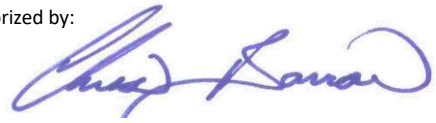
	TRAVIS COUNTY ESD #5 **MANCHACA FIRE RESCUE** **Department Best Practices** Authorized by:  Fire Chief Chris Barron	**A102**
		Effective: 7/18/2017
		Rescinds: NA
Ventilation		**Reference:** AFD A102.1
		Application: Shift Personnel

I. Purpose

To provide an overview of firefighting ventilation concepts.

II. Background

Ventilation is normally defined as the systematic removal of heat, smoke and gases and replacement with a supply of cooler fresh air. Ventilation is categorized by type: horizontal or vertical. These two types of ventilation can be accomplished by three methods: natural, positive pressure and negative pressure. Natural ventilation refers to the technique of making openings in the structure and allowing ambient wind, weather conditions and convection to affect ventilation, permitting the escape of smoke and heat. Positive pressure ventilation refers to the use of mechanical devices (primarily positive pressure ventilation (PPV) fans) to introduce cooler, fresher air and at the same time displacing the heat and smoke. Negative pressure ventilation refers to the use of mechanical devices (primarily electric smoke ejectors *or fog streams*) to draw the smoke and heat out.

Most structure fires will reach a ventilation-controlled state, so firefighters must understand that "venting" does not always lead to the removal of heat. Introducing air into a ventilation-controlled structure fire will most likely lead to an increase of the burning rate and possibly cause rapid fire progression. This can occur from any opening made in the structure including the door firefighters open to enter the structure. Therefore, it is critical the ventilation is performed properly and in coordination with fire attack.

This document is a direct adaptation of the Austin Fire Department SOG on ventilation. It has been adopted by Manchaca Fire Rescue as an Auto Aid partner to maximize standardization between partner agencies. Variations and additions to the language from the parent AFD document will be signified by text in italics. Generic changes that do not affect content such as formatting and changing "AFD" to "MFR" will not be noted.

III. Best Practices

The following best practices should be followed at all firefighting and emergency scene operations, except where deviation can be justified by Fire Officers. Any significant deviation should be communicated to responding/on-scene units as soon as possible.

A. **Importance.** Ventilation should be considered an integral component of fire attack and should be coordinated with fire attack to most effectively achieve quick fire knockdown and allow for the search and/or rescue of trapped or threatened occupants. Although ventilation is normally the responsibility of Ladder Companies, first-in and second-in Engine Officers often perform the initial coordinated Positive Pressure Ventilation. All Company Officers should be familiar with ventilation concepts and coordinated fire attack to most effectively address incident priorities.

B. **Coordination with fire attack.** Coordinated fire attack/ventilation refers to the concept of initiating ventilation prior to, entry of the fire attack handlines. This allows the fire attack team to rapidly advance to the seat of the fire. The visibility and tenability of the interior environment is improved by removing smoke and heat. This also allows search teams to conduct quicker, more efficient searches for trapped and threatened occupants. Early ventilation prior to fire attack and the operational readiness of crews to deal with the consequences may be detrimental, making coordination imperative. If the fire room is vented before the hose crew is ready to advance, the fire can accelerate and spread rapidly. If the fire room is vented while crews are inside, rapid changes in fire behavior (i.e. flashover, backdraft, etc.) can occur shortly after ventilation. The effects of these changes should be considered before entering the structure. Adequate resources to mitigate the consequences must be in place as the fire may intensify and exposures may become threatened.

C. **Horizontal ventilation.** Horizontal ventilation, including ventilating gable vents or upper floor windows, is preferable to vertical ventilation involving roof operations because it is usually a safer operation given the predominant use of lightweight construction in *the Austin area*. Normally, horizontal coupled with positive pressure ventilation should be utilized at single-family residential fires. However, vertical ventilation is an option, especially in larger structures, and should be studied and trained for by Ladder Officers and crews.

D. **Smoke color.** The presence of dense smoke coming from a structure, regardless of color, indicates a strong need for ventilation. Commonly referenced smoke colors include:

1. Whitish – incipient fire
2. Brown – wood or natural products
3. Black – hydrocarbons, plastics and other synthetics
4. Yellowish/ greenish under pressure – indication of a significantly oxygen-deficient fire with backdraft potential
5. Heavy, rolling, black under pressure – heated, fuel rich smoke conditions that are ripe for rapid fire progression.

E. **Self-venting.** Fire through the roof of a structure is an indication that the fire has self-vented; this does not eliminate the need for additional ventilation assistance. Fire through a window does not necessarily indicate adequate ventilation. Ventilation size-up and action are still required.

F. **Flow path.** Ventilation openings in a structure create "flow paths" for the products of combustion, which move from areas of high pressure toward areas of lower pressure. With no other influences, the flow is normally away from the fire area inside the structure toward uninvolved areas and any openings. However, factors such as wind and PPV fans can create different flow paths. Firefighters must consider these flow paths when creating openings in a structure. The safest location for firefighters is in the inlet (fresh air) side of the flow path. The outlet (heat and smoke) should be avoided. When possible, firefighters should use interior doors to prevent being caught in the wrong side of a flow path.

G. **Preparation of vent opening.** A ventilation opening should be thorough. Drapes, screens, curtains and any other impediments to airflow through a window ventilation opening should be completely removed.

H. **Ventilation methods.** Many factors influence the approach to ventilation. Building construction, fire and smoke conditions, life safety factors, wind direction and available resources are all to be considered prior to selecting a ventilation method. The following methods should be considered:

1. **Natural ventilation.** Natural Ventilation (horizontal or vertical) takes advantage of ambient weather conditions, wind and humidity to affect the removal of heat and smoke. An advantage of natural ventilation is the speed of implementation. However, a major disadvantage is the firefighter lack of control of the flow path. When using natural ventilation, firefighters should strive to vent with the wind to their back.

2. **Positive pressure ventilation.** Positive Pressure Ventilation (PPV) refers to the ventilation technique of using a PPV fan at the point of entry for fire attack (higher pressure) to create a flow path from the entry point toward the fire compartment and then out a vent opening in or near the fire compartment (lower pressure). PPV can rapidly ventilate a structure, allowing a dramatic improvement in visibility and quick heat dissipation. This ventilation technique normally creates a safer interior environment for firefighters making fire attack and any potential victims. However, PPV will likely increase the burning rate so it is critical to coordinate it with fire attack. PPV should be considered the standard ventilation plan for offensive attack in residential structure.

    a. **Positive pressure attack.** PPV fans can be set up and put into operation very quickly. A common technique is for an initial company to bring a PPV fan to the point of entry for fire attack. This method of using PPV ventilation in conjunction with initial fire attack is commonly referred to as Positive Pressure Attack (PPA). The steps for proper PPA include:

        i. **Fan placement.** The PPV fan is brought to the fire attack entry point, set up and started, but not directed into the opening. "Door control" should be utilized to maintain the door in the closed position until PPV is started.

ii. **Vent opening.** Meanwhile, a vent opening is made in the fire compartment or as close to the fire compartment as possible. Preferably, the Engine Officer will make this opening while doing a 360-degree size-up of the structure. When possible and timely, a blitz attack should be employed to quickly knock down the fire and/or reduce the heat in the fire compartment. Openings must be controlled in order to maximize effectiveness when using PPA. Additional openings beyond those designated for PPA must be kept to a minimum.

iii. **Turning the fan.** Then, once an attack handline is charged and the fire attack team is in place, the PPV fan is placed in position several feet from the fire attack entry opening so that the cone of air covers the entire opening. The entrance is left unobstructed, allowing easy ingress and egress. The point of entry (usually, the door) should be blocked open with a tool or wedge.

iv. **Checking flow path.** The fire attack team must allow time for the PPV ventilation effects to be realized. Ideally, a flow path in the smoke from the entry point should be seen. Then firefighters can move in to make fire attack. If the PPV does not create an effective flow path, the most likely cause is a closed interior door between the entry point and the exit vent opening. When this occurs, if the interior conditions are safe to do so, firefighters may enter the structure (PPV ventilation still in place) with a charged handline, locating and opening interior doors so that the proper flow path is created.

v. **Negative results.** In situations where PPV creates a significant negative reaction in the smoke or heat layer at the entry point or if a proper flow path cannot be established, firefighters should consider another entry point or ventilation method.

b. **Entry without PPV.** If the fire attack team entry is made into a structure fire without the use of PPV ventilation, the starting of PPV fans should be avoided until the fire is knocked down and there is no longer a possibility of creating rapid fire progression with the firefighters inside.

c. **Contraindications.** PPV fans may not be the best choice in large structures with complicated layouts.

d. **CO production.** Gasoline powered PPV fans exhaust carbon monoxide. An exhaust tube should be used when available. Electric PPV fans may be appropriate for simple smoke removal calls or when firefighters have removed their SCBAs (after air-monitoring) during overhaul.

3. **Negative pressure ventilation.** Negative Pressure Ventilation requires setting up the smoke ejectors at an opening to draw the smoke and heat out. This type of ventilation is best suited for post-fire smoke removal operations. Hydraulic ventilation used after knock down is also a very effective form of negative ventilation.

a. **Ejector placement.** Electric smoke ejectors are hung or placed in openings (doors and windows) and smoke and heat are drawn out of the structure over the ejector motor.

b. **Ejector placement with wind.** Ejectors should be set up to take advantage of any ambient wind conditions. Ejectors set up in series may assist in smoke removal.

c. **Access concerns and power.** Smoke ejectors placed in openings, especially doorways, tend to hamper ingress and egress. Electric cords and power sources must be established when utilizing electric smoke ejectors for ventilation.

d. **Use of gas-powered fans.** PPV fans can be utilized for negative pressure ventilation but gasoline-powered PPV fans trend toward poor performance when used in this manner; smoke is drawn over the engine reducing the fresh air needed for proper functioning.

I. **Vertical ventilation.** Vertical ventilation requires openings at levels above grade and demands careful planning to achieve effective results.

1. **Risk/benefit of vertical ventilation operations.** Opening a roof to achieve vertical ventilation can be a dangerous operation depending on the method chosen and the type of building construction. A careful risk/benefit analysis of the situation should be conducted prior to conducting roof operations.

2. **Lightweight construction hazards.** Prior to undertaking roof operations, a size-up of the roof support system should be made. Fire involving the structure (as opposed to contents-only) of a lightweight truss system makes roof operations extremely hazardous and alternatives should be sought. A deliberate risk/benefit analysis should also be conducted on interior operations in light of the extremely hazardous nature of fire-involved lightweight truss systems and the potential for early collapse.

3. **Alternate approaches.** Most residential structures (single family homes and many apartment complexes) can be effectively ventilated without conducting roof ventilation operations. Upper areas can be opened from the exterior of the structure by firefighters working off of ladders to open gable vents or break windows, or by breaking windows from the ground using tools (long pull down hooks, straight ladders, etc.).

4. **Commercial buildings.** Commercial occupancies may require vertical ventilation. A very safe method of vertical ventilation is taking out a skylight from an aerial ladder. A halligan tied to a rope and dropped through a skylight works well.

5. **Aerial use.** The safest way to accomplish vertical ventilation is from an aerial ladder. Ladder companies should be placed on the fire scene for this potential (unless positioning for rescue).

a. **Crew assignment.** Roof ventilation operations should be assigned to an experienced and skilled officer and crew.

b. **Roof egress.** Always provide multiple egress points for firefighters operating on a roof (ground ladders, roof stairwells, etc.). Multiple egress points may not be needed if working from an aerial ladder.

c. **Artificial roof openings.** Artificial roof openings should be utilized because of ease and speed of opening (skylights, roof ventilators, etc.).

d. **Operating on a roof.** Firefighters should avoid walking over wide expanses of roof, especially if the location of fire is unknown or the roof feels spongy. Firefighters should walk along edges where structural support members are located. Roof ladders should be utilized on pitched roofs and roof or straight ladders should be laid horizontal on flat roofs.

e. **Opening dimensions.** One large hole is preferable to several smaller holes. A safe option is to make 2' x 6' or 2' x 8' holes from the aerial ladder.

f. **Saw safety.** Power saws can be dangerous in low visibility situations, and the officer in charge should ensure that personnel are clear of the saw. A firefighter should guide the saw operator as he or she moves backwards. Consider having the spotting firefighter hold onto a strap tethered to the saw operator.

g. **Initial cut.** It is preferable to start the cut with the firefighter's back to the wind (finishing the cut upwind of the ventilation hole).

h. **Depth of cut.** A power saw should be handled by an experienced member who can gauge the cut in order that only roofing materials are removed and support members are left intact.

i. **Hoseline.** Ideally, a charged hoseline should be present during roof ventilation operations. A fire stream should not normally be directed into a vertical ventilation opening for the risk of endangering firefighters inside the structure.

J. **Vent-Enter-Isolate-Search.** "Venting-for-Life" involves the opening of doors or windows to reach trapped occupants/victims. VEIS is a relatively safe tactic and efficient way to quickly search high life hazard areas (refer to MFD Best Practices A103 Search and Rescue at Fires).

K. **Smokebuster.** The Smokebuster is an additional resource to be considered by Incident Commanders when a large volume of smoke must be removed.