Pressurized Fire Attack Precautions: THE "BIG THREEE"

BY KRISS GARCIA AND REINHARD KAUFFMANN

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Pressurized Fire Attack Precautions:

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Educational Objectives

On completion of this course, students will

1. Understand the difference between positive-pressure attack (PPA) and positive-pressure ventilation (PPV).
2. Know the conditions in which fans should not be used.
3. Know when the Diagnostic Barometer of Interior Conditions indicates that the fire situation is conducive to PPA.
4. Know to what the three "E"s in the "Big Threee" refer.

BY KRISS GARCIA
AND REINHARD KAUFFMANN

OVER THE PAST 20 YEARS, THE USE OF FANS on the fireground has steadily increased. We don't believe there is another tactic that provokes such an emotional reaction for firefighters. Some swear by the tactic and think that any other option is irresponsible. Ohers maintain just as vehemently that the use of this tactic will spell death and disaster. The fact is, like most polarizing topics, the truth is somewhere in the middle.

POSITIVE-PRESSURE ATTACK (PPA)

Using fans to bring the fire under control—called positive-pressure attack (PPA)—is effective and safe when employed correctly in structures that lend themselves to such a tactic. Many evaluations, including those by the National Institute of Standards and Technology (NIST), have confirmed the benefits of PPA when used correctly. It is also true that using fans on structure fires that don't lend themselves to PPA has the potential to contribute to on-scene hazards often associated with extreme fire behavior. To make this determination, fire companies that use this tactic must learn how fire behaves in an enhanced pressurized atmosphere. It is not enough to train firefighters in how to use a blower. They must be taught when, where, and how to deploy PPA.

PPA works so well and improves the fire environment so rapidly that even if it is not done absolutely by the book, fire companies without proper education and

(1) Command and control are necessary when using positive-pressure attack. (Photos by Kriss Garcia unless otherwise noted.)

training will get away with using it most of the time. It is when conditions are borderline or when someone who does not understand PPA intervenes inappropriately during its use that fire conditions may worsen and you may put your own members, not to mention the occupants, in peril.

No other fire tactic that is so prominently used on such a large percentage of fires by an ever-increasing number of departments has such a limited amount of empirical and practical training information available. When you look at some of the more prominent basic fire training printed resources, you see thousands of words on ventilation, hundreds of words devoted to the use of fans after the fire has been controlled (positive-pressure ventilation

or PPV), but no words that describe PPA. If fire training agencies and publishers are not going to take on the responsibility of educating the American fire service, the responsibility, if not duty, for this rests on the shoulders of the companies that make and distribute fans for the fire service.

Training agencies and publishers should not sit on the fence and let the value and use of this tactic be fought out in the streets. It is time to have one of these leaders and respected fire training organizations become the change agents and support data generated by NIST, Underwriters Laboratories, and recognized experts in the field to develop educational material aimed at making this tactic's use safe, universal, and available. This effort will then facilitate a factual, not emotional, evaluation of the use of high-powered fans on the fireground, which will lead to the development of accepted operating procedures.

This limited amount of educational material and training, along with this tactic's prolific use, makes it imperative that we, at the very least, understand the major precautions or constraints associated with its use. The less control you have over the structure, the more you have to heed these precautions prior to putting fans in operation, especially before you place firefighters in harm's way.

SETTING THE STAGE

When departments work to implement PPA, firefighters must have a basic understanding of how pressurization impacts the fire's behavior. The fire itself creates the majority of the pressure we use to make PPA work so effectively. The heated atmosphere increases the pressure inside the structure much more than any fan could.

Tests conducted by the Air Movement Control Association in its work to update ANSI/AMCA Standard 240-06 determined that, under scientifically controlled conditions, high-powered fans used in PPA slightly increased the pressure inside the evaluated area less than one-tenth of a percent. Therefore, it is important to understand that the fire itself, not the fan, creates most of the pressure in a fire. When you apply water to the fire in this enclosed space, you nearly double the interior pressure again, since the water expands when steam is created. It is this increase in pressure that interrupts the thermal balance and forces the immediately lethal environment throughout the fire area, including the floor where victims may be.

To understand why PPA is so effective, you need to establish a base pressure you can use as a reference point. Let's assign the outside, or the atmospheric pressure, a value of zero. From this reference point, let's introduce a fire into the structure. Let's assign the area where the fire is located a value of 10. We will then assign this same area after water has been applied during the attack a value of 20. On the surface, these values may appear to be oversimplified; however, under real fire evaluations as measured by fire modeling experts, the actual pressures are very close to these figures.

Glossary

Light smoke: smoke you can see through.
Heavy smoke: smoke that has no opacity.
Positive-pressure attack (PPA): the use of fans to assist in controlling the fire.
Positive-pressure ventilation (PPV): the use of fans after the fire has been controlled.

Fire will always move from an area of high pressure to an area of lower pressure. Gas laws, as well as other irrefutable laws of physics, confirm this movement. Essentially, the objective of PPA is to safely exhaust to the outside, away from the attack crews, the high pressure created by the fire and your attack. You facilitate this movement from the areas of high pressure to the lower atmospheric pressure by creating ample exhaust near the fire area. While you do this, you place gasoline-powered fans in operation at the attack entrance. This procedure places firefighters in an area that has a pressure value slightly higher than the atmospheric pressure of zero. We give this attack area a value of five. It is not necessary to overcome the pressure the fire is creating. It is only necessary to overcome the lower atmospheric pressure so that the heated products of combustion can safely be controlled and allowed to move to the exterior of the building, ahead of and away from the fire attack crew.

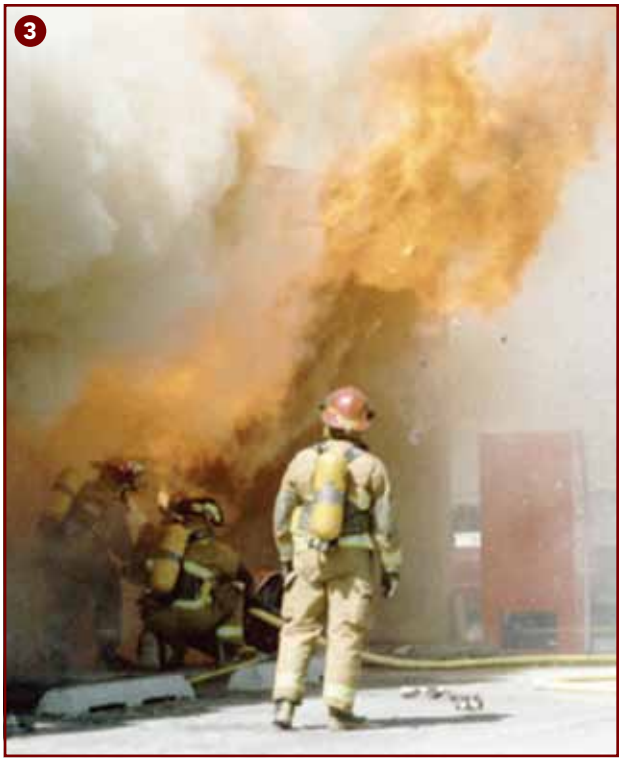
Think for a moment about attack crews that do not use fans to place themselves in an area that has a higher pressure than zero. Essentially, their attack entrance is creating an additional exhaust toward which the fire will move as it seeks lower pressure. Now, however, it is moving toward the advancing crews. The problem is that this area is where the initial attack crews are now entering the structure, and the fire loading of today's combustibles makes this environment extremely hazardous. For this reason, discipline when entering the door is absolutely necessary.

What this means to the initial entry crew members is that they should not open the attack entrance until they are ready to make a rapid advance to the seat of the fire. This entails the following: The crew members are on air, hoselines are charged, and fans are in place and running before the attack entrance is opened. You also have to make sure that the fire has ample exhaust so that the interior high pressure will move away from your crew members as they advance. Working in this fashion will ensure that the fire will continue to exhaust to the lower atmospheric pressure away from firefighters.

THE "BIG THREEE"

A review of several National Institute for Occupational Safety and Health (NIOSH) injury and fatality incidents, as well as other full-scale model evaluations, revealed that at every incident where the fans worsened the situation,

(2) Be cautious when exhausting under a heat sink, such as a porch, which may ignite fire gases.



(3) The flame above the ventilation point indicates there is insufficient exhaust to use the positive-pressure attack. [Photo by Gina Bell, Salt Lake City (UT) Fire Department.]

three common factors were present. We refer to these as the "Big Threee": Exhaust, Entry, and Execution.

• **Exhaust.** The first element prevalent in structure fires where the use of fans was attributed to aggressive fire growth was too little or no exhaust. To use fans in PPA, the dwelling must be able to easily and rapidly exhaust the energy the fire is creating. Referencing the base pressures noted above, you need to allow the pressure the fire has created (10) to easily go the lower atmospheric pressure (zero). Generally speaking, the initial size of the exhaust, at a minimum, should be two times the size of the ventilation point or the attack entrance where the fan is positioned. The need for ample exhaust has not been given the attention it deserves. The exhaust is as important as, if not more important than, the fan.

Some will say that if you open too many exhausts, you won't be able to remove all the nuisance smoke from the building after the fire is out. We cannot justify making the immediately dangerous to life and health (IDLH) portion of the fire attack less effective and more dangerous just so we can remove smoke from the structure after the fire has been controlled. Think about victims trapped on the floor of a building that is on fire. How fast do they want the products of combustion removed? Correct—as fast as possible. For this reason, you need an exhaust area large enough to remove the energy the fire is creating.

To address the issue of what constitutes adequate exhaust, we have developed a new concept—the Diagnostic Barometer of Interior Conditions. We have verified this concept with dozens of documented accounts of actual fires and full-scale evaluations. As crews are setting up the initial operation, they should direct the cone of air the fan is creating toward the ventilation point and position it so it does not cover the entire doorway but leaves a small negative pressure space at the top of this attack entrance. This space should be approximately 12 to 16 inches from the top of the doorway. To facilitate this and get the highest number of exiting cubic feet per minute, position the fan four to six feet from the attack entrance and tip it back at approximately a 15° angle. This modification of conventional pressurization tactics provides a Diagnostic Barometer of Interior Conditions crews can observe prior to making entry.

In fires where fans are used and undesired aggressive fire growth occurs, we have seen this diagnostic space exhausting flame or heavy smoke that is not clearing. This heavy smoke or flame is often a precursor to an extreme fire behavior event. If the fire has adequate exhaust ahead of initial attack crews, this same space is clear or has an ever-clearing light smoke condition.

Crews will know almost instantly after a fan is placed in operation with this diagnostic space at the top of the attack entrance used whether or not the fire and building are appropriate for the use of PPA. If heavy smoke or fire is exhausting out the attack entrance above the pressure cone, the fire does not lend itself to PPA. You need to modify one of two things before entering the structure. First, attempt to make additional exhaust. Second, when large fans are used for PPA on very small structures, you may have to turn down the throttle.

How long attack crews should wait before entering the structure is always a point of discussion and controversy. The answer is fairly simple: It depends. It depends on whether or not PPA is working. First, check your diagnostic space above the cone of air. If it is clearing and heavy smoke or flame is not present, you have enough exhaust

(4) Ample exhaust is necessary to remove the energy created by the fire. (5) Realistic department-sanctioned training, such as this training for the Detroit (MI) Fire Department, is necessary so that all department members are well-versed in the safe use of positive-pressure attack.

to safely use PPA. Once this is confirmed and conditions just inside the attack entrance start to improve, it is safe to enter the structure. Sometimes this improvement will be immediate; other times, you may have to wait 30 to 60 seconds until conditions improve to the point that crews can see where they are operating. Operating in this manner takes crews out of an obscured environment of several hundred degrees and places them in an area where the interior temperature is less than 100°F and one in which they can see.

Without an adequate exhaust, you are in effect creating a convection oven. Most of us appreciate how much faster a convection oven cooks than a regular radiant heat oven. The same elements that make these ovens cook faster are generally the same elements in effect created if fans are used during a fire attack when there is inadequate exhaust. If there is not enough exhaust, do not use PPA.

• **Entry.** The next situation that is prevalent when PPA or PPV goes bad is placing firefighters inside the structure and having fans in operation behind them without verifiable and absolute fire control. Without absolute fire control, placing fans in these situations has too many dynamic variables to make their use safe and beneficial.

A study we completed by polling students in the classroom setting provided insight into the survivability of a fire victim in the fire area if water is used prior to adequate ventilation. Eight thousand firefighters confirm that a victim in this type of environment has a less than two percent chance of survival.

With this low probability of life benefit, the risk of placing fans after crews have already entered, and prior to fire control, does not lend itself to a safe and effective fire attack. If crews have entered the structure and they cannot verify fire control, or if they have not initiated aggressive overhaul of nonfire stopped voids, they should be withdrawn to the exterior and fans should be placed using the Diagnostic Barometer of Interior Conditions to determine if the conditions are favorable for their use. Without the ability to see and, in effect, clear the area of hazards from the point of entrance into the building to where firefighters are located places them in harm's way with little benefit.

If crews have entered deep into a structure in a high-heat/low-visibility environment, they have not been able to adequately determine that the area they have moved through is clear of hazards, such as advanced fire conditions above or below them. They have also not been able to observe the areas they have passed through for potential structural dangers such as compromised floors or roof assemblies or areas that have already failed and are unsafe for firefighters to operate on or under. Therefore, knowing there is essentially no civilian life benefit to be gained by placing the fan after the thermal balance has been interrupted and the increased pressure within the structure has forced the IDLH environment to all areas within the dwelling, you are not further compromising life or property if you remove firefighters to the exterior before placing fans in operation.

NIST studies confirm that areas near the fire that are not survivable are not survivable prior to ventilation with fans. They also confirm that other survivable areas remain survivable and conditions dramatically improve with regard to tenability after PPA is started, as long as there is adequate exhaust. Therefore, if victims are dead before PPA, they are dead; if they are not, PPA increases their chance of survival not only by improving the atmosphere but also by making the fire attack much quicker so that you can safely get to the victim sooner. To visualize this, think of how long it takes you to walk from the front door of a dwelling to the back door under normal conditions. Now, place yourself in a high-heat/zero-visibility environment, and see how long it takes you to make your way through the dwelling.

• **Execution.** Inappropriate execution is the third

(6) Do not use fans at incidents involving flammable vapors.

element present when fires go bad when fans are used. The two main areas of execution where detrimental consequences result, and often cause negative issues to occur, are departmental (support) and fireground (command/control) execution.

Regarding departmental execution, it is irresponsible for departments to provide fans without providing education, training, and operational guidelines pertaining to their use. Not providing this support is a failure of departmental execution.

With the exception of water, there is nothing on your apparatus that will more dramatically impact the fire environment than a fan. Since this is the case, departments embracing PPA or PPV have to be completely committed to the use of fans.

Departments must provide all members with competent education and training. All members on the fireground need to know how to use fans appropriately, know how to support a pressurized attack, and understand the nuances of this tactic and fire behavior before PPA or PPV is implemented. Administrative support through the development and adoption of standard operating guidelines that support the department's delivery model, as well as appropriate education and training, is necessary. If there is a lack of departmental execution, all other facets of this type of attack may eventually spell disaster.

Execution on the fireground (operational execution) that is not well organized or that lacks command and control is another factor that is apparent when fire conditions deteriorate when using fans. When all members on-scene are not supporting the directed tactical operation, improper use of the fan can spell disaster. Everyone has to have a base knowledge of PPA and PPV obtained through department-sanctioned education and training. All members must be disciplined enough to work within the incident management system of a competent supervisor.

First, incident commanders (ICs) have to establish and communicate appropriate objectives. Once the IC has communicated the objectives and everyone on the fireground understands them, he cannot tolerate freelancing. When crews on the fireground are not supporting the tactical objectives, conditions can become very hazardous for members in the IDLH area. Modification of any tactical operations has to be in coordination with a strong incident management system.

SITUATIONS THAT PROHIBIT THE USE OF PPA OR PPV

As crews consider taking control of the building on fire, the following are situations when a fan absolutely should not be used for PPA or PPV.

• **The presence of backdraft conditions.** Use PPA only during the free-burning phase of fire attack. The good news is that the majority of fires have ample oxygen and are in the free-burn stage. If the fire has 21 percent oxygen and you supply more 21 percent oxygen, the area will still have 21 percent oxygen. On the other hand, if the fire has used enough oxygen so that free burning cannot take place and you supply the missing ingredient, you will be facilitating the backdraft. If the building is exhibiting signs of a backdraft, the space in question is not survivable for any victim inside, nor does the property hold any value. With so little to be gained, consider this building a potential explosive environment, and protect yourself from these situations with time, distance, and shielding. In these situations, revert to conventional backdraft strategies and tactics of exhausting high from a safe position.

• **The volatile environment.** If the environment holds combustible dust or potentially explosive vapors, unseen ignition sources will spell disaster. It is hard, if not impossible, to account for all possible ignition sources; therefore, do not use PPA in these situations. This is the case

when in combustible dust environments such as grain elevators or silos. In these situations, limit any increased turbulence of the interior environment. In the case of potentially explosive combustible or flammable vapors, be extremely cautious so that you do not move potentially hazardous atmospheres to an area where they may find an ignition source and explode.

• **A victim is standing at a potential exhaust.** In this situation, your first priority is to remove the victim. This limitation applies only when the victim is standing at a window awaiting rescue. If you start PPA and this window is an exhaust, it will have serious consequences for this victim. Studies that we and NIST have conducted in Great Britain show that tenability in the survivable area, which is 24 inches from the floor, always improves when appropriate PPA is used. Therefore, regardless of where a victim on the floor is located, conditions and tenability improve dramatically when PPA is used appropriately.

• **Leeward fire attack in high winds.** No fan made can overcome Mother Nature. If Mother Nature is dumping consistent wind into your atmospheric area, you will be fighting a losing battle if you try to turn it around. The good news is that if conditions are such that wind is going to be a negative factor, the fire most likely will already be progressing from the windward side of the structure to the leeward side. We would not fight a fire from the leeward side with or without a pressurized attack in place, because we know that it would be a losing battle. If operating from the leeward side of a structure and the windows on the windward side are lost, this situation will place firefighters in the very precarious situation of being on the wrong side of a wind-driven fire. Evaluations of the wind-driven fire show that winds less than 20 miles per hour (mph) do not present enough of an element so that they cannot be overcome with a proper PPA. Fight fires with winds greater than 20 mph from the windward side of the dwelling or one of the other sides not directly impinged by the wind.

Another execution factor to consider when using PPA is that when operating on a multistory building, you need ample exhaust on the fire floor. For example, if you are operating in a two-story house and the fire is on the second floor, make ample exhausts on the second floor. You may have to open a single exhaust on the first floor to make the environment tenable as you move through the structure, but make sure the fire has ample opportunity to exhaust from the windows on the second floor. If you open more exhausts on the first floor than on the fire floor above, you risk bringing lethal products of combustion to the lower floor, where firefighters are operating as they move to the fire. If the building has an open atrium that covers several floors, make the initial exhaust at a point above the floor where firefighters are entering, to allow exhausting to occur above them.

Although noise is not a primary factor that stops departments from using fans, some say the noise is too distracting to allow an effective fire attack. After a couple of decades of experience in using PPA, we found that not only is noise not a detriment, but it is a positive. First, the noise level for the interior divisions and groups operating is minimal once crews get inside the building. Second, if it is too noisy for the IC, he is too close and should be positioned away from the fan so he can observe the entire incident, not only the attack crews. Having interior fans operating so that the IC can hear them while supervising an incident is assuring, because he then knows that if the environment is clear enough to allow the fans to operate, it is clear enough for his crews to safely operate.

Another positive of the noise is that it ensures those individuals on the fireground that ventilation is in place and operating. Additionally, firefighters who become lost or disoriented while inside the building may find the noise beneficial. If they can make their way to the fan, they are in effect making their way to an area where they can survive. If the fan can survive and run, the environment is such that firefighters can also survive.

• • •

PPA and PPV work so well that the majority of the time they will work even if they are implemented incorrectly. Most of the time, using a pressurized attack will be beneficial. If departments follow and observe the "Big Threee" during all fires where fans are used, even when operating in marginal conditions, crews will not be in harm's way and they will conduct a safe and effective fireground operation. ●

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● **REINHARD KAUFFMANN** retired as a battalion chief from the Salt Lake City (UT) Fire Department, where he has served for more than 30 years. During his career, he has held the positions of paramedic, interim fire chief, and airport fire chief. He has a bachelor's degree in microbiology. His interest in positive pressure for firefighting began in 1989. He is also the coauthor, with Battalion Chief Kriss Garcia, of *Positive Pressure Attack for Ventilation & Firefighting* (Fire Engineering, 2006) and numerous magazine articles on this subject.

Notes

Pressurized Fire Attack Precautions: THE "BIG THREEE"

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COURSE EXAMINATION

1. In the article "BIG THREEE," which of the following is not a listed precaution?
   a. Execution.
   b. Exhaust.
   c. Exception.
   d. Entry.

2. Which of the following defines positive-pressure attack (PPA)?
   a. The use of fans to improve the immediately dangerous to life and health (IDLH) environment after crews have entered the structure.
   b. The use of fans to ventilate a building after the fire has been controlled.
   c. The use of fans to assist in fire control.
   d. The tactics assigned to truck companies in support of the interior division.

3. Once correct PPA is initiated, what happens to victims who are on the floor in the fire or the room from which the fire is exhausting?
   a. They will experience an untenable environment.
   b. Conditions will improve regardless of where they are located in relationship to the fire or exhaust.
   c. High temperatures will be forced to the ground.
   d. No change in the environment is seen at the floor.

4. Which of the following defines positive-pressure ventilation (PPV)?
   a. The use of fans to assist in fire control.
   b. The use of fans to ventilate the building after the fire has been controlled.
   c. The tactic assigned to truck companies in support of the interior division.
   d. The process of using fans anytime during or after the fire attack.

5. Which ANSI standard is applicable to the Laboratory Methods of Testing Positive Pressure Ventilators?
   a. 240-06.
   b. 1500.
   c. 1403.
   d. 240-09.

6. What is the chance of survival for a victim who is in the fire area after water is introduced into the environment prior to adequate ventilation?
   a. 30%.
   b. 50%.
   c. 10%.
   d. 2%.

7. PPA should not be deployed in all but which of the following conditions?
   a. When backdraft conditions are present.
   b. When flammable vapors are present.
   c. When combustible dust is in the structure.
   d. If you do not know if a victim in the structure.

8. Which of the following main areas of execution compromise the efficacy of PPA?
   a. Introducing carbon monoxide into the structure.
   b. Departmental.
   c. Operational.
   d. Both B and C are correct.

9. When trying to understand how PPA works, what is the relative pressure given to the atmospheric pressure?
   a. 3.142.
   b. 10.
   c. 0.
   d. 5.

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10. If the attack crews do not use a fan, how can they expect the fire to behave?

a. Fire will rapidly exhaust away from the interior division.
b. Fire will move toward the attack entrance.
c. Hoselines will push fire throughout voids in the balloon construction.
d. The open door will have no appreciable effect on the fire's behavior.

11. What is the basic premise of disciplined door entry techniques?

a. To force the door open as early as possible to make sure you can enter the structure.
b. To be completely prepared to enter the structure once the door is opened.
c. To turn the fan into the structure as early as possible and then make an exhaust.
d. To aggressively back up the initial attack crew from the door.

12. If crews have entered the building prior to fans being placed in operation, what should they do?

a. Continue to aggressively fight the fire while fans are put in operation.
b. Work very hard to clear voids of hidden fire.
c. Exit the building and then reenter, ensuring that all areas are clear of hazards.
d. Do nothing different; the fans will rapidly improve interior conditions.

13. Under what conditions is the interior of the building turned into a convection oven?

a. When fans are turned into the building prior to fire control.
b. Once vertical ventilation has taken place.
c. If fans are used during the fire attack and there is not enough exhaust.
d. When fans are used after fire control when firefighters reenter the building.

14. How long should the initial attack crew wait before making entry?

a. A minimum of 60 seconds to make sure conditions are safe.
b. 30 to 60 seconds.
c. Crews should enter immediately; conditions will improve once they are in the building.
d. Until conditions improve and the Diagnostic Barometer of Interior Conditions above the blower is clearing of smoke and fire.

15. What is the most effective placement of a fan in relation to the ventilation point during fire attack?

a. Six to 10 feet allow more exhausting cubic feet.
b. As close as possible to allow more cubic feet per minute to enter the building and to make the Diagnostic Barometer of Interior Conditions above the cone larger.
c. Four to six feet and tilted at a 15° angle.
d. It doesn't matter; new fans are so powerful that it doesn't make much of a difference in the fire attack or the exhaust capabilities.

16. Generally speaking, how large should the exhaust be?

a. No more than 1½ the size of the ventilation point or attack entrance.
b. A 1-1 ratio should be strictly adhered to.
c. You cannot take out too many exhausts.
d. Two to three times the size of the ventilation point or attack entrance.

17. In a multistory building, "adequate exhaust" should be made where?

a. Above the fire floor to allow convection to assist with ventilation.
b. At the main level to clear the area firefighters are entering.
c. On the floor or floors that are involved with the most fire.
d. It does not matter, as fans are so powerful that the lethal products of combustion will exhaust regardless.

18. The negative space above the cone of air at the attack entrance is referred to as what?

a. A mistake; the cone of air should cover the entire door during PPA.
b. The attack exhaust.
c. The Diagnostic Barometer of Interior Conditions space.
d. The primary exhaust.

19. Winds of what speed should be considered too high for a blower to overcome in attempting a leeward side fire attack?

a. Any consistent wind speed greater than 20 mph.
b. It doesn't matter; fans will overcome most winds because of the pressure gradient.
c. Do not use PPA if there is any current or predicted wind.
d. Any consistent wind greater than 10 mph.

20. If at all possible, the attack should start on which side of the building?

a. Front.
b. Under a porch.
c. Leeward.
d. Windward.

Continuing Education

Pressurized Fire Attack Precautions: THE "BIG THREEE"

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2.	❑ A	❑ B	❑ C	❑ D	12.	❑ A	❑ B	❑ C	❑ D
3.	❑ A	❑ B	❑ C	❑ D	13.	❑ A	❑ B	❑ C	❑ D
4.	❑ A	❑ B	❑ C	❑ D	14.	❑ A	❑ B	❑ C	❑ D
5.	❑ A	❑ B	❑ C	❑ D	15.	❑ A	❑ B	❑ C	❑ D
6.	❑ A	❑ B	❑ C	❑ D	16.	❑ A	❑ B	❑ C	❑ D
7.	❑ A	❑ B	❑ C	❑ D	17.	❑ A	❑ B	❑ C	❑ D
8.	❑ A	❑ B	❑ C	❑ D	18.	❑ A	❑ B	❑ C	❑ D
9.	❑ A	❑ B	❑ C	❑ D	19.	❑ A	❑ B	❑ C	❑ D
10.	❑ A	❑ B	❑ C	❑ D	20.	❑ A	❑ B	❑ C	❑ D

COURSE EVALUATION

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 1.

1. To what extent were the course objectives accomplished overall?	5	4	3	2	1
2. Please rate your personal mastery of the course objectives.	5	4	3	2	1
3. How would you rate the objectives and educational methods?	5	4	3	2	1
4. How do you rate the author's grasp of the topic?	5	4	3	2	1
5. Please rate the instructor's effectiveness.	5	4	3	2	1
6. Was the overall administration of the course effective?	5	4	3	2	1
7. Do you feel that the references were adequate?		Yes		No	
8. Would you participate in a similar program on a different topic?		Yes		No	

9. If any of the continuing education questions were unclear or ambiguous, please list them.

10. Was there any subject matter you found confusing? Please describe.

11. What additional continuing education topics would you like to see?

PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.

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COURSE EVALUATION and PARTICIPANT FEEDBACK
We encourage participant feedback pertaining to all courses. Please be sure to complete the survey included with the course. Please e-mail all questions to: Pete Prochilo, peterp@pennwell.com.

INSTRUCTIONS
All questions should have only one answer. Grading of this examination is done manually. Participants will receive confirmation of passing by receipt of a verification form.

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Completing a single continuing education course does not provide enough information to give the participant the feeling that s/he is an expert in the field related to the course topic. It is a combination of many educational courses and clinical experience that allows the participant to develop skills and expertise.

COURSE CREDITS/COST
All participants scoring at least 70% on the examination will receive a verification form verifying 4 CE credits. Participants are urged to contact their state or local authority for continuing education requirements.

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