

# Lesson 5

## Engine Company Operations

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### Lesson Objectives

- The Student Shall:
  - Name the 6 Engine Company functions
  - Identify 4 types of water supply
  - Discuss advantages and disadvantages of forward and reverse lays
  - Identify how color of smoke pertains to type of fuel involved

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### Lesson Objectives

- The Student Shall:
  - Name 5 variables of Flashover
  - Name 6 Indicators of Backdraft
  - Discuss the advantages and disadvantages of smooth bore vs. fog nozzles
  - State and apply the NFA Fire Flow Formula

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## Lesson Objectives

- **The Student Shall:**
  - State the friction loss rule of thumb
  - Identify the proper placement of attack lines
  - Discuss proper supply of sprinkler and standpipe systems

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## Engine Company Functions

- Water supply
- Fire Attack
- Exposure Protection
- Auxiliary Appliance Support
- Vapor suppression
- Hydraulic Ventilation

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## Apparatus Positioning

- **Considerations**
  - Departmental SOP's
  - Orders from IC / Company Officer
  - Street Conditions
    - Width / Obstacles / Weather Conditions
  - Fire Conditions
  - Exposure Profile

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## Apparatus Positioning

- **Rule #1:** Leave room for Truck Co.
  - Hose bends, ladders don't
- **Know where the truck is coming from**
  - Same direction –position just past building
  - Opposite direction –position just short of the building

**COMMUNICATE!!**

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## Apparatus Positioning

- **Backing into position**
  - Provides flexibility / options
  - Use a Guide
  - Leave room for Ground Ladders
  - Usually applies to later-arriving engines

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## Water Supply

- **Static Water Sources**
  - Drafting
    - Lakes, streams, ponds, pools, etc.
    - Pre-planned drafting sites
  - Tanker Shuttles
    - Reflex time
    - Equipment availability / limitations
    - Dump site / Fill Site

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## Water Supply

- Hydrant Systems
  - Public
    - Grid Systems
    - Dead-end Hydrants
    - Main Sizes / Pressures
    - Obstacles / Thread compatibility
    - Tamper-proof hydrants

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## Water Supply

- Hydrant Systems
  - Private
    - Industrial / Commercial Occupancies
    - Yard Hydrants
      - Not for FD use – robs auxiliary system
    - Gravity Tanks (usually Roof mounted)
    - Pressure tanks (3000 GPM or less)
      - Limited water supply
      - Once empty, useless

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## Water Supply

- Hydrant Volume
  - N.F.P.A. Marking System
    - Blue 1500 GPM +
    - Green 1000 – 1500 GPM
    - Yellow or Orange 500-1000 GPM
    - Red 500 or less GPM
  - Colors found as bonnet color or hydrant banding

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## Water Supply

- **Supply Line Size**
    - LDH vs. Dual lines (small diameter)
  - **Two 3" lines = One 4" line**
  - **5" line: 1000 gpm AT 1000': NO friction loss**
    - Like bringing main up to the street
- What does your Dept use?**

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## Forward Lay Hydrant-to-Fire

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|--|---|
| <ul style="list-style-type: none"><li>• <b>Advantages</b><ul style="list-style-type: none"><li>– Engine / Tools in front of building</li><li>– Pump operator has visual contact with operation</li></ul></li></ul> | <ul style="list-style-type: none"><li>• <b>Disadvantages</b><ul style="list-style-type: none"><li>– Must leave a FF at hydrant</li><li>– Full flow not available if supply line too long</li><li>– May need 2<sup>nd</sup> engine to boost pressure</li></ul></li></ul> |
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## Reverse Lay Fire-to-Hydrant

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| <ul style="list-style-type: none"><li>• <b>Advantages</b><ul style="list-style-type: none"><li>– Early size-up</li><li>– Engine at water source provides best pressure / flow</li><li>– Most direct way to supplement hydrant pressure and draft</li></ul></li></ul> | <ul style="list-style-type: none"><li>• <b>Disadvantages</b><ul style="list-style-type: none"><li>– Must have enough hose dropped</li><li>– Leaves a member remote from scene</li><li>– Tools not immediately available</li></ul></li></ul> |
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## Relay Operations

- Largest capacity engine on hydrant
  - Largest diameter hose nearest hydrant
- 20 psi residual on engines in relay
- 10 psi residual on hydrant pumper
  - Coordination between pump operators is essential
  - Water Supply Officer as coordinator

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## 2-Engine Fire Attack

- 1<sup>st</sup> engine is attack engine
  - Stretches attack line
  - Works off tank water
  - May leave supply line at hydrant
- 2<sup>nd</sup> engine is water supply
  - May back down to attack engine on narrow street
  - May pass by on wide street and drop supply line before going to hydrant

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## Bumping

- Effective on narrow streets with 2-engine attack strategy
  - When both engines arrive before Truck Co.
    - 1<sup>st</sup> engine is bumped up to water supply duties
    - 2<sup>nd</sup> engine assumes attack position
    - Will not work if 1<sup>st</sup> engine already has dropped hose
    - 2<sup>nd</sup> Officer MUST be on the ball

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## Fire and Smoke Conditions

- Color
- Volume & Density
- Expected Fire load / Occupancy
- Risk vs. Gain

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## Fire and Smoke Conditions

- Color
  - Black / Dark brown = hydrocarbon based fuels
    - Plastics
    - Flammable Liquids
    - Asphalt based products
    - Accelerants / Arson
    - Foam Rubber / Rubber

**BEWARE OF FLASHOVER!!!**

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## Fire and Smoke Conditions

- Color
  - Brown to Gray
  - Class A Combustibles
    - Wood
    - Paper
    - Cardboard
    - Natural Fiber Product

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## Fire and Smoke Conditions

- Color
  - Yellow-gray
  - Oxygen-starved fire
  - Backdraft Conditions

**CORRECT TACTICS HERE ARE CRITICAL**

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## Fire and Smoke Conditions

- Color
  - White Smoke
    - Steam Leaks
    - Unattended Cooking
    - Initiation (Incipient) Phase Fire
    - Stream effectiveness
      - White indicates streams are hitting fire (creating steam)

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## Fire and Smoke Conditions

- Color
  - Unusual Colored Smoke
    - Think Haz Mat
    - Extreme Caution Required
    - Slow things down
    - Get information before rushing in

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## Fire and Smoke Conditions

- **Volume & Density**
  - Deep Seated Hot Fire
  - May Indicate Flashover
  - Obscures true seat of fire
  - Victim survival improbable

The more Voluminous and Dense the Smoke is, the bigger the problem

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## Fire and Smoke Conditions

- **Expected Fire load / Occupancy**
  - Does the Occupancy and Expected Fire Load Match the Smoke and Fire Conditions Present?
  - Is there more than meets the eye here?

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## Fire and Smoke Conditions

- **Risk vs. Gain**
  - Can you reach the seat of the fire safely?
  - Can you produce enough water flow to solve the problem?
  - Are there savable victims?
  - Has building been compromised?

WILL YOU CHOOSE THE CORRECT STRATEGY??

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## Flashover Variables

- Ceiling Height
- Room Size or Void Size
- Size / Number of openings in Room or Space
- Insulation qualities of Structure
- Fire Load

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## Flashover Indicators Exterior

- Smoke Color
- Smoke Volume
- Smoke Movement and Pressure
- Vent Point Ignition

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## Flashover Indicators Interior

- Lean Flashover
- Blinding Smoke to floor
- High Heat Condition
- Rollover
- Test the Atmosphere
  - Look above you
  - Feel above you
  - Water test

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## Flashover Safety Considerations

- Recognize the Signs
- Listening to Reports
- Recon
- Limited search in areas of egress
- Controlled tactics

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## Flashover Tactics

- Water kills Flashover
  - Indirect Attack
  - Proper Coordinated Ventilation
- Vertical Ventilation
  - Draws gases up and out
  - Cooler air introduced from below

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## Backdraft Indicators

- Yellow-Gray smoke
- Puffing / Pushing of Smoke
- Sealed up Building or Area
  - Roll-Down Gates
  - Thermopane Windows
- Small fire present at building openings
- Stained Glass
- Void Backdraft
  - Cockloft

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## Backdraft Safety Considerations

- Recognition of the Signs
- Line Placement at Flanking Positions **ONLY** until vent is completed
- Stay Clear of Windows / Doors
  - Consider Blast zone and debris travel
- Coordination of Vertical Vent and Attack

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## Backdraft Tactics

- Vent at the Highest Point
- Engine Company Ops have to put on hold until **AFTER** vertical vent has been accomplished
  - VENTILATION MUST BE CONFIRMED
  - REQUIRES OPERATIONAL DISCIPLINE
- Indirect Attack Strategy is an option

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## Engine Officer Size-Up

- Hoseline chosen based on:
  - Building size / setback
  - Location & extent of fire
  - Class of fire
  - Personnel available
  - Water available

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## Hose Length Making the Right Choice

- **Height of Building**
  - 1 length per floor + 1 working length
  - Open stairwell rule = 1 length per 5 floors + one working length
- **Size of building**
  - --Have enough hose equal to the width plus the depth plus one length for each floor above or below grade

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## Hose Diameter Making the Right Choice

- 1-3/4" or 2-1/2"??
- **Based on:**
  - **Occupancy / Fire Load**
    - Commercial vs. Residential
  - **Fire Involvement**
    - Big fire = big water

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## Hose Diameter Making the Right Choice

- 1-3/4" or 2-1/2"??
- **Based on:**
  - **Fire Spread Potential**
    - Exposure priority
  - **Length of Stretch**
    - Beware of Friction Loss

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## Nozzle Selection

### Solid Bore Nozzles

- **Uses: Cool and Quench**
  - Master Streams
    - Deck Guns / Elevated Master Streams
  - Large Diameter Handlines
    - 2-1/2" handlines
  - High Rise Operations
  - Large, open areas
  - More efficient on direct attack

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## Nozzle Selection

### Solid Bore Nozzles

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>• <b>Advantages</b><ul style="list-style-type: none"><li>– Reach and Penetration</li><li>– Less disturbance of thermal balance</li><li>– Less nozzle maintenance</li><li>– Less nozzle pressure/reaction</li><li>– Larger flows</li></ul></li></ul> | <ul style="list-style-type: none"><li>• <b>Disadvantages</b><ul style="list-style-type: none"><li>– More difficult to handle due to increased flows</li><li>– No ability to vary pattern; less versatile</li><li>– Less heat absorption</li><li>– Can't play pinochle</li></ul></li></ul> |
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## Nozzle Selection

### Fog Nozzles

- **Uses: Heat Absorption**
  - Readily produces steam, smothering fire
- Interior attack **with** proper ventilation
- Fog Ventilation
- More suited to indirect and combination attack

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## Nozzle Selection Fog Nozzles

- **Advantages**
  - High water-to-steam conversion
  - Moves large amounts of air
- **Disadvantages**
  - Steam burns
  - Coordinated vent operations crucial
  - Higher nozzle pressure / reaction
  - More nozzle maintenance
  - Affected by wind

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## Nozzle Selection Broken Stream Nozzles

- **Types:**
  - Piercing Nozzles
  - Bresnan Distributor
  - Cellar Nozzles
  - Bent Applicators
  - Chimney Nozzles

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## Rule of Thumb

- **Burst Hoseline Replacement**
  - When replacing a burst hoseline, always use two lengths to replace one
    - Charged lines lengthen
    - One line ain't gonna make it, brother

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## Fire Flow

- **NFA Formula**

$$\text{GPM} = (L \times W \div 3) \times \text{number of floors involved}$$

- **Add 25% for each exposure**  
– Ex: Floor above fire

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## Fire Flow and Resources

- **Every 500 GPM = 1 Engine**
- **Every 2 Engines = 1 Truck**  
– Task Force (2 eng. + 1 trk)
- **1 Chief Officer for every Task Force**
- **Talk forget about tactical reserve for when troops are spent**

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## Nozzle Pressures

- **Handlines**
  - Fog = 100 PSI N.P.
  - Solid Bore = 50 PSI N.P.
  - Low Gallonage Fog Nozzles
- **Master streams**
  - Fog = 100 PSI N.P.
  - Solid Bore = 80 PSI N.P.

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## Nozzle Diameter & Flow Handlines

- Applies to Solid Bore Nozzles
  - 1 1/4" = 400 GPM
  - 1" = 200 GPM
  - 15/16" = 180 GPM

TIP DIAMETER NO MORE THAN 1/2 THE SIZE OF HOSE DIAMETER

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## Friction Loss Rule of Thumb

- 1-3/4" lines @ 150 GPM
  - 15 PSI per 50' length
- 2" lines @ 200 GPM
  - 15 PSI per 50' length
- 2-1/2" lines @ 250 GPM
  - 5 PSI per 50' length

Add 5 PSI per 10' elevation (per floor)

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## Line Placement Rule of Thumb

- 1<sup>st</sup> Line
  - To seat of fire via safest, most effective path of least resistance
  - Attack from unburned side
  - Protect egress paths
  - Protect primary search
  - Coordinate with Vent operations

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## Line Placement Rule of Thumb

- 2<sup>nd</sup> line
- Should be larger or equal to the attack line diameter
  - Reinforce (Back-up) attack line
  - Adjacent areas
  - Floor above
  - Support pre-control overhaul

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## Line Placement Rule of Thumb

- 3<sup>rd</sup> line
  - Next most important exposure
  - Stretched via an alternate route
    - Uncovered floors
    - Vertical voids
    - Cockloft / Attics
    - Exterior exposure line
    - Attached exposure coverage

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## Line Advancement Guidelines

- Check the entry point
- Hoseline Management
  - No kinks, man
  - Keep stretches short
  - Choose proper pattern (narrow vs. wide)
- Personnel Management
  - Keep stairs clear
  - Don't crowd the nozzleman (person)
- Utilize only as much personnel needed to complete task

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## Exposure Protection Considerations

- Based on:
  - Distance from fire source
  - Wind
  - Exposure construction type
  - Occupancy type
  - Attached vs. Unattached
  - Available resources

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## Exposure Protection Strategy

- Eliminate the exposure
  - Apparatus placement
  - Motor vehicles
  - Combustible clearing ops
- Wet the exposure
  - Reduce radiant heat
  - Water on exposure

**NO WATER CURTAINS ALLOWED**

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## Master Stream Considerations

- Keep Supply lines short
- Maintain collapse zones
- Anticipate fire spread
- Proper nozzle selection
  - Smooth bore vs. fog
- Tip size vs. GPM

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## Master Stream Strategies

- Pump in VOLUME
- Hit fire only
- No streams into vent holes
- Once fire is darkened, shut down stream
  - Consider interior operations
  - Safety check first

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## Nozzle Diameter & Flow Master Streams

- Applies to Solid Bore Nozzles
  - 2" = 1000 GPM
  - 1 1/2" = 800 GPM
  - 1 1/4" = 600 GPM
  - 1 1/8" = 400 GPM

TIP SIZE MUST MATCH GALLONAGE AVAILABLE

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## Fire through the roof

- Doesn't necessarily mean exterior ops
  - Assign Div. Cmdr
  - Pull Ceilings
  - Operate streams from below
  - Closely monitor interior conditions and reports

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## Fire through the roof

- **Top floor untenable:**
  - Order crews from roof & interior
    - PAR
  - Direct streams from ground level to attack fire from below roof
    - Outside collapse zones
    - Protect adjacent exposures
      - Can still operate inside exposures
    - Streams directed in vent opening will push fire laterally

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## Fire through the roof

- **Until good portion of roof burns away, no streams above roof**
  - Streams appear through the roof (wetting the sky) is the cue
  - Once most of roof has burned away, elevate streams and redirect at main body of fire burning behind wall
    - Maintain collapse zones

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## Standpipe Supply

- Preplan system
- Types of Systems
  - Wet vs. Dry
- Early FD Support
  - Supply Early and Often
- Minimum 2 - 2 1/2" supply lines
- Know how to troubleshoot problems
- Start supply at 150 psi
  - Do not exceed 200 psi

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## Standpipe Operations

- Connect 1 floor below fire
- Standpipe control person
  - Check for and remove pressure reducing devices / debris
  - Flush system before connecting
- Expect problems / solve them
  - Missing control wheels / damaged threads / closed supply valves

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## Types of Systems

- Class I: Fire Department only
  - 2-1/2" outlet / no hose
- Class II: Occupant only
  - House line – usually 1-1/2"
  - Not for FD use (inadequate flow)
- Class III: Combination system
  - 2-1/2" outlet with house line
  - Contains pressure reducers

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## Sprinkler Operations

- Supply system early
- Minimum 2 – 2½" supply lines
- Supply from different main than system feed
- Designate supply engine in SOP
- Supply system at 150 psi

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## Summary

- Engine Company Functions
- Water Supply Systems
- Fire / Smoke Indicators
- Flashover / Backdraft
- Smooth Bore Vs. Fog
- NFA Fire Flow Formula
- Sprinklers and Standpipes

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## Conclusion

- Smart Firefighters are assigned to Ladder Companies
- Don't take it personally
- Engine Companies have **1** job:
  - Put the Wet Stuff on the Red Stuff in proper form and quantity

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## Next Lesson

- Lesson 6
  - Truck Company Operations
- Reading Assignment:
  - Fireground Strategies
    - Ch. 11
    - Review Handouts to this point

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