



Emergency Scene Management I - FIRE-1112

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Emergency Scene Management I



Hilary Clark

<https://pixabay.com/photos/career-firefighter-relaxing-job-1501615/>



SCHOOL OF
PUBLIC SAFETY

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Chapter 1 - Rules and Regulations, Policies, and Standard Operating Procedures



Policy vs Procedure

Fire Officers must thoroughly know the department's regulations, policies and standard operating procedures. Officers, especially new ones, are expected to understand and enforce department rules. They must know the difference between rules & regulations, policies, and SOPs.

Rules and Regulations

Rules and regulations are developed by various government or government-authorized organizations to implement a law that has been passed. Rules may also be established by a local jurisdiction or within a fire

department that set conditions of employment. For example, a fire department may have a rule that requires all members to wear their seat belts when riding in vehicles.

Rules and Regulations do not leave any room for latitude or discretion.

Policies

Policies are developed to provide definite guidelines and act as a building block for present and future actions. Policies outline what is generally expected in stated conditions. Policies often require personnel to make judgments and to determine the best course of action within the stated policy. For example, a policy could state that the fire officer shall ensure that the station sidewalks are maintained to provide safety from slips and falls during winter conditions. This is a directive policy because it gives the officer latitude in determining how to ensure the safety of pedestrians.

Standard Operating Procedures / Standard Operating Guidelines

Standard Operating Procedures (SOPs) are sometimes referred to as Standard Operating Guidelines (SOGs) and are written by a specific response organization to standardize a method or activity performed by members of the organization. They provide detailed information to perform an expected action, and allow for judgement calls, recognizing that situations can be different. SOP's affect only the organization that wrote them. They must conform to all applicable laws and regulations; for example, a response agency cannot have an SOP that directs members

to operate in chemical protective clothing without any backup. SOPs should be in place to cover all areas of activity in which an organization's members take part. They are reviewed and amended periodically and are approved by the chief of the department.

Rules and Regulations	Policies	Standard Operating Procedures
implement a law that has been passed	provide definite guidelines	provide detailed information to perform an expected action
do not leave any room for latitude or discretion	outline what is generally expected in stated conditions	affect only the organization that wrote them
	leave any room for latitude or discretion	leave any room for latitude or discretion

Chapter 2 - Construction Classifications



Codes

Historically, a number of building codes were used throughout North America, but several of these codes have been combined. The most prominent codes used now are those published by the International Codes Council (ICC)®, NFPA 5000®, Building Construction and Safety Code® published by the National Fire Protection Association, and the National Building Code of Canada published by National Research Council Canada. Canada’s Constitution gives the ten provinces and three territories jurisdiction over construction. Some cities also have this authority through a special relationship with their provincial authority. In general, construction classifications are based on the types of materials used in the construction and on the fire-resistance ratings of major structural components.

It is important to remember that fire resistance ratings are a measure of how long structural assemblies will maintain their load-bearing ability under fire conditions,

not of how easy or difficult it will be to fight a fire in that building. Most building codes have the same five construction classifications that are described in NFPA® 220, Standard on Types of Building Construction , but may use slightly different terms to name the classifications. The five types of building construction listed in NFPA® 220 include:

- Type I – Fire-Resistive
- Type II – Noncombustible
- Type III – Ordinary
- Type IV – Heavy Timber
- Type V – Wood Frame

Type I Construction – Fire-Resistive



Type I Building
John Foxx/Alamy Images

Known also as fire-resistive construction, Type I construction maintains its structural integrity during a fire. Fire-resistive construction consists mainly of reinforced concrete with structural members, including walls, columns, beams, floors and roofs that are protected either by blown-on insulation or automatic sprinklers. The fire-resistive compartmentation, provided by partitions and floors, tends to retard the spread of fire through the building. These features allow time for occupants to exit the building and firefighters to conduct interior firefighting.

Limited combustibility of the materials of construction, makes the primary fire hazards the contents of the structure and the interior finishes. This allows firefighters to launch an interior attack with greater confidence than in a building that is not fire-resistive. The ability of fire-resistive construction to confine the fire to a certain area can be compromised by openings made in partitions and by improperly designed and in-adequately dampered heating and air-conditioning systems.



Steel Fireproofing

JUAN RODRIGUEZ

<https://www.thebalancesmb.com/>

[fireproofing-method-structural-members-845033](#)

Strengths:

- Resists direct flame impingement
- Confines fire well
- Little collapse potential from the effects of fire alone
- Impervious to water damage

Weaknesses:

- Difficult to breach for access or escape
- Difficult to ventilate during a fire
- Massive debris following collapse

- Floors, ceilings and walls retain heat

Type II Construction – Noncombustible



Type II Building

Dennis Tokarzewski/Shutterstock. Inc.

Type II construction, also known as noncombustible construction, is made of the same types of materials as fire-resistive construction except that the structural components lack the insulation or other protection of Type I construction. Type II construction has a fire-resistance rating on all parts of the structure including exterior and interior load-bearing walls and building materials. All-metal buildings also fall into this classification. Materials with no fire-resistance ratings, such as untreated wood, may be used only in limited quantities. Again, one of the primary fire protection concerns is the contents of the building. The heat buildup from a fire in the building can

cause structural supports to fail. Another potential problem is the type of roof on the building.

Noncombustible or limited combustible construction buildings often have flat, built-up roofs. These roofs consist of a combustible or noncombustible roof deck covered by combustible felt, noncombustible insulation and roofing tar. Fire extension to the roof can eventually cause the entire roof to become involved and fail.



Non-Insulated Steel Beam

East Harding Construction

<https://eastharding.com/pine-bluff-main-library-press-release/>

Strengths:

- Almost as resistive to fire as Type I construction
- Confines fire well
- Almost as structurally sound as Type I construction

- Impervious to water damage

Weaknesses:

- Difficult to breach for access or escape
- Difficult to ventilate during a fire
- Massive debris following collapse
- Floors, ceilings and walls retain heat
- Steel components subject to weakening by fire
- Steel components subject to weakening by rust and corrosion



11 Sep 2001, Financial District, Manhattan, New York, New York, USA — New York City firefighters walk through the rubble at the World Trade Center, the skeletal remains of the Twin Towers behind them. On the morning of September 11, 2001, two hijacked planes were crashed into the Twin Towers in Manhattan, killing nearly 3,000 people, including hundreds of firefighters involved in rescue operations. — Image by © Neville Elder/CORBIS

Type III Construction – Ordinary



*Type III Building
Ken Hammond/USDA*



*Strip Mall
Anthem Properties Group Ltd.
<https://anthemproperties.com/properties/heritage-hill-retail/>*

Known also as ordinary construction, Type III construction requires that exterior walls and structural members be made of noncombustible or limited combustible materials such as concrete blocks or day tile blocks. Interior

structural members including walls, columns, beams, floors and roofs are completely or partially made of wood. The wood used in these members is of smaller dimensions than that required for heavy-timber construction. See the Type IV-Heavy Timber construction that follows.

The primary fire concern specific to ordinary construction is the problem of fire and smoke spreading through concealed spaces. These spaces are between the walls, floors and ceiling. The heat from a fire may be conducted to these concealed spaces through finish materials, such as gypsum drywall or plaster, or the heat can enter the concealed spaces through holes in the finish materials. From there, the heat, smoke and may spread to other parts of the structure. If enough heat is present, the fire may actually burn within the concealed space. These hazards can be reduced considerably by packing fire-stops inside these spaces to limit the spread of the combustion byproducts (heat, smoke, etc)

Strengths:

- Resists fire spread well from the outside
- Relatively easy to vertically ventilate

Weaknesses:

- Interior structural members vulnerable to fire involvement
- Fire spread potential through concealed spaces
- Susceptible to water damage
- Walls can retain heat

Type IV Construction – Heavy Timber



Type IV Building

Courtesy of APA – The Engineered Wood Association

Also known as heavy timber construction, Type IV construction requires that exterior and interior walls and their associated structural members be made of noncombustible or limited combustible materials. Other interior structural members, including beams, columns, arches, floors and roofs are made of solid or laminated wood with no concealed spaces. This wood must have dimensions large enough to be considered heavy timber. These dimensions vary depending on the particular code being used.

Heavy Timber construction was used extensively in old factories, mills and warehouses. Traditional Heavy Timber construction is rarely used today in new construction

except for decorative reasons. The use of Heavy Timber construction with glue-lam beams is growing.

The primary fire hazard associated with Heavy Timber construction is the massive amount of combustible contents presented by the structural timbers in addition to the contents of the building. Although the Heavy Timbers remain stable for a long period under fire conditions, they give off tremendous amounts of heat and pose serious exposure protection problems for firefighters.

Strengths:

- Resists collapse due to flame impingement of heavy beam
- Structurally stable
- Relatively easy to vertically or horizontally ventilate
- Relatively easy to breach for access or escape
- Manageable debris following collapse

Weaknesses:

- Susceptible to fire spread from outside
- Potential for flame spread to other nearby structures
- Susceptible to rapid interior flame spread
- Susceptible to water damage
- Large open spaces

Type V Construction – Wood Frame



Type V Building

Jones and Bartlett Learning. Courtesy of MIEMSS

Also known as Wood Frame construction, Type V construction has exterior walls, bearing walls, floors, roofs and supports made completely or partially of wood or other approved materials of smaller dimensions than those used for Heavy Timber construction. Wood frame construction is the type commonly used to construct the typical single-family residence or apartment house of up to seven stories. This type of construction presents almost unlimited potential for fire extension within the building of origin and to nearby structures, particularly if the nearby structures are also wood-frame construction. Firefighters must be alert for fire coming from doors or windows extending to the exterior of the structure.

Strengths:

- Easily breached for access, ventilation or escape
- Resistant to collapse from earthquakes due to lightweight and flexibility
- Collapse debris is relatively easy to manage

Weaknesses:

- Susceptible to fire spread from outside
- Susceptible to rapid flame spread inside
- Susceptible to total collapse due to fire or explosion
- Susceptible to water damage

Non-standard Construction

(sometimes referred to as Hybrid Construction)



*Standard Construction – Shaughnessy Tudor
Kettle River Timberworks Ltd.
<http://www.kettlerivertimber.com/>*



*Non-Standard Construction “Curve Appeal”
Kettle River Timberworks Ltd.
<http://www.kettlerivertimber.com/>*



Log Cabin

Booking.com

<https://www.booking.com/hotel/ca/riverside-resort-whistler.html>



Pre-Fabricated Home

Ovlix

<https://www.ovlix.com/property/>

8Y5kB5-23-8508-Clerke-Road-Coldstream-BC-V1B1N2

In many parts of North America, local building codes allow non-standard buildings to be constructed under certain circumstances. These structures do not conform to any of the standard construction types listed in NFPA® 220. Some non-standard structures are allowed to be built on large properties that are in very remote areas. Others are simply new construction concepts that are not yet recognized by national building codes. Even these innovative structures must conform to local zoning and land-use standards. One example of non-standard construction are Manufactured Homes.

Other forms of non-standard construction are allowed in certain jurisdictions. To protect yourself and your fellow firefighters, you must be aware of what types of structures are being built in your area of responsibility. In other words, you must pay attention to what is going on in your response district and make frequent preincident planning surveys of construction sites.

Attic, Basement Void Space Considerations

There are aspects of the building construction that make it difficult for firefighters to get the line where it needs to be. Areas that present access issues like basements, attics and void spaces present issues that need to be addressed by the Incident Commander.

Basements are below-grade spaces. Basements are built in a variety of forms however the main consideration is there access and egress. It is easier to identify basements on the method of access: walk-out, look-out, walk-up. Walk-out basements have access points to the outside meant for access and egress from that level. Look-out basements have windows but don't allow for regular exterior access.

Walk-up basements are below grade and access and egress are via stairs interior and exterior. It is imperative that Incident Commanders evaluate the ventilation profile of basement fires, both current and future.

The latest UL studies have found that water applied via the interior basement stairs had a limited effect on cooling the basement or extinguishing the fire. However, water applied through an exterior window or door, quickly darkened down the fire and reduced the temperatures throughout the building and no fire or hot gases were “pushed” up the interior stairs.

Attics and voids are usually not meant for normal human occupancy and have restricted or no access. They usually have unprotected structural elements. The lack of fire protection in these spaces allows for the fire to spread at a more rapid pace. Consideration should be given to the structural stability of the involved systems, and possible collapse concerns. Further, when opening up spaces it should be understood that each opening presents a new flow path for gasses to move and the possible effects on the energy production of the fire.

If the attic space eaves can be accessed with the hose stream from the exterior, that is where we should start flowing water....it has been proven to be the best method to apply water into the attic space and apply water on the actual materials that are burning.

Chapter 3 - Incident Command System



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The Incident Command System (ICS) is a standardized on-site management system designed to enable effective, efficient incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure. The ICS is used to manage an incident or a non-emergency event and can be used equally well for both small and large situations.

The ICS is a usable, adaptable and well-tested approach to emergency management, that is used by government, first responder agencies and industry.

The success of the ICS rests with its:

- modular organization; (can be easily expanded or contracted as needed)
- the use of common terminology;
- unified command structure;
- span-of-control; and
- resource management

These features and positions of ICS are explained in more detail.

General Staff Functions

When an incident is too large or too complex for just one person to manage effectively, the Incident Commander may appoint General Staff Positions, called Section Chiefs, to oversee major components of the Operation.

These positions include:

- Operations “the do-ers”
- Planning “the thinkers”
- Logistics “the getters”
- Finance “the payers”

Operations (“The Do-ers”):

The Operations Section is responsible for all tactical operations at the incident. This section carries out tactical goals identified by the Incident Commander including fighting the fire, performing rescues, treating patients, and other tasks to deal with the emergency. All tactical

positions and operations report through the Operations Section Chief. These include:

- Branches
- Groups & Divisions
- Strike Teams & Task Forces
- Single Resources

Note – Staging reports to Operations when established; if not, Staging will report to Command

Planning (“The Thinkers”)

The Planning Section is responsible for the collection, evaluation, dissemination, and use of information relevant to the incident. This Section reports directly to the Incident Commander. Units within the Planning Section include: Resources Unit, Situation Unit, Documentation Unit, Demobilization Unit and Technical Specialists

Logistics (“The Getters”)

The Logistics Section is responsible for providing facilities, services and materials for the incident. In a large scale event, the Logistics Section is typically divided into two branches: The Service Branch & The Support Branch

- The Service Branch includes: Communication Unit, Medical Unit & Food Unit
- The Support Branch includes: Supply Unit, Facilities Unit & Ground Support Unit

Finance/Administration (“The Payers”)

The Finance/Administration Section is responsible for the accounting and financial aspects of an incident, as well as any legal issues that may arise. Units within the Finance/

Administration Section include: Time Unit, Procurement Unit, Compensation/Claims Unit and Cost Unit

Command Staff Functions

Command Staff Positions include Safety Officer, Liaison Officer & Information Officer. These functions are performed by the Incident Commander until the Span of Control or Incident Nature dictate they be delegated.

Safety Officer

By nature of the duties they perform, emergency responders are at risk of death, injury or illness. Incident safety should be a primary concern of all those who respond to the aid of the community or jurisdiction they serve. To help minimize the risk to responders, one of the ways the Incident Command System (ICS) provides for responder safety is by giving the Incident Commander (IC) the ability to appoint and use a Safety Officer. This position is a member of the ICS organization's command staff. While the IC has the overall responsibility for the safety of the responders, the ISO has the direct responsibility to focus on the safety aspects of the incident.

The Safety Officer is an advisor to the incident commander but has the authority to stop or suspend operations when unsafe situations occur. This authority is clearly stated in national standards, including NFPA 1521 "Standard for Fire Dept Safety Officer Professional Qualifications." General Safety Officer Duties Include:

- Monitoring safety conditions and develops measures for ensuring the safety of all assigned personnel.

- Corrects unsafe situations via the chain of command.

- May stop activity if personnel are in imminent danger.

- Prevent injury and loss of life through risk management and hazard reduction

Will continuously walking the scene, the Safety Officer will note and identify life safety hazards including but not limited to:

Swimming pools, open excavations, downed power lines, elevation changes, blocked egress points, significant changes in fire dynamics, traffic & indications of illicit and illegal activity or any other hazard to personnel.

At large scale & complex incidents, Assistant Safety Officers may be assigned to assist the ISO.

The Safety Officer should be qualified and knowledgeable in firefighting tactics, structural integrity and well versed with Department Guidelines, Policies & Procedures

The timing of Assigning a Safety Officer is dependant on a number of factors: including span of control, complexity and nature of the incident, and available personnel.

Typically a Safety Officer will come from the second alarm.

Safety Officer priority is given to incidents including high rise fires, incidents over water, commercial or industrial building fires, specialty incidents, aircraft incidents, weather extremes or Hazardous Materials incidents.

Liaison Officer

The command staff member who is responsible for the IC's communication with outside agencies. This role buffers the Incident Commander from having to deal with a number of external agencies.

(Public) Information Officer

A Command Staff position that is responsible for gathering and releasing incident information to the news

media and other appropriate agencies. This position reports directly to the Incident Commander.

This position can also be used to pass on information to on-scene crews.

Additional ICS Positions and Functions

Branches

A Branch is a Supervisory Level which is established in either Operations or Logistics to provide for appropriate Span of Control. Branches are supervised by a Branch Director in charge of a number of divisions or groups. This position reports to a Section Chief or the Incident Commander. Examples include Fire Branch, Police Branch, Special Operations Branch, EMS Branch and HAZMAT Branch.

Divisions

A Division is a Supervisory Level to divide an incident into geographical areas of operations. Divisions are supervised by a Division Supervisor in charge of a geographical operation. Examples include Division 2 (operating on the second floor), Roof Division (operating on the roof) and Charlie Division (operating at the rear of the building).

Groups

A Group is a Supervisory Level established to divide the incident into functional areas of operation. Groups are responsible for performing an assignment. They can move throughout an event and can also be established with both functional and geographical designations (e.g., west wing Rescue group and east wing Rescue group). Groups are supervised by a Group Supervisor in charge of a functional operation at the tactical level. This position reports to a Branch Director, the Operations Section Chief or the

Incident Commander. Examples include Search Group, Fire Attack Group and Ventilation Group.

Note – divisions and groups are at the same supervisory level and do not report to one another. It is the supervisors who are required to coordinate their actions and activities with each other.

Strike Teams

A Strike Team is a specific combination of the same kind and type of resources. Strike Teams are supervised by a Strike Team Leader in charge of a group of similar resources. For example, 5 Engines assembled which can be utilized to accomplish a common goal.

A Strike Team is 3-7 similar units assembled to accomplish a common goal.

Task Forces

A Task Force is a combination of mixed resources assembled for a tactical need. A Task Force is supervised by a Task Force Leader in charge of dis-similar resources. Examples include 1 Engine, 1 Rescue, 1 Ladder assigned to a single alarm building fire or 1 Engine, 1 Police Unit, 1 Ambulance assigned to mitigate a common goal.

A Task Force is 3-7 mixed units assembled to accomplish a common goal.

Single Resources

Single Resources are Companies and Crew available for tactical needs

Company is the apparatus and staff that operate it

Crew is only the staff, not including the apparatus

Single Resources are individual pieces of equipment and/or personnel available for tactical needs.

Staging

Staging is a standard procedure to manage uncommitted resources at the scene of an incident. This organization allows the incident commander to determine the most

appropriate assignment for each. Without proper staging, an IC can quickly lose control of resources at a scene. There are two levels of staging:

Level 1 Staging

Level 1 staging is in total control of the Incident Commander and typically represents the first alarm assignment. Generally at the incident or close at hand for the IC to utilize during the initial tactical operations, down the street, nearest corner, secondary water supply etc. Level 1 staging allows the IC time to determine the best initial strategy and tactics and to minimize on scene congestion allowing for an organized positioning of apparatus and deployment of initial resources.

Level 2 Staging

This level of staging is generally used for greater alarm assignments and directs responding companies to a designated standby location (chosen by the IC) located a short distance away from the immediate scene location. All other support services can be directed to this location. This distance should be no closer than 300 feet from the incident but close enough for immediate deployment of resources when requested. Level 2 staging areas always have a staging manager and preferably at least 1 assistant, who reports directly to the IC when running the incident or to the Operations Section Chief if one has been established. Areas within level 2 staging can include on-deck or immediately available crews, and food, medical, rehab, fuel, etc.

Fire Ground Geography



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For the purposes of firefighting operations, the exterior of the scene is generally divided into specific regions or designations based on geography. Building sides are designated as Alpha, Bravo, Charlie and Delta.

The front, or “address side” is usually identified as the Alpha with Bravo, Charlie and Delta follow clockwise to the left of Alpha .

Although Alpha is the “normally” the address side, the Alpha side can be wherever the IC designates.

Hazard Control Zones

The concept of limiting access to the fire scene can be defined in a variety of ways. It seems appropriate to extend the lessons learned from hazardous materials responses regarding zones, as similar zones are possible at structure fires. Working areas for responders are generally defined as Hazard Control Zones, whereas a fire perimeter or fire zone is an exclusion area to keep unauthorized people away from the scene.

These areas and zones can include:

Fire Zone – a wide perimeter beyond the working zones usually staffed by police to keep unauthorized people away from a scene and out of danger.

Hot Zone – a working or operating zone considered safe for only responders wearing appropriate levels of protective clothing.

Warm Zone – a working zone established when different levels of protective clothing are needed for

various areas. A Warm zone is not always necessary at a structure fire.

Cold Zone – a working zone considered safe for responders where protective clothing is not required. Areas commonly located in this zone can include the command post, medical treatment and rehabilitation areas, or other areas for staff and command functions. In most cases, there should be a cold zone established.

Securing the Scene

A fire officer who suspects that a crime has occurred should immediately request the response of a fire investigator or police. In these circumstances, the scene must be secured to protect any evidence that exists. Protecting the scene includes preventing unauthorized personnel from entering. The fire officer must ensure that fire department personnel maintain custody of the scene until it can be turned over to an investigator or police.

Responsibilities of Command

The Fire Officer is responsible for completing three strategic priorities:

- Life Safety
- Incident Stabilization
- Property Conservation & Environmental Protection
- Establishing Command

The first fire officer or fire department member to arrive at a scene is expected to assume command of the incident. Assuming command includes providing an initial radio report announcing:

- Who is in command

- What do I see
- What am I doing
- What do I need

Example: “Dispatch, Engine 1 is on scene at 123 Main Street. We have a 2-storey type V legacy construction 50’ x 100’ detached single-family house...with heavy black turbulent velocity smoke and flame self-venting from the second story alpha-bravo corner. Engine 1 is establishing Main Street Command and is located on the Alpha Side. We have secured a water supply and will be doing some confinement and this will be an offensive attack. Command is requesting a second alarm, Police x4, BC EHS x2, Hydro & Gas.”

Command Options

The IC has three options when arriving at an incident and assuming command.

Investigation Mode

Used when no obvious hazard is present and further investigation is required

Fast Attack Mode

Used when immediate intervention is required for life safety or incident stabilization. While the first Officer is in Command, this is designed for a short duration until the situation is stabilized. If the situation cannot be stabilized quickly, the Officer must withdrawal and transition to Command Mode. Fast Attack can also be used when a Company Officer is task involved, and command is transferred to the next arriving Company Officer.

Command Mode

Some events are so large, complex, or dangerous

that they require an immediate establishment of Command

Functions of Command

1. Determining Strategy
2. Selecting Incident Tactics
3. Setting the Action Plan
4. Developing the ICS Organization
5. Managing Resources
6. Coordinating Resource Activities
7. Providing for Scene Safety
8. Releasing Information about the Incident
9. Coordinating with Outside Agencies

Levels of Command

The ICS includes three levels of command, with a set of responsibilities being assigned to each level.

Strategic Level

Strategic Goals: Prioritized strategic goals must be formulated prior to the development of tactical assignments. Strategic goals are broad-based objectives that commonly answer the question “what needs to be one?” Rescue is an example of a strategic goal. The commonly used acronym for determining strategic goals is RECEOVS

Tactical Level

Tactical Objectives: Tactics are more specific than strategies but are based on strategic goals. Tactics commonly answer the questions “how are we going to accomplish this goal?” For example, a “right-hand primary

search” could be a tactic that would be chosen to support the strategic goal of rescue.

Task Level

Task Level Assignments: The task-level involves the “doing part” of the action plan. This is based primarily on training, Operational Guidelines and established practices. Task level assignments also answer the questions “who is going to do it and what will they need?” An example would be “Engine Four’s Company will conduct the primary search on the second floor with a charged hose line.”

One Company Officer may operate at any of these three levels simultaneously. For example: at an early stage of an incident as the Incident Action Plan develops. As the incident expands in scope and complexity and more resources arrive, the management responsibilities can be shared, delegated or subdivided in order to maintain span of control.

Transfer of Command

During a major incident, the first-in officer will usually transfer command to a higher ranking officer or chief officer upon their arrival. A “large incident” is department-specific, however, all departments have the ability to utilize the Incident Management System to ensure the situation is covered from all angles. The initial Company Officer will start the scene, start their own IAP and once relieved of command, will support the IC within the expanded system. Not all incidents fully develop the IMS; however all incidents will utilize several positions – and if the call gets out of control quickly, it can be expanded to give the Department the tools necessary to mitigate the problem

Command is transferred by:

- Face to Face or radio communication by Acting IC and incoming IC with information about the call ie: Confirmation of tactical assignments, strategic mode and action plan
- Verbal broadcast over the radio so all teams and dispatch are aware of who is now in Command

Sizing Up the Incident

Size-up is a systematic process of gathering and processing information to evaluate the situation and then translating that information into a plan to deal with that situation.

Size-up Phases

The National Fire Academy (NFA) has developed a size-up system that includes three phases:

1. Pre Incident information
2. Initial size-up
3. Ongoing size-up

Phase One: Pre Incident Information

Phase one considers what you know before the incident occurs. Information about the building and occupancy, such as building layout and construction type, built-in fire protection systems, nature of the contents and construction type are all needed to perform an accurate size-up. Pre Incident information should also identify water supply sources including their: location, accessibility and capacity.

Phase Two: Initial Size-up

The second phase of the size-up begins with receipt of an alarm.

Three questions to be answered are:

1. What do I have?
2. Where is it going?
3. How do I control it?

This phase often involves a 360 walk-around of the building to determine what the problems are? Problems assessed can include:

- Fire and location
- Room and contents fire vs structural involvement
- Confirmed or possible occupants
- Smoke conditions including colour, volume, density, colour and rate of change
- Building construction type
- Water supply and exposure concerns, or
- Any other problems or concerns identified

S.L.I.C.E.R.S. is a common size-up acronym that stands for **Size-Up** = **L**ocate the Fire, **I**solate the Flow Path, **C**ool from a Safe Distance, **E**xtinguish and then **R**escue and **S**alvage are considered tactics of opportunity added in as necessary. While most agree that the latest research can improve firefighter safety, they struggle to translate the research into fireground tactics and implement that change in a successful model – SLICERS was developed to “operationalize” fire dynamics research. This acronym rethinks the tactics of old and incorporates the latest research into operations with a focus on fire flow path and rapid water for cooling, from outside if possible. The

concept has been vetted with the lead researchers involved at UL and NIST and has their endorsements.

The SLICERS acronym is NOT designed to replace the well known RECEOVS method (discussed later) that has been widely adopted by the fire service over the years but instead is to be used by the first arriving company officer to assist with size-up. Where RECEOVS is more for the Battalion Chief/Incident Commander and their tactical priorities and remains an overall incident management tool.

Phase Three: Ongoing Size-up

The third phase addresses the need to continually size up the incident as it evolves. This phase includes ongoing analysis of the situation and the ongoing evaluation of the effectiveness of the plan being executed.

The ongoing size-up requires a constant flow of feedback. The Incident Commander needs to know when:

- An assignment is completed
- An assignment cannot be completed
- Additional resources are needed
- Resources can be released
- Conditions have changed
- Additional problems have been identified
- Emergency conditions exist

Given the amount of information that an IC must assimilate, it is easy to lose track of how much time has passed on the fireground. NFPA 1500 now requires dispatch centers to notify command every 10 minutes until the fire is knocked down, the incident becomes static, or the IC cancels the notification. This notification helps the IC track elapsed time.

Note – it is critical that burn time takes into account the time the fire was burning prior to notification and while units were responding, not just the amount of time since they arrived on the fire scene.

Operational Mode

As part of a size-up, the incident commander should declare an operational mode. This lets everyone on the fireground, and those responding know what the rules of engagement will be. Generally, there are three operational modes:

Offensive Mode

An offensive strategic mode is appropriate in a fire's early growth or when sprinklers are limiting the fire's growth. This mode is chosen when firefighters are going to enter the building to fight the fire and/or rescue occupants. Offensive mode is often selected in a fire that involves room and contents only and has not progressed to include the structural components of the building. A suitable initial tactic when fire is showing from the exterior of a building is to pencil the fire in order to confine it and set the fire clock back. This tactic is often utilized by first arriving crews to stabilize the situation until additional resources arrive or water supply is established. Depending upon the success of this initial water application from the exterior an offensive operational mode can then be selected.

Structural conditions bear heavily on the offensive or defensive decision. Even with sufficient resources, an interior attack should not be conducted in an unsafe building.

Defensive Mode

A defensive mode is appropriate when initial attack efforts are not successful or when a fire has progressed

to the point where the structural stability is questioned. A defensive mode is also appropriate when insufficient resources or water are available to fight a fire. It should be noted that once an operational mode is chosen it can be changed. For example, an offensive operational mode may initially be chosen to perform a rescue or to fight a fire, once complete the decision can be made to switch to defensive mode.

Transitional Mode

Used when initial crew(s) arrive one scene and are presented with smoke and flames showing from an exterior opening, usually a window. The initial tactic is to use a handline to action/confine the fire (straight stream, steep in the window and steady – no movement of the stream). The goal is to reset the fire clock, buying time for resources to arrive while at the same time making conditions inside the structure more enable for possible occupants and entering fire attack teams. Also with the fire knocked down, more aggressive ventilation can follow without the risk of inducing flashover.

NIST and UL studies showed that this offensive exterior attack – introducing water from the outside – reduced temperatures in other parts of the house at some distance from the fire but did not completely extinguish the fire. It slowed the growth of the fire by cooling huge quantities of very hot gaseous fuel and solid fuel below its ignition temperature. This offensive exterior attack is sometimes referred to as a blitz attack, a transitional attack or, by using a military metaphor, softening the target.

Non-intervention Mode

There are times when non-intervention is the most appropriate option, such as when hazardous materials are involved and the runoff would be environmentally worse than letting the fire burn or when it is simply too dangerous

to fight a fire. It is important to emphasize that these decisions are often made following a risk vs. benefit analysis.

Developing an Incident Action Plan (IAP)

The first arriving officer at a fire incident assumes the role of the incident commander. The initial incident commanders responsibilities include conducting a size-up, developing an incident action plan to mitigate the situation, assigning resources to execute the plan, develop a command structure to manage the plan and ensuring the plan is executed safely.

After size-up, the incident commander develops an IAP based on incident priorities.

There are two major components to the IAP:

Strategies

The determination of the appropriate strategy (strategic goals) to mitigate an incident.

Strategic Goals – prioritize strategic goals must be formulated prior to the development of tactical assignments. Strategic goals are broad-based objectives that commonly answer the question "what needs to be done?" Rescue is an example of a strategic goal. The common acronym for determining a strategic goal is RECEOVS.

Tactics

The development of tactics (tactical objectives) to execute the strategy.

Tactical Objectives – tactics are more specific than strategies but are based on strategic goals. Tactics commonly answer the question "How are we going to accomplish this goal?" For example, "a right-hand primary

search” could be a tactic that would be chosen to support the strategic goal of rescue.

Incident Priorities

Life Safety

The life safety priority refers to all people who are at risk, this includes the general public and all responders. Life safety is firefighters’ highest priority. That said, there are a number of ways to protect life at a building fire and these Incident Priorities are not necessarily in order. An example is a first arriving engine company who is presented with a trapped occupant due to a fire. It may be beneficial to control the fire, initially, and create a safer atmosphere for occupants while waiting for more fire apparatus and resources.

Incident Stabilization

The incident stabilization priority is directed toward keeping the incident from getting any worse. If one structure is fully involved, protecting exposures is part of incident stabilization. In such a case, the burning structure cannot be saved, but firefighters can ensure that the fire will not spread beyond the initial building. At a fire incident, it is important to remember that the fire department was called for a fire. For example, in a room and contents fire that is self-venting from an exterior window is crucial to apply water early to stabilize the incident and prevent it from worsening. In doing so responders accomplish life safety, incident stabilization and property conservation.

Property Conservation

Property conservation is directed toward preventing any additional damage from occurring. Such measures could include minimizing water damage by covering building

contents with salvage covers or to remove contents from harm's way. Although property conservation is an important incident priority, many contents are now easily replaceable. As consumer goods have evolved to be more "throwaway" it is important to balance property conservation with firefighter safety and other incident priorities such as environmental protection.

Environmental Protection

Environmental protection has become increasingly important in the past years. Fire service organizations are being held to a higher standard in terms of protecting the environment. This is due to increased awareness and more strict environmental regulations. An example for the fire service may be to let a fire burn, given there are no immediate life-safety concerns, as a way to protect the environment from toxic runoff at a hazardous materials fire.

Tactical Priorities

When the first company officer arrives on scene there are a number of things that need to be accomplished. Identifying an incident's tactical priorities will assist the officer in prioritizing the things needing to be done and in what order. The acronym RECEOVS+RIT can be applied to help provide guidance. The acronym stands for: Rescue, Exposures, Confinement, Extinguishment, Overhaul, Ventilation, Salvage and RIT or Rapid Intervention Team. The priorities are interchangeable based on the event and can be altered to ensure the highest hazards are dealt with first, and others when resources are available to do so.

For example, Rescue can be an operation that happens simultaneously with confinement. Further, if the occupants are not in immediate danger it may be safer to confine

and extinguish prior to removing the occupant from the building.

RECEOVS + RIT

Rescue

Rescue is one of the highest incident priorities. Rescue involves, searching for and removing occupants them from the hazardous area. Search can depend on the availability of resources, the size and complexity of the building and the condition of occupants. The possibility of occupants varies based on

- Occupancy
- Season
- Day of the week
- Time of day
- Hours of operation

Exposures

Exposures are adjoining spaces, neighbouring buildings or property that has the likelihood of being negatively affected by the fire. The risk to exposures can also be limited by accomplishing other tactical priorities prior to.

Confinement

Confinement is done to control the spread of a fire and limit the involved areas.

This can be accomplished by:

- Pencilling the fire. Applying water from the exterior through openings into the fire compartment.
- Positive Pressure Pressurization (PPP). Pressurizing a “box” in order to inhibit the

spread of fire from an adjoining “box”. The theory is that fire will generally travel from a high-pressure area to an area of lower pressure.

- Positive Pressure Attack (PPA) . Using positive pressure to direct fire flows from an opening to an exit/exhaust close to the fire compartment, creating a unidirectional flow.
- Closing doors and Windows. Limiting the fresh air the fire will limit the amount of energy the fire is able to create. By reducing energy production, temperatures are reduced and fire spread is slowed.

Extinguishment

Extinguishment is the mitigation of the hazard. It is the ceasing of energy production from the fire. NIST and UL research highlight the dramatic impact of initial water. As little as 30-60 seconds of water directed into a compartment will provide benefits like a dramatic reduction in energy production, and improved interior conditions benefiting both occupant and suppression firefighters.

Overhaul

Overhaul is seeking to ensure the fire is completely out. All six sides for the involved areas have been investigated to ensure there has not been any further extension. The six sides include the four walls, the floor, the ceiling and the last are any concealed or void spaces. During this process, ventilation can be used to increase visibility as well as using a thermal imager to detect any sources of energy production that may not be visible to the eye.

Ventilation

Ventilation as a tactic, when performed by firefighters,

should be accomplished with clear communications and agreed-upon expectations and outcomes. Tactical ventilation is altering the natural flow paths of the fire event and changing them to enhance the abilities of firefighters to stabilize the incident. Methods performed in the confinement portion can also be applied in this area. Consideration should also be paid to environmental and hydraulic effects on ventilation:

Environmental: take into account wind direction and its effect on the direction of flow at openings. Crews should avoid working downwind of a fire. High winds can dramatically change the flow of openings and drastically change the flows through the interior of the structure.

Hydraulic ventilation can also be used to remove products of combustion and improve visibility.

Positive Pressure Ventilation (PPV): the use of a positive pressure by way of a high-velocity mechanical fan to push products of combustion out of the fire compartment improving visibility.

Salvage

Salvage is the protection and removal of property to reduce the extent to which the fire event has affected them. This may include using salvage covers, hiding electronics under mattresses, or removing medications from the building.

Chapter 4 - Risk-Benefit Analysis



David Mark

*[https://pixabay.com/photos/
fire-flames-building-house-home-89353/](https://pixabay.com/photos/fire-flames-building-house-home-89353/)*

The Risk vs Benefit Analysis is a key component to the IC's size-up when deciding on a strategic mode. The Fire Department will "risk a lot to save a lot", "risk a little to save a little" and "risk nothing to save nothing"

Risk a lot to Save a Lot

The IC will determine that there is a high chance of survivability and they have a strong chance of rescuing an occupant, protecting property or the environment. They

will assign crews to do an aggressive fire attack and search while risking the health and potential death of a firefighter. These risks could include floor collapse, roof collapse, medical emergency, flashovers and backdrafts. An offensive attack with multiple crews entering a two-story house with a compartmentalized fire and heavy smoke with reports of a trapped child would be risking a lot to save a lot.

Risk a little to save a little

The IC will determine that there is a low to moderate chance of survivability or protecting the structure, property or environment. While there may be the potential for a patient to be rescued, the fire might need to be controlled before the firefighters enter the structure. A quick attack from outside the structure to darken the fire may allow the firefighters to then enter and perform their tasks.

Risk nothing to save nothing

The IC will determine that there is no benefit to risking the firefighters' life, safety and health when there are no signs of survivability or damage to the property/environment is too great. Significant fire involvement, extreme heat or building collapse would lead the IC to this decision. This would become a defensive fire, and firefighters would attack it from outside only.

Contributing factors into the Risk vs Benefit Analysis

Time of Day

Is the building occupied? At night, a house is

expected to have people inside vs daytime when they might be at work/school

Is it a Holiday/Stat or a regular workday

Vehicles

Are there cars parked in the driveway/parking lot, or is the driveway/parking lot empty

On Scene Reports/Indications

Occupant indicates there are people still inside the structure

Neighbours can inform you if the family is away on holidays, or if they are normally home at this time

Are there children who should be at school, or toddler aged children who would normally be home with a parent

Are there elderly, handicap or special needs people inside the house

Is the house abandoned/boarded up/slated for demolition

Smoke & Fire Conditions

Is there significant fire involvement throughout the house

Is the fire through the roof/has the roof collapsed

Is the fire isolated to a single room

Are the smoke conditions favourable for an occupant to survive

Where is the fire located

Structural Specific

How long has the fire been burning, and has it started to affect the frame structure

What type of building construction

What is the layout of the building

Are there sprinkler systems/shelter-in-place procedures

What is the Occupancy Class

Fire Department Specific

Is there a water supply available

How close is the next in Apparatus

Is there a RIT team

Chapter 5 - Communications, Accountability and Rapid Intervention Teams



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Communications

Clear effective communications are essential for a fire officer. These skills are required to provide direction to crew members, review new policies and procedures, and simply exchange information in a wide range of situations. One of the most important skills for a fire officer to develop is the ability to communicate effectively and manage communications during emergency incidents. Emergency

communications require the fire officer to be confident and direct. This involves asking precise questions, giving clear and specific orders and providing accurate information in a timely fashion. That said, your success as a supervisor or an incident commander depends on how effectively you listen. As firefighters and team leaders provide updates and feedback to you it is essential that you listen and support them. Listening skills must be continually practiced.

Effectively transmitting radio reports requires a unique skill set. It is important for a fire officer to demonstrate proper radio protocols. The exchange of information should consist of a standardized format.

One example is the “**Three C’s Format: Connect, Convey and Confirm**

Connect with the intended recipient

Example, (sender) “Attack 1 this is Command”
(receiver) “go ahead”

Convey your message

Example, (sender) “your clear to enter from Alpha 1st floor to Delta 2nd floor for fire attack.”

Confirm that the message understood

Example, (receiver) “Attack 1 is entering Alpha on 1 going to Delta on 2 for fire attack.”

To further enhance effective radio communications, the fire officer should use common language in a Calm, Clear and Concise manner.

Firefighter Accountability & Crew Integrity

Crew integrity is a critical element for firefighter safety. This means that firefighters stay together as a team of two or more, and at no time is a firefighter alone when operating inside a burning structure. It is critical that everyone at the scene is being supervised by someone.

Following this concept will ensure that no one goes unaccounted for.

Accountability is a system used to track the location of crews while operating at an emergency scene. This system is overseen by Regulatory Bodies and Department SOG/P's & Policies. There are many different systems available to track responders working on an emergency scene. For example, in British Columbia, most fire departments use the Passport Accountability System. This system utilizes a series of individual name tags placed on passports representing companies (Engines, Ladders and Rescues).

Rapid Intervention Team (RIT)

The Rapid Intervention Team's sole task is to be "a dedicated crew of firefighters who are assigned for rapid deployment to rescue lost or trapped members." NFPA 1407, Standard for Training Fire Service Rapid Intervention Crews explains what is required from a Rapid Intervention Crew. The crew can be two members from the Initial arriving apparatus, however, should be replaced by a dedicated crew of 2-4 (at a minimum) Officer/Firefighters at the earliest possibility.

Most Departments have developed RIT training and deployment procedures and utilize the standard "MAYDAY" communication to indicate a lost firefighter, injured firefighter or to transmit critical life-safety information to the Incident Commander. Any time a RIT team is deployed, they have priority on the radio system. Depending on a Departments Procedures, Dispatch may automatically initiate another alarm once a RIT deployment has happened. This can include additional engines/trucks, ambulances and Chief Officers. During a RIT deployment, it is possible that the RIT team leader

might stay outside the building to liaison with the Incident Commander.

Rapid Intervention Teams should be consistently monitoring the building for changes in fire, smoke, structural stability, as well, monitoring radio communications to ensure they are aware of the number of firefighters and their locations inside the building.

The primary duties of a RIT are to prepare for, and to rescue trapped, injured or missing firefighters. Secondary duties can include: establishing a second means of egress on every floor firefighters are working at a structure fire, to control utilities, prepare a rescue action plan and to establish a RIT staging area equipped with dedicated rescue equipment. Examples of RIT equipment include:

- Additional SCBA/cylinders
- Forcible Entry Tools
- Search Ropes
- Thermal Image Cameras
- Dedicated Hose Lines
- Chainsaw/Rotary Saw depending on Building Construction
- Emergency Medical Equipment
- Other tools as per Operating Guidelines

In British Columbia, Worksafe BC Occupational Health and Safety Regulation 31.23 states the following:

“(1) When self-contained breathing apparatus must be used to enter a building, or similar enclosed location, the entry must be made by a team of at least two (2) firefighters.

(2) Effective voice communication must be maintained between firefighters inside and outside the enclosed location.

(3) During the initial attack of an incident, at least one (1) firefighter must remain outside.

(4) A suitably equipped rescue team of at least two (2) firefighters must be established on the scene before sending in a second entry team and not more than ten (10) minutes after the initial attack

(5) The rescue team required by subsection (4) must not engage in any duties that limit their ability to make a prompt response to rescue an endangered firefighter while interior structural firefighting is being conducted.”
(Worksafe BC, 2019)

Chapter 6 - Firefighter Survivability and Structural Stability

A 30-year review of NFPA annual firefighter fatality reports by the Fire Analysis and Research Division identified a concerning trend (Fahy, 2007, p. 49);

The one area that had shown a marked increase during the period is the rate of deaths due to traumatic injuries while operating inside structures. In the late 1970s, traumatic deaths inside structure occurred at a rate of 1.8 deaths per 100,000 structure fires and by the late 1990s had risen to approximately 3.0 deaths per 100,000 structure fires. Since that time, the rate has fallen and now stand at 1.9 deaths per 100,000 structure fires, a rate only slightly lower than that observed in the early 1980s. Almost all of the non-cardiac fatalities inside structure fire were the result of smoke inhalation (62.1 percent), burns (19.1 percent) and crushing or internal trauma (16.5 percent).

Although firefighter deaths per 100,000 structure fires have decreased since the late 1990s, there are newer concerns the fire officer must be aware of. The hazards firefighters are exposed range from those like building construction, building contents and fire dynamics.

The modern fire environment has seen the introduction of a number of new elements that are changing the way fires grow and spread. Buildings structural members are made with low surface-to-mass ratios which allow them to more rapidly break down and become less stable, thus failing sooner. Foam insulation that when heated, rapidly

releases toxic gasses. Open floor plans allow for air to move more easily through the structure creating energy with higher efficiency.

Many of the contents in homes today are made from man-made synthetic materials. Today's smoke contains some of the most dangerous and fatal chemicals known, including; hydrogen cyanide, polyvinyl chloride, formaldehyde, hydrogen chloride and carbon monoxide. Not only is modern fire smoke significantly more toxic than the smoke of yesterday but there is more of it. Synthetic building contents have a smoke production level that may be as much as 500 times that of a similar fire burning wood and cotton contents.

The information coming from NIST and ULFSRI have provided context into the ways the fire dynamics are changing the fire environment. Implementing fire dynamic principles on the fire ground is a tool probationary and veteran firefighters must learn and develop. The ability to identify flow paths is important to determine where a fire is, and where it may go in the future. The skill of interpreting smoke and understanding its relationship to pressure will provide clues to the fire's level of involvement, location and possibility for growth.

Understanding the variety of problems in today's modern fire environment will hopefully equip the Fire Officer with the tools necessary to identify and mitigate modern hazards.

Structural Stability

Structural failure can occur at any time. Fire intensity, burn time, content loads and construction methods and materials all affect structural stability. As fuel packages and heat release rates have increased, changes to building

design and construction have created new challenges for firefighters. Increasingly, buildings are being constructed from lightweight and engineered materials and components decreasing their ability to withstand the effects of fire. As a result, we are seeing buildings fail faster than ever before.

Always consider structural stability when sizing up the fire scene.

Chapter 7 - Structure Fire Research



NIST

<https://www.nist.gov/news-events/news/2008/03/nist-evaluates-firefighting-tactics-nyc-high-rise-test>

The time-temperature graph typically referenced in instructional manuals has changed to reflect the modern fire environment. Based on studies from ULFSRI and NIST it has been shown that the amount of energy produced by the fire is related to the available air. A fire in a box will produce energy in proportion to the amount of air in the box. As the air in the box is used and oxygen levels decrease so too will the energy production, and the fire will begin to decay. If an opening is created in the

box, and air enters, the fire will begin to produce energy again. The amount of air is the governing factor for the amount of energy produced. If a second opening is made in the box the energy production would further increase, this will reflect in greater energy production and higher temperatures than the first two examples.

Consideration should also be given to the length of time between the decay stage and the introduction of fresh air. The introduction of fresh air can happen as a result of a failure in a window or through firefighting tactics. The speed at which the fire will resume producing energy is dependant on a number of circumstances, but we need to understand that if nothing is done and the fire is given air, the energy production will increase and things are going to get worse.

The energy production of a fire can be looked at in a **Fuel Limited vs. Vent Limited relationship**. In the early stages of fire development, energy production is predominantly governed by the amount of fuel, making it Fuel Limited. As the fire grows the energy production becomes predominantly dependent on the amount of oxygen available, making it Vent Limited. Identifying the difference between the two provides context for the fire officer to begin to evaluate other fire indicators.



The energy production of the fire and its effects on the movement of gasses requires a deeper look into gas laws, pressure, flow paths. These core concepts will allow the

officer to evaluate and identify ventilation openings and smoke characteristics to make educated decisions on the extent and location of the fire.

Gas Laws

The Gas Laws help us to interpret what the smoke is telling us, and are governed by physics.

- **Charles Law 1787** states that the volume of a gas at constant pressure is directly proportional to its temperature
 - Gasses expand when heated, and contract when cooled
 - Gasses become less dense and rise when heated
- **Guy-Lussac's Law 1802** found when the volume of gas remains the same and the temperature is increased, pressure increases in proportion to the temperature of the gas.
 - When gasses are confined and heated, pressure increases.
 - Increased pressure indicates higher temperatures.

These laws can be used to begin to evaluate the smoke exiting a structure. If it moves fast, the smoke has heat and the fire is creating a lot of energy. With the heat comes the creation of pressure, and with pressure comes higher temperatures. We can evaluate the smoke based on these characteristics and look at the Flow Path or Paths and

smoke characteristics to gain further information on the location and extent of the fire.

Flow Path

The Flow Path is the movement of heat and smoke from the higher pressure fire area toward the lower pressure areas on the interior and exterior of the structure. The Flow Path or Paths can provide clues for evaluating the fire problem. Evaluating the opening and determining the location of the neutral plane, as well as the direction of flow, the officer will begin identifying the possible level and location of the fire problem.

The atmospheric balance between the higher temperature gasses and the fresh air. The neutral plane can be used to assess the opening and its role in the flow path. If the neutral plane is in the middle of the opening it is likely a main ventilation opening for the fire. If the neutral plane is at the top or bottom of the opening the flow is unidirectional and is an indication that there is another ventilation opening somewhere else in the structure.

- **Uni-Directional** – gas flow in one direction through a single opening. As an inlet or an outlet, the officer must come to a resolution that there is another opening completing the equation.
- **Bi-Directional** – gas flow both ways through an

opening. Fire gasses exit the top part of the opening while fresh air enters the bottom. Often this indicates that this opening is the only inlet/exhaust to the fire area.

Ventilation opening classification and identification requires an understanding that higher temperature gasses will seek lower pressure areas. As pressure is created in the area of origin, smoke will move through the path of least resistance. These flows will be governed by gas laws with hot gasses going up and away to lower pressure areas.

With the assessment of flow paths, it is also important to understand the principles of conservation of mass. We are unable to see fresh air moving, however, if we see smoke exiting, the Conservation of Mass Principle tells us that something is replacing it. So, when applied to bidirectional flow, we can see smoke exiting, but only on the top half of the window, and void space below. We know, based on this principle that it is fresh air that is replacing the smoke that is exiting. We also know that the fresh air will bring oxygen that will allow the fire to continue to create energy.

Evaluating Smoke

Evaluating smoke can further provide context for the officer to assist to create an effective Incident Action Plan. Evaluating smoke involves requires interpreting the Volume, Velocity, Density and Colour.

- **Volume** – how much. If there is a lot of smoke, it is likely that it is a large fire beyond the incipient stage.
- **Velocity** – how fast. If smoke is moving fast

there is a greater temperature difference between where the smoke is being generated and connected spaces. Hot smoke will be turbulent and rise fast, whereas cool smoke will have a laminar flow. In comparing the two, laminar flow smoke has travelled some distance from the seat of the fire versus turbulent smoke that rises quickly is indicative of smoke with a lot of temperature.

- **Density** – how thick. The thicker the smoke, the less complete the combustion. Smoke is fuel. If the fuel is too rich and unable to burn due to oxygen limitations, consideration has to be given to the flammability range of dense smoke and its capacity to further spread the fire.
- **Colour** – how it appears. It is not an exact science. It is more likely to be used as a tool to indicate the stage of heating and location of the fire within the building by comparing smoke in different locations. Light colour smoke can be considered early stage burning. Black or carbon-rich smoke can indicate incomplete combustion.

Flow-Path Videos

Second Floor Vented Bedroom Fire (bedroom door closed)



*A YouTube element has been excluded from this version of the text. You can view it online here:
<https://pressbooks.bccampus.ca/esm1/?p=83>*

Second Floor Vented Bedroom Fire (bedroom door open)



*A YouTube element has been excluded from this version of the text. You can view it online here:
<https://pressbooks.bccampus.ca/esm1/?p=83>*

Second Floor Vented Bedroom Fire – Forced Ventilation
(bedroom door closed)



*A YouTube element has been excluded from this version of the text. You can view it online here:
<https://pressbooks.bccampus.ca/esm1/?p=83>*

Smoke as Fuel



*A YouTube element has been excluded from this version of the text. You can view it online here:
<https://pressbooks.bccampus.ca/esm1/?p=83>*

Second Floor Vented Bedroom Fire – Forced Ventilation
(bedroom door open)



*A YouTube element has been excluded from this version of the text. You can view it online here:
<https://pressbooks.bccampus.ca/esm1/?p=83>*

Bidirectional Flow through Front Door – First Floor Fire
(bedroom door open)



*A YouTube element has been excluded from this version of the text. You can view it online here:
<https://pressbooks.bccampus.ca/esm1/?p=83>*

Level Entry Unvented Bedroom Fire (bedroom door closed)



*A YouTube element has been excluded from this version of the text. You can view it online here:
<https://pressbooks.bccampus.ca/esm1/?p=83>*

Level Entry Unvented Bedroom Fire – Door control



*A YouTube element has been excluded from this version of the text. You can view it online here:
<https://pressbooks.bccampus.ca/esm1/?p=83>*



A Justice Institute of British Columbia element has been excluded from this version of the text. You can view it online here: <https://pressbooks.bccampus.ca/esm1/?p=83>

Chapter 8 - Calculating Fire Flow

There are different calculations available to formulate the rate of flow required at a structure fire.

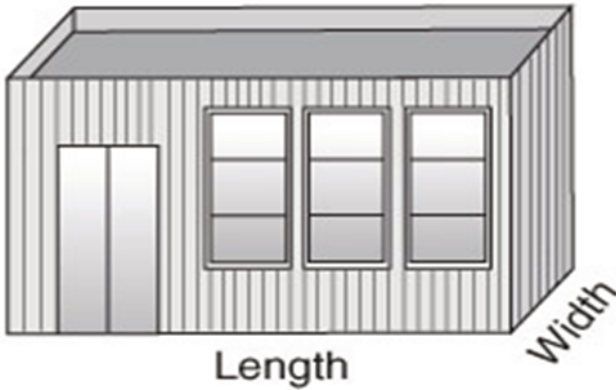
This program will utilize the National Fire Academy Formula (NFA) formula.

$[(\text{Length} \times \text{Width}) \div 3] \times \text{percentage of involvement} = \text{GPM Required}$

Given the difficulty of accurately calculating the square footage, a strong recommendation is to include estimating size during training operations and including building sizes on pre-incident planning.

Problem:

A 40' x 30' building is $\frac{1}{4}$ involved



Solution

Equation: $[(40' \times 30') \div 3] \times .25 = 100 \text{ (GPM)}$

The fire flow of 100 GPM is easily attainable by a single 1 3/4" handline set at 125 GPM. The Incident Commander will utilize their firefighters inside the structure to determine if there is enough water flowing for their attack. If firefighters report that the GPM is not a high enough flow rate, then the IC should consider the possibility that water is not being effectively applied to the burning material, the nozzle is set to an incorrect gallonage or a different attack strategy is required.

Chapter 9 - Personnel Requirements



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There are three NFPA requirements for Personnel at a Structure Fire:

- NFPA 1710 – Career First Alarm Assignments
- NFPA 1720 – Volunteer First Alarm Assignments
- NFPA 1500 – Initial Staffing Requirements

NFPA 1710 – Career First Alarm Assignments

This standard establishes the minimum staffing levels for the initial response:

- Tasks to be accomplished
- Personnel needed
- Minimum of 14 personnel (15 if an aerial device is being used)
- If needs are not met, must call for mutual aid or additional alarms

NFPA 1720 – Volunteer First Alarm Assignments

This standard applies to Volunteers. In general, 1720 provides the following benchmarks:

Urban Zones with greater than 1000 people/square mile
Calls for 15 staff to assemble an attack in 9 minutes, 90% of the time

Suburban Zones with 500-1000 people/square mile
Calls for 10 staff to assemble an attack in 10 minutes, 80% of the time

Rural Zones with less than 500 people/square mile
Calls for 6 staff to assemble an attack in 14 minutes, 80% of the time

Remote Zones with a travel distance equal to 8 miles
Calls for 4 staff, once on scene, to assemble an attack in 2 minutes, 90% of the time.

NFPA 1500 – Initial Staffing Requirements

This standard stipulates that a minimum of **four firefighters are an initial crew** at a working structure fire.

Exceptions:

- Unless imminent life-threatening situation exists
- Three is acceptable in situations of imminent danger

Worksafe BC does not allow for entry into an Immediately Dangerous to Life or Health (IDLH) atmosphere unless there is one person at the pump panel maintaining a reliable water supply and one person prepared to facilitate a rescue in the event the initial entry crew runs into trouble. The pump operator may not act as the outside safety backup during initial operations with a single crew on the scene.

Estimating Resource Capability and Requirements

The IC will compare resource capability to the incident requirements during size up.

The IC must:

- Apply sound risk management principles to ensure firefighter safety
- When developing a plan, decide what will be needed to conduct the appropriate attack

Staffing Needs & Concerns will be based on:

Rate of water flow

How many hoselines are needed to meet the Area ÷
3 equation

Backup lines

How many backup teams & hoselines are required
Protect the crew on the initial attack line and can
provide additional flow if required

Protect egress routes

At least as large and as long as the initial attack line

Placement of lines above the fire

Are there additional teams required

Secondary water supply

How is this being established

**Adequate number of personnel and relation to setup
time**

Initial attack delay based on:

Company staffing is less than four

Imminent life-threatening situation does not exist

Number of Attack Lines

Based on flow requirements

A single 1 ¾” hose line for most dwelling fires

Meet the rate of flow in the immediate fire area

Backup hose line

Protection of internal/external exposures

Primary Search

Size of the area to be searched

Smoke conditions

Rescue methods available

Condition of the occupants

Secondary Search

May, or may not involve increased staffing

Interior Rescue/Evacuation

Could be the same requirement for Primary Search

Additional teams may be assigned to remove
victims

Exterior Rescue/Evacuation

Additional staffing will be needed if ladders are used

Most exterior rescues require more staffing

Operational Mode

Offensive Attack: personnel intense. More firefighters for hand lines

Transitional Attack: limited personnel. Single hand line used to turn back the fire clock; buying time for other units to arrive.

Defensive Attack: apparatus intense. Master streams handled by one person, pumpers for water supply or drafting, tankers for water shuttle operation, aerials for defensive operation.

Apparatus Needs

Normally sufficient for initial response to an offensive operation

Proper positioning crucial

Use only those necessary to meet tactical objectives

Large scale incidents or Staging area

Staging Officer

Staged Apparatus: staffed

Out of service apparatus: not staffed

Staffing Factors: Total Available vs Total Needed

IAP will require resources

Exact number may not be known

Approximations will need to be made

Staffing is the most important and difficult resource to obtain

IC must match incident requirements with available resources

Standard Residential House Fire

14-15 firefighters are for safe fire attack with the following factors:

Working fire

Multi-level single-family dwelling

One or two house lines

Life hazard

Limited areas to search

More Staffing necessary if:

Size and complexity of property increases

Additional hoselines needed

Searching large areas

Physically removing victims

Larger rate of flow requirements

Areas beyond a fixed water supply

Calling for Additional Resources

It is best to call for help before it is needed

Need must be anticipated

Calls made after the need obviously arrive too late

Chapter 10 - Water Supply



Ulrike Leone

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Establishing and maintaining sufficient water to achieve strategic goals will greatly influence the operational mode and whether that mode can be maintained or have it changed. Water Supply will be challenged the size of the fire, exposures and operational modes.

Water Supply Needs

- Defensive operations may be more challenging than offensive attacks

- Master streams can require the total pump capacity of the apparatus

- Reliable water systems can be exhausted

- Large-diameter hose is effective

- Water-shuttle operations remain a possibility

Two supplies are recommended

IC cannot solely rely on water tank supply

Must supply and maintain a rate of flow including backup and exposure lines

To complete a Water Supply Size-up, the following must be asked:

What are the fire flow needs?

What source(s) will supply the required flow?

What delivery method will be used?

What resources (apparatus, personnel, equipment) are needed?

How long will it take to develop the water supply?

How effective or reliable is the water supply?

Is there a backup water supply plan?

What coordination with other tactics is needed?

Chapter 11 - Exposures



raedon

<https://pixabay.com/users/raedon-41115>

Protecting exposures will vary on many factors. Fire Officers should be able to identify exposures; and understand how tactical operations can affect, create and eliminate exposure problems.

Types of Exposures

Internal: fire extends from one area to another within a structure

External: fire extends from the fire building to surrounding buildings/property

Internal Exposures

Fire can travel through natural pathways like concealed spaces, stairs, chutes and shafts. It can also extend vertically up the exterior from building windows or other openings

The concept of protecting interior exposures is to keep fire away from areas that can become involved with fire. These areas can be divided by firewalls. The greater the fire rating, the more protection the exposure has from being involved. Protecting valuables such as computer equipment, company/personal records, stock and machinery can have very favourable outcomes.

External Exposures

Protection of external exposures is critical

Should be prioritized in terms of

Life safety

Extinguishment

Property Conservations

Adjacent Buildings

Improper Ventilation can expose buildings

Consider fire apparatus and equipment parked near the fire building

Separate buildings, whether attached to the fire building or not, are classified as exterior exposures

General exposure distances:

A building up to 30 feet from the fire is classified as an exposure

A building 30-100 feet from the fire may be classified as an exposure

A building more than 100 feet from the fire is not an exposure

These are not definite rules due to:

What is burning

Radiant heat being produced

Weather conditions

Wind and direction of travel

Protecting Exposures

Dependant on available staffing and apparatus resources

Using water on the exposure is the most effective way of protection

Directing a stream between buildings is less effective

Radiant heat travels through transparent materials such as water

Tactics for Protecting Exposures

Coordinated attack on the fire with an adequate flow is the best way to protect exposures

Wash the face of exposed buildings with water to prevent ignition of exposed surface areas by reducing the amount of heat absorbed

Push the fire back into the original area to prevent extension to exposures

Reduce the intensity or extinguish the fire at the points where heat transfer is threatening exposures

Place ventilation holes where the change in convection currents will draw fire away from exposures

Stretch lines to the inside of exposures to cover the possible outbreak of fire

Charge sprinkler system of exposure, if available so that the system is not overwhelmed if fire extends into the exposure

Radiant Heat Considerations

Involves the distance of the exposure and the heat output of the fire

The closer a building is to the fire building = the greater the radiant heat being absorbed

Exposures above/higher than the fire are also at a greater risk

Wind direction

Life hazard in the exposure

Hazard presented by the exposed occupancy

Prioritizing Exposure

Distance between exposed structures

Volume and location of fire

Common Terms

abandon

A verb when used on the fire ground is an immediate action message to firefighters to get out of a building or area to safety. Similar to ships' captain issuing an order to "Abandon Ship." This is an emergency message indicating an extreme immediate action or the consequences will be dire.

air track

This is the chosen ventilation path of air through a structure, from the entrance to the exit port. Continual air track monitoring is critical to a safe and efficient PPA Attack.

auto extrication

the act of removing a patient from an auto

benchmarks

Predetermined milestones that signify progress on the fire ground. Examples of these benchmarks include: "fire knocked down", "all clear" and "fire under control."

bidirectional flow

When heat and fire gases are moving in more than

one direction through a building (either in an opening or out an opening/exhaust) such as a door or window. Simply stated a bidirectional flow can be seen when heat and fire gases move out the top of an opening such as a door or window and cool fresh air can be seen moving in the bottom.

blitz line

A 2-1/2 inch pre-connected attack line.

combination attack

Utilizing an exterior fire attack line prior to entry for interior fire control operations. This generally involves pencilling the fire.

diagnostic space

The space that is left unsealed at the top of entrance port during PPA fire attack. This space is approximately one foot in depth. The purpose of the diagnostic space is to assess fire conditions inside the structure and to gauge the effectiveness of the air movement through the tract.

evacuate

A Term used to describe removing occupants (civilians) from a building or occupancy.

fire knocked down

The point at which all visible fire has been

extinguished from a room but extension may still be an issue.

fire struck

Occurs after knockdown. All possible routes of extension have been checked and the fire attack team is convinced that the fire is out.

flow path

Can be defined as the movement of heat and smoke from higher pressure within the fire area to all other low-pressure areas both inside and outside of the fire building. For firefighters, understanding how fire and smoke move throughout a building and the concept of flow paths is critical. One of the most dangerous places for a firefighter to be is between the fire and where the fire is going.

hardening the exterior of a building

Defensive control measures that are also commonly referred to as “surround and drown.” Hardening the exterior involves the use of master streams that are positioned outside of the collapse zone, for the purposes of fire control.

hi vol

4 inch or 5 inch supply lines

loss stop

All possible measures to limit damage to a structure and its contents have been taken.

marginal conditions

Interior fire attack and search at or near the end of the recreation time period.

neutral plane

The separation between the Over-Pressure region and the Under-pressure regions developed in a compartment fire (sometimes referred to as the smoke/air interface). The neutral plane can be seen quite clearly when thermal balance exists in the fire compartment.

pencilling

Controlling the fire from an exterior position by utilizing a straight stream that is applied in short bursts. The intent is to “darken down” the fire without either upsetting the thermal balance or creating pressure through excess steam production. “Turning back the fire clock” will allow crews the time to properly set up for interior attack. Potentially this tactic delays the development of the fire from “a room and contents fire” to a “structural fire.”

PPA

Utilizing ventilation in concert with fire attack.

PPP

Pressuring a “box” in order to inhibit the spread of fire from an adjoining “box”. The theory is that fire will generally travel from a high-pressure area to an area of lower pressure.

rapid attack mode

This mode is sometimes broadcast at the end of the initial report or on an early update. This message signifies that the first arriving company officer has decided on an immediate aggressive interior attack.

recreation time

Safe time for an interior fire attack based on fire conditions and structural integrity.

softening the exterior of a building

Measures that are taken by RIT in order to gain access to a structure. The purpose of this access is to provide a secondary means of egress for interior companies.

strategic goals

Prioritized strategic goals must be formulated prior to the development of tactical assignments. Strategic goals are broad-based objectives that commonly answer the question “What needs to be done?” Rescue is an example of a strategic goal. The commonly used acronym for determining strategic goals is RECEOVS.

strategic mode

A clear statement of strategic mode is critical to safe fire ground operations. Action plan tactics are based on the chosen strategic mode. The options are offensive, transitional, defensive or non-intervention. Chief Brunicini likens being in two modes at once to “turning artillery on yourself.”

tactical objectives

Tactics are more specific than strategies but are based on strategic goals. Tactics commonly answer the question “How are we going to accomplish this goal?” For example, a “right-hand primary search” could be a tactic that would be chosen to support the strategic goal of rescue.

task level assignments

The task level involves the “doing part” of the action plan. This is based primarily on training, Operational Guidelines and established practices. Task level assignments also answer the questions “Who is going to do it and what will they need?” An example would be “Engine Four’s Company will conduct the primary search on the second floor with a charged hose line.”

unidirectional flow

When heat and fire gases are moving in one direction through a building (either in an opening or out an opening/exhaust) such as a door or window, then that flow is said to be unidirectional or moving in one direction. Simply stated a unidirectional flow can be

described as, only heat out; or just fresh air in based on other openings or vent points.

VVDC

The four characteristics of smoke that are critical to smoke reading (volume, velocity, density and colour)

wind driven fire

This situation occurs during windy conditions when the exit port for the fire is on the windward. The prevailing wind easily overcomes the PPA attack and the fire engulfs advancing fire attack teams.

withdraw

A verb used to direct fire crews to (with urgency) to gather equipment, hose lines etc. and leave an area or building. Commonly used when deciding to make a strategic change on the fire ground, switch operational modes, or deciding to write off a structure or building.

This is where you can add appendices or other back matter.

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