ARE FOG NOZZLES NOT THE ANSWER?
By John D. Wiseman, Jr.

Andrew Fredericks in his two part article, published in FIRE ENGINEERING in February-March 2000 entitled “Little Drops of Water: 50 years Later”, concludes with the following statement.

> *“Fifty years after Layman’s “Little Drops of Water”, it’s time to admit that fog nozzles are not the answer.”*

The phrase “Little Drops of Water” is the title of a speech delivered to the Fire Department Instructors Conference (FDIC) at its meeting in Memphis, TN, in January, 1950. Chief Lloyd Layman presented the results of research that he conducted at the U.S. Coast Guard Fire Fighting School at Baltimore, MD, during World War II. He experimented with Navy type fog nozzles used to extinguish fuel oil fires on board ships. In this research, he devised a new method of fire attack, that he called the “indirect method of attack”. Chief Layman also explained how he later adapted these fog nozzles and the indirect method to fighting Class A structure fires in his hometown of Parkersburg, W.V.

This speech, more than any other single event, initiated the change over from the use of solid stream nozzles to the use of fog nozzles, in the United States at least. So Fredericks title is certainly appropriate since it highlights the beginning of a new era in fighting fires. Chief Layman made the following comment about this new era.

> *“The development of equipment that enables fire-fighting personnel to apply water in the form of finely divided particles was the most progressive advance in equipment since the advent of the power-driven pumping unit. This development has provided the basic weapon that is destined to revolutionize the art of fire fighting. Little, if any, progress can be made toward improving the tactical employment of water in fire-fighting operations until the fire service recognizes the gross inefficiency of the solid stream form of application.” (FIRE FIGHITNG TACTICS, 1953, NFPA, p. 11)*

Chief Layman added that the solid stream nozzle “will continue to have a limited degree of usefulness in fire-fighting operations, but it is destined to become the secondary form of application”. (ibid., p. 12)

Layman’s prediction certainly has come true, and it is still true 50 years later. So is it time to end this revolution in the art of fire fighting and go back to the “gross inefficiency” of the solid stream form of application?

Fredericks thinks so, and he bases his argument upon supposed changes in the fire environment that have happened within the past 50 years. These changes must be radical indeed to nullify the progressive advance obtained by using “little drops of water”, and at the same time somehow overcome the “gross inefficiency” of solid stream nozzles. Are we suddenly confronted with a strange new world of fire fighting in which what was grossly inefficient now becomes more efficient? That would be a strange new world indeed.

So let’s see how Fredericks argument proceeds. Part One outlines the history of the development of the use of fog nozzles including Chief Layman’s new indirect method of attack. The role of the Exploratory Committee on the Application of Water is briefly discussed. Then Fredericks continues with a presentation of the research done at Iowa State University beginning in 1951 by Bill Nelson and Keith Royer. Included is a statement of the Iowa Rate-of-Flow Formula plus the combination attack.

Unfortunately, Part One is marred by numerous errors in describing the work of Layman, Nelson and Royer. Apparently Fredericks has read all the articles and books published by these three men. At least they are referenced., so that is not the source of the errors. Perhaps the errors occur because Fredericks does not really understand the theory and practice of the use of fog nozzles.

One error, for example, occurs when Fredericks states that the "fog nozzle must be held in a fixed position". It is puzzling how such an error could occur. Chief Layman clearly did not advocate this. (See p. 48, ATTACKING AND EXTINGUISHING INTERIOR FIRES.) In fact Layman stated just the opposite. He advocated a high degree of dispersion within the upper stratum. He wanted the high velocity cone elevated upward at a gradual angle to avoid the stream hitting the ceiling before dispersing. He even advocated a slight, brisk, and <u>continuous</u> manipulation of the nozzle.

One of the fundamental principles of a fog attack is that a wide dispersion of the "little drops of water" is required for an effective fog attack. Apparently Fredericks does not understand this principle.

Second, Fredericks contends that a major change in the fire environment is the difference in the turnout clothing and the lack of breathing equipment in the 50s and 60s. These differences, he claims, restricted fire fighting largely to exterior attacks compared to the interior attacks more commonly used today. Fredericks asserts that turnout clothing "lacked the thermal protective qualities of modern fabrics", and that "many fire departments had few, if any, self-contained breathing masks available."

While it is undoubtedly true that turnout clothing protects better today, the turnout clothing in use then did not prevent firefighters from making an interior attack. In fact I can personally testify that in the 60s I have made an interior attack on a number of occasions, and I did not suffer any harm from the turnout coat that I was wearing. The main difference was that we wore rubber boots that pulled up to our hips. Admittedly this was not nearly as good protection as the turnout pants worn today.

Likewise, we had air packs, the same Scott air packs that are in use today. To be sure we used them to make interior initial attacks. We had four packs per pumper (an ISO requirement then) and so did our neighboring fire departments, and as far as I know, so did all the fire departments in the entire state. There was a difference. Our air packs were carried in suitcases stored in a compartment on our pumper.

I asked Keith Royer about this sometime ago. After a moment of reflection, he said: "Come to think of it, we did an awful lot of interior fire fighting." So there was no essential difference in strategy or tactics between now and 50 years ago. The combination attack and the indirect attack can be used as an interior attack or an exterior attack with equal effectiveness. Here again Fredericks has made assertions about fire fighting in the 50s and 60s without any real knowledge of what took place then. Whether few, or many, fire departments lacked air masks or adequate turnout clothing is irrelevant. The essential point is that the research done by Layman, Royer, and Nelson did involve the use of air masks and interior fire fighting.

One final note. The videos produced by Royer and Nelson could not have been done if an interior attack were made. It would not have been possible to do so inside a structure with all the smoke and lack of lighting.

In previous writings, Fredericks has claimed that neither Layman nor Royer and Nelson, in any of their writings, specifically addressed the issue of the impact of steam on trapped occupants. After reading Layman's ATTACKING AND EXTINGUISHING INTERIOR FIRES, Fredericks discovered that Layman did indeed discuss this issue. (See p 148). Layman said that he had been asked frequently two questions. One was: "What will be the effect of steam or fog on persons trapped in the structure?" Layman answered that "we can only state that we have never heard of any adverse effects." Layman continued:

> *"Contrariwise, the much more rapid flame suppression with indirect application makes it possible to reach endangered persons more quickly so as to be able to remove them to safety and render aid as necessary."*

Amazingly enough, Fredericks claims that "this statement" does not specifically address the impact of steam exposure on trapped occupants. Once you are confronted with the truth, I suppose that it is hard to admit that you are wrong. I think that any reasonable person would agree that both of Layman's statements specifically address the issue in question. In fact how could you make a stronger statement. Layman said that he had <u>never</u> heard of an adverse impact. What more do you want?

Fredericks continues to claim that insofar as Royer and Nelson's writings are concerned, that there is no mention of the impact of steam on trapped occupants. Even though Fredericks cites Bill Nelson's book, QUALITATIVE FIRE BEHAVIOR, apparently he had not read all of it. On p. 109 is a section whose title appears in red and in caps

EFFECT OF EXPANDING STEAM

In this section Nelson specifically addresses the issue of people trapped in the building. I will not quote the two paragraphs in this section, only the conclusion.

> *"In other words, immediate application of proper rates of flow of water can help occupants trapped in the building rather than endanger them."*

Here we have a statement equivalent to Layman's "never any adverse impact." If Fredericks is looking for an issue to force the abandonment of fog nozzles, he won't find it here. Both Layman and Nelson state that fog nozzles are far superior in their ability to handle the top priority for any fire department.

Fredericks fears the effect of steam upon trapped occupants because I think that he does not understand one critical scientific fact about fighting fires. This fact is what is commonly called the Latent Heat of Vaporization of Water. This is not a good name because the phrase "Latent Heat" indicates that heat is a substance of which there are two types: (1) sensible heat that we can feel; and (2) latent heat that we cannot feel. Heat is not a substance, so there cannot be two kinds of something that does not exist. The correct scientific name is "The Enthalpy of Vaporization of Water."

What we are talking about is a simple fact (no matter what name is used). When liquid water undergoes a physical change at 212°F from liquid water to a gas (steam), this process absorbs 941 btus/pound of water. This amount of heat must be retained by the steam to remain a gas. Now we come to the critical fact about the vaporization of water. This process, this change of state, does not increase the temperature of the steam above 212°F. I don't believe that Fredericks realizes the extreme importance of this fact. In other words, if the right amount of water is applied to a fire, then this water will absorb all the excessive heat being produced by the fire, and the temperature of the steam remains at 212°F. It is not superheated\

To be sure this saturated steam at 212°F is dangerous enough to fire fighters. However, as Bill Nelson states on page 109 in the section on EFFECT OF EXPANDING STEAM

> *However, if proper size lines are used and handled in the proper manner, the products of combustion and steam forced into remote areas will be cooler than those originally being forced there by the fire."*

This leads to Nelson's conclusion that was previously quoted. It should be obvious to anyone that the use of fog nozzles rests upon a solid scientific foundation.

There is one final issue discussed in Part One. Fredericks states:

> *Misapplication of Royer and Nelson's methods began almost immediately .For example, the concept of managing heat—using the thermal balance within the fire area to advantage—was quickly lost on many practitioners of the combination attack."*

Fredericks then begins to speculate on the reasons why this misuse happened. He also enlists the help of David Fornell in this speculation. However, none of this speculation comes close to the real reason why fog nozzles were widely misused.

Bill Nelson in QUALITATIVE FIRE BEHAVIOR has perhaps the best statement on this issue. (See p. 100).

> *"…Tests were run and discussion and arguments were heated during the 1950s. About 1960, the pendulum swung. Fog became fashionable for all fires in most fire departments and the fire service was plunged into a dark decade of thermal imbalance. Buildings continued to burn while fog streams flowed. Slowly fire fighters learned that fog was a useful tool, but needed to be carefully used if it was to save more buildings than it lost. Certain stubborn individuals continued to point out that straight streams used properly were just as effective as fog and usually did not cause thermal imbalance problems."*

How true. So how have fog nozzles been misused to produce thermal imbalance problems?

> The answer is very simple and very basic .Bill Nelson has made the following statement (page 102) that is perhaps the most profound statement ever made about the use of fog nozzles.

> *"In principle, fire fighting is very simple. All one needs to do is put the right amount of water in the right place and the fire is controlled."*

Thus to use a fog nozzle properly, or carefully, you must use the right amount of water. How do you misuse a fog nozzle? Use too little or too much water. It is as simple as that. While it should be no surprise that using too little water is a weak attack that has little effect upon a fire, what may be surprising is that using too much water is counterproductive. Common sense might tell you that using more than enough water will simply gain control of the fire quicker, but not so.

This is where fire departments have gone astray. Using too much water causes massive thermal imbalance problems. In the attempt to solve these problems, new tactics and strategy were devised, tactics not based upon any scientific foundation. It is easy enough to misuse a fog nozzle. Open up your nozzle to full flow, and you will flow entirely too much water for your smaller fires.

So what is the answer to these problems? The answer is that fire fighters must learn how to properly use fog nozzles. After 50 years, it is about time to do so. While Fredericks is undoubtedly right in saying that misuse has occurred, I am not convinced that all fire departments do so. Many fire departments do make effective use of fog nozzles., and have done so in the past.

One important question remains in this discussion of the proper use of fog nozzles.

How is the right amount of water determined?

The answer to this question is postponed until an analysis of Part Two of Fredericks article.

PART TWO

Part Two begins with an analysis of the modern fire environment that Fredericks says is "far more hostile and unpredictable than it was in the 1950s". Fredericks cites two things present today as justification for this statement.

(1) Plastics
(2) Energy-efficient windows (EEW)

First, plastics. Fredericks states that the heat of combustion of plastics is, on the average, about twice that of ordinary cellulosic (wood based) fuels. Then he proceeds to a discussion of Thornton's Rule that was presented in a 1997 article in FIRE ENGINEERING. Fredericks seems to indicate that Thornton's Rule applies only to "laboratory findings", or is valid only from a "theoretical, laboratory perspective".

Fredericks does not state Thornton's Rule, so before proceeding I think that it is a wise idea to know what we are talking about. DR. Vytenis Babrauskas, author of Appendix A in the 17th Edition of the NFPA Handbook, states Thornton's Rule as follows.

> *"Recently, however, increasing engineering use is made of the observation that the heat of combustion per kg of oxygen consumed is nearly constant for most organic fuels, It can be shown that the value of*
>
> $$\Delta h^l/r_o \ = \ 13.1 \ \ MJ/kg \ \ for \ O_2$$
>
> *is near constant."*

Only recently has the oxygen consumption method (based upon Thornton's Rule) been used as the most convenient and practical means of conducting laboratory experiments. Thornton's Rule existed long before this was done.

However, the fundamental principle in all of science is that a particular chemical process is invariant no matter whether is occurs in a laboratory fire or in a structure fire, or whenever it occurs—now or 50 years ago. Thus Thornton's Rule is valid for the hydrocarbon air diffusion flame process (that we call fire) whenever and wherever it occurs.

There is a second important fact. Notice that Babrauskas's statement refers to the "heat of combustion" of fuels, and that the heat of combustion is constant, or a near constant, for almost all hydrocarbon fuels. So plastics, as well as cellulosics, all release the same amount of heat per unit of oxygen consumed. Thus the greater heat content of plastics is irrelevant for determining the rate of heat release for structure fires.

This conclusion is reinforced by Dr. Babrauskas, in his article "Burning Rates" in the SFPE Handbook of Fire Protection Engineering (2nd Edition), when he states:

> *"If a correlation is simply attempted with the total specimen fuel load (heat content) long considered in building codes as a good predictor of fire hazards, Figure 3-1.7 shows that absolutely no correlation is achieved."*

Notice the strong language, "absolutely no correlation is achieved". In plain English, Fredericks argument is absolutely worthless, and is not accepted in fire engineering today.

This conclusion should be qualified for certain plastics. Bert Cohen in his article "Plastics and Rubber" in the l7th Edition of the NFPA Handbook, states that:

> *"Plastics other than cellulose nitrate are classified as ordinary combustibles…Nevertheless, unusually high burning rates, unusually heavy smoke production, and a higher heat content per unit weight are responsible for greater concern about the fire behavior of <u>certain</u> plastics".*

It is a fact worth noting that many plastics are treated with inhibitors that retard flame spread and increase ignition temperatures. In view of this, Cohen concludes that:

> *While there are no special hazards for most accepted uses of plastics, some exhibit burning characteristics that are considerably different from those encountered with the more traditional cellulosic building materials."*

So this narrows Fredericks argument down to a limited number of plastics. What is the best solution to the problem? Certainly there is no justification to abandoning fog nozzles. A more appropriate and direct solution is to identify the hazardous plastics, fix them, or better yet ban them.

Thornton's Rule: Two Questions

The first question that could reasonably be asked about Thornton's Rule is this.
(1) Is there any difference in structure fires that might affect Thornton's Rule?

Clayton Huggett of the National Bureau of Standards, Washington, D.C., examined this question in an article appearing in 1980 in FIRE AND MATERIALS magazine. Since almost all structure fires involve incomplete combustion, the question narrows down to what effect incomplete combustion has on Thornton's Rule.

After examining this question in detail for various fuels and products of combustion, Dr. Huggett reaches the following conclusions.

1. *The rate of heat release in a fire can be estimated with good accuracy from two simple measurements, the flow of air through the fire system and the concentration of oxygen in the exhaust system.*
2. *The heat release from a fire involving conventional organic fuels is 13.1 kj/gram of oxygen consumed with an accuracy of ± 5% or better.*
3. *Incomplete combustion and variation in fuel have only a minor affect on this result. Appropriate corrections can be made if necessary.*
4. *The oxygen consumption technique of heat release measurement is adaptable to a wide range of applications ranging from small- scale laboratory experiments to very large scale fire system tests.*

Notice the third conclusion that fire behavior in an actual structure fire has only a minor effect upon Thornton's Rule. So this is conclusive proof that the validity of Thornton's Rule as a scientific law that governs fire behavior in structure fires.

This conclusion is a second reason why Frederick's assertion about the heat content of plastics is irrelevant. The heat content of plastics is calculated assuming complete combustion. Since complete combustion seldom occurs in structure fires, their heat content is seldom fully released. The best evidence of this fact is the pictures and descriptions of fires given by Fredericks himself. The black smoke referred to is proof positive that these fires involve incomplete combustion. So there should be complete agreement on this significant fact about structure fires.

The second question that reasonably can be asked about Thornton's Rule deals with the heat of combustion of hydrocarbon fuels. Since Thornton's Rule does not deal with the rate of heat release of these fuels,

What if an unlimited supply of oxygen is available in a structure fire?

All scientists, or engineers, agree that the rate of heat release in a structure fire is limited by either

(1) the fuel surface area available to the fire, or by
(2) the oxygen available to the fire.

It is a scientific fact that the rate of heat release in structure fires is oxygen limited, or ventilation controlled, during most of their fire development. John A. Campbell, writing in the 17th Edition of the NFPA Handbook in his article "Confinement of Fire in Buildings", states that:

> *"Considerable ventilation is required for a fully developed fire to burn at a fuel-surface controlled rate…Many, if not most, building fires will be ventilation controlled at least during the period of time in which containment is a consideration…The maximum intensity of a post-flashover room fires occur when ventilation is just sufficient to permit fuel surface controlled combustion."*

Thus, except for the very beginning at ignition, a structure fire is ventilation controlled up to the time of maximum, or peak, intensity. Dr. Campbell cites as an example a 20 x 20 foot room with an 8-foot ceiling, with an exposed combustible surface of 800 square feet of ordinary combustibles. For such a room, over one fourth of the wall area would have to be open to shift to fuel surface area controlled combustion.

So for structure fires, the amount of oxygen available does limit the growth in the rate of heat release, and lead to incomplete combustion. The examples of structure fires cited by Fredericks in his article are perfect examples of this fact. Opening doors, or making other openings, lead to an increase in intensity of the fires because of the additional supply of oxygen made available. This is further proof of the validity of Thornton's Rule as it applies to structure fires.

I think that Fredericks does grudgingly concede that Thornton's Rule may have validity when he states

> *"Although these laboratory findings viewed independently may indicate that plastics pose no more of a hazard to fire fighters than the cellulosic materials of fires past…"*

Discounting the error of limiting Thornton's Rule to laboratory "findings", this does count as a concession. I think that Fredericks is aware of this because he immediately shifts the argument to "other factors". He then claims that these other factors suggest that "the dangers faced by fire fighters have increased dramatically in the past 50 years".

The "other factors" that Fredericks lists are identical to those listed by T.T. Lie in his article "Fire Temperature Time Relations" in the SFPE Handbook on Fire Protection Engineering. He states that the intensity and duration of a fire in buildings can vary in a wide range as much as 50% from the most probable prediction. He says that it is not possible to predict the temperature course of a fire in a building. This uncertainty is created by parameters that change with time. He lists the following parameters.

Amount of fuel surface area
Arrangement of fuels
Wind (direction, velocity)
Fire load
Ventilation
Thermal properties of bounding materials

T.T. Lie states that it is only possible:

> *"to indicate the time-temperature curve with reasonable likelihood that <u>will not be exceeded.</u>"*

Thus we are faced with scientific uncertainty in contrast to Fredericks certainty that there has been a dramatic change within the past 50 years.

Engineers use these parameters to calculate time-temperature curves. These curves closely resemble the standard fire curves that have been used for years to test the fire resistance of various materials. The Standard Fire Curve used in North America (Canada and the United States) has been in existence since 1918. This curve has been adopted by the ASTM, the American Society of Testing Materials, and has been used for almost all fire resistance testing since then.

So there is no indication from any of this engineering work that there has been any dramatic change in fire behavior that would justify changing or modifying the standard fire curve. It is certainly true that scientific uncertainty was greater 50 years ago than it is today. As more engineering research is completed, the ability to predict fire behavior will increase our scientific certainty. This is just the opposite of what Fredericks claims.

Energy-Efficient Windows (EEW)

The second justification made by Fredericks for his statement that "the fire environment is far more hostile and unpredictable than it was in the 1950s" is the presence of

(3) Energy-efficient Windows (EEW)

The presence, or absence, of windows is one building feature that plays a crucial role in fire fighting. It is still almost universally true that every room in a house has at least one window. That hasn't changed. What is different is that instead of single pane plate glass windows we now have double pane insulated windows.

Has the presence of EEWs produced a dramatic change in fire behavior? First, it may not be common knowledge that plate glass windows (single pane) break from thermal stress early in the development of a structure fire. This begins at a temperature range of 550°F to 600°F. This temperature range is well below the temperature needed to produce flashover (1,100°F).

There was an interesting experiment conducted by two instructors at the Rockland County Fire Training Center (N. Y.). They conducted a side-by-side test of a single pane window and a double pane window. Their test results were published in FIREHOUSE magazine. Much to their surprise the double pane window broke out earlier than the single pane window. In fact the entire double pane window fell out because of the melting of the vinyl frame. The authors did conduct a thorough search for any data or testing done on the behavior of windows in a fire, but they were unable to find any.

However, there is some information published in the 17th Edition of the NFPA Handbook in an article by Robert W. Fitzgerald, entitled "Structural Integrity During Fires.". He makes the following statement about window glazing(glass).

> *"It quickly cracks because of the temperature difference between the surfaces. Double glazing does not provide much improvement. No glazing should be relied upon to remain intact in a fire."*

In fact the Rockland test detected no improvement whatsoever. So here again Fredericks claim is at odds with the facts as stated by a recognized authority in the NFPA Handbook.

Fredericks continues Part Two with a discussion of fire fighting actions including two newer methods of attack: positive pressure ventilation (PPV) and the use of Class A foam. Throughout this discussion I think that it is evident that Fredericks continues to misrepresent what Layman, Nelson and Royer have advocated. They have never advocated the exclusive use of either the indirect attack or the combination attack.

Chief Layman has said (page 40 in ATTACKING AND EXTINGUISHING INTERIOR FIRES) that fires in the initial phase of development have not accumulated enough heat to justify an indirect attack. He says:

> *A fire of this nature must be located and extinguished by direct attack. In making the initial size up of a building fire an experienced and capable officer should have little difficulty in determining if the situation demands a direct or indirect attack."*

Likewise Royer and Nelson have taken the same position. In my conversations with Keith Royer, he had emphasized time and time again the principle that there is "no magic pill", that is, no one method of attack that will solve all of your fire fighting problems. In view of Royer's phrase, I am suspicious of Fredericks statement that

> *"Although fog streams did not turn out to be the "magic pill" some had hoped…"*

I trust that "some" does not refer to Royer, or Nelson, or Layman. If it does, then again Fredericks has strayed from the truth.

Next Fredericks turns right around and advocates a single method of attack for all fires, the direct method using a solid stream nozzle. Fredericks needs to listen to the men who introduced fog nozzles to the fire service. There is "no magic pill". All methods of attack have their appropriate place in fire fighting.

Fredericks further recommends a minimum of 150 gpm fire flow for residential fires, and 250 gpm for commercial fires. If you read all of Fredericks article, I think that you will realize that there is nothing in the entire article that justifies these recommendations. The reason why is simple. Fredericks does not have a formula that can tell you how much water is really needed to control or extinguish a given size fire. Remember Nelson's fundamental principle:

> *In principle fire fighting is very simple. All one needs to do is put the right amount of water in the right place and the fire is controlled."*

The most creative contribution of Royer and Nelson is the discovery of the Iowa Rate-of-Flow Formula. This formula is based upon two scientific facts: (1) One gallon of water expands to 200 cubic feet of steam. (2) One gallon of water absorbs all the heat produced by the oxygen in 200 cubic feet of air.It is quite remarkable that both facts validate the same number, 200. The Iowa rate-of-flow formula, generalized with time as a variable is:

$$\text{NFF} \times t = \frac{\text{Vol}}{200}$$

where NFF = Needed Fire Flow in gpm, t = time in minutes or fraction of a minute, Vol = volume in cubic feet, and 200 is the Iowa constant.

Let's do one simple calculation of the right amount of water. Let's Take an average size room, say 2,000 cubic feet. To distribute the little drops of water, let's take the minimum time of 10 seconds, or 1/6 of a minute. Substituting these numbers into the formula gives

$$\text{NFF} \times 1/6 = \frac{2{,}000}{200}$$

The fraction 2,000/200 = 10 gallons—the right amount of water. So multiplying both sides of the equation by 6 produces the answer.

$$\text{NFF} = 60 \text{ gpm}$$

Only 10 gallons of water is needed for fire control, and a flow of 60 gpm brings fire control in 10 seconds.

These facts give the proper perspective to judge Fredericks recommendation. A minimum flow of 150 gpm is far too excessive for control of a 2,000 cubic foot fire. The inevitable result is a massive disruption of the thermal balance that exists in a fire. It should be obvious that Fredericks recommendation is not the answer.

The only answer is the proper use of fog nozzles. Such use does not cause any thermal imbalance problems. Only improper use of fog nozzles causes these problems by using too much water. In other words, I dispute Fredericks claim that "violent disruption of the thermal balance is characteristic of the indirect and combination methods." This is not true. Fog nozzles used properly with the right amount of water do not cause thermal imbalance problems.

What constitutes the proper use of fog nozzles: There are four tactical requirements.

(1) Adjust the reach of the stream so that it just reaches across the room
(2) Adjust the flow to provide a rate-of-flow near the ideal rate.
(3) Distribute the little drops of water evenly throughout the fire area (clockwise rotation)
(4) Shut the nozzle off when the flames disappear and white condensing steam appears.

By contrast the solid stream nozzle can do only one of these tactical requirements.

(1) The reach is fixed, cannot be adjusted, and extends too far for most rooms.
(2) The flow rate is fixed with a ball type shut-off valve that must be opened fully.
(3) With a narrow slug of water it is extremely difficult to distribute the water evenly.

There is another huge difference between a solid stream nozzle and a fog nozzle. The rate of absorption of heat by water is directly proportional to the surface area of the water. At a droplet size of 0.01 inch diameter, the little drops of water have a surface area 1,4000 times greater than a solid slug of water of the same volume. Thus a fog nozzle is more than 1,000 times more efficient than a solid stream nozzle in absorbing heat.

Remember Chief Layman's fundamental principle.

The control and extinguishment of interior fires must be based upon the principle of removing excessive heat from the involved building.

Is there any wonder that Chief Layman spoke of the "gross inefficiency" of the solid stream form of application.

Keeping in mind Layman's statement of principle, the answer to fire fighting problems is not to return to the grossly inefficient form of application. That would just create more danger for fire fighters, and with the excessive flow rate recommended, simply compound the problem of using too much water thereby causing massive thermal imbalance problems.

The only satisfactory answer is the proper use of fog nozzles. It is easy enough to learn how to do this. You must reduce your flow rates below 100 gpm for your smaller fires. The fog nozzles most suited for this are the TFT automatic nozzles with 6 detent stops, or the non automatic nozzles with the manual volume control rings. Use these nozzles properly and you will find that fire fighting is very simple indeed.

In reality, the two sides are not that far apart in this continuing debate that Fredericks talks about. Remember Bill Nelson's statement

Certain stubborn individuals continued to point out that straight streams used properly were just as effective as fog and usually did not cause thermal imbalance problems.

Certainly Nelson and Royer count themselves among "those stubborn individuals".

So there is really no disagreement on the proper use of straight streams. Also remember that a combination attack is a direct attack on a fire. as well as an indirect attack on a fire. So there should be no disagreement here as far as making a direct attack is concerned. If Fredericks would abandon his extreme position, his insistence of only one method of attack suitable for all fires, then both sides could come together and unite behind the principle that

There is no magic pill.

All type of nozzles, and all methods of attack have their proper place in the arsenal of weapons of fire combat. This is the principle upon which we should all be able to agree.