HOSE STREAM MECHANICS

LESSON PLAN

INTERIOR SUPPRESSION

STUDENT OBJECTIVE

Given the information from discussion, handouts, and video references, the student will demonstrate knowledge of employing different stream types, application patterns, stream angles, methods of deflection, and different advancement techniques to effectively distribute water during interior suppression operations.

The student will also demonstrate the importance of managing the level of air entrained into the hose stream depending on the outcome desired and ventilation profile present.

MOTIVATION

Learning how to employ different stream types, application patterns, stream angles, methods of deflection, and different advancement techniques will assist the nozzle operator in fireground decision-making to most effectively distribute water and map the surfaces of a structure during interior suppression operations, on both the approach to and into the various fire compartments. Past research has shown the importance of a flow and move approach during interior fire suppression for the survivability of trapped occupants and the safety of operating firefighters. This advancement technique, coupled with the choice of a straight or solid stream, and applied with the appropriate pattern, can essentially seal off the space ahead of the advancing hoseline, taking advantage of air entrainment to draw fresh air in behind. This will prevent the products of combustion from coming back over the firefighters while allowing the higher temperature, higher pressure gases behind the firefighters to ventilate out of the structure. Venting of the gases behind the advancing crew will improve survivability for trapped occupants and visibility for searching firefighters.

INSTRUCTOR NOTES

Single 1½ or 1¾ inch handline with the ability to switch between a combination nozzle and smooth bore nozzle set to a flow and pressure of your choice.

Full personal protective ensemble (PPE) recommended.

The streamer flags to visualize air entrainment should be installed and in place at the entrance of the hallway prior to the start of this evolution.

ASSOCIATED REFERENCES

Fire Attack Study
Coordinated Fire Attack Study

LEARN MORE

Visit fsri.org/hose-stream-mechanics

LESSON: IMPACT OF STREAM ANGLE

1 VARYING STREAM ANGLE

Watch a Demonstration of this Exercise

Technique
Apply water to the centerline of the hallway ceiling, via a straight or solid stream, varying the angle. The angle should be varied from shallow (stream impacts ceiling near end of hallway) to steep (stream impacts ceiling near start of hallway into the overhead).

Nozzle Setting: Straight or Solid Stream

Outcome
With a shallow stream angle, the water will all be propelled forwards towards the end of the hall, radiating to the side walls, and falling to the floor in sheets. As the stream angle becomes steeper, the water will radiate outwards in 360 degrees and propel water both ahead of and behind the nozzle team, coating the ceiling and side walls of the hallway.

Discussion
The impact of stream angle in the hallway should demonstrate the importance of both applying water into the overhead as well as down range on the advance to a fire compartment for maximum surface cooling. These stream angles get incorporated into the flow and move approach during interior suppression for protection of both the advancing nozzle team and any potentially trapped occupants.

LESSON: IMPACT OF AIR ENTRAINMENT

2 FIXED STRAIGHT OR SOLID STREAM

Watch a Demonstration of this Exercise

Technique
Ensure the door at the end of the hallway is open. Apply water in a straight or solid stream down the hallway and out of the doorway, in a fixed pattern with no manipulation.

Nozzle Setting: Straight or Solid Stream

Outcome
The streamers located at the start of the hallway will show little to no movement. Any movement will be inwards into the hallway, showing minimal entrainment with a straight or solid stream held fixed.

Discussion
Suppose that you are positioned at the start of a hallway holding a straight or a solid stream aimed down range in a fixed position, with no manipulation. In this case, you are entraining about 1000-2000 cubic feet per minute of air into the hose stream.

3 ROTATING STRAIGHT OR SOLID STREAM

Watch a Demonstration of this Exercise

Technique
Ensure that the door at the end of the hallway is open. Apply water in a narrow fog stream down the hallway, in a fixed pattern with no manipulation.

Nozzle Setting: Straight or Solid Stream

Outcome
The streamers located at the start of the hallway will be drawn into the structure, showing entrainment with a rotating straight or solid stream, commonly utilized in a flow and move approach.

Discussion
As soon as you start to manipulate the stream into an O-pattern, you increase the air entrained to approximately 4000-6000 cubic feet per minute.

These values are similar regardless of whether you choose a straight stream from a combination nozzle or a solid stream from a smooth bore nozzle. Air entrainment in hose streams is less dependent on the flow and nozzle pressure, and more dependent on the movement of the nozzle and speed of the pattern chosen.

4 FIXED FOG STREAM

Watch a Demonstration of this Exercise

Technique
Ensure that the door at the end of the hallway is open. Apply water in a narrow fog stream down the hallway, in a fixed pattern with no manipulation.

Nozzle Setting: Narrow Fog Stream

Outcome
The streamers located at the start of the hallway will be drawn into the structure, showing entrainment with a fixed narrow fog stream

Discussion
When we change from a straight or solid stream to a fog stream, the air entrainment increases dramatically. For example, a narrow fog stream held fixed entrained approximately 10,000 cubic feet per minute of air.

Using a fog stream may be effective at absorbing heat from the gas layer, but the size of the droplets do not allow for sufficient surface cooling along the length of the building. With minimal surface cooling and maximal air entrainment, fog patterns are not an effective stream choice for initial knock-down of a post-flashover, ventilation-limited fire.

5 ROTATING FOG STREAM

Watch a Demonstration of this Exercise

Technique
Ensure that the door at the end of the hallway is open. Apply water in a narrow fog stream down the hallway, rotating the nozzle into an O pattern.

Nozzle Setting: Narrow Fog Stream

Outcome
The streamers located at the start of the hallway will be drawn into the structure, showing entrainment with a rotating narrow fog stream.

Discussion
If we manipulate that fog stream into an O pattern, we can expect to see air entrainment in excess of 15,000 cubic feet per minute. This magnitude of air entrained with fog streams can be comparable to that of a positive-pressure fan.

Using a fog stream may be effective at absorbing heat from the gas layer, but the size of the droplets do not allow for sufficient surface cooling along the length of the hallway. With minimal surface cooling and maximal air entrainment, fog patterns are not an effective stream choice for initial knock-down of a post-flashover, ventilation-limited fire.

LESSON: ADVANCEMENT TECHNIQUES

6 FLOW AND MOVE ADVANCE

Watch a Demonstration of this Exercise

Technique
Apply water in a straight or solid stream down the hallway, in a rotating O pattern, while advancing towards the fire compartment.

Nozzle Setting: Straight or Solid Stream

Outcome
All surfaces in the hallway (walls, ceiling, and floor) will be properly coated and cooled as the nozzle firefighter advances towards the fire compartment. The nozzle firefighter will seal off the space ahead of the stream by advancing down the hallway with the bale open and flowing while moving.

Discussion
One successful means of extinguishment is to employ an O pattern on the advance to a fire compartment. During a flow and move advance, this pattern can essentially seal off the space ahead of the advancing hoseline, taking advantage of air entrainment to draw fresh air in behind. This will prevent the products of combustion from coming back over the firefighters while allowing the higher temperature, higher pressure gases behind the firefighters to vent out of the structure. Venting of the gases behind the advancing crew will improve survivability for trapped occupants and visibility for searching firefighters.

7 SHUTDOWN AND MOVE ADVANCE

Watch a Demonstration of this Exercise

Technique
Apply water in a straight or solid stream down the hallway, in a rotating O pattern, from several fixed positions in the hallway prior to entry into the fire compartment.

Nozzle Setting: Straight or Solid Stream

Outcome
All surfaces in the hallway (walls, ceiling, and floor) will be properly coated and cooled as the nozzle firefighter flows from several stationary positions on the advance to the fire compartment.

Discussion
Applying an O pattern on the approach to a fire compartment will ensure that the surfaces are cool and will limit the thermal exposure to the nozzle team on the advance. Water applied in the hallway is simply used to help the nozzle team get to the fire compartments safely and begin to take control of the space to improve conditions inside the structure. However, water applied in the hallway will not be able to coat the surfaces of the fire compartments.

8 DOORWAY DEFLECTION METHOD

Watch a Demonstration of this Exercise

Technique
Position on the side of the hallway opposite the entry to the fire compartment. Apply water to the vertical frame of the doorway in an up and down motion to deflect water off of this surface and into the room.

Nozzle Setting: Straight or Solid Stream

Outcome
Water will deflect off of the door frame and into the fire compartment from the start of the hallway.

Discussion
Once the nozzle team has an idea of the location of the fire, attempts should be made to get water into the compartment as early as possible. This could include deflecting the hose stream off the door frame to the fire compartment for early water application onto the seat of the fire.

9 COMPARTMENT ENTRY TECHNIQUES

Watch a Demonstration of this Exercise

Technique
At the threshold of the fire compartment, apply water to the ceiling surface in a rotating O pattern to initially distribute water in 360 degrees and coat the ceiling and walls simultaneously. Then bring the stream lower into the compartment, continuing the rotating O pattern to coat and cool the base fuels for complete extinguishment.

Nozzle Setting: Straight or Solid Stream

Outcome
Water will be distributed to all surfaces in the compartment (walls, ceiling, and floor).

Discussion
As the nozzle team reaches the threshold of the compartment, the same approach to that of exterior water application should be taken. An initial steep angle will coat all surfaces in the compartment. Once the fire is darkened down, the stream can be brought lower to the remaining burning fuels. After the fire is extinguished, the nozzle team should employ hydraulic ventilation out of any available opening in the fire compartment to aid in the smoke removal from the structure.