a large room

B. Size and number of openings within a room

C. The rate and amount of heat released

D. The insulation qualities of a structure

E. Ceiling height – ceilings of 15 to 20 feet can result in dangerously misleading flashover size-up information.

**F. Ventilation**

1. Venting a fire can delay a flashover or make it occur, depending on the stage of growth of the fire.
2. Before venting, a fire fighter should ask:
  - a. What do I want to accomplish?
  - b. What type of fire condition am I going to create after I ventilate?
  - c. Should I vent or close the door?
3. Positive pressure ventilation
  - a. A proper exit point must be established before starting positive pressure ventilation
  - b. Without an exit point, thermal balance will be distributed and flashover can continue to occur.

**VII. Flashover Survival Techniques**

A. Recognize the warning signs of heat and rollover

B. Avoid disorientation – use proper search techniques

1. Follow a system
2. Work in teams of at least two fire fighters
3. Take a rope or hoselines to be followed out
4. Take a flashlight and forcible entry tool



## VII. Flashover Survival Techniques- continued

- C. Before entering a structure, note secondary means of egress should an emergency occur.
- D. Enter and leave through the same door
- E. Should you become lost or disoriented – make every effort to remain calm and control your breathing
- F. Do not remove your SCBA facepiece
- G. Always wear full protective clothing and equipment
- H. Know the “Point of No Return”
  - 1. Fire fighters can reach the point of no return should a flashover occur. Beyond this point, they will not be able to escape to safety.
  - 2. Without a hoseline, a fire fighter in full protective gear can travel an average of 2.5-feet per second
  - 3. A fire fighter has approximately 2 seconds to exit when a flashover occurs
  - 4. There is possibility of escape if fire fighter is 5-feet or less from an exit
  - 5. **This is not to say that a fire fighter is not going to get burned, but there is a chance of getting out alive.**

## VII. Nozzle Techniques That Might Delay Flashover

- A. Recognize the warning signs of potential flashover
- B. Test the atmosphere with the nozzle on full fog
  - 1. Hold the nozzle straight up and above helmet
  - 2. Use a short burst of water into the upper atmosphere
  - 3. Do not use so much water as to upset the thermal balance and bring the smoke and steam down.
  - 4. If drops of water fall on the facepiece, the atmosphere is less than 212° F.
  - 5. If no water falls back down, then the water has turned to steam and the possibility of flashover exists.
- C. Aggressive cooling in conjunction with penciling
  - 1. If no water falls back down, set the nozzle on 60° fog pattern and hold as high as possible.
    - a. Give several sort intermittent bursts of water into the upper atmosphere to absorb the heat and cool the flammable gases to below their ignition point.
    - b. Do not use enough water to upset the thermal balance
    - c. Move the nozzle in a circular pattern to provide maximum cooling from the water droplets
  - 2. Penciling
    - a. Set nozzle to straight stream
    - b. Use several, depending on the area involved, short intermittent bursts of water, cool the walls and ceiling
    - c. Move the nozzle to cool different areas of the room
    - d. This technique will cool the walls and ceiling down and slow the re-radiation.
- D. This technique of aggressive cooling in conjunction with penciling is to be used to possibly delay a flashover long enough to allow all fire fighters to immediately exit the structure.
- E. **These techniques are only designed to buy the fire fighter a few extra seconds to exit**

## IX. Nozzle Tactics If Flashover Occurs

- A. Get as close to the floor as possible
  - 1. Coolest area
  - 2. Less fire gases to burn near floor
- B. Put nozzle on full fog
- C. Operate nozzle
  - 1. Open nozzle fully and leave open
  - 2. Hold nozzle above helmet
  - 3. Move nozzle in circular pattern to provide maximum cooling
- D. **EVACUATE THE AREA AS QUICKLY AS POSSIBLE**

## X. Purpose of 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
- C. **IT MUST BE CLEARLY UNDERSTOOD THAT THE FLASHOVER CONTAINER IS ONLY A TRAINING AID**
- D. The instructors will cause the fire to produce several flashovers during the training 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 fire fighters additional escape time.
- F. Individual observations
  - 1. Provides an opportunity for fire fighters to recognize their personal limitations prior to thermal collapse
    - a. Individual response to heat
    - b. Individual response to stress
  - 2. Provides an opportunity for fire fighters to test the limits of their protective clothing and equipment prior to thermal collapse.

## XI. Description of Flashover Container

- A. Container and training program were developed by the Swedish National Rescue Services Board in 1986
- B. Training is designed to meet NFPA 1500 and NFPA 1403
- C. Constructed of two sea cargo containers to form two non-combustible rooms
  - 1. Observation Room
    - a. Two doors
    - b. Damper to keep heat and gases at the front end of the room toward the burn room
    - c. Vent control cable
    - d. Row of seats on each side for students and instructors (optional)

## XI. Description of Flashover Container- continued

2. Burn Room
  - a. Designed for five sheets masonite to be placed along the walls, doors, and ceiling
  - b. Cut-away barrel for crib fire (no flammable or combustible liquids are to be used)

## XII. Instructions Prior to Container Operations

Instructor shall properly demonstrate each technique

1. Open the nozzle for full fog (rubber bumper all the way to left) On/Off - rapid
2. Change to straight stream (bumper all the way to right) On/Off - rapid
3. Change nozzle to 60° fog. This will have to be estimated by practice to know exactly how much to turn the bumper. Start overhead and work downward- about one second.
4. Have each student practice each technique in the position they will be inside the container. (lying on their back with their feet forward)

### B. Don protective clothing and SCBA

1. Protective clothing must be NFPA approved and will include:
  - a. Turnout coat
  - b. Turnout pants
  - c. Boots
  - d. Helmet
  - e. Protective hood – ear flaps built into helmets do not provide adequate protection
  - f. Gloves
2. Don self-contained breathing apparatus
  - a. Cylinder must be full
  - b. Cylinder valve fully open
  - c. Don facepiece
  - d. Protective hood must be on outside of facepiece
  - e. Do not attach hose to regulator until told to do so
  - f. All students and instructors enter the container. Safety and operational procedures will be practiced and discussed.
  - g. Students exit container and prepare for Safety Check.
3. Soot encrusted protective clothing absorbs heat rather than reflecting it
4. Protective clothing can ignite if fabric is heavily embedded with grease, oil, or hydrocarbon deposits
5. Hydrocarbon deposits can conduct electricity

## **XII. Instructions Prior to Container Operations- continued**

- C. The designated Safety Officer will check each participant prior to entering the container for the following:
1. All protective clothing properly donned
  2. Neck strap on coat secured
  3. Protective hood on outside of facepiece
  4. No bare skin areas exposed
  5. All straps secure
  6. SCBA Cylinder fully charged and fully opened
- D. NO ONE WILL ENTER THE FLASHOVER CONTAINER FOR THE TRAINING EXERCISE WITHOUT BEING CHECKED BY THE SAFETY OFFICER**

## **XIII. Flashover Container Operations**

- A. Students will enter the container and be seated
- B. Crib fire will be ignited
- C. The instructor in charge will demonstrate the proper operation of the nozzle and water application techniques.
- D. Once the fire begins its development, we will allow it to burn about half way across the ceiling. We will then pencil the walls and ceiling with a straight stream, using a very small amount of water.
1. This will reduce the flame production to keep from burning up all the materials
  2. This will also increase the production of fire gases. (Vent should be closed)
  3. We let the fire rise again (vent closed)
- E. Take notice of the high-pressure zone at the burn room ceiling. This is created because the air and fire gases expand as heated.
- F. The low-pressure zone is at the floor. This is where there is fresh air.
- G. You will see a pillow of smoke developing. Immediately below this pillow is the neutral zone.
- H. As the smoke pillow develops, we will perform a temperature check.
1. Short burst of a full fog stream directed straight up
  2. If water droplets fall, the atmosphere is not hot enough for flashover to occur
- I. The neutral zone is even. We will open the vent doors. Over the neutral zone, the fire will continue and we will notice it as a weak flame through the smoke. Notice the convection currents and the fire behavior.
- J. In the burn container we will see the flames start to move into the neutral zone and appear as “snakes” in the smoke. *This is a sign that flashover is near.*
- K. While we are in the container we will notice what we called “black snakes”. These are pockets of gases that are too rich to burn or not hot enough to burn. These “black snakes” will seek the oxygen in the neutral zone.
- L. As the fire snakes reach out of the burn room, cool the burn room walls and ceiling with 2 or 3 quick bursts of water on a 60° fog.

### **XIII. Flashover Container Operations- continued**

- M. Immediately pencil the walls and ceiling with 2 to 3 short bursts on straight stream. Close the vent doors
- N. Bursts of water must be kept extremely short so as not to upset the thermal balance and bring stream down on the crews.
- O. The instructor should be the only one talking during the exercise so instructions can be heard. Pay attention and follow all instructions.
- P. No one stands up during the burns
- Q. Do not grab or touch other people. Pushing hot protective clothing onto skin can cause steam burns. If you must get someone's attention, grab their SCBA tank.
- R. If you must leave at any time, tell the nearest instructor, then crawl out of the container and report to the outside safety officer.
- S. The final phase is to cool the burning fuels and prepare for the next drill. Open the container doors and cool the fuel. Continued use of SCBA is necessary for protection from carbon monoxide and flying ash.

### **XIV. After Each Burn Exercise**

- A. Doff SCBA in appropriate area – remember your life can depend on this equipment and it should be treated with respect and not dropped.
- B. Remove turnout gear and keep your gear together in one area
- C. Report to the rehab area for monitoring of vital signs
- D. Re-hydrate by drinking liquids

### **XV. Important Points to Remember**

- A. It must be understood that the flashover container is only a training aid.
- B. We will cause several flashovers to be produced so everyone has a chance to observe and practice control techniques.
- C. Everyone must remember that in an actual fire emergency, these techniques are used in order to give fire fighters additional time to escape a flashover.
  - 1. Fog
  - 2. Pencil
  - 3. GET OUT!
- D. In an actual situation, fire fighters would be on the same level as the burn room when the flashover warning signs begin.
- E. There are no routine structure fires! Because of unknown conditions present at every fire scene, treating any fire as routine can result in injury or death to fire fighters.

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## Flashover Quiz

1. List the four signs of impending flashover.

- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
- D. \_\_\_\_\_

2. What actions can be taken to delay or to stop flashover?

- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
- D. \_\_\_\_\_

3. What is the most common fire gas we find in structure fires and what is its ignition temperature?

\_\_\_\_\_

4. How many BTU's of heat can be absorbed by one gallon of water when completely converted to steam?

\_\_\_\_\_

5. What is the definition of backdraft?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6. Why is it important to drink plenty of fluids during firefighting operations and live training?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

7. Give your own definition of what causes flashover.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8. Is the flashover condition in the container a rich or lean condition? Please explain your reasoning!

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

