

Fire Suppression

I. Introduction

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- Fire suppression

- Refers to all tactics and tasks to achieve extinguishment of the fire
- Accomplished through a variety of methods
- Can remove
  - Fuel
  - Oxygen
  - Heat
  - Break chemical chain reaction
- Typically we extinguish with water

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II. Offensive versus Defensive Operations

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- **Offensive vs. Defensive Operations**

- Interior operations are offensive.
- Exterior operations are defensive.

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- **Offensive Operations**

- Exposes fire fighters to heat and smoke
- Objective is to apply extinguishing agent directly to overpower the fire.
- When successful, causes least amount of property damage
- Used when fires are small
- Usually uses small handlines, but may use large handlines

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- **Defensive Operations**

- Usually uses large handlines or master streams
- Used when fire is too large for offensive attack or risk too great to fire fighters
- Objective is to prevent fire from spreading
- Water is directed from exterior while fire fighters maintain a position of safety, and/or onto exposures to keep the fire from spreading to them

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- Factors for Strategic Decisions
- If the risk is too great, defensive is only option
- If offensive, must consider where and how
- Factors to consider
  - What are the risks vs. potential benefits?
  - Is it safe?
  - Are there any structural concerns?
  - Are there any lives at risk?
  - Does the size of the fire prohibit entry?
  - Is there enough help for an interior operation?
- Two-in/Two-out rule
  - Is there an adequate water supply?

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### III. Operating Hose Lines

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- Operating Hose Lines (1 of 2)
- Small handlines
  - Operated by one fire fighter
  - A second is helpful for advancement and maneuverability
- Large handlines
  - Require two or more fire fighters for advancement
  - One fire fighter can operate if the line is well-anchored.

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• Operating Hose Lines  
(2 of 2)

- Master streams
  - Operated from a fixed position
- on the ground
- on top of a fire apparatus(deck gun)
- on an elevating device (water tower)
- Used for defensive operations

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• Fire Streams

- Nozzle defines the pattern and the form of the water discharged.
- Produced by either
  - Smooth bore nozzle
  - Adjustable nozzle
- Operator must know how to set the discharge pattern.

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• Fog Stream

- Divides water into droplets with large surface area
- Absorbs heat very efficiently
- Can lower heat levels very quickly
- Can protect fire fighters from the heat of a large fire
- Usually adjustable from straight stream to narrow fog to a very wide fog

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• LATENT HEAT OF VAPORIZATION

When 1 pound (about a pint) of water is raised in temperature from its melting point (32 F) to its boiling point 212 F. It absorbs 189 Btu's. If it is then vaporized into steam, (from 212 F boiling to 212 F steam), an additional 970.3 Btu's will be absorbed. 5.4 times more Btu's are absorbed going from boiling to steam than from freezing to boiling!

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• LATENT HEAT OF VAPORIZATION

Another view

It is the process of vaporization that water exerts its maximum cooling action; one gallon of water will absorb approximately 1,250 BTU's going from 62 Degrees F to 212 degrees F. When going from 212 boiling water to 212 steam; this gallon will have absorbed an additional 8,080 BTU's; for a total of 9,330 BTU's. It has absorbed almost 7 times the amount of BTU's vaporizing into steam as going from 62F to 212F boiling.

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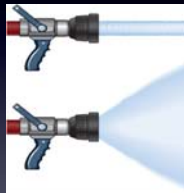
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• Straight Stream

- Provides more reach than a fog stream
- Keeps water concentrated for penetration
- Created by the narrowest setting on a fog nozzle
- Consists of highly concentrated droplets



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## Solid Stream

- Produced by smooth bore nozzles
- More reach and penetration than straight stream
- Consists of a continuous column of water

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## Solid Stream

- Produced by smooth bore nozzles
- More reach and penetration than straight stream
- Consists of a continuous column of water



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## • Points to Remember

- Air is moved along with the water.
- Fog streams move large amounts of air.
  - Thermal balance may be disrupted, pushing hot fire gases onto fire fighters.
- Straight streams move very little air, causing less thermal inversion.

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## • Interior Fire Attack

- Offensive operation where fire fighters enter a structure
- Fires inside a structure are much more challenging and involve greater risk.
- Three methods of attack:
  - Direct
  - Indirect
  - Combination

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## • Direct Attack

- Most effective attack method
- Uses straight or solid stream
- Delivers water directly to seat of fire
- Uses short, controlled bursts of water
- Only applies as much water as required



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## • Indirect Attack

- Used when area is ready to flash over
- Short burst of water applied to ceiling
- Absorbs heat by converting to steam
- Uses straight, solid, or narrow fog stream
- Can cause serious injuries if too much water is used



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• Indirect Attack

An indirect attack can be performed using a straight stream, a solid stream, or a narrow fog stream. Once the temperature has been reduced and the area has been properly ventilated, fire fighters can switch to a direct attack to complete extinguishment. As soon as enough steam has been produced to reduce the fire, the fire stream should be shut down so that the thermal layer is disturbed as little as possible.

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• Indirect Attack

When water is converted to steam, it tends to displace the hot gases that were near the ceiling and push them down toward the floor. This mixture of steam and hot gases is capable of causing serious steam burns to fire fighters through their protective clothing

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• Combination Attack

- Employs both indirect and direct method
- Uses indirect to cool atmosphere, then direct to extinguish
- Only use enough water to control the fire.

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### **Locating and Suppressing Fires Behind Walls & Under Subfloors**

Locate the area of the fire building where a hidden fire is believed to be.

Look for signs of fire such as smoke coming from cracks or openings in walls, charred areas with no outward evidence of fire, and peeling or bubbled paint or wallpaper. Listen for cracks and pops or hissing steam.

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### **Locating and Suppressing Fires Behind Walls & Under Subfloors**

3. If available, use a thermal imager to look for areas of heat that may indicate a hidden fire.
4. Using the back of your hand, feel for heat coming from a wall or floor.
5. If a hidden fire is suspected, use a tool such as an axe or Halligan to remove the building material over the area.

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### **Locating and Suppressing Fires Behind Walls & Under Subfloors**

6. If fire is located, expose the area as well as possible and extinguish the fire using conventional firefighting methods. Be sure to expose as much area as needed without causing unnecessary damage.

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• Large Handlines

- Used for both offensive and defensive attacks
- Large flows can extinguish larger interior fires and have greater reach.
- More difficult to maneuver
  - Use at least 3 fire fighters inside a building.
  - When outside
- May use one-fire fighter method to operate
- May use two-fire fighter method to operate

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**Skill Drill 21-4**  
One-Fire Fighter Method for Operating a Large Handline

Step 1: Close the nozzle and then make a loop with the hose, assuring that the nozzle is UNDER the hose line that is coming from the fire apparatus.



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**Skill Drill 21-4**  
One-Fire Fighter Method for Operating a Large Handline

Step 2: Lash the hose together at the section of hose where they cross, or use your body weight to kneel or sit on the hose line at the point where the hose crosses itself.



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### Skill Drill 21-4

#### One-Fire Fighter Method for Operating a Large Handline



Step 3: Be sure to allow enough hose to extend past the section where the line crosses itself for maneuverability.



Step 4: Open the nozzle and direct water onto the designated area.

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### Skill Drill 21-5

#### Two-Fire Fighter Method for Operating a Large Handline



Step 1: Stretch the hose line from the fire apparatus into position.



Step 2: Advance the hose line as needed.

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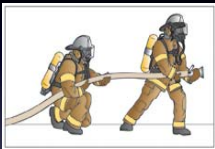
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### Skill Drill 21-5

#### Two-Fire Fighter Method for Operating a Large Handline

Step 3: Before attacking the fire, the fire fighter on the nozzle should cradle the hose on his or her hip, while grasping the nozzle with one hand and supporting the hose with the other hand.



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### Skill Drill 21-5 Two-Fire Fighter Method for Operating a Large Handline

Step 4: The second fire fighter should stay approximately 3' behind the fire fighter on the nozzle. The second fire fighter should grasp the hose with two hands and may use a knee to stabilize the hose against the ground if necessary. Open the nozzle in a controlled fashion and direct water onto the fire or designated exposure.



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### • Master Stream Devices

- Produce high-volume water streams for large fires
- Includes
  - Portable monitors
  - Deck guns
  - Ladder pipes
  - Other elevated stream devices
- May be manually operated or by remote
- Should NEVER be directed into a building where fire fighters are inside

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### • Deck Gun

- Permanently mounted on a vehicle with a piping system for the water
- Sometimes called turret pipes or wagon pipes
- The driver/operator can usually open a valve to start the flow.
- Sometimes may require a hose to be hooked up to operate

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• Portable Monitor

- Can be positioned wherever needed, with hose lines connected to supply the water
- May be placed on the ground
- Hose lines are connected to supply water.
- May be equipped with a strap or chain to help secure
- Safety lock is provided to limit use beyond 35°



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• Elevated Master Streams

- Can be mounted on aerial ladders, aerial platforms, or hydraulic booms
- Ladder pipe is mounted on an aerial ladder.
  - May require a hose to be attached to provide water
- Many have fixed piping for water

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IV. Protecting Exposures

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### • Protecting Exposures

- Taking actions to prevent the spread of fire to areas not already on fire
- Consideration at all fires, but most important at large fires
- At small fires, the best way may be to extinguish the fire
- IC considers capabilities required.
- Often, the best method is to apply water directly to exposed building exterior.

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### • Ventilation

- Before interior attack, structure must be ventilated.
- Requires coordination
- Allows hot smoke and gases out and improves visibility
- Improperly done, may make it more difficult for fire fighters

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### Concealed Space Fires

- Fires may burn in void spaces.
- Must be found and extinguished to prevent from spreading



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## Basement Fires

- Present many challenges to fire fighters
  - Limited routes of egress
  - Difficult to ventilate
- Fire fighters should identify safe entry/exit points.
- Consider possibility of a basement fire when entering a structure.



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## • Above Ground Level Fires

- Must protect vertical paths
- Always look for secondary exit route.
- Be aware of risk of structural instability and collapse.
- Standpipes may be available.
- Stage equipment 1-2 floors below the fire.



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## • Fires in Large Buildings

- Fire fighters may become lost or disoriented.
- Tag lines can be used to help prevent fire fighters from becoming lost or from running out of air.
- A pre-incident plan can be essential.
- Prior knowledge of occupancy and hazards is helpful.

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• Fires in Buildings during Construction, Renovation, or Demolition

- These buildings are at greater risk.
- Often have large quantities of exposed combustibles without the fire-resistant features
- Often have unlimited oxygen supply
- Fire systems may not be operational
- Subject to accidental and intentional fires
- If no life hazard, use defensive operations.

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• Fires in Lumberyards

- Prime candidate for defensive operations
- Contains large quantities of combustibles
- Plenty of air is available.
- Exposure protection is primary objective.
- Collapse zones should be established.

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• Fires in Stacked or Piled Materials

- Materials may collapse without warning.
- Caused by fire or soaking up water
- Approach very cautiously.
- Use equipment to move material.
- Class A foam often used to extinguish smoldering fires
- Overhaul requires the materials to be separated.

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• Trash Container and Rubbish Fires

- Usually occur outside of a structure
- Wear full personal protective equipment and SCBA.
- Will require overhauling
- Class A foam can be useful.
- Can use deck gun to extinguish fire then fill the container with water (with an open butt hose)

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• Confined Spaces

- Fires in underground vaults and transformer vaults too dangerous to enter
- Contact the utility company.
- OSHA requires special training and permits.
- Spaces may be oxygen deficient or high in combustible gases.
- Strict accountability is essential.

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V. Vehicle Fires

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• Vehicle Fires

- Common in most communities
- Important to wear SCBA
- Use 1 1/2 or 1 3/4 hose line
- Vehicles have shock absorbers, bumpers, and trunk/hatchback components that are gas-filled and may burst.
- Consider other hazards.

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• Fires under the Hood  
(1 of 3)

- Approach from uphill and upwind at a 45° angle.
- Direct water into wheel wells and through the front grill.
- Wheels should be chocked.

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• Fires under the Hood  
(2 of 3)

- Pull hood release latch. @ bottom of "A" post
  - If successful trip secondary latch
  - If not, use a Halligan to pry up a corner on the hood.
  - Or, break the grill, cut the release cable and pull with pliers
- Open the hood and extinguish fire.
- Care should be used to prevent splashing battery acid.

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• Fires under the Hood  
(3 of 3)

- Consider leaking fluids that may be flammable.
- Overhaul same as a structure fire
- Use water liberally if significant damage has already occurred.

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• Fires in the Passenger Area

- Approach from upwind at 90° angle.
- Use straight stream from 50' and approach with slow, sweeping motion.
- Change to a fog when closer
- Foam can be used for any burning flammable liquids.
- Begin overhaul after steam clears.
- Do not place yourself in path of airbags.

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• Fire in the Trunk

- Use a Halligan tool to force the lock for entry.
- Charged line must be ready.
- Approach with caution; may have a variety of hazards inside.

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• Alternative Fuel Vehicles  
(1 of 3)

- Be alert for these vehicles.
- Use unmanned master streams.
- Compressed Natural Gas (CNG).
  - Cylinders similar to SCBA cylinders
  - Usually in the trunk
  - Nontoxic and lighter-than-air

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• Alternative Fuel Vehicles  
(2 of 3)

- Liquefied Propane Gas (LPG)
  - Cylinders similar to those in heating/cooking
  - Heavier than air, vapors will pool or collect in low areas.

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• Alternative Fuel Vehicles  
(3 of 3)

- Hybrid vehicles
  - Small gasoline motors and large battery banks
  - Batteries are very hazardous and may explode when burning.
  - Runoff is hazardous
  - High voltage lines can cause serious injury or death if cut.

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## VI. Flammable Liquid Fires

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- Flammable Liquid Fires

- Found in almost any type of occupancy
- Most vehicles fires involve flammable or combustible liquids.
- Special tactics are required.
- Special extinguishing agents are needed.

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- Flammable liquids fires can be classified as either two-dimensional or three-dimensional

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## Flammable liquids Fires

Refers to a spill, pool, or container of liquid where only the top surface is burning

- Controlled with appropriate Class B foam
- Watch for hot surfaces or open flames which may re-ignite.

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## • A three-dimensional Flammable Liquids Fire

A three-dimensional fire refers to a situation where the burning liquid is dripping, spraying, or flowing over the edges of a container.

A three-dimensional fire is much more difficult to extinguish with foam

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## VII. Flammable Gas Cylinders

30 mins.

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• Propane Gas

- Used for heating, cooking, and vehicle fuel
- At temperatures above 44°F exists as a gas
- When stored under pressure, changed to a liquid
- Expansion ratio of 270:1

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• Propane Containers  
(1 of 2)

- Space with propane gas above the liquid level
- Piping draws from the vapor space.
- Containers vary in size.
- Made of aluminum or steel
- Discharge valve controls the flow of gas.

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• Propane Containers  
(2 of 2)

- A connection hose, tube, or pipe allows gas to flow to its destination.
- Cylinders equipped with relief valve
- Containers must be in upright position or the relief valve may release liquid propane.

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• Propane Hazards

- Highly flammable, nontoxic but can cause asphyxiation
- Odorless
  - Mercaptan is added to create a distinctive odor.
- Heavier than air
- Approach uphill and upwind
- Full PPE and SCBA required

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• BLEVE

- Boiling-Liquid, Expanding-Vapor Explosion (BLEVE)
- Pressure increases from a fire.
- Release valve may open to vent pressure.
- If flame is impinging on vapor space, container then fails violently.
- Best method to prevent is heavy streams of water from a distance

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• Propane Fire Suppression  
(1 of 3)

- If from a pipe or regulator failure, shut off main discharge valve
- DO NOT EXTINGUISH flames unless fuel source is shut off or fuel has been consumed.
- Approach with two 1 3/4" lines set on an interlocking fog pattern.
- Team leader is between the lines.
- Once at the tank, reaches in and closes the valve

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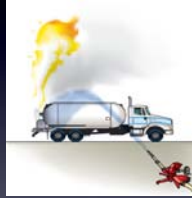
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• Propane Fire Suppression  
(2 of 3)

- Back away with lines still flowing.
- For severe fires, use unmanned master streams and evacuate area.



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• Propane Fire Suppression  
(3 of 3)

- If relief valve is bypassing, container is under stress.
- Will sound like a tea kettle
- If rising in frequency, an explosion may be imminent.

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• Shutting Off Gas Service

- Most residential gas supplied through a meter connected to the distribution system and flow can be stopped by closing quarter-turn valve.
- If an LPG tank is outside, closing the valve will stop the flow.
- When shut off, use a lockout tag.

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## VIII. Fires Involving Electricity

15 minutes

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- Fires Involving Electricity

- Greatest danger is possibility of electrocution.
- Only Class C extinguishers should be used on energized equipment.
- Once electricity is disconnected, most are controlled as a Class A fire.
- Turn off electricity on structure fires.
- May use breaker box or power company

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- Suppression

- Best approach is often to wait until power is disconnected.
- If immediate action is required, use Class C agents only.
- For electronic equipment use halon or CO2.

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- **Power Lines and Transformers**
  - Do not attack until power is disconnected.
  - Transformers may contain PCB's.
  - Water may cause the hot oil to boil over.
    - Use dry chemical after electricity is cut.
  - Large transformers may require foam once the power is cut.

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- **Underground vaults and Electrical rooms**

Underground power lines and transformers are often located in vaults beneath the surface.  
CO2 and dry chemical may be used in underground vaults.  
Large structures often have high-voltage electrical service connections and interior rooms

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**Summary**

15 mins.

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(1 of 3)

- Some of the most basic skills that must be mastered by every fire fighter involve the use of hose lines to apply water onto a fire.
- An interior fire attack is an offensive operation that requires fire fighters to enter a building and discharge an extinguishing agent (usually water) onto the fire.
- Large handlines can be used for either offensive fire attack or for defensive operations.

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(2 of 3)

- Master stream devices are used to produce high-volume water streams for large fires.
- Exposure protection is a consideration at every fire; however, it is a much more important consideration when the fire is large.
- Vehicle fires are common in most communities.

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(3 of 3)

- Special tactics must be used when attempting to extinguish a flammable liquids fire.
- The popularity of propane gas for heating and cooking has caused these cylinders to become commonplace in residential areas and many other locations.
- The greatest danger with most fires involving electrical equipment is the possibility of electrocution.

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