Truck Company Operations
Instructor Guide

Session Reference: 1-3

Topic: Ventilation

Level of Instruction:

Time Required: 90 Minutes

Materials:

References:
- Truck Company Fireground Operations, Second Edition, Chapters 4 and 5
- Essentials of Fire Fighting, Third Edition, Chapter 7

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PREPARATION:

Motivation:

Objective (SPO): 1-3-1

The student will demonstrate a basic understanding of ventilation theory, ventilation decisions, methods of ventilation, and ventilation techniques.

Overview:

Ventilation
- Definition
- Basic principles
- Natural ventilation
- Forced ventilation
- Smoldering fires

SESSION 1-3 VENTILATION

SPO 1-3-1 The student will demonstrate a basic understanding of ventilation theory, ventilation decisions, methods of ventilating, and ventilation techniques.

1-3-1 Define ventilation and describe the importance of ventilation to the overall fire suppression activity.

1-3-2 Describe convection currents and their effect on ventilation.

1-3-3 Explain natural ventilation.

1-3-4 Explain forced ventilation.

1-3-5 Describe the signs and special ventilating considerations related to smoldering fires.

I. Definition (1-3-1)

A. Ventilation is the controlled removal of smoke, heat, and gases and the replacement with fresh air.

B. Ventilation contributes directly to accomplishment of basic fire fighting objectives by

1. Reducing danger to trapped occupants and extend time for rescue operations

2. Increasing visibility thereby decreasing danger inherent in other fireground operations and increasing efficiency

3. Permitting quicker and easier entry to allow search operations or to advance lines

4. Minimizing time required to locate seat of fire

5. Minimizing time required to find areas to which fire has spread

6. Decreasing or stopping spread of fire

7. Reducing chance of flashover or backdraft

C. Results depend on size and type of occupancy involved, extent and location of fire, and whether fire is free burning or smoldering

D. When properly performed, ventilation increases effectiveness of most operations

E. Ventilation techniques require doing damage to building

F. Small amount of ventilation damage results in larger reduction in fire damage

G. Ventilation aids in saving lives

II. Basic Principles (1-3-2)

A. Fire travel by convection presents greatest fire fighting problem

B. Smoke moves vertically and horizontally - mushrooming

C. A separate fire may ignite from hot air and combustion products rising

D. Accumulation of hot air and combustion products under roof must be allowed to escape

E. Opening should be under hot air and combustion product accumulation

F. Accumulation on fire floor should be relieved also

G. General rule is open fire building so that all accumulations of heat and combustion products leave building by natural convection

III. Natural Ventilation (1-3-3)

A. Windows

1. When time permits, windows should be opened; avoid breaking glass, if possible

   a. Double hung windows should be opened two-thirds down from the top and one-third up from the bottom

   b. Open other types of windows as much as possible

   c. Storm windows must also be opened or removed

   d. Shades, blinds, drapes, curtains, and other window coverings must be moved away or removed

2. Effects of wind

   a. When wind is a factor, windows on leeward side should be opened first

   b. Windows on windward side should then be opened

   c. If windward side is opened first, wind will churn smoke and gas around in interior

3. Window and roof ventilation

a. When roof or roof features must be opened for venting, windows on top floor should be opened

b. If windows on several floors must be opened, begin at top and work down

c. Opening windows from below first may cause fire and smoke spread

B. Natural roof openings

1. In multi-story buildings, vertical shafts carry stairways, elevators, dumbwaiters, electric wiring, heating ducts, and plumbing and sewer pipes

2. Shafts extend full height of building

3. Convected heat, smoke, and gases will rise within and around shafts

4. If shafts are not vented at top, fire will travel horizontally

5. Pressure will force heat, smoke, and gases throughout upper part of building

6. Shafts are capped at roof with various closures

C. Skylights

1. Positioning of skylights can give idea of building layout

a. In office or apartment building, row of skylights most likely located over corridor

b. In shops or factories, line of skylights over work area

c. Often located over stairways, corridors, elevator shafts, air shafts, and bathrooms

d. Bathroom coverings may have louvered ends

e. Area immediately below skylight usually boxed to separate cockloft or attic space

f. Warning should be given to fire fighters below before removing skylights

2. Opening skylights

a. Preferred method of opening skylight is to lift from opening or tip over

b. Flashing joining skylight to roof must be cut or pried away

c. For skylights mounting on foundations, flashing must be cut or pried

d. Lay skylight upside down as warning for fire fighters

e. If skylight cannot be lifted or tipped, glass can be cut

f. Less damage done by peeling back metal striping and sliding out panes

g. If not removable quickly, knock glass out

h. More than one or two fire fighters may be required

3. Plastic skylights and roof panels

a. Mounted same as glass skylights

b. If skylight cannot be removed, frame should be cut where it meets plastic

c. Avoid stepping on panels placed in a roof and serving as simple skylights

d. Plastic panels can be pulled up after roof is cut or pried up along edge

4. Effects of wind - keep backs or sides to wind

5. Opening below the skylight

a. Smoke should flow freely once skylight is opened

b. May be swinging transom or panel at ceiling line

c. Be careful to avoid heat and smoke from opening

d. Cockloft must be vented from opening in roof

e. Roof scuttle can be used for venting roof if not boxed

f. Boxed area below skylight can be opened for venting

g. If fire is directly under roof, make opening as close over fire as safety allows

D. Roof shuttles (hatches) - placed in a roof to allow access to the roof from the interior

1. Opening scuttles

a. If cover is not securely locked, can be pried off

b. If not easily removable, cut off

2. Opening below the scuttle

a. Might be boxed to separate from cockloft

b. Check to see if scuttle is open at ceiling level

c. Building and/or cockloft may be vented by scuttle

d. Ceiling closure must be removed

e. Enclosure below scuttle must be opened to vent cockloft

E. Pre-fire inspection

1. Every building has some natural openings

2. Only sure way to know which natural openings can be used in fire fighting is by making pre-fire inspections

3. Pre-fire inspections save time and effort on fireground

F. Cutting Through Roofs

1. At times, only way to properly ventilate is cut hole in roof

   a. Roof made of boards can be cut with axe

   b. Roof may of plywood should be cut with power saw

   c. Care should be taken not to cut joists or other structural members

2. Single large hole is more effective than several small holes

   a. One 4' X 8' hole has twice area of four 2' X 2' holes

   b. All roof boards should be cut through before any pulled up

   c. Keep back to wind when pulling boards

   d. When all boards ripped up, make opening in ceiling below

3. Special care should be taken when fire is immediately below roof

   a. Open roof as close as possible to seat of fire

   b. If not, fire will be drawn across top of building to opening

   c. Hot spots may develop on roof

   d. If roof is flat, opening should be made at hot spot

e. On gabled roof, opening should extend from hot spot to peak

f. Draft can be increased by making an additional opening just above the eave line on side opposite original opening

g. Care should be taken so that opening does not increase fire spread

IV. Forced Ventilation (1-3-4)

A. Smoke ejectors

1. Cannot be used as a substitute for natural venting techniques

a. Heat, smoke, and gases most effectively removed by natural convection through natural or forced openings

b. Crews should perform natural ventilation and carry out other necessary duties

c. Fans should not be used in partially or completely confined spaces in which there is fire

d. May be used in confined areas after fire has been knocked down

2. Fan placement

a. Most effective when placed where they tend to increase natural air flow

b. When fans are positioned in windows or doorways, all shades, drapes, blinds, curtains, and screens should be removed

c. If possible, open area around fan should be closed to increase fan efficiency by directing air through opening and preventing smoke from re-entering

d. Be careful not to exhaust smoke into congested areas or into heating and cooling intakes

3. Fans in tandem

    a. Can be especially effective when used in pairs

    b. Place one fan near an outside opening blowing smoke out and other inside room to blow smoke to first fan

    c. Fans can be used to exhaust smoke and draw in fresh air at same time

    d. Exhaust fan should be mounted high in vent opening

    e. Intake fan should be lower

B. Positive pressure blowers

1. Introduction

    a. Fresh air introduces to increase pressure

    b. Selective process of opening and closing doors and windows

    c. Initiated outside structure

    d. Has potential of moving fire and fire gases

    e. Generally speaking, initiated between fire fighters and fire or between fire and trapped victims

2. Advantages of positive pressure ventilation

    a. Can maintain primary and secondary egress routes

    b. Does not require explosion proof fans

    c. Can be initiated from exterior of building

    d. Effective on all structures when doors and windows maintained

    e. Does not require smoke and fire gases to pass through fan

f. Quicker than negative ventilation

g. Air velocity within building increased

h. Works well in large areas

3. Fan placement

a. Place fan far enough away from door to fill opening with cone of air

b. Stacking fans increases volume greatly

c. For oversized doors, place fans side by side or in tandem

d. For single fan, place 6 to 10' from doorway

e. For multiple fans, place 3 to 5' from doorway

4. Working with positive pressure

a. Ventilation critical to overall operation

b. Must identify location of fire

c. Place pressure zone to support rescue or fire attack

d. Take care not to destroy integrity of doors and windows

5. Special situations

a. High rise buildings

b. Heavier than air gases and below grade conditions

c. Confined space

d. Emergencies involving temperatures

C. Fog streams

1. Can be used to start venting immediately after fire has been knocked down

2. To be most effective, stream should be positioned so fog pattern covers most of window opening

3. Hold nozzle few feet inside window

4. Observe smoke movement to determine proper position of nozzle

5. Fog streams should not be used for venting if they damage

a. Items removed for protection

b. Outside of fire building or enter adjourning buildings

c. Inside of room from which directed

6. They should not cause ice to form outside

7. Should be short term operation

NOTE: The instructor may want to discuss applying natural and forced ventilation to particular situations.

V. Smoldering Fires (1-3-5)

A. Indications

1. Much smoke visible, but no open fire can be seen or heard

2. Smoke rising rapidly from building, indicating that it is hot

3. Smoke leaving building in puffs or at intervals

4. Some smoke being drawn back into building around windows, doors, and eaves

5. Although no flames are showing, windows stained brown from intense heat

6. Occasionally, one or more panes broken by heat

7. Small rim of fire can appear around edges of broken glass

8. Smoldering fire has sufficient heat and fuel to become free burning

9. Smoldering fire needs only oxygen to burst into flame

10. Fire can be smoldering in building of any size or type or in only one area of large structure

B. Backdraft

1. Smoldering fire must be ventilated before it is attacked

2. Addition of oxygen to heat and fuel will lead to immediate ignition

3. Sudden ignition can take any form

   a. Gases and heated combustibles simply burst into flame

   b. Force of ignition might be enough to blow windows, doors, and fire fighters out of building

   c. Could be explosion strong enough to cause structural damage

C. Venting

1. An opening must be made as high on the building as safely possible to release gases and allow them to move out of structure

2. Difference between free burning and smoldering fire is that venting must be done before entering structure in smoldering fire

3. Natural roof openings can be used for ventilation

4. If roof venting seems particularly dangerous, knock out tops of highest windows with ladder or solid stream

5. Avoid approaching building directly to avoid violent explosion - approach from oblique angle or parallel to building

6. Attack lines should be charged and ready for use during building ventilation

7. If there is a possibility of backdraft, apparatus should not be positioned in direct line of building

8. Once ventilated, fire will burn freely

SUMMARY:

Review:

Ventilation
- Definition
- Basic principles
- Natural ventilation
- Forced ventilation
- Smoldering fires

Remotivation:

Assignment:

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EVALUATION: