

By Kriss  
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# The Power of Negative Thinking

Negative pressure (−) has a much greater (>) impact on fire spread than positive pressure (+)

If positive pressure attack (PPA) were invented today, it would evolve around the *negative* pressure aspects, rather than the *positive* pressure aspects, of structural fires. Fire instructors explaining PPA would talk not about the volumes of pressure PPA introduces into a building, but rather the importance of enhancing the *negative* pressure areas to prevent fire extension, while improving interior tenability and safety for advancing crews. I sometimes wish I could turn back the hands of time and reach into a box, pull out this relatively new and obviously controversial tactic, and start teaching it afresh.

In this article, I'll demonstrate why changing the way you think about PPA can increase the effectiveness of the tactic. I've also included a shortened sample standard operating procedure for PPA.

## FIRE BEHAVIOR

As we look at PPA with a fresh mind, let's talk for a moment about basic fire behavior. Fire naturally moves from areas of higher, or positive, pressure to areas of comparatively lower, or negative, pressure. The largest area of negative pressure during a fire is *outside* the structure. The positive pressure area inside and the negative pressure area outside are separated by the walls and roof of the structure.

Specifically, PPA entails making an exhaust opening to the outside or improving an existing opening where the fire is already exhausting, then using a blower to add slightly to the already higher interior pressure.

Now that we've identified the areas of high and low

pressure, we must ask: What creates the substantial increase in pressure when a structure is on fire? There are two causes. The first is the fire itself. As molecules heat and expand, they substantially increase the interior pressure within a building or within a fire area. This increase has been measured at approximately 7 percent overall.

The second substantial increase in interior pressure is caused by water application. This increase, due to steam production, is less dependent on stream selection than on extremely hot interior temperature, the hot surfaces our water strikes and the volume of the fire space relative to the negative area where pressure could exhaust.

The pressure created inside a structure by fire and the steam generated by water application is actually much higher than a positive pressure blower can create. When tested separately without a fire to interfere with the results, a blower increases the interior pressure within a test chamber only a fraction of 1 percent.

Given this, why then do we talk so much about the blower used in fire attack as *creating* the pressure? The reason: It doesn't take much of a difference in pressure to cause the fire to actively seek a path of less resistance or an area of less pressure. Luckily for us, most of the time this is out a window.

## PROBLEMS WITH PPA

When PPA goes wrong, it's usually attributable to one or two conditions, or their combination. First, mistakes result from a lack of coordination and control

on the fireground, including a lack of department-wide training and education in the use of PPA.

Second, problems may arise from insufficient or no forward exhaust. When products of combustion are emitted under pressure ahead of the attack crews, substantial exhaust is needed. Two to three large windows in a dwelling are generally sufficient exhaust as you begin your attack. As fire seeks the lower pressure on the exterior, fire spread throughout the structure, where pressure is higher, is decreased.

If heavy smoke and/or fire is returning to the attack entrance exhausting above the blower, *do not enter!* In these situations you don't have enough forward exhaust, suggesting rapid interior fire growth or a flashover is a possibility. In this situation, firefighters must create additional exhaust or change tactics. Again, fire moves from an area of high pressure to an area of low pressure, and the larger the exhaust opening, the more products of combustion will exit ahead of advancing crews. This irrefutable gas law does not change just because our fires are on the East Coast or the West Coast or anywhere in between. It's a law as absolute as gravity.

What does this mean to us in the fire service? When we see fire and smoke coming out windows with pressure, the fire has found an area where it wants to go and, generally speaking, all we have to do is to make sure it continues to exit the building where it's already exhausting as we make a rapid interior attack. Oftentimes, this calls for increasing the size of the exhaust opening while we place our firefighters in an area of slightly higher pressure created by the initial-attack fan.

## WHERE VENTING FITS IN

Why, then, would we want to increase or add an additional negative pressure area by opening the roof? This tactic, while proven to be effective at times, should also be thought of as a means of adding to or increasing negative pressure areas within the structure (not outside).

Built-in ventilation elements, such as gable or soffit vents, haven't been shown to increase the negative pressure space into the attic area substantially enough to cause rapid fire spread. *Remember:* Fire and the products of combustion will go to the largest negative area; most of the time, this is through a failed exterior window.

Test after test shows an increase in viability of the structure within seconds after PPA is initiated—as long as windows are used for an exhaust. For victims who cannot self-rescue, this means their chance of survival increases because the lethal products of combustion—the colloid of toxic elements we call heavy or thick smoke—are safely exhausted over the top of the victim. Generally speaking, venting the roof takes longer than deploying an interior hoseline (increasing positive pressure); therefore, interrupting the thermal balance prior to exhausting actually worsens conditions for victims. *Remember:* Without PPE, we often



As fire develops, it moves from areas of high pressure to areas of lower pressure. In the photo above left, we see fire burning within the structure. Right, we see the fire exhaust out the window shortly after PPA is initiated and the fire environment controlled.



A single exhaust fan ensures fire and lethal products of combustion escape to the area of greatest negative pressure. This simple action will greatly assist advancing crews.

# Before You Vent

## Initial considerations for using PPA

For PPA to work as a tactical option, the entire fire department must commit to it. Before your department is ready to use PPA at incidents, you must:

- Ensure first-arriving crews have high-volume positive pressure blowers readily available on all apparatus.
- Establish a protocol or procedure for putting blowers in operation as part of a coordinated attack.
- Thoroughly train and educate all personnel in PPA, including theory, application and precautions.
- Ensure all personnel understand that PPA is a fire-attack option.
- Define when you will use PPA. Consider an incremental approach initially. *Example:* Authorize the use of PPA on single-family dwellings or commercial buildings less than 5,000 square feet, where crews can readily attack from the unburned side of the structure, and/or situations where crews are able to create ample exhaust in the immediate area of the fire in coordination with an interior attack.

## The Power of Negative Thinking

would not survive the conditions our tactics create; we can't expect more from our victims.

### THINK NEGATIVE

All departments should seek fire professionals with proven PPA experience prior to implementation. You need education first, then training. Having done that, at your next fire, identify the largest amount of negative area. Allow the fire to safely rise off the floor level by using windows as exhausts, rather than doors, and attack the fire from a safe area of slightly higher pressure created by your attack fan. A bonus of using this tactic: The area you're attacking from remains relatively clear, so you can see hazards in your interior environment. As the PPA quickly clears the area, the structure is protected without interrupting the thermal balance and forcing the lethal products of combustion onto the floor or bed level, where victims who can no longer rescue themselves are located.

*Remember:* Negative pressure (–) has a much greater (>) impact on fire spread than positive pressure (+). Or as we like to put it: – > +. ☺

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Crews train at a building designed to represent realistic fire behavior at an advanced PPA course.

PHOTO: RAY SCHELBLE

## The Positives of Positive Pressure

PPA benefits to fire operations include:

- Heat and smoke are rapidly cleared from the fire structure early in the operation;
- The chances for victim survival are increased;
- Improved visibility aids firefighters in search and rescue;
- Clean, cool air replaces the toxic interior atmosphere, so victims and firefighters face less exposure to heat and dangerous products of combustion;
- Damage to property from heat and products of combustion is decreased;
- Crews that would normally be assigned to roof ventilation operations are available for search and rescue and fire control;
- Attack lines can be rapidly advanced to the seat of the fire;
- Fire spread is decreased due to cooling and rapid confinement; and
- Post-knockdown ventilation is controllable by using simple measures such as opening or closing doors or turning off the blower.

## Sample PPA SOP

Following is an abbreviated version of an SOP for PPA. For the complete version, go to [www.positivepressureattack.com](http://www.positivepressureattack.com).

### Basic PPA Procedures

PPA can be broken down into four steps, with steps 1 and 2 happening at generally the same time.

- 1 Identify the ventilation opening and position the blower.** The blower should be positioned at the entrance crews will be using to enter for fire attack. For maximum effectiveness, a blower should be positioned 6–10 feet away from the ventilation opening. Start the blower as soon as possible, but don't direct the air stream into the ventilation opening until the attack crew is ready to enter and the firefighter assigned to create the exhaust opening and survey the building gives the OK.
- 2 Survey the building exterior and create or improve an exhaust opening.** Make or improve an exhaust at a location near the fire. This opening should be substantial enough to exhaust the products of combustion, generally by opening 2–3 windows. When there's already an obvious exhaust opening where fire and smoke are showing, use it and increase its size. When there's no obvious exhaust opening in the

involved portion of the building, make one according to your best judgment and experience. If there's no substantial exhaust from the first attempt, move to a window in the same area but a different room and attempt to create another exhaust opening.

- 3 Begin pressurization and fire attack.** Crews must not enter until the blower has pressurized the structure for a short time or until conditions improve and the interior environment starts to clear. The blower must always be "at the backs" of the initial-attack crew. Use the upper area of the ventilation opening (doorway) as an indicator of the effectiveness of pressurization and interior fire activity. Heavy smoke or fire exhausting from the top of the opening above the pressure cone could be an indication that the exhaust openings are inadequate and may result in dangerous fire behavior if allowed to continue.
- 4 Make sure the fire is out.** Overhaul aggressively! As early as possible in a fire, open up spaces in walls, ceilings and other areas that have been impinged on by the fire. Before leaving the fire scene, turn off the blower for 10 to 15 minutes, then thoroughly reexamine all involved areas for hidden fire.

**Note:** The complete version of this SOP also lists considerations for specific fire situations.

### Safety Precautions

- Department members must be properly trained in PPA, with strong command and control of the fire being of prime importance.
- All first-arriving apparatus must be equipped with blowers.
- Command should only order PPA before firefighters enter the structure. Pressurization should never be initiated after fire personnel are inside a structure.
- The area near an exhaust opening can be hazardous. Do not begin PPA when a victim is awaiting rescue at a potential exhaust opening. Do not use the exhaust opening as an entrance. Keep fire crews and the public away from the exhaust opening. If necessary, take steps to protect exposures in the proximity of the exhaust opening.
- Never use a blower where backdraft conditions may be present, or in the presence of combustible dust or flammable vapors.
- Do not attempt PPA without securing an exhaust opening. If fire or heavy smoke is exhausting above the blower at the ventilation point, do not enter until enough forward exhaust can be obtained.