FDNY
Vindicator Fire Nozzle
Evaluation Report

Testing guidelines established by FDNY Safety & Research & Development
FDNY Point of contact Chief Al Turi

Testing performed at the Nassau County Fire Academy, New York

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Section 1
Flow Delivery Comparison

A catch tank was utilized to capture the water from the streams of both nozzles for a certain amount of time and a predetermined distance for both nozzles. The flow rate for the 15/16ths tip was 180-gpm and 240-gpm for the Vindicator Heavy Attack. These flow rates were chosen due to the fact that the nozzle reaction from both tips at these flow rates provided approximately the same reaction. The total time water was flowed was measured with a stopwatch and then simple physics were used to determine the exact amount of water that was delivered into the tank. Using the known flow rates and the total time water was flowing a total flow was able to be determined. Subtracting the amount of water in the tank from the total flow provides us with the amount of water that was not placed into the catch tank.

Standard numbers used for both tests

Tank Size: 137" Diameter tank / 68.5" Radius

Distance: 60 feet

Total time: 7.47 minutes

The amount of water into the tank was determined by using ¶R²X D Divided by 231.

¶ or Pie=3.14159265
R= Radius of the tank: 137"/2 = 68.5
D = Depth
231= cubic inches of a gallon of water

Test # 1 Results

Vindicator Heavy Attack - Flow Rate 240-gpm

Tank filled to a depth of 24.5 inches

Total water flowed – 1,792.8 Gallons

Total water in tank – 1,563.4538 Gallons

Percentage of total flow that hit the tank: 87.2%

3.14159265 X (68.5 x 68.5) X 24.5 / 231 = Total water into the catch tank

3.14159265 X 4692.25 X 24.5 / 231 = 1563.45 Gallons of water in the Catch Tank

¶ or Pie=3.14159265
R= Radius of the tank: 137”/2 = 68.5
D = Depth - 24.5 inches
231= cubic inches of a gallon of water

Test #2 Results

15/16th Smooth Bore tip - Flow Rate 180-gpm

Tank filled to a depth of 18.5 inches

Total Water Flowed – 1,344.6 Gallons

Total water in the tank – 1,180.5672 Gallons

Percentage of total flow that hit the tank: 87.8%

3.14159265 X (68.5 x 68.5) X 18.5 / 231 = Total water into the catch tank

3.14159265 X 4692.25 X 18.5 / 231 = 1180.56 Gallons of water in the Catch Tank

¶ or Pie=3.14159265
R= Radius of the tank: 137”/2 = 68.5
D = Depth – 18.5 inches
231= cubic inches of a gallon of water

Flow Delivery Summary

By looking at Section 3 we can see that although the flow rates used in this test were different, the actual reaction felt by the firefighter was virtually the same. Realizing that we were able to flow 60-gpm more than the current 15/16ths tip with no increase in the measured nozzle reaction we can conclude the following:

1. The Vindicator Heavy Attack provided 382 more gallons of water to the tank in the same time frame as our 15/16ths tip. This represents a 25% increase in flow.

2. The Vindicator Heavy Attack provided 87% of its water to the target, which is virtually the same percentage as the 15/16ths tip.

3. With increased flow and no increase in reaction the Vindicator may very well provide the badly needed advantage on the fire ground by providing a more rapid fire knockdown or control.

Section 2
Flow Impact Comparison

This test was done using an impact plate attached to a certified load cell that measures actual impact in pounds per square inch. The flow rate for the 15/16ths tip was 180-gpm and 240-gpm for the Vindicator Heavy Attack. The distance for both tests was 60 feet.

Test #1 Results

Vindicator Heavy Attack

Flow Rate – 240-gpm

Impact Measurement – 60.2 PSI

Test #2 Results

15/16ths Tip

Flow Rate - 180-gpm

Impact Measurement - 53.4 PSI

Flow Impact Summary

Again, realizing that the actual reaction felt by the firefighter is virtually the same we can conclude the following from this test:

1. The Vindicator Heavy Attack provided 6.8 PSI (11%) more impact than our current 15/16ths tip.

2. With an increase in impact performance the Vindicator provides a better penetration of our fire stream into the fire. This would mean that not only does it flow more water but also it would carry it deeper into the fire.

Section 3
Nozzle Reaction Testing

This test was done using a certified load cell attached to a device that measures actual reaction from the nozzles in pounds per square inch. The flow rate for the 15/16ths tip was 180-gpm and 240-gpm for the Vindicator Heavy Attack.

Test #1 Results

Vindicator Heavy Attack

Flow Rate – 240-gpm

Reaction measurement – 60.2 PSI

Test #2 Results

15/16ths Tip

Flow Rate - 180-gpm

Reaction measurement – 62 PSI

Nozzle Reaction Summary

Even though the Vindicator was flowing more water we can see that it was able to offer approximately 2 pounds less reaction. With less nozzle reaction we can conclude the following from this test:

1. The Vindicator Heavy Attack provided 1.8-PSI (3%) less reaction with 25% more flow.

2. With a decrease in reaction force coupled with an increase in flow the Vindicator provides a safer option for our firefighters. This is based on the fact that more water with less reaction leads to a safer fire ground operation.

Section 4
Hose Kink Testing

It has been a common opinion that common fire ground hose kinks cause a dramatic loss in our flow rates. This test was done to provide evidence based on facts, which prove otherwise. The Vindicator Heavy Attack was used at two different flow rates. When a kink was placed in the line the flow drop was recorded. Please note that the kink placed in the line was a very solid kink that was beyond what we would commonly find on the fire ground.

Test #1 Results

Vindicator Heavy Attack

Flow Rate 180-gpm

Nozzle Pressure – 30-psi

Flow Rate with the Kink – 175-gpm

Test #2 Results

Vindicator Heavy Attack

Flow Rate 240-gpm

Nozzle Pressure – 45-psi

Flow Rate with the Kink – 220-gpm

Hose Kink Testing Summary

The long accepted opinion that a kinked line causes us to loose a dramatic amount of water was not found to be accurate. In fact, with a "very" substantial kink placed in the line a flow decrease of only 20-gpm was achieved during test #2. This test also eliminates the opinions that a low nozzle pressure causes hose kink problems resulting in a dramatic loss of flow. With only 30-psi of NP a flow drop of only 5-gpm was noted from the Vindicator.

Section 5
Heat absorption comparison of the 15/16th FDNY tip and the Vindicator Heavy Attack.

Utilizing a controlled burn facility with Thermocouples to measure temperature a series of test burns were done to evaluate the Vindicator's performance compared to the current 15/16ths tip currently used by FDNY. A total of 6 Oak pallets were used for each burn. An attempt was made to ensure each burn and fire attack was done the same resulting in a more accurate comparison. The actual fire attack began at a point when the ceiling temperatures stabilized and offered no indication of increasing.

Test #1 Results

15/16ths Smooth Bore at 50-psi NP

Ceiling temp peaked at 830 F

After 3 seconds of water application ceiling temp was 183 F

Fire knockdown 6 seconds -(No visible fire on pallets)

After 10 seconds the ceiling temp rose to 192F

Total Flow time 10 seconds

Test #2 Results

Vindicator Heavy Attack at 180-gpm (Same flow rate as Test #1)

Ceiling Temp peaked at 860 F

After 3 seconds of water application ceiling temp was 170F

Fire Knockdown 6 seconds – (No visible fire on pallets)

After 6 seconds the ceiling temp dropped to 110F

Total flow time 6.2 seconds

Test #3 Results

Vindicator Heavy Attack at 240-gpm

Ceiling Temp peaked at 890 F

After 3 seconds of water application ceiling temp was 170F

After 6 seconds the ceiling temp dropped to 140F

Fire Knockdown 7 seconds – (No visible fire on pallets)
(less nozzle movement was noted by the nozzle-man and observers.)
(MUCH LESS MOVEMENT NOTED IN THE VIDEO)

Total flow time 7.8 seconds

Test #4 Results

Vindicator Heavy Attack at 260-gpm

Nozzle Pressure 50-psi (Same as Test #1)

Ceiling Temp peaked at 820 F

After 3 seconds of water application the ceiling temp was 102F

Fire Knockdown 4 seconds – (One sweep on the pallets at the 4.5 second mark. No visible fire on pallets)

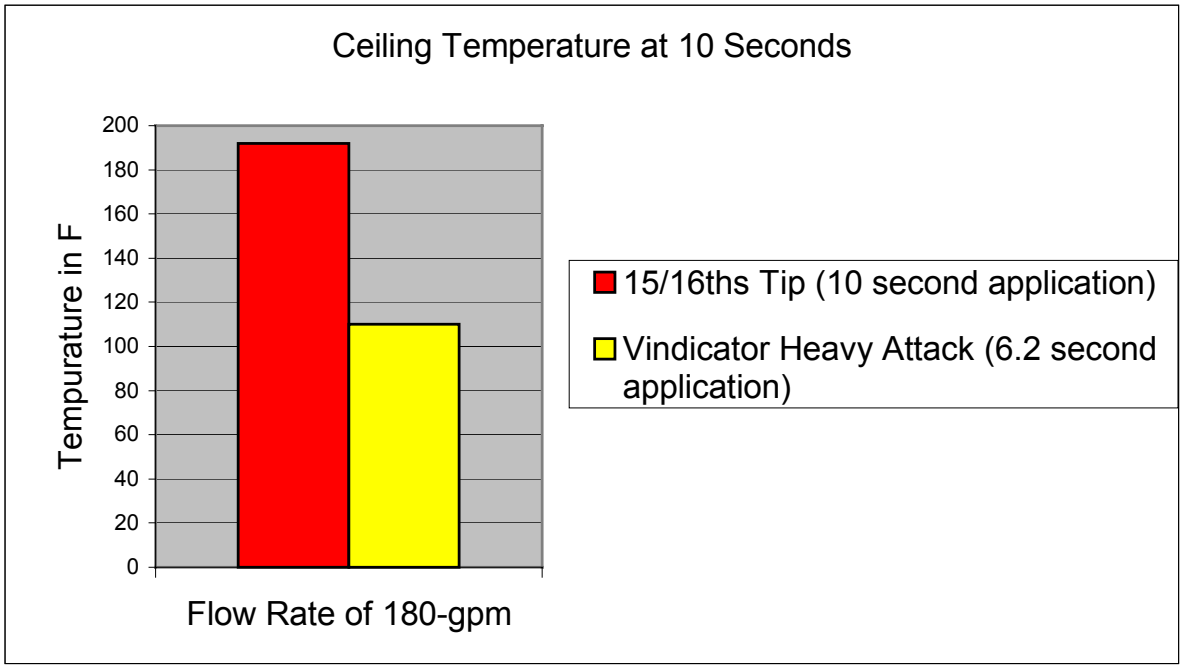
After 10 seconds the ceiling temp dropped too less than 100F

Heat Absorption Comparison Summary

By evaluating the above test results we can conclude the following regarding the Vindicator Heavy Attack nozzle.

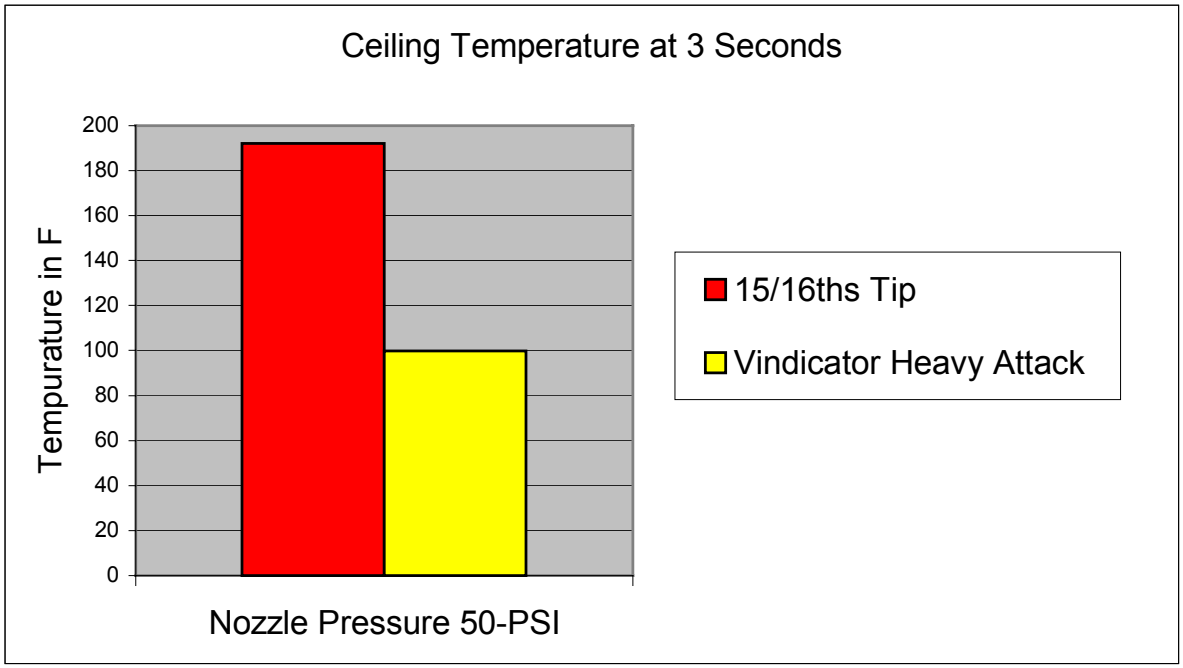
1. Utilizing the same flow the Vindicator was able to absorb more heat and did so 38% faster than the 15/16ths tip.

2. At the same flow rate the Vindicator reduced the final room temperature 42% more than the 15/16ths tip.


Ceiling Temperature at 10 Seconds
Tempurature in F
200
180
160
140
120
100
80
60
40
20
0
Flow Rate of 180-gpm
15/16ths Tip (10 second application)
Vindicator Heavy Attack (6.2 second application)

3. At the same Nozzle Pressure the Vindicator was able to bring the room temperature down 44% lower than the 15/16ths tip in the same amount of time.

4. At the same nozzle Pressure the Vindicator was able to knock the fire down 33% faster and reduced the final ceiling temperatures 48% lower than the 15/16ths tip.


Ceiling Temperature at 3 Seconds
Tempurature in F
200
180
160
140
120
100
80
60
40
20
0
Nozzle Pressure 50-PSI
15/16ths Tip
Vindicator Heavy Attack

Section 6
Summary

Based on the extensive testing performed on the Vindicator fire nozzle from First Strike Technologies, Inc. the following summary is provided.

1. The Vindicator nozzle has to date performed completely to the manufactures specifications. In fact, in numerous cases, it does more than what is promoted.

2. The Vindicator nozzle provides superior heat absorption compared to our current 15/16ths tips.

3. The Vindicator nozzle provides faster fire knockdown or control times compared to our current 15/16ths tips.

4. The Vindicator nozzle provides less nozzle reaction with more flow compared to our current 15/16ths tips.

5. The Vindicator nozzle provides a wider flow range than our current 15/16ths tip.

6. The Vindicator nozzle provides the same 88% of its flow to the target as our current 15/16ths tip.

7. The Vindicator provided an increased impact to the target than our 15/16ths tip.

All things considered, the results clearly point to a simple conclusion. The Vindicator may not be a traditional looking nozzle but it has shown that it simply outperforms what we currently are using when it comes to the basic necessities for fire Suppression.

The challenge to date has been training. The extensive testing we have done to date has open up many areas that need to be addressed regarding our flow rates with the most important being our hose and its limitations. An example of what we mean is attached as a supporting document regarding issues we may have with hose.