

This training bulletin is chock-full of good information. It would be safe to say that information from this TB could show up any promotional exam. Compare this study guide to the actual TB.

Obvious places that questions come from are: Types of heat transfer and what they cause; Differences between Rollover, Flameover, Flashover, Backdraft, and Smoke Explosion. Know the difference, when they could occur, and of course, warning signs.

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- A burn from steam would considered to be a burn from a _____ heat source. (radiated, convective, conductive)
- Steam burns can produce _____ thickness burns in < _____ seconds.
- The major cause of convective heat source burns to firefighters is from disruption of the _____ layer by the use of high flow _____ nozzles.
- One of the greatest risks firefighters encounter during firefighting operations is _____ burns.

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- Tests indicate that exposure to temperatures of only _____ degrees F to _____ degrees F will cause extreme pain and severe, _____ thickness burns to all **unprotected** skin.

(The information)

Burns	
Type or Degree of Burn	Temperature or Result
2 nd degree burn can occur with exposure to only	111 degrees of heat
2 nd degree burn can occur within	20 seconds @ 111 degrees
2 nd degree burn can occur with	1 second @ 158 degrees
Steam burns develop faster and are more severe than dry heat burns	At the same temperatures, due to latent heat of transfer
Direct flame impingement is the	MOST severe type of exposure

(Now you do it)

Burns	
Type or Degree of Burn	Temperature or Result
2 nd degree burn can occur with exposure to only	_____ degrees of heat
2 nd degree burn can occur within	_____ seconds @ _____ degrees
2 nd degree burn can occur with	_____ second @ _____ degrees
Steam burns develop _____ and are more severe than _____ heat burns	At the _____ temperatures, due to _____ heat of _____
_____ flame impingement is the	_____ severe type of exposure

- When caught just _____ feet inside a room during a **flashover** – will be exposed to temperatures of _____ to _____ degrees F. AND will be exposed to direct flame impingement for at least _____ seconds.
- Same types of firefighting tactics must be applied as when firefighters did not have the PPE protection that we have now.

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BASIC FIRE BEHAVIOR

- Products of Combustion (POCs) cause the great majority of civilian fire fatalities and injuries by obscuring visibility, reducing available oxygen content, or replacing the oxygen in the lungs.
- Any kind of energy can be converted to heat.

Heat Measurement

- Heat ALWAYS moves from warmer bodies to _____ bodies (objects)
- **British Thermal Unit (BTU)** is: The amount of heat to raise _____ pound of water _____ degree F. (The rest of the definition not included here is "... @ 60 degrees")
- **Specific Heat:** is the thermal _____ of a substance. (Referring to 1 pound of a substance having its temperature raised 1 degree F.)
 - The specific heat of water is _____ BTU
- **Latent Heat:** is the _____ of heat **absorbed** by a substance when passign between phases (i.e., solid to liquid, liquid to gas)
 - **Latent Heat of Fusion** = _____
 - **Latent Heat of Vaporization** = _____
 - Water has a Latent Heat of Fusion of _____ BTUs
 - Water has a Latent Heat of Vaporization of _____ BTUs
- **Heat of Combustion:** is the maximum amount of heat _____ in BTUs by the complete combustion of a unit mass of a combustible material.

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Heat Transfer Methods

- Heat is transferred in three (3) different ways.

Radiation:

- Similar to light waves. Emanates equally in all directions, in _____ lines.
- As distance is increased, intensity is _____
- **When heat source is smaller than exposed objects:** Double the distance = intensity (temperature to the exposed by is **reduced** _____).
- When heat source is larger or same size as exposed objects: Temperature is reduced by _____.

Convection:

- The transmission, spread, or distribution of heat through the motion of _____.
- Is the _____ method of heat transfer within _____.
- Responsible for the majority of fire and _____ spread within structures.
- The higher up in the room, the hotter the temperature.
- **Mushrooming** – Smoke goes up and banks down.

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Conduction:

- The transfer of heat through matter **without** any _____ motion of the matter.
- Fire extension through matter occurs only in rare circumstances.
- **The primary consideration** relative to conduction is structural _____.
- The weakening of metal connections to wooden members is a major cause of structural collapse.

_____ is the most dangerous & threatening product of combustion

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Fire Progress and Development

- There are _____ stages in the development of an interior fire:

Growth Stage:

- Fire increases in size from _____ fire to fire that involves the entire room or area. Taking from _____ seconds to several hours.

The rate of combustion, fire intensity, and total combustion output are governed by six (6) major factors:

1. The _____ of exposed combustible
 2. The _____ of combustible surfaces
 3. The _____ of fuel source
 4. The _____ of combustible surfaces
 5. The _____ of combustible surfaces to room or area
 6. The amount of available _____ flow or ventilation
- The amount of combustible material effects **how long** the fire will burn, unchecked.
 - The amount of _____ area of material, type of fuel, size and fire intensity determines the ease of ignition.
 - _____ or _____ surfaces absorb heat faster (with conduction)

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- **If adequate air supply** the ratio of combustible surface to room or area volume is the _____ factor that determines the time to _____ or full room involvement.
- The **rate** of sustained combustion determined by available _____ or airflow.

Fully Developed Stage:

- Entire room or area & contents become involved.
- **Flashover** occurs at the _____ of the growth stage.
- **Flashover** marks the _____ of the fully developed stage.

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Decay Stage:

- Combustion Rate & Temperature output begin to _____.

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FIRE PHENOMENA**Flashover: IS**

- Sudden _____ room or area involvement in flame OR
- Sudden _____ of combustible surfaces and/or gases in an area heated by **convection** and/or **radiation** resulting in a sudden and intense rise in temperature.
- Flashover IS one of the major causes of fire ground _____.
- _____ IS the **MOST DANGEROUS** stage of fire development.

Flash Phenomena

There are three (3) flash phenomena that can occur in a superheated, smoke filled environment:

1. **Rollover** – a sudden sporadic generation of _____ mixed with _____ at the _____ ceiling level. This happens just _____ flashover occurs.

It is the _____ warning for firefighters to withdraw **IF** charged lines are **not** in place and operating effectively.

Caused by _____ gases released during the _____ stage – mixed with air as they enter their flammable range.

Rollover is a warning of a more deadly event to follow!

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2. **Flashover** takes place _____ rollover – at the _____ of the growth stage of the fire.

Flashover is the **most deadly** of the flash phenomena

Especially if they are first-in without proper ventilation and backup.

3. **Flameover** usually occurs _____ flashover and is defined as:

Rapid flame spread over one or more surfaces during the fire.

Caused by sudden ignition of _____ vapors that are produced from the heated surface.

Firefighters may be encircled and trapped by flameover.

Warning Signs of Flashover: (5)

- Fire producing buildup of heated smoke at the _____ levels of a structure.
- Smoke is _____ in **heat** and **density**
- Rapid _____ down of heated smoke
- Fire of significant intensity exposing contents and surrounding areas to _____ and/or _____ heat.
- A _____ is occurring. Flame is visible in the _____, rolling out the _____ of open doors or windows. Flames and smoke in the upper ceiling levels inside the fire area.

Note: These warning signs may **not** be apparent in a _____ building with enclosed floor or attic spaces AND ceilings heights are _____ to _____ feet above the floor or joist level.

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- In a building with “normal” ceiling heights of _____ to _____ feet, fire & smoke will quickly accumulate.
- Experienced firefighters stay _____.
- In structure with high _____ or large _____ super-heated smoke can accumulate

Smoke Explosions:

- Conditions for smoke explosions develop _____ firefighters enter a building OR when smoke particles buildup in hidden areas when firefighting is going on.
- To ignite and explode the smoke it only needs "**a little more O₂**"
- Can occur **after** unsuccessful _____ and extinguishment operations have been underway for _____ time.
- It is _____ and unexpected.

When operating inside, watch for the following warning signs of a smoke explosion: (4)

1. _____ OR intermittent flame
2. Smoke being drawn past you, _____ the fire area of the structure.
3. _____ smoke, _____ with great force.
4. _____ flames in the smoke above you.

Backdraft:

- A "true" backdraft is extremely rare. It is a _____ damaging explosion.
- It occurs at the _____ Stage of the fire.
- Oxygen content falls to between _____% and _____ %
- Temperatures can reach _____ degrees F. to _____ degrees F.
- It only needs _____ to get it started.

Warning Signs of Backdraft: (8)

- Smoke issuing out of wall _____ windows frames, roof, attic vents
- Smoke _____ as it rolls into the outside air.
- Heavy _____ smoke is visible by **no** _____ can be seen or heard.
- Windows _____ - may look like _____.
- Structure appears to be "breathing"
- _____ may form on the windows
- Windows are _____ or rattling from internal psi.

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- Large plate glass windows may _____ from heat and internal psi.

Differences Between Flashover and Backdraft:

- Is there AIR or is there not air?

Flashover – occurs during the _____ or _____ Stage of the fire.

- There is _____ oxygen to support combustion.
- The triggering event is **more** _____. Primarily re-radiated or _____ heat.
- Combustibles are _____ to their **auto ignition** temperature.

Backdraft – occurs during the _____ or _____ Stage of the fire.

- There is **not** enough oxygen to support combustion.
- The triggering event is **more** _____. Broken window, opened door.
- Prior to a backdraft, there is **inadequate** oxygen to support combustion.

STRUCTURAL COLLAPSE

After a flashover has occurred the fire becomes a “structure” fire. The building itself is burning.

Some considerations about a structure fire:

- The building itself may burn
- Contents of the building may burn
- Occupants can be trapped
- Building layout may complicate the fire attack
- Building may partially or fully collapse
- Firefighters may be injured or killed

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- Beams, trusses, walls, and columns are the _____ structural elements that carry and transfer loads throughout the building.
- Characteristics of building materials change when in a fire.
- A building that is on fire IS under demolition.

There are four (4) construction features that present the greatest hazards to firefighters:

1. _____
2. _____ masonry
3. Any _____ construction
4. _____ steel construction

Those four types of construction **fail** suddenly, rapidly, and _____ warning.

FIRE GROUND SURVIVAL

It is important for all members to make their own **personal** size-up. Consider the following areas:

- The occupancy involved
- The age of the building
- The construction type
- Smoke conditions
- Fire location AND intensity AND is it a “contents” fire vs a “structure fire?”
- How long has it been burning?
- Operation problems – Engine vs Truck
- Water supply, weather and

Entry & Exit considerations:

- Go through _____ (1st choice)
- Fire escapes are usually good, but _____ out the opening to create a doorway.
- **WINDOWS** should be the _____ choice. ***Make sure the windows are completely cleaned out!***
- When vertical ventilation is required, place _____ ladders to the roof.
- Make roof openings over the fire (where possible) and _____ enough to exhaust heat and smoke quickly.
- Ladders should go to _____ floors of multi-story structures – provides _____ access and egress for firefighters.
- **When inside** stay low, work the nozzle in the _____ atmosphere to affect cooling and push back a _____.
- Water must reach the seat of the fire.
- Pull ceilings when there is a _____ line ready to go.
- **Never** let fire go between you and the way out.
- **Always** reassess heat buildup – to it continually
- **When** is the time to get out?

OFFICERS

What to do if everything goes wrong . . .

- Use extreme self control – don’t panic – keep thinking
- Communicate your situation – location – actions to escape
- Stick together
- Buddy Breathe

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- Use your knowledge or knowledge of your partner.
- Activate your emergency button - (**Remember TB 2?**) This is a good time to review it!
- When you do get out – count heads.
- Critique your fires **while on scene.**

The end