

## Operating Guideline # 227

### Hostile Fire Events

September 30, 2019



#### **PURPOSE:**

The purpose of this Operating Guideline (OG) is to create an awareness of the hostile fire events that can endanger a firefighter during structural firefighting operations.

#### **ISSUE/RATIONALE:**

Firefighters are exposed to a variety of dangerous conditions during fireground operations. During extreme fire events, firefighters may be exposed to conditions that give rise to certain "Hostile Fire Events" which can be life-threatening in many cases. Understanding that these events occur, and recognizing the warning signs and how to prevent these from occurring may help to prevent injuries from occurring.

The term "hostile fire event" is used to describe several different types of fireground phenomenon including:

- Flame-over (also known as "Roll-over")
- Backdraft
- Flashover
- Explosive Growth

Each of these is explained briefly in the following paragraphs.

"Flame-over" is described as a hostile fire event that includes the ignition and sustained burning of the overhead smoke layer in a room and/or hallway. Lower contents do not necessarily ignite, but when they do, they will ignite quickly where plenty of air exists, flame-over typically originates at the seat of the fire and travels along the heat flow paths. The flame-over travel is usually opposite in a ventilation limited phase fire that finally gets air. The flames start near the ventilation opening and burn back to the fire seat where they can trigger a flashover of the room.

A "Backdraft" is an explosive event that occurs when air is suddenly reintroduced to a closed space that is filled with pressurized, ignition-temperature, and oxygen-deprived products of combustion and pyrolysis. In many ways, explosive-growth and backdraft are similar; both are the result of air introduction into an ignition-temperature smoke environment. They differ in the rate of air introduction and the resulting force and speed of ignition. The explosive growth event (flame-over and delayed flashover) is triggered by a volume shift between smoke and air that occurs over a 10-to-90 second time span, whereas a backdraft is instantaneous upon the introduction of air into the oxygen-depleted environment. The backdraft ignites like a detonation and will likely have an accompanying shock-wave.

A "Flashover" is a sudden hostile fire event that occurs when all the surfaces and contents of a space reach their ignition temperature nearly simultaneously, resulting in full-room fire involvement. In most cases, a flashover occurs because the room itself (walls, ceiling) can no longer absorb heat and begins to reflect radiant energy back into itself. The super-heated upper gas layer expands downward and rapidly heats floor level fuels to their

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ignition temperature. A room may have been heated to the point of flashover but a flashover may not occur because no combustion air is available, setting the stage for an explosive growth event.

“Explosive Growth” fires are said to occur when air is introduced to a ventilation-limited fire. It can include flame-over into flow paths and flashover of individual rooms that are heat saturated.

Firefighters need to have an intimate understanding of these events and study them thoroughly in order to better protect oneself from the consequences of being exposed to each.

#### **GUIDELINE:**

1. Some of the signs that a hostile fire event is about to occur may include the following:

a) high heat – the presence of high heat or the rapid, sudden build-up of high heat within a structure or confined area

b) The presence of optically dense (BLACK, or yellow-grey in colour) smoke that rapidly increases in volume, is turbulent, or has a pulsing or breathing movement (for backdraft specifically)

c) Air flow/movement may be turbulent and of high velocity; bi-directional movement (some visible pushing out an open doorway with fresh air being drawn in at the bottom)

d) For backdraft, smoke seen to be “puffing” from window cracks, cracks in mortar joints, crazed and cracked smoke stained windows.

2. To reduce the opportunity for a hostile fire event to occur, Incident Commanders and firefighters should consider the following:

a) Gas cooling/cooling the fire compartment prior to entry is an effective way of reducing the threat of a hostile fire event.

b) Tactical Ventilation of the fire compartment or building is critical to preventing or reducing the impact of a hostile fire event.

c) Transitional fire attack should be considered if appropriate.

3. Building Construction plays a significant role in how fires develop and how long a structure can withstand the destructive capacity of fire with respect to collapse. Firefighters must understand the differences between “legacy construction” and “modern construction” (including the proliferation of “light weight” building elements such as trusses and “I” beams). Recent studies by ULC and other agencies have revealed that unprotected floor assemblies can fail (collapse) within a very short time frame (minutes) after exposure to fire.

4. The combustibility of contents of a modern structure have dramatically altered fire conditions being experienced on the fireground in the modern era. Building contents have far greater heat release rates than those of even a few decades ago. Understanding how the contents of a modern fire interplay with modern building construction and larger building compartments (open floor area’s) along with having an understanding of flow paths and how firefighting tactics can influence flow paths can have an impact on rapid fire progression is

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also critically important. The study of fire dynamics should also include the difference between ventilation- limited and fuel-limited fires.

5. Personal Protective Equipment and clothing (including SCBA) plays a vital role in keeping firefighters safe under normal operating conditions, however, no PPE is capable of protecting an individual from prolonged exposure to the very extreme conditions that occur when a hostile fire event occurs.

6. Firefighter survival training is critically important to the safety of all staff. Understanding various rescue techniques and how to self-rescue are critical skill sets for every firefighter.

7. This OG should be regarded as a simple primer on the subject matter. It would be impossible to provide an adequate summary of the myriad of issues that impact on firefighter safety related to hostile fire events in an Operating Guideline. Every firefighter is urged to study the phenomena described herein for a more detailed and thorough understanding of the warning signs of hostile fire events; prevention; firefighting tactics to be employed; the impact of building construction; and firefighter survival strategies and techniques.

8. Having water ready before entry and ventilation is an important consideration when dealing with hostile fire conditions. This is important as homes are well sealed and introduction of air may be the ingredient required to create an event.

#### **RESPONSIBILITY:**

It is the responsibility of all members to comply with the provisions of this OG and particularly that Company Officers (supervisors), and firefighters or other staff (workers) ensure that they adhere to their duties in accordance with the provisions of this document and the Occupational Health and Safety Act.

#### **REFERENCES:**

- Occupational Health and Safety Act (RSO 1990, c. 0.1)
- Section 21 Committee Guidance Note GN 6-6 Rapid Fire Progression
- Section 21 Committee Guidance Note GN 7-6 Hazardous Fire Conditions – Rollover, flashover and Backdraft
- IFSTA Essentials of Fire Fighting and Fire Department Operations, 6<sup>th</sup> Edition
- GFD OG 804 – Initial Considerations for Structural Fire Attack
- Fire Dynamics: The Science of Fire Fighting; by Daniel Madrzykowski, NIST 2012