



Missouri Division of Fire Safety
FIRE FIGHTER I & II



**FIRE
CONTROL**



UNIT OBJECTIVES

Upon completion of this unit of study, the student should be able to:

1. Explain the procedures involved with the extinguishment of the following types of fires:
 - a. Piles of combustible materials
 - b. Ignitable liquids
 - c. Vehicle fires
 - d. Storage containers
 - e. Combustible materials within a structure
 - f. Ground cover
 - g. Flammable gas cylinders
2. Extinguish and control the following types of fires:
 - a. Piles of combustible materials
 - b. Vehicle fires
 - c. Storage containers
 - d. Combustible materials within a structure
 - e. Ground cover
3. Extinguish and control the following types of fires:
 - a. Exterior combustible liquid fire using foam
 - e. A fire involving a flammable gas cylinder
4. Coordinate an interior attack in a structural fire.



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Successful completion of the information in this section is necessary to fulfill the requirements of the following sections of NFPA 1001-2008:

Fire Fighter I Standard

5.3.7* Attack a passenger vehicle fire operating as a member of a team, given personal protective equipment, attack line, and hand tools, so that hazards are avoided, leaking flammable liquids are identified and controlled, protection from flash fires is maintained, all vehicle compartments are overhauled, and the fire is extinguished.

(A) Requisite Knowledge. Principles of fire streams as they relate to fighting automobile fires; precautions to be followed when advancing hose lines toward an automobile; observable results that a fire stream has been properly applied; identifying alternative fuels and the hazards associated with them; dangerous conditions created during an automobile fire; common types of accidents or injuries related to fighting automobile fires and how to avoid them; how to access locked passenger, trunk, and engine compartments; and methods for overhauling an automobile.

(B) Requisite Skills. The ability to identify automobile fuel type; assess and control fuel leaks; open, close, and adjust the flow and pattern on nozzles; apply water for maximum effectiveness while maintaining flash fire protection; advance 38 mm (1½ in.) or larger diameter attack lines; and expose hidden fires by opening all automobile compartments.

5.3.8* Extinguish fires in exterior Class A materials, given fires in stacked or piled and small unattached structures or storage containers that can be fought from the exterior, attack lines, hand tools and master stream devices, and an assignment, so that exposures are protected, the spread of fire is stopped, collapse hazards are avoided, water application is effective, the fire is extinguished, and signs of the origin area(s) and arson are preserved.

(A) Requisite Knowledge. Types of attack lines and water streams appropriate for attacking stacked, piled materials and outdoor fires; dangers — such as collapse — associated with stacked and piled materials; various extinguishing agents and their effect on different material configurations; tools and methods to use in breaking up various types of materials; the difficulties related to complete extinguishment of stacked and piled materials; water application methods for exposure protection and fire extinguishment; dangers such as exposure to toxic or hazardous materials associated with storage building and container fires; obvious signs of origin and cause; and techniques for the preservation of fire cause evidence.

(B) Requisite Skills. The ability to recognize inherent hazards related to the material's configuration, operate handlines or master streams, break up material using hand tools and water streams, evaluate for complete extinguishment, operate hose lines and other water



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application devices, evaluate and modify water application for maximum penetration, search for and expose hidden fires, assess patterns for origin determination, and evaluate for complete extinguishment.

5.3.10* Attack an interior structure fire operating as a member of a team, given an attack line, ladders when needed, personal protective equipment, tools, and an assignment, so that team integrity is maintained, the attack line is deployed for advancement, ladders are correctly placed when used, access is gained into the fire area, effective water application practices are used, the fire is approached correctly, attack techniques facilitate suppression given the level of the fire, hidden fires are located and controlled, the correct body posture is maintained, hazards are recognized and managed, and the fire is brought under control.

(A) Requisite Knowledge. Principles of fire streams; types, design, operation, nozzle pressure effects, and flow capabilities of nozzles; precautions to be followed when advancing hose lines to a fire; observable results that a fire stream has been properly applied; dangerous building conditions created by fire; principles of exposure protection; potential long-term consequences of exposure to products of combustion; physical states of matter in which fuels are found; common types of accidents or injuries and their causes; and the application of each size and type of attack line, the role of the backup team in fire attack situations, attack and control techniques for grade level and above and below grade levels, and exposing hidden fires.

(B) Requisite Skills. The ability to prevent water hammers when shutting down nozzles; open, close, and adjust nozzle flow and patterns; apply water using direct, indirect, and combination attacks; advance charged and uncharged 38 mm (1½ in.) diameter or larger hose lines up ladders and up and down interior and exterior stairways; extend hose lines; replace burst hose sections; operate charged hose lines of 38 mm (1 in.) diameter or larger while secured to a ground ladder; couple and uncouple various handline connections; carry hose; attack fires at grade level and above and below grade levels; and locate and suppress interior wall and subfloor fires.

5.3.18 Turn off building utilities, given tools and an assignment, so that the assignment is safely completed.

(A) Requisite Knowledge. Properties, principles, and safety concerns for electricity, gas, and water systems; utility disconnect methods and associated dangers; and use of required safety equipment.

(B) Requisite Skills. The ability to identify utility control devices, operate control valves or switches, and assess for related hazards.



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5.3.19* Combat a ground cover fire operating as a member of a team, given protective clothing, SCBA if needed, hose lines, extinguishers or hand tools, and an assignment, so that threats to property are reported, threats to personal safety are recognized, retreat is quickly accomplished when warranted, and the assignment is completed.

(A) Requisite Knowledge. Types of ground cover fires, parts of ground cover fires, methods to contain or suppress, and safety principles and practices.

(B) Requisite Skills. The ability to determine exposure threats based on fire spread potential, protect exposures, construct a fire line or extinguish with hand tools, maintain integrity of established fire lines, and suppress ground cover fires using water.

Fire Fighter II Standard

6.1.1 General Knowledge Requirements. Responsibilities of the Fire Fighter II in assuming and transferring command within an incident management system, performing assigned duties in conformance with applicable NFPA and other safety regulations and AHJ procedures, and the role of a Fire Fighter II within the organization.

6.1.2 General Skill Requirements. The ability to determine the need for command, organize and coordinate an incident management system until command is transferred, and function within an assigned role in an incident management system.

6.3.1* Extinguish an ignitable liquid fire, operating as a member of a team, given an assignment, an attack line, personal protective equipment, a foam proportioning device, a nozzle, foam concentrates, and a water supply, so that the correct type of foam concentrate is selected for the given fuel and conditions, a properly proportioned foam stream is applied to the surface of the fuel to create and maintain a foam blanket, fire is extinguished, reignition is prevented, team protection is maintained with a foam stream, and the hazard is faced until retreat to safe haven is reached.

(A) Requisite Knowledge. Methods by which foam prevents or controls a hazard; principles by which foam is generated; causes for poor foam generation and corrective measures; difference between hydrocarbon and polar solvent fuels and the concentrates that work on each; the characteristics, uses, and limitations of fire fighting foams; the advantages and disadvantages of using fog nozzles versus foam nozzles for foam application; foam stream application techniques; hazards associated with foam usage; and methods to reduce or avoid hazards.



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(B) Requisite Skills. The ability to prepare a foam concentrate supply for use, assemble foam stream components, master various foam application techniques, and approach and retreat from spills as part of a coordinated team.

6.3.2* Coordinate an interior attack line for a team's accomplishment of an assignment in a structure fire, given attack lines, personnel, personal protective equipment, and tools, so that crew integrity is established; attack techniques are selected for the given level of the fire (e.g., attic, grade level, upper levels, or basement); attack techniques are communicated to the attack teams; constant team coordination is maintained; fire growth and development is continuously evaluated; search, rescue, and ventilation requirements are communicated or managed; hazards are reported to the attack teams; and incident command is apprised of changing conditions.

(A) Requisite Knowledge. Selection of the nozzle and hose for fire attack, given different fire situations; selection of adapters and appliances to be used for specific fireground situations; dangerous building conditions created by fire and fire suppression activities; indicators of building collapse; the effects of fire and fire suppression activities on wood, masonry (brick, block, stone), cast iron, steel, reinforced concrete, gypsum wallboard, glass, and plaster on lath; search and rescue and ventilation procedures; indicators of structural instability; suppression approaches and practices for various types of structural fires; and the association between specific tools and special forcible entry needs.

(B) Requisite Skills. The ability to assemble a team, choose attack techniques for various levels of a fire (e.g., attic, grade level, upper levels, or basement), evaluate and forecast a fire's growth and development, select tools for forcible entry, incorporate search and rescue procedures and ventilation procedures in the completion of the attack team efforts, and determine developing hazardous building or fire conditions.

6.3.3* Control a flammable gas cylinder fire, operating as a member of a team, given an assignment, a cylinder outside of a structure, an attack line, personal protective equipment, and tools, so that crew integrity is maintained, contents are identified, safe havens are identified prior to advancing, open valves are closed, flames are not extinguished unless the leaking gas is eliminated, the cylinder is cooled, cylinder integrity is evaluated,



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hazardous conditions are recognized and acted upon, and the cylinder is faced during approach and retreat.

(A) Requisite Knowledge. Characteristics of pressurized flammable gases, elements of a gas cylinder, effects of heat and pressure on closed cylinders, boiling liquid expanding vapor explosion (BLEVE) signs and effects, methods for identifying contents, how to identify safe havens before approaching flammable gas cylinder fires, water stream usage and demands for pressurized cylinder fires, what to do if the fire is prematurely extinguished, valve types and their operation, alternative actions related to various hazards, and when to retreat.

(B) Requisite Skills. The ability to execute effective advances and retreats, apply various techniques for water application, assess cylinder integrity and changing cylinder conditions, operate control valves, and choose effective procedures when conditions change.



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	<p>I. Fire Control (<i>Essentials p. 759</i>)</p> <ul style="list-style-type: none">A. The ability and knowledge of the fire fighters on the initial fire attack team determines the success or failure of fire control operationsB. An uncoordinated attack can result in a small fire developing into a major loss and increase the dangers to personnel and the publicC. Fire fighter safety in any fire control situations must always be the first priority<ul style="list-style-type: none">1.2. Fire fighters must constantly be alert to any potentially hazardous conditions:<ul style="list-style-type: none">a. Possible building collapseb.c. Holes, weaken floors, and other fall hazardsd. Overhead loads on weakened supportse. Hazardous materialsf.g. Utility hazardsh. Overexertioni.



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	<p data-bbox="618 411 1398 485">D. Fire attack must be coordinated with rescue operations, forcible entry, ventilation, and utility control</p> <ol data-bbox="667 527 1398 1818" style="list-style-type: none"><li data-bbox="667 527 1398 863">1.<ol data-bbox="716 642 1398 863" style="list-style-type: none"><li data-bbox="716 642 1398 716">a. Property can be replaced but a human life cannot<li data-bbox="716 747 1398 863">b. Includes the lives of fire fighters, those in danger, other emergency responders, and spectators<li data-bbox="667 905 1398 1136">2. Incident stabilization involves stopping the emergency from growing and getting worse through:<ol data-bbox="716 1020 1398 1136" style="list-style-type: none"><li data-bbox="716 1020 1398 1062">a. Performing rescues<li data-bbox="716 1094 1398 1136">b. Extinguishing a fire<li data-bbox="667 1178 1398 1818">3.<ol data-bbox="716 1325 1398 1818" style="list-style-type: none"><li data-bbox="716 1325 1398 1398">a. The fire service is committed to saving as much property as possible<li data-bbox="716 1440 1398 1818">b. Property conservation involves:<ol data-bbox="764 1514 1398 1818" style="list-style-type: none"><li data-bbox="764 1514 1398 1587">(1) Minimizing further damage created during fire suppression<li data-bbox="764 1629 1398 1703">(2) Using salvage operations to protect property<li data-bbox="764 1745 1398 1818">(3) Preventing a fire from reigniting after extinguishment



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	<p>E.</p> <ol style="list-style-type: none">1. Size-up is the mental evaluation of the fire which determines the course of action2.3. Proper size-up is based on:<ol style="list-style-type: none">a.<ol style="list-style-type: none">(1) Time of emergency(2) Location of emergency(3) Nature of emergency(4) Life hazard(5) Exposures(6) Property involved(7) Weather conditionsb.<ol style="list-style-type: none">(1) Potential changes in the life hazard(2) The routes of fire extension(3) The probability of explosion or collapse(4) Potential weather changes



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	<p data-bbox="711 415 737 443">c.</p> <ol data-bbox="760 485 1406 863" style="list-style-type: none"><li data-bbox="760 485 1406 558">(1) Personnel and equipment available and enroute<li data-bbox="760 600 1406 674">(2) What additional assistance is enroute or can be available<li data-bbox="760 716 1406 747">(3) How much water supply is available<li data-bbox="760 789 1406 863">(4) What actions have already been taken to either improve or worsen the situation <p data-bbox="570 940 1203 978">II. Structural Fire Fighting (<i>Essentials p. 762</i>)</p> <p data-bbox="618 1020 1398 1087">A. Coordination between different crews performing different functions is essential for a successful outcome</p> <ol data-bbox="667 1136 1390 1738" style="list-style-type: none"><li data-bbox="667 1136 691 1167">1.<li data-bbox="667 1251 1390 1356">2. Entry teams must carry any equipment which they may need to force entry, check for fire extension, and make an emergency exit<li data-bbox="667 1398 1390 1503">3. Entry teams must also be in contact with exterior teams to prevent opposing fire attacks and in case of a sudden endangering situation<li data-bbox="667 1545 1390 1629">4. Before entering the fire area, air must be bled from the nozzle by opening the nozzle slightly<li data-bbox="667 1671 1390 1738">5. The nozzle pattern should also be checked before entering



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	<ul style="list-style-type: none">6.<ul style="list-style-type: none">a. Personnel should be to one side of the entranceb. They should stay low to allow heated gases and fire to exit over their heads7. The fire should be approached and attacked from the unburned portion of the building<ul style="list-style-type: none">a.b. Opposing attacks can not only spread fire but cause injuries to personnel8. When the fire has been contained, initial attack crews should be relieved and replaced with fresh personnel <p>B. Fire stream requirements</p> <ul style="list-style-type: none">1.<ul style="list-style-type: none">a. Allows the smoke, heat, and steam a place to gob. Helps maintain thermal layeringc. The stream can be swept across the ceiling to break the water into smaller drops to rain down on the fire2. If ventilation is not provided, a straight stream directed at the base of the fire should be used<ul style="list-style-type: none">a.



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	<ul style="list-style-type: none">b. Less chance of steam burnsc. Does not push heat, smoke, and fire into other areasd. Uses less watere. <p>3. The thermal layering can be upset with either fog or straight streams, however, less disturbance will occur with straight streams</p> <p>4.</p> <ul style="list-style-type: none">a. Applying water into smoke decreases visibility and increases water damageb. <p>5. The size of the stream and hoseline depends on:</p> <ul style="list-style-type: none">a. Fire load and materials involvedb.c. Stream reachd.e. Mobility requirementsf. Speed of deployment



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	<ul style="list-style-type: none">g. Potential fire spread <p>6.</p> <p>7. Hose stream characteristics</p> <ul style="list-style-type: none">a. 1½" or 1¾": 40 to 175 gpm<ul style="list-style-type: none">(1)(2) Used for quick attack(3) When personnel are limited(4) For rapid relocation of linesb. 2½" or 3": 125 to 350 gpm<ul style="list-style-type: none">(1)(2) When size and intensity of fire is beyond reach and control of 1½" or 1¾" lines(3) When there is enough water and personnel(4) When exposure protection requires larger volumes of waterc. Master streams: 350 to 2,000 gpm<ul style="list-style-type: none">(1)(2) When size and intensity of fire is beyond reach and control of handlines(3) When water supply is ample



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	<p>(4) When there is sufficient pumping capacity</p> <p>(5) When interior attacks are no longer feasible</p> <p>C. Types of fire attacks</p> <p>1. Gas cooling</p> <ul style="list-style-type: none">a. Simply a way to reduce the hazard from the hot gas layerb. Effective with a "shielded fire," where water cannot reach the burning material because it cannot be seenc. Remember, smoke is fuel which can cause rollover, flashover, or a backdraftd.e. <p>(1) Set the nozzle pattern between a 40 to 60 degree fog</p> <p>(2) Direct it upward to the hot gas layer</p> <p>(3)</p> <p>(4) When droplets fall from the gas layer, stop spraying water</p> <p>(5) Continued water application will upset the thermal balance and create steam</p> <p>(6) Repeat the technique while the attack crew advances under the gas layer</p>



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	<ul style="list-style-type: none">2.<ul style="list-style-type: none">a.b. Another technique is to cool hot surfaces by applying water over the hot materials ("painting")c. Avoid upsetting thermal balance by limiting water used. Shut the line down when the fire darkens down3.<ul style="list-style-type: none">a. Used when fire fighters are unable to enter the building because of intense fireb. Should not be used when there may be trapped victims or when fire spread cannot be containedc.d. Results in steam production to darken firee. Once the fire has darkened and the area ventilated, the line should be advanced for a direct attack4. Combination attack<ul style="list-style-type: none">a. Combines playing stream off ceiling to cool the hot gas layer and applying directly to the burning materialsb. Starting with penciling in short bursts



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	<ul style="list-style-type: none">c. Nozzle is moved in a "T," "Z," or "O" pattern with a straight stream with its edge reaching ceiling, walls, and floor <p>D. Master streams</p> <ul style="list-style-type: none">1.2. May be used for:<ul style="list-style-type: none">a. Direct fire attackb. To backup handlines used from the exteriorc. Exposure protection3. A master stream must be properly positioned because it must be shut down to be moved<ul style="list-style-type: none">a. If directed into a building, the master stream should be close enough to hit the base of the fireb. The master stream should be aimed upward to deflect off the ceilingc. If used for exposure protection, the stream should provide maximum coverage on the building's surface4. Master streams flow a minimum of 350 gpm and should be supplied with at least two 2½" hoselines for an adequate flow5.



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	<ul style="list-style-type: none">6. A fire fighter should remain with the master stream unless it is being used in a hazardous location such as close to a weakened structure or compressed gas storage tanks 7. Elevated master streams may be used to apply water to the upper stories of buildings and are delivered by different types of apparatus<ul style="list-style-type: none">a. Quints: an apparatus equipped with a pump, water tank, and aerial device b. Aerial ladder: apparatus equipped with a hydraulically operated extension ladder, usually have a built-in waterway to supply master stream nozzles c. Aerial platforms: apparatus with an aerial device equipped with a personnel-carrying platform<ul style="list-style-type: none">(1) Aerial ladder platform: combines an aerial ladder with a platform supported at the end of the ladder (2) Articulating aerial platform: a personnel-carrying platform is supported at the end of two or more booms hinged and operating in a folding manner d. Water tower: a pumper equipped with a hydraulically operated boom dedicated to applying water which cannot be used for rescue



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	<p>III. Fighting Class B Fires (<i>Essentials p. 773</i>)</p> <p>A. Extra caution is needed when attacking Class B fires</p> <ol style="list-style-type: none">1.2. Protective clothing can absorb fuel and burn3.4. All ignition sources in the leak area must be controlled5. Unless the leaking product can be turned off, fires burning around relief valves or piping should not be extinguished6. Never assume that relief valves are sufficient to safely relieve pressures under fire conditions7.<ol style="list-style-type: none">a. The sudden release and vaporization of the liquid can result in tank ruptureb. BLEVE:<ol style="list-style-type: none">(1) Results in the explosive release of pressure, fragmentation of the container, and large fireball(2) Occurs when flames impinge the tank shell above the liquid level or when insufficient water is applied to cool the tank(3)



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	<p data-bbox="618 411 1162 443">B. Using water to suppress Class B fires</p> <ol data-bbox="667 489 1386 1776" style="list-style-type: none"><li data-bbox="667 489 691 520">1.<li data-bbox="667 604 1373 674">2. To help move fuels to areas where they can safely burn or can be more easily controlled<ol data-bbox="716 720 1386 898" style="list-style-type: none"><li data-bbox="716 720 1365 789">a. Streams should never be plunged into burning liquids<li data-bbox="716 835 1386 898">b. Fog streams should be swept from side-to-side to move the fuel<li data-bbox="667 947 1122 978">3. To dissipate flammable vapors<li data-bbox="667 1024 1292 1056">4. To displace fuel from pipes or leaking tanks<li data-bbox="667 1102 1373 1171">5. As a protective cover for crews advancing to shut off the flow of a fuel<ol data-bbox="716 1218 1386 1776" style="list-style-type: none"><li data-bbox="716 1218 1386 1287">a. Two hoselines should be used with slow, coordinated movements<li data-bbox="716 1333 740 1365">b.<li data-bbox="716 1522 1386 1591">c. Straight streams should be applied to the top of the tank to run down both sides<li data-bbox="716 1638 1317 1707">d. As the lines are advanced, the streams are widened to fog patterns to protect crews<li data-bbox="716 1753 740 1785">e.



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	<p>C. Bulk transport vehicle fires</p> <ol style="list-style-type: none">1. The techniques for approaching and controlling bulk transport vehicle fires are the same as those for storage tanks2. Fire fighters will face additional hazards:<ol style="list-style-type: none">a. Risks from trafficb.c. Difficulty in containing spills and runoffd.e. Vehicle instabilityf. Exposure concernsg.3. The type of cargo should be determined as soon as possible4. At least one lane of traffic in addition to the incident lane should be closed during initial operations5. <p>D. Control of gas utilities</p> <ol style="list-style-type: none">1. Emergencies involving natural gas or liquefied petroleum gas (LPG) can occur in any jurisdiction



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	<ul style="list-style-type: none">2.<ul style="list-style-type: none">a. Comprised of mostly methane with ethane, propane, butane, and pentane addedb.c. Utility companies add mercaptan as an odorant for leak detectiond. No odorant is added to gas moved through cross-country pipelinese. Pressures<ul style="list-style-type: none">(1) Up to 1,000 psi in pipelines(2) About 50 psi in distribution piping to consumers(3) Approximately 0.25 psi at the point of usef.g. Explosive in concentrations between 5% and 15%h. To stop the flow of gas into a structure, the gas meter should be located (may be on the exterior or interior a structure)<ul style="list-style-type: none">(1) The shutoff valve (petcock) is usually located on the supply pipe side of the meter(2) The petcock should be rotated using a wrench or spanner from in line with the piping to where it is facing across the piping



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	<p>(3)</p> <p>3. LPG</p> <ul style="list-style-type: none">a. Propane is the most commonly used as a fuel gasb.c. Odorless until an odorant is addedd.e. Explosive in concentrations from 1.5% to 10%f. Nontoxic but acts as an asphyxiant when it displaces oxygeng. Transported by buried pipelines, in cylinders and tanksh.i. All LPG containers can BLEVE when exposed to intense heat or flamej. <p>4. Flammable gas leaks</p> <ul style="list-style-type: none">a.b. All vehicles should approach and stage on the upwind side



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	<ul style="list-style-type: none">c. The area around the leak and downwind should be evacuatedd. Eliminate all ignition sourcese. Surrounding areas and buildings should be checked for gas concentrationsf. Fire fighters must never attempt to operate pipeline valves which could worsen the situationg. If the gas is burning, it should not be extinguished<ul style="list-style-type: none">(1) Unburned gas could flow to other areas(2) Use streams to protect exposures <p>5. Compressed gas tank and cylinder fires</p> <ul style="list-style-type: none">a. Flammable gas tanks and cylinders with the relief valve operating should not be approached<ul style="list-style-type: none">(1) If the relief valve is operating, the tank is under stress(2)b. Cool upper vapor portion of vessel from maximum distance until the relief valve resetsc. Wearing full protective equipment, two teams of fire fighters using a minimum of two 1½" lines, should advance using wide overlapping fog patterns



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	<p>d.</p> <p>e. Personnel must be on the inside of the lines with the leader between the nozzle operators</p> <p>f. Water must be kept on the vessel at all times</p> <p>g. Staffed backup lines must also be ready</p> <p>h. When the cylinder is reached, the nozzle teams should isolate the shutoff valve from the fire with the fog streams</p> <p>i. Without breaking the stream patterns, the team leader should then close the tank valve to shut off the fuel</p> <p>j. After the burning is extinguished, fire fighters should continue to apply water to cool the tank</p> <p>k.</p> <p>IV. Suppressing Class C Fires (<i>Essentials p. 780</i>)</p> <p>A.</p> <p>B. Fire fighters must always remember to consider any electrical equipment or wires as energized until the utility company confirms that the power is off</p>



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	<p>C. Procedures for electrical equipment fires</p> <ol style="list-style-type: none">1. In some commercial and high-rise buildings, power will be needed to operate elevators and air-handling equipment<ol style="list-style-type: none">a. The power to the entire building should not be shut down until orderedb. When shut down, the main power switch should be locked-out or tagged out to prevent it from being turned back on before it is safec. If lockout or tagout devices are not available, a fire fighter with a portable radio should be assigned to the switch until power can be restoredd.2. Fires involving delicate electronic or computer equipment should be extinguished with carbon dioxide or halogenated agents3. Using water on energized electrical equipment is inappropriate and if absolutely necessary it should only be used from a distance as a fog stream4. Fires in electrical transmission lines and equipment<ol style="list-style-type: none">a. Fires in ground-level transformers can be extinguished with chemical or carbon dioxide extinguishersb. Fires in pole-mounted transformers should be allowed to burn until utility company personnel arrive with personnel protecting any exposures



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	<ul style="list-style-type: none">c. Downed power lines may start fires in ground cover<ul style="list-style-type: none">(1)(2) Fire fighters should wait until a ground fire burns at least one span length away from the line break before extinguishing the fire5. Fires in underground electrical systems, such as cableways and vaults present additional hazards<ul style="list-style-type: none">a. A spark or arc can ignite gases, causing an explosionb. Utility manhole and vault covers can be thrown considerable distances from the explosionc.d. There is a higher than normal possibility of backdraft with utility vault firese. Carbon dioxide or dry chemical can be discharged into the utility vault and the cover replacedf. Water must not be discharged into utility vaults6. High-voltage commercial installations<ul style="list-style-type: none">a. Some commercial and industrial facilities may have electrical equipment in excess of 600 voltsb. Some transformers contain flammable coolants creating more hazards



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	<ul style="list-style-type: none">c. d. Smoke from these fires is extremely hazardous because of the plastic insulation and coolants used so decontamination procedures must be followed <p>D. Controlling electrical power</p> <ul style="list-style-type: none">1. Fire personnel must be able to control the flow of electricity into structures where emergency operations are underway<ul style="list-style-type: none">a. In some situations, power may be needed to operate lighting, HVAC equipment, or fire pumpsb. If fire involves only one area of a building, other areas may be left energizedc.d. The Incident Commander should make the decision about shutting down the electrical service to a fire building2.<ul style="list-style-type: none">a. An explosive arc can occur if the meter is improperly removed causing injury or death



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	<ul style="list-style-type: none">b. In some occupancies, removing the electric meter does not stop the flow of electricity<ul style="list-style-type: none">(1) The meter may be only there to measure usage and removal will not discount the power(2) In some installations, backup generators may start when the utility power is shut downE. Electrical hazards<ul style="list-style-type: none">1. Normal residential current can deliver a fatal shock2. Electrical hazards include:<ul style="list-style-type: none">a. Cardiac arrestb. Ventricular fibrillationc. Respiratory arrestd. Paralysise. Joint damagef. Arc burns to eyesg. Ventricular fibrillationh. Surface or internal burnsi. Involuntary muscle contractions3. The seriousness of an electrical shock depends on:<ul style="list-style-type: none">a. Electrical path through the body



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	<ul style="list-style-type: none">b. Degree of skin resistance: wet (low) or dry (high)c. Length of exposured. Available current: amperage flowe. Available voltagef. Frequency: AC or DC current <p>F. Electrical emergency guidelines</p> <ul style="list-style-type: none">1.2. Establish an exclusion zone equal to one span in all directions from downed power lines3. Wires may have been weakened by a short circuit and may fail anytime4. Use only tested and approved tools with insulated handles5. Guard against electrical shocks, burns, and eye injuries from arcs6.7. Use caution with ladders around power lines8.9. Jump clear of any apparatus (keeping both feet together) that may be in contact with electrical lines



NOTES	STUDENT GUIDE
	<p>10.</p> <p>11. Beware that fences and guard rails can be energized by power lines</p> <p>12. If wires are down and there is any tingling sensation in the feet, back away</p> <p>13. Avoid "ground gradient" hazards by maintaining a safety zone around downed lines</p> <ul style="list-style-type: none">a. Ground gradient is produced when current from downed lines passes along the groundb. Current flows outward in concentric circles from the point of contactc. Voltage drops as it spreads from the sourced. Walking normally through a ground gradient area is dangerous because of the difference in the electrical potential between the feet and the grounde. To back out of a ground gradient area, keep both feet in contact with each other and hop or shuffle out of the affected area <p>V. Suppressing Class D Fires (<i>Essentials p. 787</i>)</p> <ul style="list-style-type: none">A. Water is only effective on combustible metal fires when attempting to cool the metal below its ignition temperatureB. Directing water onto burning metals can result in violent decomposition of the water and release of hydrogen gas



NOTES	STUDENT GUIDE
	<p>C.</p> <p>D. Special extinguishing agents may be shoveled or sprayed from extinguisher to try to cover the burning metal</p> <p>E. An ash layer may cover the burning material and give the impression the fire is out</p> <ol style="list-style-type: none">1. There may be an extended period before the metal cools to safe levels2. Combustible metal fires may be greater than 2000°F even after they appear to be out <p>VI. Structural Fire Tactics and Operations (<i>Essentials p. 787</i>)</p> <p>A.</p> <ol style="list-style-type: none">1. If smoke or fire is visible on arrival, this engine may stop and lay a supply line from a hydrant or the end of a driveway to the scene2. The first-arriving company officer should conduct a rapid initial assessment:<ol style="list-style-type: none">a. Are rescues needed immediately?b. Are only the contents or is the structure burning?c. Are exposures threatened?d. Are there sufficient resources on the scene or en route to handle the situation?



NOTES	STUDENT GUIDE
	<ol style="list-style-type: none">3. The answers to these questions will determine the actions of the first-arriving company<ol style="list-style-type: none">a.b. If an immediate rescue is needed, it may be done even before there are enough fire fighters on scene to form a rapid intervention crewc. If the fire is threatening to extend to a nearby structure, lines may be pulled to protect the exposure4. With a small room and contents fire, the officer should transmit a radio report confirming:<ol style="list-style-type: none">a. The exact locationb. The conditions at the scenec. If additional resources are needed5. Once the fire's location is known, the first attack line should be placed to:<ol style="list-style-type: none">a.b. Protect the primary means of egressc.d. Begin extinguishment <p>B. The second arriving engine:</p> <ol style="list-style-type: none">1. Should establish an adequate water supply, unless otherwise assigned



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">2. Once water supply is established, this crew should:<ul style="list-style-type: none">a.b. Protect a secondary means of egressc. Prevent fire extensiond.e. Assist with fireground support operationsC. A support company (truck or rescue company) may arrive after the first engine and should be responsible for:<ul style="list-style-type: none">1. Forcible entry and ventilation2. Search and rescue3. Ladder placement4. Salvage and overhaul5. Setting up lighting equipment6. Controlling utilities7. Checking for fire extension8. Overhaul9. These functions may be performed by other engine companies



NOTES	STUDENT GUIDE
	<p>10. A support company may use a master stream in a "blitz attack"</p> <ul style="list-style-type: none">a. Must be coordinated with other operations to prevent injuriesb. <p>11. Support companies may also be assigned to shut down building utilities</p> <p>D. Rapid intervention crews (RIC)</p> <ul style="list-style-type: none">1. It is not possible to predict when an emergency can happen on the fireground<ul style="list-style-type: none">a. Trapped fire fightersb. Equipment failurec. Collapse or explosion2. A rapid intervention crew should be in place and ready should they be needed to assist other personnel<ul style="list-style-type: none">a.b. A rapid intervention crew is not to perform any other assignmentsc. More than one rapid intervention crew may be established based on the size of the incident and the number of emergency workers in the hazard area



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">d. E. Chief officer/incident commander<ul style="list-style-type: none">1. After arriving on the scene, a chief officer may assume command from the original incident commander2. If the incident is well organized and progressing well, the chief officer may choose to assume another role in the command system F. Fires in the upper levels of structures<ul style="list-style-type: none">1.<ul style="list-style-type: none">a. Require a greater number of fire fightersb. Equipment has to be taken to the level where needed before the fire attack can beginc.d. In addition to attacking the fire directly, floors above should be checked for extensione. Staging of personnel and equipment is normally two floors below fire floorf.2. Attic fires<ul style="list-style-type: none">a.



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">b. Roof ventilation will be necessaryc.d. Do not use ventilation holes for attack from above the attic <p>G. Fires below grade in structures</p> <ul style="list-style-type: none">1. Structure fires below grade create extremely dangerous conditions2. Stairs become chimneys for smoke and superheated gases from basement3. A thermal imaging camera can be used on the floor above the fire to locate the seat of the fire<ul style="list-style-type: none">a. Once located, a hole can be cut in the floor and a cellar nozzle inserted in to the basementb. After the heat is reduced, a nozzle crew can be sent in to the basement to complete extinguishment4. If a thermal imager or cellar nozzle is not available, fire fighters may have to go down stairs to attack fire in extremely punishing conditions<ul style="list-style-type: none">a.b.c. If proper ventilation is done away from the stairs, fire fighters may use a wide fog nozzle pattern when descending the stairs



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">(1) Basements windows should be opened opposite the stairway down(2) If no windows are available a ventilation opening can be cut in the ground level floor near a window(3) A smoke ejector can be placed in the window to vent the smoke and heat from the basement to the outsided. Avenues of vertical fire spread should be protected:<ul style="list-style-type: none">(1) Stairs(2) Walls(3) Shaftse. Horizontal extension to adjoining buildings should be monitoredH.<ul style="list-style-type: none">1. Piercing nozzles, distributors, or high expansion foam may be used2. Personnel should continuously check for vertical extension3.I. Fires in buildings with fixed fire suppression systems<ul style="list-style-type: none">1. Supporting fire suppression system must be a high priority during a fire



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">a. Sprinkler systemsb. Carbon dioxide systemsc. Standpipe systemsd. Clean-agent systemse. Dry and wet chemical systemsf. Foam systems <p>2. Dangers which may encountered where fixed system are present:</p> <ul style="list-style-type: none">a. Oxygen depletion after carbon dioxide system activationb.c. Energized electrical equipmentd.e. Increased water damage and water loading <p>3. Preincident planning should include details on system support and system connections</p> <p>4. Fire fighters must follow department procedures on what actions to take when sprinkler systems are in operation during a fire</p> <ul style="list-style-type: none">a. Assign a fire fighter with a radio to the main control valve to open or close it as orderedb. Install wooden wedges or sprinkler stops to stop the flow from open sprinkler heads



NOTES	STUDENT GUIDE
	<p data-bbox="711 415 737 441">c.</p> <p data-bbox="711 600 1370 709">d. Most fire departments do not restore sprinkler systems to normal or replace open sprinkler heads due to the liability involved</p> <p data-bbox="570 789 1062 823">VII. Vehicle Fires (<i>Essentials p. 796</i>)</p> <p data-bbox="618 867 1398 940">A. Fires in single-passenger vehicles are some of the most common types of fires encountered</p> <p data-bbox="618 982 646 1008">B.</p> <p data-bbox="618 1098 984 1131">C. Fire fighting procedures</p> <ol data-bbox="667 1173 1377 1814" style="list-style-type: none"><li data-bbox="667 1173 693 1199">1.<li data-bbox="667 1289 1206 1323">2. Position apparatus uphill and upwind<li data-bbox="667 1365 1341 1398">3. Full protective clothing and SCBA are required<li data-bbox="667 1440 1349 1514">4. Hoselines should be placed between the vehicle and any exposures<li data-bbox="667 1556 1365 1629">5. Attack the fire from a 45-degree angle to the long axis of the vehicle<li data-bbox="667 1671 1377 1745">6. Extinguish fire on ground around and under before moving into vehicle<li data-bbox="667 1787 693 1812">7.



NOTES	STUDENT GUIDE
	<p>D. Engine compartment fires</p> <ol style="list-style-type: none">1. The fire must be knocked down before the hood can be opened2. A piercing nozzle can be used through the hood, fenders or wheel wells3. Fire fighters can make an opening between the hood and fender with a prying tool and then use a narrow fog stream through the hole <p>E.</p> <ol style="list-style-type: none">1.2. A medium fog stream should be used in a circular motion into the interior <p>F.</p> <ol style="list-style-type: none">1.2. By bouncing the stream off the pavement under the vehicle onto the undercarriage3. By opening the hood and directing the stream through the engine compartment <p>G. Additional hazards with vehicle fires:</p> <ol style="list-style-type: none">1.2. Reduced water supply where many such fires occur along highways and rural roads3.



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">4. Instability of vehicles5.6. Weakened fuel tanks and piping7. Pressurized "shock absorber" bumpers<ul style="list-style-type: none">a. When heated, these can explode and throw the bumper considerable distanceb. May explode after a fire has been knocked downc. Personnel must avoid working in front or behind a vehicle8. Struts used to support the truck lid, hatch, or hood can be launched from the vehicle or open with extreme force9. Air bags which can deploy from steering wheels, dashboards, and door columns10. Hollow drive shafts and hatchback supportsH. Alternative fueled vehicles are increasing in popularity<ul style="list-style-type: none">1. LPG or compressed natural gas<ul style="list-style-type: none">a.b. Cylinders can explode during any fire2. Hybrid vehicles<ul style="list-style-type: none">a. Operate from gasoline and high-voltage batteries



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">b. c. If heated sufficiently, it is possible that the plastic modules inside the high-voltage battery could melt down, exposing the inner components of the high-voltage battery d. Where a fully involved hybrid vehicle fire is encountered, large amounts of water will generally be the extinguishing agent of choice e. Fire suppression crews will not be shocked or electrocuted during direct attack on a hybrid vehicle fire, even if flames are impinging on the battery pack itself f. g. Burning batteries will produce large amount of hydrogen increasing fire intensity h. Apply sufficient quantities of water to the batteries to cool the metal housing of the battery pack and control the fire until the battery modules that are actually on fire burn themselves out i. Orange-colored cables and components contain high-voltage electrical power



NOTES	STUDENT GUIDE
	<p data-bbox="570 411 1157 443">VIII. Dumpster and Trash Container Fires</p> <p data-bbox="618 489 646 520">A.</p> <p data-bbox="618 600 1352 669">B. It is difficult to know what is burning in a trash container</p> <ol data-bbox="667 716 1130 1052" style="list-style-type: none"><li data-bbox="667 716 695 747">1.<li data-bbox="667 793 695 825">2.<li data-bbox="667 871 1130 903">3. Flammable/combustible liquids<li data-bbox="667 949 695 980">4.<li data-bbox="667 1026 1287 1058">5. Compressed gas cylinders and aerosol cans <p data-bbox="618 1104 1390 1173">C. A Wisconsin fire fighter died on Dec. 29, 2009 when a burning dumpster suddenly exploded</p> <ol data-bbox="667 1220 1398 1780" style="list-style-type: none"><li data-bbox="667 1220 1398 1360">1. Volunteer firefighters responded to the scene after a Calumet County Sheriff's Deputy reported a fire in the trash bin that appeared to be melting the container<li data-bbox="667 1407 1398 1547">2. An explosion that killed St. Anna Fire Fighter Steven Koeser and injured eight others was caused when firefighters sprayed water and fire-suppressant foam into a burning trash bin<li data-bbox="667 1593 1398 1703">3. The trash bin contained aluminum alloy shavings and 55-gallon steel barrels of aluminum dross (slag)<li data-bbox="667 1749 1398 1780">4. Koeser, 33, was operating a pump near the trash bin



NOTES	STUDENT GUIDE
	<p>D. Fire fighting procedures</p> <ol style="list-style-type: none">1.2. Size of fire stream should be determined by size of container and proximity to exposures3. Check exposures for extension4.5. Overhaul to prevent rekindle <p>IX. Fires in Confined Spaces (<i>Essentials p. 800</i>)</p> <p>A. Fire fighting may sometimes be necessary in locations below grade or without natural or forced ventilation</p> <ol style="list-style-type: none">1. Underground vaults2. Caves3. Sewers4. Storage tanks5. Trenches <p>B. Fire fighters must remember to recognize the inherent hazards of confined spaces</p> <ol style="list-style-type: none">1.2. Flammable gases and vapors3.



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">4. Extreme temperatures5.6. Limited means of entry and egress7. Cave-ins or unstable support members8. Standing water or other liquids9.C. Facility personnel can be of great assistance at the scene because of their knowledge of the facility, hazards present, and the probable location of the fireD. Preincident planning should be conducted of existing confined spaces where emergencies may occur to familiarize personnel with facilitiesE. Procedures<ul style="list-style-type: none">1. The command post and staging areas must be established outside of the hot zone2. Staging must not obstruct the entrance3. Personnel must be tracked entering and leaving the confined space4. Fire may be indirectly attacked using penetrating nozzles, cellar nozzles, or distributor nozzles5.



NOTES	STUDENT GUIDE
	<p>X. Wildland Fires (<i>Essentials p. 800</i>)</p> <p>A. Between 1990 and 2008, 335 fire fighters have died fighting wildland fires in the United States</p> <p>B.</p> <p>1. _____: classified by grouping those with similar burning characteristics</p> <ul style="list-style-type: none">a. Subsurface fuels: roots, peat, and partially decomposed materials that are under the ground's surfaceb. Surface fuels: twigs, grass, brush, crops, logs, and heavy limbs on the ground's surfacec. Aerial fuels: suspended and upright fuels such as snags, leaves, branches, and brush over 6'd. The burning characteristics of fuels can be affected by:<ul style="list-style-type: none">(1) Fuel size: small fuels burn faster than larger ones(2) Fuel compactness: tightly packed fuels burn slower than those loosely piled(3) Continuity: fire spreads faster in fuels close together(4) Volume: the amount of fuel influences a fire's intensity(5) Fuel moisture content: drier fuels ignite easier and burn more intensely



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">2.<ul style="list-style-type: none">a. Wind: fans flames and supplies fresh air to fire and affects direction of spreadb. Temperature: has effects of wind and closely related to humidity, primarily affects drying of fuelc. Relative humidity: affects moisture content of dead fuelsd. Precipitation: determines moisture content of live fuels3. _____: features of the earth's surface<ul style="list-style-type: none">a. The steeper the slope, the faster the fire will travelb. Aspect: the compass direction a slope faces determines solar heating of the fuel. Wildland fires usually burn faster on southern exposuresc. Local terrain features: obstructions such as ridges, trees, and bluffs may alter airflow and fire behaviord. Wind restrictions (drainage, sink holes, depressions): can create updrafts causing a chimney effectC. Parts of a ground cover fire: any natural cover fire will contain at least two of these parts<ul style="list-style-type: none">1. Origin: where the fire started and from which it spread



NOTES	STUDENT GUIDE
	<ol style="list-style-type: none">2.<ol style="list-style-type: none">a.b. Usually on side opposite from wind directionc. Burns intensely and usually does the most damaged.3.<ol style="list-style-type: none">a. Long, narrow strips extending from the main fireb.4. Perimeter: outer boundary or distance around the outside edge of the fire, also called the "fire edge"5.<ol style="list-style-type: none">a. Side opposite the headb.c. Burns downhill or against the wind6.<ol style="list-style-type: none">a. Sides of the fireb. Fingers form from the flanksc.



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">7. Islands: unburned areas inside the fire perimeter8.<ul style="list-style-type: none">a. Caused by flying sparks and embersb. Could trap fire fighters between firesc.9. Green: the area of unburned fuels next to the involved area<ul style="list-style-type: none">a. Not necessarily a safe areab. Simply is the opposite of the burned area10. Black: the area where the fire has consumed or blackened the fuels <p>D. Wildland protective clothing and equipment</p> <ul style="list-style-type: none">1. Standard structural fire fighting protective clothing is inappropriate and can be dangerous in wildland situations2. Wildland PPE should meet the requirements of NFPA 1977, <i>Standard on Protective Clothing and Equipment for Wildland Fire Fighting</i>3. Fire fighters must be equipped with the following:<ul style="list-style-type: none">a. Helmet with eye protection and neck shroudb. Flame retardant shirt and pants or one-piece jumpsuit



NOTES	STUDENT GUIDE
	<ul style="list-style-type: none">c. Protective footwear (sturdy boots without steel toes)d. Glovese. Fire-shelter in crush-resistive case <p>E. Fire fighting procedures</p> <ul style="list-style-type: none">1.<ul style="list-style-type: none">2. Direct attack on the flames at the edge or closely parallel to the edge3. Indirect attack<ul style="list-style-type: none">a. Attempt to cut off progress of fireb. Establish fire breaks that completely surround fire areac.d.e. Assign personnel to check and extinguish spot fires outside of fire breaks4. Size-up must be continuous during a wildfire so adjustments can be made when required



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	<p data-bbox="618 411 1390 516">F. Ten Standard Fire Fighting Orders: serve as guidelines for fire fighters to identify and avoid high-risk situations</p> <ol data-bbox="667 562 1390 1514" style="list-style-type: none"><li data-bbox="667 562 1321 632">1. Keep informed on fire weather conditions and forecasts<li data-bbox="667 678 1256 709">2. Know what your fire is doing at all times<li data-bbox="667 753 1373 823">3. Base all actions on current and expected behavior of the fire<li data-bbox="667 869 1365 938">4. Identify escape routes and safety zones, and make them known<li data-bbox="667 984 1295 1016">5. Post lookouts when there is possible danger<li data-bbox="667 1062 1338 1131">6. Be alert, keep calm, think clearly, and act decisively<li data-bbox="667 1178 1386 1247">7. Maintain prompt communications with your forces, your supervisor, and adjoining forces<li data-bbox="667 1293 1365 1362">8. Give clear instructions and insure they are understood<li data-bbox="667 1409 1281 1440">9. Maintain control of your forces at all times<li data-bbox="667 1486 1354 1518">10. Fight fire aggressively, providing for safety first <p data-bbox="570 1591 932 1623">XI. Fire Control Summary</p> <ol data-bbox="618 1669 1398 1892" style="list-style-type: none"><li data-bbox="618 1669 1373 1780">A. The tactics of the fire fighters on the initial fire attack team determines the success or failure of fire control operations<li data-bbox="618 1824 1398 1892">B. Fire attack must be coordinated with rescue operations, forcible entry, ventilation, and utility control

FIRE CONTROL



MISSOURI DIVISION OF FIRE SAFETY FIRE FIGHTER I & II

NOTES	STUDENT GUIDE
	<p>C. Life safety is always the first and most important tactical priority regardless of the situation</p> <p>D. In any fire situation, coordination between different crews performing different functions is essential for a successful outcome</p>