Top 20 Tactical Considerations from Firefighter Research

Steve Kerber, PE
Director
UL Firefighter Safety Research Institute
If you hear...

- Never ventilate…
- Never go inside…
- Always throw water from the outside…
- Never go over a basement fire…
- Never vertically vent…
- Everything you did in the past is wrong…

You aren’t listening!
What you should hear/be thinking…

• It is rare that always and never applies
• That’s why we do that, glad I have been doing it
• That could work for my department if we train on it
• I can use this information to be more educated /aggressive than ever to:
  o Put the fire out faster and more efficiently
  o Have less of a chance of getting hurt or killed
  o Reduce the chance victims are hurt or killed

The Science of Firefighting is not that Complicated!
#20 – No amount of technology is going to replace the need for you to know your profession.
#19 – Your workplace has changed, you have to evolve
Today’s Fire Environment

- Larger Homes
- Open Spaces
- Evolving Fuel Loads
- Inc. Voids Spaces
- Changing Bldg. Materials
- Smaller Lots
- New Technologies

- Faster fire propagation
- Shorter time to flashover
- Rapid changes in fire dynamics
- Shorter escape times
- Shorter time to collapse
- Inc. Exposure Problems
- New and Unknown Hazards
Comparison of Room Furnishings

<table>
<thead>
<tr>
<th>Legacy Room</th>
<th>Modern Room</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

00:00
#18 – You never want to be between where the fire is and where it wants to go without water or a door to close.
#17 – Fire flows from high pressure to low pressure.
Venting Near the Seat of the Fire
#16 – Vent, Enter, ISOLATE, Search (VEIS)
#15 – Venting does not always lead to cooling; well-timed and coordinated ventilation leads to improved conditions.
Tactical Patience
#14 – Water in the eaves can get the water where it needs to go for attic fires.
#13 – Don’t let our training props set us up for failure.
Ventilation Training
#12 – Forcing the front door is ventilation and must be thought of as ventilation.
#11 – Controlling the door: Limit the air, limit the size of the fire.
Control the Front Door
Control the Front Door

Door Control

Door Open

5x Real Time
Door Control

• Door control is a temporary action (water on fire / door open)
• Door control is not only for hoseline advancement (search)
• Door control is not only for the front door (apartments)
• If door may relatch then use tool, hoseline or different tactic
#10 – No smoke showing means nothing. Once and opening is made read it.
Reading Smoke
Smoke Tunneling Effect/Rapid Air Movement

Smoke tunneling vs. smoke lifting

Sign that the fire is ventilation limited

Should trigger awareness.
You can learn a lot at the front door if you take the time to look.
Coordination of vertical ventilation must occur with fire attack just like with horizontal ventilation.
UL Vertical Ventilation Experiments

5x Real Time

4 ft. by 4 ft. Vent Hole

4 ft. by 8 ft. Vent Hole
#8 – Knowing how your turnout gear works is critical. Energy flows from high to low.
Heat Transfer through Turnout Gear
Uncompressed

Diagram showing layers of turnout gear:
- External Incident Flux: High
- Air Gaps
  - Outer Shell
  - Moisture Barrier
  - Thermal Liner
  - Shirt
- Skin Layers
#7 – Keep the wind at your back.
#6 – Thermal imagers may help indicate there is a basement fire but can't be used to assess structural integrity from above.
TICs and Floor Collapse

- Top of Subfloor: 86°
- Top of Padding: 75°
- Surface of Carpet: 73°
- Bottom of Subfloor: 1274°
- Air (mid-depth): 1330°
- Side of I-Joist (mid-depth): 1173°
- Bottom of I-Joist: 1293°
#5 – Fight the fire on the level it is on.
Protecting the Stairs
Protecting the Stairs

Flow Path from Open Front Door and exits through Open Front Door
Basement 3 (644C) – 25 seconds of water

*Flowing Water into the 1st Floor Basement Door Has Little Effect*

- **Top of Stairs**
  - 600°F → 400°F
  - 21 kW/m² → 7 kW/m²

- **Front Door**
  - 275°F → 260°F

- **Base of Stairs**
  - 1250°F → 1450°F

- **Outlet**

- **Closed Bedroom**
  - 110°F → 110°F

- **Open Bedroom**
  - 225°F → 210°F

- **Basement Rear**
  - 750°F → 750°F

- **Basement Front**
  - 1200°F → 1500°F

- **Flowing Water into the 1st Floor Basement Door Has Little Effect**
Water in the Basement Window
Water through the Basement Window

Flow Path from Open Basement Window and Bilco Door, exits through Open Front Door
Basement 3 (644C) – 60 seconds of water

Flowing Water on the Fire Improves Conditions Everywhere in the Structure

Outlet

Inlet

Front Door
250°F → 200°F

Base of Stairs
1200°F → 400°F

Top of Stairs
600°F → 200°F
14kW/m² → 0kW/m²

Basement Rear
800°F → 300°F

Basement Front
1700°F → 300°F

Exterior Water Application

Closed Bedroom
110°F → 110°F

Open Bedroom
225°F → 190°F

Inlet
#4 - Use a broken stream to flow water on solar panel systems.
Firefighter Safety and Photovoltaic Systems
#3 – Water does not push fire.
Softening the Target
Transitional Attack
Quick Water
Fast Water
Hit it Hard from the Yard
10 Seconds for Safety
Blitz Attack
Darken it from the Exterior
WRECEO

.........
Water in a Window Does Not Push Fire
Water in a Window Does Not Push Fire

Flow Path from Kitchen Windows
Rail Road Flat 2 (642A) – 14 Seconds of Water
Fire Cannot be Pushed – No Flowpath

Kitchen
1400°F → 200°F

Middle Room
600°F → 300°F

Rear Room
500°F → 300°F

Hallway
550°F → 300°F

EXPOSURE 1

Water Application
#2 – Door closest to the fire truck should not dictate line/stream placement.
Breakfast  Kitchen  Bedroom 3  Bath  Bedroom 2
Dining  Living  M. Bedroom
Foyer

Side A

59
#1 – Flow path and suppression must be considered together.
Understanding Flow Path (Interior Water Application)
Understanding Flow Path (Interior Water Application)
Understanding Flow Path
(Interior Water Application)
Understanding Flow Path
(Exterior Water Application)
Fire Behavior Position Statement

1. Size-up
2. Identify the flow path
3. Cool or “soften” the fire from the exterior
4. Assess and understand smoke tunneling
5. Vent close to the fire origin
6. Coordinate ventilation with hose attack
7. Vent Enter Isolate Search (VEIS)
8. Close the door
9. Control the access door
Online Training Programs

Access online training programs at www.ULfirefightersafety.com
Recent Project Updates

Follow UL FSRI’s full-scale experiments that help firefighters understand and anticipate new and dangerous situations.

View all Projects →

Eave Fire Experiments Completed
August 31, 2013 - No Comments (edit)
In July, a series of 3 large scale experiments were conducted that examined exterior fire spread into the eaves and how the speed at which exterior fires transitioned to […]

Apply to be a part of the UL FSRI PPV Study’s Technical Panel
August 30, 2013 - No Comments (edit)
Since we announced the funding of the PPV study, we have received an overwhelming amount of support and inquiries to be a part of the project. Our funding is limited […]

UL Firefighter Safety Research Institute Launches Vertical Ventilation and Suppression Online Training
August 28, 2013 - 16 Comments (edit)
UL FSRI is proud to announce the release of “Effectiveness of Fire Service Vertical Ventilation and Suppression Tactics in Single Family Homes” – an online course that serves as a […]

www.ULfirefightersafety.com
Recent News

Fire Fighting Research On-Line

Recently, there has been a high level of interaction between fire researchers and the fire service. The objective of the interaction has been to generate research results that can be used to increase the safety and the effectiveness of firefighters. The research demonstrates the changes that fuel loads and construction methods have had on the fire environment within residential structures. These changes have altered the model of fire behavior taught to the fire service for decades. In addition, firefighter protective equipment has also changed over the years. All these factors lead to an assessment that firefighting tactics may need to evolve in order to keep in step with the changing conditions on the fireground. As noted, these findings are the result of research conducted in collaboration with the fire service. To get some insight into this research and the potential applications on the fire ground, a list of web based presentations given by NIST, UL and fire service leaders from across the country are provided with hyperlinks below. The links listed below have been posted within the last year. This is just a partial list of the many free firefighter training resources that are available on the internet.

IAFC Webinar. Under Fire Prevention

The Changing Severity of Home Fires. Presenters: Steve Kerber (UL), BC Sean DeCrane (Cleveland Fire Department) and Dan Madrzykowski (NIST)
Technology Transfer - Online Training Programs

Single Family Detached Dwelling Fire Tactics Program
Modern Construction Considerations for Company Operations

http://learn.isfspi.org/

Fire Dynamics
Station Night Club Fire Analysis
Super Sofa Store Fire Analysis
Thermometry – Underdevelopment

www.ULfirefightersafety.com  www.cfitrainer.net
ALIVE: Web-Based and Mobile Applications

www.poly.edu/fire

Wind Driven High Rise Fires
Modern Residential Fires
Fire Dynamics (July 2014)

http://www.lacofdtturnout.com/
QUESTIONS and DISCUSSION

Contact Information:

Steve Kerber, Director, UL Firefighter Safety Research Institute
Stephen.kerber@ul.com

Dan Madrzykowski, Group Leader, NIST Firefighter Technology Group
Madrzy@nist.gov

Follow us on Facebook, Twitter and YouTube