The Maryland Fire and Rescue Institute of the University of Maryland is the State’s comprehensive training and education system for all emergency services.

The Institute plans, researches, develops, and delivers quality programs to enhance the ability of emergency service providers to protect life, the environment, and property.
Introduction to Aerial Apparatus and Equipment

Student Performance Objective
Given information from discussion, handouts, and reading materials, identify the requirements, skills, and selection considerations for aerial apparatus drivers/operators; duties and responsibilities of aerial apparatus drivers/operators; the different types of aerial devices and aerial apparatus features; the equipment standards as prescribed by national, state, and local agencies; and the operations and safety precautions for aerial devices. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Overview
- Driver/Operator Selection
- Duties and Responsibilities
- Types of Aerial Devices
- Common Features of Aerial Devices
- Equipment Standards
- Operations and Safety Precautions
Driver/Operator Selection

• Challenges
  – Transport personnel, apparatus, and equipment safely
  – Operate apparatus properly, swiftly, and safely
  – Ensure apparatus and equipment is ready at all times
• Skills needed
  – Ability to read and comprehend material
  – Ability to write and communicate
  – Ability to perform mathematical computation
• Physical requirements
  – Fitness, vision, and hearing

Driver/Operator Selection

• Selection requirements
  – Completion of training
  – Successful testing
• Driving requirements
  – Be aware of pertinent laws
  – Be able to adjust to road conditions
  – Be able to maintain control of apparatus
  – Have appropriate licenses

Duties and Responsibilities

• Truck company duties
  – Search and rescue
  – Ventilation
  – Entry
  – Checking for fire extension
  – Laddering
  – Salvage
  – Overhaul
  – Providing elevated streams
  – Lighting
  – Utility control
Duties and Responsibilities

• Truck company duties versus other fire company actions
  – Any unit with the needed equipment and staffing can perform truck company or support duties
  – The primary difference between truck companies and other fire companies is that the truck has an aerial device and may carry more of any particular item

• Truck company responsibilities
  – Understand the equipment
  – Understand the duties

Types of Aerial Devices

• Aerial ladders
  – Are power-operated on a turntable
  – Have working heights ranging from 50-135 feet
  – Are mounted on 2- or 3-axle single-chassis vehicles or on three-axle tractor-trailers
  – Use truss construction for the support beams (trusses are stronger when the assembled members form triangles)
  – Are constructed from heat-treated aluminum alloy and steel

• Aerial ladders (continued)
  – Have three main parts
  – Have a minimum 18-inch width for any section
  – Rise to the maximum elevation and extension, and rotate 90º
  – Have a minimum 250-pound tip load when fully extended at any elevation, if manufactured since 1991
Types of Aerial Devices

- Elevating platforms
  - NFPA common design requirements
    - Leveling system so the platform is horizontal to the ground at all times
    - Platform floor area of 14 sq. ft. at a minimum
    - Complete rail enclosure with no opening under the railing greater than 24 inches
    - Kick plate 4 inches high at floor level
    - Drain opening
    - Two control stations: one on the turntable and one in the platform

- Backup hydraulic system
- Heat-protective floor shield
- Water fog curtain nozzle
- Load capacity
  - Minimum 1,000-gpm water delivery system
  - Platforms of 110 feet or less capable of rising to maximum elevation and extension and rotating 90° in 150 seconds or less

- Aerial ladder platforms
  - Use a work platform attached to the end of the aerial ladder
  - Have working heights ranging from 85–110 feet
  - Are midship- or rear-mounted on a 3-axle, single-chassis vehicle
Types of Aerial Devices

- Elevating platforms
  - Types of elevating platforms
    - Telescoping aerial platforms
      - Are equipped with a small ladder attached to the boom; used as an escape ladder
      - Have working heights ranging from 75–100 feet
      - Are made with two or more sections of box-beam or tubular truss-beam construction
Types of Aerial Devices

- Elevating platforms
  - Types of elevating platforms
    - Articulating aerial platforms
      - Are similar in construction to telescoping aerial platforms
      - Have hinged boom sections to form an elbow when folded
      - Have working heights ranging from 55–85 feet
      - Are rear-mounted on 3-axle, single-chassis vehicles

Types of Aerial Devices
Articulating Aerial Platform

Types of Aerial Devices
Water towers
- Pumper: telescoping or articulating devices that
  - Deploy the elevated master stream as the primary function
  - Use a remote ground-level control for tower movement and stream
  - Have working heights ranging from 50–130 feet
  - Are capable of flowing 1,000–5,000 gpm
  - Have a ladder attached for emergency escape, but do not meet the NFPA requirements for aerial ladders
Types of Aerial Devices

Pumper With Water Tower

• Water towers (continued)
  – Quints (combination aerial devices and pumpers) have five major components
  – Aerial ladder or elevating platform with a permanently piped waterway
  – Volume pump with a minimum 1,000-gpm capacity
  – Fire hose with a minimum 800-foot supply of hose, 2½-inch or larger, and a 400-foot supply of attack hose
  – Water tank that holds a minimum of 300 gallons
  – Small equipment including 85-foot minimum of ground ladders

• Quints have two working heights
**Common Features of Aerial Devices**

- **Hydraulic systems**
  - Hydraulic fluid is the medium used to transmit force.
  - Hydraulic fluid is practically incompressible and allows transmission of force over long distances with little loss of power.
  - Hydraulic fluid may be under pressure of 3,500 psi or higher.
  - PTO-powered hydraulic pumps create a force on the fluid.
  - Steel tubing and aircraft-type steel braided hoses supply the fluid.
  - Check valves prevent the backward flow of fluid.

- **Pressure limiting and control valves**
  - Relief valves limit pressure buildup.
  - Counterbalance valves prevent any unintentional or undesirable motion.
  - A selector valve directs the fluid to either the stabilizers or aerial device.
  - Actuators convert the system fluid power into mechanical force using hydraulic cylinders.
  - Double-acting cylinders are capable of receiving oil under pressure from both sides of the piston, creating force in either direction.
  - An auxiliary pump is provided if the main pump fails.

- **Stabilizer cylinders**
  - Cylinders force the arms out and down.
  - Cylinders are operated by hydraulic fluid.

- **Hoisting cylinders**
  - The trunnion is anchored to either an aerial device or the turntable on the end of piston rod outside the cylinder.
  - Normal operating pressure is 850–3,000 psi.
  - Newer hoisting cylinders are equipped with safety valves that lock and hold fluid in the cylinder in the event of a leak or a blowout.
Common Features of Aerial Devices

- Extension cylinders, cables, or chains
  - Dual cylinders extend the second section
  - Cables and pulleys extend other sections

- Rotation mechanism
  - Rotation mechanism operates on a large sheer ball-type bearing
  - Bearing is fastened to the turntable on one side and to the aerial device on the other side
  - Geared teeth on the periphery rotate the turntable

Common Features of Aerial Devices

- Control pedestal
  - Three separate levers control the elevation, extension, and rotation
  - Other possible controls and instruments include the
    - Engine speed switch (high idle)
    - Light switch (for control panel, ladder lights, or tip lights)
    - Hydraulic oil pressure gauge
    - Extension indicators
    - Stop and lock controls
    - Rung alignment indicator

- Other possible controls and instruments (cont.)
  - Inclinometer
  - Engine starter switch
  - Communications equipment
  - Elevated master stream controls
  - Hydraulic lock valve
• Water delivery systems
  – Piped aerial ladder waterways
  • Bed ladder pipe systems
    – Usually have a 3- or 3½-inch internal diameter attached to the underside of the ladder bed section in a non-telescoping section
    – Usually have a manually-operated solid stream nozzle
    – Are operator-controlled from the tip or, preferably, from the ground by guy ropes attached to the nozzle
    – Are supplied through a 2- or 3-way Siamese connection at the turntable

Common Features of Aerial Devices

• Water delivery systems (continued)
  – Piped aerial ladder waterways
  • Telescoping waterways
    – Extend to the tip of the fly section
    – Usually have a remote-controlled fog nozzle
    – Have a minimum 4-inch internal diameter
    – Are capable of flows up to 1,000 gpm

Common Features of Aerial Devices

• Water delivery systems (continued)
  – Detachable ladder pipe systems
    • Consist of detachable ladder pipe, nozzle, fire hose, hose straps, clappered Siamese, and hose gate or ball valve
    • Have clamps secured to the top two rungs on the last fly
    • Are operator-controlled from the tip or, preferably, from the ground by guy ropes attached to the nozzle
    • Are limited to flows of up to 750 gpm
Common Features of Aerial Devices

• Water delivery systems (continued)
  – Detachable ladder pipe systems
    • Are supplied by a single 3- or 3½-inch hose run up the center of the rungs
    • Have two to three hose straps secure the hose
    • Restrict lateral movement to 15º with greater coverage achieved by rotation
    • Restrict elevation between 70º and 80º

Common Features of Aerial Devices

• Water delivery systems (continued)
  – Elevating platform waterway systems
    • Are similar to piped aerial ladder systems with the nozzle or nozzles in the platform
    • Have piping systems capable of flows up to 2,000 gpm
    • Are safer and more comfortable, if it is necessary to place a firefighter at the tip
    • Are equipped with at least one 2½-inch discharge in the platform allowing for handlines, if needed
    • May have pre-connected attack lines

Common Features of Aerial Devices

• Water delivery systems (continued)
  – Water tower systems
    • Are similar in design to aerial ladders with piped waterways
    • Have a control panel either on the engine step or on the pump panel
    • Commonly discharge water from the fire pump
    • May have a video camera at the tip and monitor at the panel for use under special conditions
    • May have piercing nozzles capable of flows up to 300 gpm
Common Features of Aerial Devices

Communication systems
- Hands-free transmitter/receiver at ladder tip or platform
- Hands-free transmitter/receiver at turntable control

Breathing air systems
- Allow personnel at the tip of the device to breathe clean air without standard SCBA
- Support at least two firefighters
- Sound a low-air warning at both the upper and lower control stations when capacity reaches 20%

Apparatus mounted special systems
- Electrical generation equipment
  - Portable generators provide up to 5,000 watts
  - Fixed generators provide up to 50,000 watts
  - Inverters increase fuel efficiency and reduce noise when power requirement is small

Scene lighting and power distribution
- Portable lights with 300–1,000 watts per light
- Fixed lighting with 500–1,500 watts per light
- Electrical cables or extension cords
- Junction boxes
- Hydraulic extrication tool system or electric power system
Common Features of Aerial Devices

Equipment Standards

- NFPA 1901 (1999), Standard for Automotive Fire Apparatus
- MSFA, Article D, Section 4 of the By-Laws

Operations and Safety Precautions

- Operational Precautions
  - Never move the ladder with firefighters on it
  - Never forcefully extend the end of the ladder against a structure
  - Use jacks with ground plates
  - Operate with deliberate motions and apply power smoothly
  - Perform one operation at a time in the correct operating sequence
  - Ensure that the truck is set for ladder operation before leaving the cab
Operations and Safety Precautions

Operational Precautions

- Never use the ladder for pulling down walls or structural members
- Observe the inclinometer to ensure the safe angle of operation and safe loadings
- Have the operator remain near the truck while the aerial is in use and the engine is running
- Keep the hydraulic circuits operating to prevent freezing or sluggishness in cold weather
- Use the proper hydraulic fluid and check it regularly
- Exercise extreme caution when the ladder is coated with ice, which may cause failure of the ladder if it is moved before defrosting

Operations and Safety Precautions

Operational Precautions

- Never attempt to move the ladder truck with the ground jacks in contact with the ground
- Never move the truck with the ladder raised to one side
- Use sand or salt under the jacks and wheels when operating on ice and/or snow
- Control the nozzle from the turntable or the ground whenever possible in ladder pipe service operation
- Secure hose lines to the ladder; ensure that hose ropes or straps do not interfere with the use of the rungs

Operations and Safety Precautions

Operational Precautions

- Ensure that the ladder locks are off and the sections have been extended to free the pawls before applying power to lower the ladder
- Ensure that all emergency controls are in the “off” or “neutral” position except when needed
- Detach removable manual controls, such as hand cranks, before applying power
- Promptly report to the responsible officer any difficulty with the ladder, including inadequate hydraulic power
- Brace a ladder extended at a low angle with a ground ladder
Operations and Safety Precautions

- **Safety Precautions**
  - Operate the aerial ladder carefully and responsibly; it is only as good or as safe as the operator is competent.
  - Never permit firefighters to climb an aerial ladder until the operator indicates it is set for climbing.
  - Do not allow firefighters to use a leg lock on the aerial; they should use a life belt or rope hose tool.
  - Ensure the stability of any structure supporting the ladder.
  - Illuminate the top of the ladder and the rungs at night.
  - Never use an aerial ladder for stunts.

- Periodically and after every use inspect cables, pulleys, rails, and rungs for wear and tightness.
- Never abuse an aerial ladder by careless handling, overloading, or using in a manner for which it is not designed.
- Limit the number of firefighters on the ladder and on each section in accordance with the manufacturer’s instructions.
- Use extreme caution when working around electric wires.
- Use extreme caution and reduce the load when operating in a strong or gusty wind.

- Periodically and after any exposure to flame or fire damage, or after major repairs, test each aerial ladder as outlined in NFPA 1901, *Standard for Automotive Fire Apparatus, Chapter 18-24, Certification Tests*.
- Take precautions both in securing the vehicle and in placing the ladder when operating on steep hills.
Student Performance Objective

Given information from discussion, handouts, and reading materials, identify the requirements, skills, and selection considerations for aerial apparatus drivers/operators; duties and responsibilities of aerial apparatus drivers/operators; the different types of aerial devices and aerial apparatus features; the equipment standards as prescribed by national, state, and local agencies; and the operations and safety precautions for aerial devices. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Review

- Driver/Operator Selection
- Duties and Responsibilities
- Types of Aerial Devices
- Common Features of Aerial Devices
- Equipment Standards
- Operations and Safety Precautions
Student Performance Objective

Given information from discussion, handouts, and reading materials, describe aerial apparatus maintenance and testing procedures. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Overview

- Maintenance Program
- Apparatus Inspection
- Pre-Service Testing
- Service Testing
### Maintenance Program

- Maintenance and repair
- SOPs for systematic maintenance programs
- Keeping the apparatus clean
- Glass care
- Interior cleaning
- Waxing
- Recordkeeping

### Apparatus Inspection

- Circle- or walk-around inspection
- Approaching the vehicle
- Left- and right-front side inspection
- Front inspection
- Left- and right-rear side inspection
- Rear inspection
Apparatus Inspection

- In-cab inspection
- Engine compartment inspection
- Post-trip inspection
- Battery inspection
- Aerial device inspection
Pre-Service Testing

- Pre-service testing is
  - Conducted before placing the apparatus in service
  - Conducted at the manufacturer’s facility (except acceptance testing)
  - Conducted by the manufacturer or a third party

Pre-Service Testing

- Testing methods
  - Load testing
  - Non-destructive testing
  - Operational testing

Pre-Service Testing

- Manufacturer testing
  - Road test
  - Hydrostatic test
- Certification tests
  - Stability test
  - Flow test
  - Fire pump certification test
- Acceptance tests
Pre-Service Testing

• Stability Testing

Service Testing

• Aerial ladders
  – Frequency of tests
    • At least annually
    • After major repairs or overhaul
    • After unusual conditions, exposures, stresses or loads
    • After any usage exceeding manufacturer’s recommendation
    • At least every 5 years for complete inspection and testing

Service Testing

• Aerial ladders (continued)
  – Signs of failure
  – Service records
  – Visual inspection
  – Stabilizer examination
  – Turntable and torque box examination
  – Aerial ladder examination
Service Testing

• Aerial ladders (continued)
  – Operational testing
    • Load testing
      – Conduct when the wind is less than 10 mph
      – Closely watch the load tests
      – Place the ladder in the most stable position
      – Use manufacturer’s load chart or operator’s manual to determine maximum rated live load

Service Testing

• Load Testing

Load testing involves suspending an appropriate weight from the tip of the aerial device.

Service Testing

• Aerial ladders (continued)
  – Operational testing
    • Load testing
      – Attach and center test cable hanger to top rung
      – For single-chassis, rear-mounted apparatus, rotate until positioned over the rear and parallel to centerline
      – For a midship-mounted ladder, rotate slightly off center
Service Testing

- Load Testing—Rear Mount

  The aerial device is extended directly over the rear of the apparatus.

Service Testing

- Load Testing—Mid-ship Mount

  The aerial device is rotated slightly off center and then extended off the rear of the apparatus.

Service Testing

- Aerial ladders (continued)
  - Operational testing
    - Horizontal load test
      - Place ladder in horizontal position and extend fully
      - Apply section locks
      - Close cylinder holding valve
      - Apply weight equal to rated live load
      - Test weight hangs freely for 5 minutes
Service Testing

• Load Testing—Horizontal

Ladder is placed in horizontal position and fully extended; test weight is applied to equal manufacturer’s rated live load.

Service Testing

• Aerial ladders (continued)
  – Operational testing
    • Maximum elevation load testing
      – Elevate to maximum height; extend fully with weight attached
      – Apply section locks
      – Close cylinder holding valve
      – Apply weight equal to rated live load and retain in place for 5 minutes

Service Testing

• Load Testing—Elevation

The ladder is extended to maximum working height. Weight is gravitationally applied to bucket suspended from tip — up to manufacturer’s rated live load.
Service Testing

- Aerial ladders (continued)
  - Operational testing
    - Water system tests
      - Retracted ladder pressure test
      - Extended ladder pressure test
      - Flowmeter accuracy test
      - Pressure gauge test
      - Waterway relief valve test

- Elevating platforms
  - Frequency, review and inspection
    - Conduct annually
    - Review service records
    - Visually inspect device and stabilization systems
      - Stabilizer, turntable and torque box examinations
      - same as aerial ladders

- Elevating platforms (continued)
  - Elevating platform examination
  - Articulating aerial lower boom examination
  - Articulating aerial upper boom examination
Service Testing

- Elevating platforms (continued)
  - Telescoping platform boom examination
  - Operational tests
  - Water tower apparatus tests
  - Post-test activities
    - Keep complete records of testing
    - Stop and correct problems when found
    - Obtain manufacturer’s approval for maintenance

Student Performance Objective

Given information from discussion, handouts, and reading materials, describe aerial apparatus maintenance and testing procedures. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Review

- Maintenance Program
- Apparatus Inspection
- Pre-Service Testing
- Service Testing
Lesson 2-2
Apparatus Safety

Student Performance Objective

Given information from discussion, handouts, and reading materials, describe all safety precautions when driving and operating an aerial device. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Overview

• Collisions
• Personal Readiness
• Rider Safety
• Backing the Apparatus
Collisions

- Collisions:
  - Some are avoidable
    - Improper Backing
    - Reckless Driving
      - By the public
      - By the aerial device driver/operator
  - Some are caused by lack of driver/operator judgment or driving skills
  - Some are unavoidable

Personal Readiness

- Attitude
- State of Mind
- Physical Ability

Rider Safety

- SOPs governing donning and doffing of PPE prior to entrance to the vehicle
- SOPs governing seatbelt use
- SOPs governing loading hose while the vehicle is in motion
- SOPs that govern tillers and/or tillering
Backing the Apparatus

- Backing the Apparatus
  - Is a hazardous action while driving fire apparatus of any kind
  - Can be done safely with
    - Two spotters
    - Emergency lights
    - Technology
    - Hand signals

Student Performance Objective

Given information from discussion, handouts, and reading materials, describe all safety precautions when driving and operating an aerial device. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Review

- Collisions
- Personal Readiness
- Rider Safety
- Backing the Apparatus
Lesson 3-1
Positioning Apparatus

Student Performance Objective

Given information from discussion, handouts, and reading materials, describe the principles of positioning an aerial apparatus at the emergency scene. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Overview

- Standard Operating Procedures
- Tactical Considerations
- Spotting Considerations
Standard Operating Procedures

• Apparatus positioning examples
  – Two aerials respond
    • First unit takes the front and the second unit the rear or side.
      or
    • First unit’s position is based on conditions and the second unit is staged.
  – One aerial responds: takes a strategically sound location in the front.

Standard Operating Procedures

• Engine company interface with the aerial unit
  – Leave room to position the aerial unit
  – Do not allow another unit to block access to the ground ladders
  – Be aware of the large diameter hose (LDH) and clearance for the aerial apparatus
  – Consider the water supply for elevated streams and plan for an engine company’s access to the aerial apparatus.

Building Height

Outside, If Building Is Less Than 5 Stories

Inside, If Building Is Greater Than 5 Stories
Tactical Considerations

- Proper distance between the objective and the aerial
  - Maximum stability
  - Best climbing angle
  - Adequate extension ability
- Long extensions at low angles—place maximum stress on an aerial and reduce the load capacity
- Condition of the fire building

Tactical Considerations

- Stresses that work against the aerial’s strength
  - Degree of angle
  - Nonparallel positions
  - Supported vs. unsupported position
  - Length of extension
  - Nozzle reaction
  - Wind
  - Ice
  - Weight and movement
  - Improper operation
  - Heat exposure
  - Impact
  - Improper stabilization
  - Road travel wear

Tactical Considerations

- Four main tactical uses of aerials
  1. Rescue
     - Approach from upwind
     - Position the unit at the corner
     - Use hoselines for protection
     - Position the platform to get the victim in
  2. Access
     - Position upwind and maximize coverage
     - Afford maximum safety for firefighters
Tactical Considerations

- Four main tactical uses of aerials (continued)
  3. Ventilation
    - Pitched roof: position the aerial over the roof for direct access
    - Flat roof: position the aerial on the unburned side
    - Horizontal roof: position the aerial with access to as many windows as possible
  4. Fire suppression
    - Blitz attacks: position for reach
    - Defensive attacks: position at the corner, or at a safe distance

Spotting Considerations

- Surface conditions
  - Soft soil
  - Frozen soil
  - Thin-skinned pavement
  - Vaulted surfaces
  - Soft or unstable surfaces
Spotting Considerations

• Weather conditions
  – Cold temperature hazards
  – Hot temperatures hazards
  – Wind hazards

Spotting Considerations

• Electrical hazards and obstructions
  – Overhead power lines
  – Fences
  – Vegetation
  – Vehicles
  – Structural overhangs
  – Trash containers

Potential Electrical Contact Points

Aerial devices have multiple contact points.
Spotting Considerations

• Angle and location
  – Operate the aerial in line with the longitudinal axis of the apparatus
  – Increase the angle of the aerial away from the longitudinal axis to decrease the amount of load
  – Position the device parallel to the apparatus to increase stability
  – Back in rear-mounted apparatus to maximize reach and stability
  – Jackknife a tillered aerial apparatus to improve stability
  – Turn the tractor 60° and angle the aerial away to reach stability
  – Operate aerial so that ladder rungs are parallel to the ground

Aerial Device Angle and Location

Spotting Considerations

• Scene conditions
  – Be aware of signs of potential building collapse
  – Be aware that the size of the collapse zone is equal to 1½ times the height of the building
  – Consider potential fire growth and always leave a way out
  – Be alert for falling debris
Collapse Zone

The collapse zone is equal to 1½ times the height of the building.

\[ Y = 1.5X \]

Spotting Considerations

- Staging
  - Level I involves two companies
    - First-due company proceeds to the scene
    - Late-arriving units stage one block away

Level I Staging
Spotting Considerations

• Staging (continued)
  – Level II
    • Is initiated when the IC requests additional alarms
    • Uses a designated staging area
    • Includes assignment of a staging manager

Level II Staging

Spotting Considerations

• Highway incidents
  – Access
  – Water supply
  – Driver safety
  – Firefighter safety
Positioning the Apparatus as a Traffic Barrier

Spotting Considerations

- HazMat incidents
  - Identify material first
  - Do not park on utility covers or storm drains
  - Approach upwind and uphill
  - Recognize control zones
  - Be aware of exposure dangers
  - Avoid staging all apparatus in bomb or terrorist threat area

Spotting Considerations

- Railroad incidents
  - Minimize hazards
  - Operate with caution
Spotting Considerations

- **Emergency medical incidents**
  - Allow the ambulance the best position for loading
  - Park off-street
  - Use caution in residential areas
  - Consider using the apparatus as a shield

- **Aircraft incidents**
  - Use the aerial device to access the aircraft's interior
  - Be familiar with approach and positioning
  - Park as close as possible
  - Avoid hindering deployment of slides and chutes
  - Avoid positioning near running engines
  - Follow general safety requirements

**Aircraft Access: Ladder Tip in Doorway**
Spotting Considerations

• Bridge incidents
  – Make sure the bridge load capacity can support the apparatus
  – Use caution when raising the aerial
  – Make sure road is in good repair
  – Follow the principles for setting up the aerial on an incline
  – Be alert for wind conditions
  – Recognize that large bridges are designed to sway in response to wind, traffic, and water forces
  – Be aware that bridges and elevated sections of the road will freeze first

Spotting Considerations

• Petroleum storage or processing facility incidents
  – Follow SOPs
  – Keep all apparatus outside the dike area
  – Park in an upwind location for direct fire attack
  – Discharge the foam streams downwind
  – Position aerial to limit exposure
  – Know the facility’s challenges

Positioning in Petroleum Storage Area

- Keep all apparatus outside the dike area.
Spotting Considerations

- Technical rescue incidents
  - Position based on use
  - Avoid unstable surfaces
  - Be aware of dangling debris and unstable structures
  - Follow general positioning guidelines

Student Performance Objective

Given information from discussion, handouts, and reading materials, describe the principles of positioning an aerial apparatus at the emergency scene. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Review

- Standard Operating Procedures
- Tactical Considerations
- Spotting Considerations
Student Performance Objective

Given information from discussion, handouts, and reading materials, describe the principles of stabilizing the apparatus for aerial or platform operation. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Overview

- Aerial Device Stabilizing Systems
- Setting Stabilizers
- Special Stabilizing Requirements
Aerial Device Stabilizing Systems

- Stabilizers broaden the base
  - Deploying stabilizers and pads
    - Lifting of a tire or outrigger does not always indicate instability
    - Fully deployed stabilizers maintain the center of gravity
  - Short-jacking
    - Causes the center to extend
  - Operating on lateral grades
    - Causes a shift in gravity to the lower side
  - Overloading an aerial
    - Has an adverse affect

Aerial Device Stabilizing Systems

Deployed Stabilizers

The base of stability increases when the stabilizers are deployed.

Aerial Device Stabilizing Systems

- Common types of stabilizers
  - Straight jacks
  - A-frame, scissor or X-style
  - Box stabilizers
Setting Stabilizers

- Automatic transmission without fire pump
  - Engaging the PTO
    - Set the parking brake and engage the tiller axle brake; turn off the Jacobs engine brake, if equipped
    - Place the transmission selector in drive
    - Activate the PTO selector switch
    - Place the transmission selector in neutral

- Automatic transmission without fire pump
  - Disengaging the PTO
    - Return the engine to idle speed
    - Return the transmission selector to neutral
    - Deactivate the PTO control switch
Setting Stabilizers

• Manual transmission without fire pump
  – Engaging the PTO
    • Set the parking brake and engage the tiller axle brake; turn off the Jacobs engine brake, if equipped
    • Depress the clutch pedal
    • Place the transmission selector in neutral
    • Activate the PTO selector switch
    • Release the clutch pedal

Setting Stabilizers

• Manual transmission without fire pump (continued)
  – Disengaging the PTO
    • Return the engine to idle speed
    • Depress the clutch pedal
    • Return the transmission selector to neutral
    • Deactivate the PTO control switch
    • Release the clutch pedal slowly

Setting Stabilizers

• Automatic transmission with fire pump in use
  – Engaging the PTO and fire pump
    • Set the parking brake and engage the tiller axle brake; turn off Jacobs engine brake, if equipped
    • Place the transmission selector in drive
    • Activate the PTO selector switch
    • Place the transmission selector in neutral
    • Operate the pump shift control
    • Place the transmission selector in the appropriate pumping gear
Setting Stabilizers

- Automatic transmission with fire pump in use (cont.)
  - Disengaging the PTO and fire pump
    - Return the engine to idle speed
    - Return the transmission selector to neutral
    - Deactivate the pump control switch
    - Deactivate the PTO control switch

Setting Stabilizers

- Manual transmission with fire pump in use
  - Engaging the PTO and fire pump
    - Set the parking brake and engage the tiller axle brake; turn off the Jacobs engine brake, if equipped
    - Depress the clutch pedal
    - Place the transmission selector in neutral
    - Activate the PTO selector switch

Setting Stabilizers

- Manual transmission with fire pump in use
  - Engaging the PTO and fire pump
    - Release the clutch pedal
    - Operate the pump shift control
    - Depress the clutch pedal
    - Place the transmission selector into the pumping gear (direct drive gear)
    - Release the clutch pedal
Setting Stabilizers

- Manual transmission with fire pump in use
  (continued)
  - Disengaging the PTO and fire pump
    - Return the engine to idle speed
    - Depress the clutch pedal
    - Return the transmission selector to neutral
    - Deactivate the pump control switch
    - Deactivate the PTO control switch

Setting Stabilizers

- Setting the stabilizers
  - Chock the front or rear wheels
  - Engage the PTO
  - Anticipate path of the stabilizers
  - Check for loose objects
  - Position the selector valve
  - Activate the outrigger controls
  - Extend to maximum distance
  - Place the plates or pads before activation is complete

Setting Stabilizers

- Setting the stabilizers
  (continued)
  - Activate vertical cylinder controls
  - Lower one side before the other
  - Engage interlocks
  - Bring to recommended hydraulic pressure
  - Insert the steel pins in jacks
  - Reposition the selector valve
  - Reverse the process to raise
Setting Stabilizers

- Manual stabilizers
  - Store the extension arm perpendicular to the apparatus for a mid-ship
  - Store the extension arm in a recessed position for a tractor-trailer
  - Remove locking pins, move arms, and re-insert pins
  - Lower the jacks firmly

Setting Stabilizers (continued)

- Stabilize tractor-trailer apparatus
  - Maximum stability occurs when the tractor angle is 60º from the centerline of the trailer
  - The aerial is operated toward the outside of the angle for maximum stability
  - Position the apparatus at angles no greater than 90º
  - Achieve an angled position
  - Cut the tractor wheels sharply to the center and away from the objective and pull the apparatus slightly forward

Special Stabilizing Requirements

- Uneven terrain
  - Lateral grade (side to side)
    - Correct grades up to 5-6% (5% means 5 feet for every 100 feet)
    - Lower stabilizers on the high side first until they contact the ground
    - Lower the low side to level the apparatus with the high side
    - Raise both sides to activate the interlocks, if necessary
    - Operate over the high side if possible; otherwise, reduce the extension and loading

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Special Stabilizing Requirements

- Uneven terrain (continued)
  - Longitudinal grade (end to end)
    - Correct from 6–14% of grade (6% means 6 feet for every 100 feet)
    - Position the aerial to minimize stress
    - Attempt to operate directly over the front or rear of the chassis
    - Operate off the rear for articulating apparatus
    - Use stabilizers to level the apparatus
    - Restrict loads to stabilize

Special Stabilizing Requirements

Longitudinal Grade

Operating on a Longitudinal Grade

Telescoping aerial devices may be operated over the front or rear of the apparatus.

Articulating aerial devices should be operated over the rear of the apparatus.
Special Stabilizing Requirements

- Obstructions
  - Avoid placing stabilizers on curbs, sidewalks, parking blocks, water valve covers, or other obstructions
  - Place stabilizers at the same angle as the incline
  - Ensure objects under the stabilizers are solid and capable of supporting the weight

Student Performance Objective

Given information from discussion, handouts, and reading materials, describe the principles of stabilizing the apparatus for aerial or platform operation. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Review

- Aerial Device Stabilizing Systems
- Setting Stabilizers
- Special Stabilizing Requirements
Student Performance Objective

Given information from discussion, handouts, and reading materials, describe the operation of telescoping and articulating aerial apparatus. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

Overview

- Operating Telescoping Apparatus
- Operating Telescoping Apparatus Under Adverse Conditions
- Operating Articulating Apparatus
- Operating Articulating Apparatus Under Adverse Conditions
Operating Telescoping Apparatus

• Tasks before deployment
  – Position for maximum efficiency
  – Place transmission in gear and operate the PTO
  – Fully deploy stabilizers
  – Switch selector valve to aerial position

Operating Telescoping Apparatus

• Raising the telescoping aerial device
  – Release hold-down locks
  – Move tiller operator’s station
  – Attach pipe and connect hoses
  – Allow personnel to board
  – Check for obstructions
  – Elevate the aerial
  – Rotate the aerial
  – Extend the aerial
  – Lower to the objective
  – Activate the locks
  – Climb the aerial device

Operating Telescoping Apparatus

• Lowering the telescoping aerial device
  – Remove personnel
  – Drain the waterway
  – Disengage the locks
  – Raise the aerial
  – Retract the aerial
  – Check for obstructions
  – Rotate the aerial
  – Lower the aerial
  – Allow personnel to exit
  – Remove ladder pipe, hose, and equipment
  – Replace tiller operator’s station
  – Activate hold-down locks
Operating Telescoping Apparatus

- Safe operating practices for telescoping apparatus
  - Apply the load perpendicular to the rungs
  - Avoid low angles
  - Avoid shock loading
  - Keep position close to front or rear
  - Ease gently toward objective
  - Engage locks and close valves
  - Avoid overloading
  - Avoid exceeding weight capacity
  - Subtract equipment weight
  - Realize strong winds affect load

Operating Telescoping Apparatus

(continued)

- Avoid lifting items heavier than the rated capacity
- Contact manufacturer for safe operating principles and limitations
- Never extend or retract with firefighters on it
- Always look for overhead obstructions

Operating Telescoping Apparatus Under Adverse Conditions

- Low-angle failures or limitations
  - Involve over-loading and over-extending
  - Require supporting a minimum 250-lb. load for ladders built since 1991
  - Occur after shutting off the water
Operating Telescoping Apparatus Under Adverse Conditions

- Sloped grades
  - Create a twisting force when rungs are not parallel to the ground
  - Limit operations to carrying a full load capacity on grades up to 6%
  - Restrict operation to maximum grades ranging from 9-14%
  - Require operations to sustain a static load of 1 1/3 times tip capacity on a 5° downward slope
  - Require optimum positioning, proper stabilization, and knowing load restrictions

Operating Telescoping Apparatus Under Adverse Conditions

- High winds
  - Impose a dynamic load
  - Affect load capacity and stability
  - Limit full operation to 35-40 mph winds
  - Require operator to estimate wind speed
  - Apply guy ropes

Operating Telescoping Apparatus Under Adverse Conditions

Wind Load on Raised Telescoping Aerial Device

Wind can impose a significant load on a raised aerial device.
Operating Telescoping Apparatus Under Adverse Conditions

Guy Ropes in High Winds

- Tie guy rope to sign
- Tie guy rope to tree

The manufacturers of some older aerial apparatus recommend guy ropes in high winds.

Operating Telescoping Apparatus Under Adverse Conditions

- Low temperatures
  - Increase hydraulic oil’s viscosity
  - Cause changes to steel structural members
  - Cause ice formation
  - Require deicing

Operating Telescoping Apparatus Under Adverse Conditions

- Fire products
  - Be aware of sources of damage
  - Be aware of signs of heat damage
  - Use hose streams as a protective measure
  - Remove the apparatus from service and test when damage is noted or suspected
Operating Telescoping Apparatus Under Adverse Conditions

- Mechanical or power failure indicators
  - Leaking fuel
  - Leaking hydraulic fluid
  - Leaking water from engine cooling system
  - Leaking motor oil
  - Overheating of mechanical components
  - Unusual noises or vibrations
  - Drifting of device when raised

Operating Articulating Apparatus

- Tasks before deployment
  - Place the apparatus in proper position for maximum efficiency
  - Place transmission in gear and operate the PTO
  - Fully deploy the stabilizers
  - Switch selector valve to aerial position

Operating Articulating Apparatus

- Raising the articulating aerial platform
  - Release hold-down locks
  - Make hose connections
  - Check for obstructions
  - Energize platform controls
  - Elevate lower boom, and move to ground level; allow personnel to board
  - Place in position
  - Charge the waterway system
  - Engage the locks
Operating Articulating Apparatus

- Lower the articulating aerial platform
  - Disengage locks
  - Drain waterway system
  - Check for obstructions
  - Rotate the aerial ladder until the booms are in line with support cradle
  - Lower the platform to the ground so personnel can exit
  - Check that the hold-down hooks are open and ready
  - Lower the ladder onto the travel cradle
  - Hook and latch stabilizer arms

Operating Articulating Apparatus

- Safe operating practices
  - Position on firm, level ground
  - Understand that maximum load capacity decreases in proportion to reaction force
  - Set brakes and stabilizers
  - Use caution near power lines

Operating Articulating Apparatus

- Safe operating practices
  - Prevent water hammer when closing nozzles
  - Stand on platform during operations
  - Lock in the transport position and retract stabilizers
  - Rotate turntable to face work area
  - Contact manufacturer for safe operating principles and limitations
Operating Articulating Apparatus Under Adverse Conditions

- Sloped grades
  - Create a twisting force when rungs are not parallel to ground
  - Limit operations to carrying a full load capacity on grades up to 6%
  - Restrict operations to maximum grades ranging from 9-14%
  - Require operations to sustain a static load of 1/3 times tip capacity on a 5º downward slope
  - Require optimum positioning, proper stabilization, and knowing load restrictions

Operating Articulating Apparatus Under Adverse Conditions

- High winds
  - Impose a dynamic load on the device
  - Affect load capacity and stability
  - Limit full operation to 35-40 mph winds
  - Require operator to estimate wind speed

Operating Articulating Apparatus Under Adverse Conditions

Wind Load on Raised Articulating Device

Wind can create a significant load on a raised aerial device.
Operating Articulating Apparatus Under Adverse Conditions

- Low temperatures
  - Increase hydraulic oil's viscosity
  - Cause changes to steel structural members
  - Cause ice formation
  - Require deicing

Operating Articulating Apparatus Under Adverse Conditions

- Fire products
  - Be aware of sources of damage
  - Be aware of signs of heat damage
  - Carefully use hose streams as a protective measure
  - Remove the apparatus from service and test when damage is noted or suspected

Operating Articulating Apparatus Under Adverse Conditions

- Mechanical or power failure indicators
  - Leaking fuel
  - Leaking hydraulic fluid
  - Leaking water from the engine cooling system
  - Leaking motor oil
  - Overheating of mechanical components
  - Unusual noises or vibrations
**Student Performance Objective**

Given information from discussion, handouts, and reading materials, describe the operation of telescoping and articulating aerial apparatus. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off list.

**Review**

- Operating Telescoping Apparatus
- Operating Telescoping Apparatus Under Adverse Conditions
- Operating Articulating Apparatus
- Operating Articulating Apparatus Under Adverse Conditions
Student Performance Objective

Given information from discussion, handouts, and reading materials, describe aerial apparatus strategy and tactics and the steps to operate aerial apparatus for elevated streams. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off sheet.

Overview

- Rescues
- Exposure Protection
- Ventilation
- Elevated Fire Streams
Rescues

• Priority considerations
  – Victims in imminent danger
  – Multiple victims in different locations
  – Remaining victims in descending order of numbers
  – Victims in exposed areas

Rescues

Rescue Priorities

1st Priority
Occupants on or Just Above Fire Floor

2nd Priority
Multiple Victims

3rd Priority
Remaining People in Fire Area

Rescues

• Raising the aerial ladder
  – Position perpendicular to the objective
  – Position at an angle
  – Aim above the victim, and lower
  – Seat the extension locks
  – Watch for debris
Rescues

Supported Aerial Ladder Tip

The supported aerial tip rests on its target.

Rescues

Unsupported Aerial Ladder Tip

Wall Cutaway

The unsupported aerial device tip should be slightly above its target.

Rescues

• Window positioning
  – Do not diminish or obstruct the opening
  – Place first rung even with the sill for ladders
  – Place top rail even with the sill for platforms
  – Place access gate even with opening as an alternative
Rescues
Aerial Platform Rail Window Rescue

The platform rail may be placed even with the windowsill so that victims may crawl or be placed directly in bucket.

Rescues
Aerial Ladder Tip Roof Rescue

For roof rescue, the aerial tip should be at least 6 feet (2 m) above the roof line.

Rescues
Aerial Platform Floor Roof Rescue

Place the bottom of the platform just above and over the roof edge to allow victims to crawl directly into platform through access gate.
Rescues
Laddering a Roof Parapet

It may be necessary to ladder a tall roof parapet.

Rescues
• Removing victims
  – Moving down ladders
    • Position rescuers inside and at the tip
    • Determine best position when using only one firefighter
    • Guide capable adults
    • Keep space between victims
    • Cradle infants and small children
    • Carry larger victims over the shoulder
    • Place the unconscious victim across both rails

Rescues
• Removing victims (continued)
  – Moving with platforms
    • Do not use for mass evacuations
    • Limit passengers by load capacity
    • For conscious victim, use 1-2 firefighters
    • For unconscious victim, use at least 2 firefighters
Rescues

- Removing victims (continued)
  - Lowering basket litters with ladders
    - Place on the rungs and slide down
    - Place on the rails and slide down
    - Attach to a lifeline

Rescues

Sliding a Litter Down an Aerial Ladder

Rescues

- Removing Victims (continued)
  - Lowering with immobilization equipment
    - Stokes basket
    - SKED stretcher
    - Reeves sleeve
Rescues

- Removing victims (continued)
  - Lowering with mechanical advantage systems
    - Block and tackle
    - Z-rig

Rescues

- Water rescue with aerials
  - Typical scenarios
    - Trapped in high water
    - Trapped in trees
  - Safety issues
    - Lack of suitable location
    - Contact with swift-moving water
    - Exceeding tip-load capacity
Rescues

• Aircraft rescues with aerials
  – Use aerials only as a last resort in aircraft rescue and fire fighting (ARFF) incidents
  – Use aerials when chutes or slides fail, or fire threatens
  – Follow the guidelines of window positioning for exit openings
  – Follow the guidelines of roof positioning for wings
  – Use aerials to gain access to small aircraft in elevated locations

Rescues

• Below-grade operations
  – Use aerials to deploy master streams
  – Use ladders to support other operations
  – Use 3-boom articulating platforms to reach below the surface
  – Use platforms to lift victims

Exposure Protection

• Conditions that affect exposure hazards
  – Present and recent weather
  – Building construction
  – Spacing between the building and exposure

• Types of elevated streams
  – Fog pattern
  – Straight or solid
Exposure Protection

• Positioning challenges
  – Allow for safe stream placement
  – Position for maximum exposure coverage
  – Use drastic measures to protect from exposure if not properly positioned
  – Position one master stream to alternate between exposure and fire
  – Position two master streams with one each for the fire and exposure
  – Always leave an escape route
Ventilation

- **Types of ventilation**
  - ** Mechanical**
    - Provide power to interior ventilation units
    - Provide support for mechanical ventilation equipment
  - **Natural**
    - Place personnel on the roof
    - Place personnel at the ladder tip
    - Place tip to break glass

- **Positioning for roof operations**
  - Position ladders 6 ft. over the edge
  - Position platform floor even with or over the edge
  - Ladder two sides for alternate escape routes
  - Check roof integrity
  - Position for roof parapets

**Positioning for horizontal or cross ventilation operations**
- Position the aerial device slightly above and upwind
- Secure firefighter with safety belt
- Take out downwind windows first, if windy
- Take out upper story windows with pike pole

**Coordinating ventilation and firefighting**
- Perform ventilation in relation to fire
- Do not direct streams into openings

Elevated Fire Streams

- **Types of water delivery systems**
  - Piped aerial ladder waterways
  - Detachable ladder pipes
  - Elevated platform waterways
  - Water towers

- **Hazards to personnel on the ladder tip using detachable ladder pipes**
  - Exposure to heat and combustion products
  - Injury from loose nozzle or burst hose
  - Distracted or unavailable control operator
  - Moving while hose and nozzle are charged
Elevated Fire Streams

• General safety principles for detachable ladder pipes
  – Allow only one person on top section when changing the pattern
  – Avoid sudden movements or surges
  – Position hose in the center of the ladder
  – Supply from two different water sources
  – Direct streams with slow, smooth movement
  – Use the 75-80-80 rule
  – Limit to 15° lateral movement
  – Do not use 2½-inch hand line as a ladder pipe
  – Follow manufacturer’s guidelines

Elevated Fire Streams

75-80-80 Rule of Thumb

• Elevate to 76°.
• Extend no more than 80% of its length.
• Use solid stream nozzle pressure of no more than 80 psi (560 kPa).

Elevated Fire Streams

• Tip selection
  – Tip types
    • Fog nozzle
    • Solid bore or straight tip
  – Nozzle reaction: counterforce is directed back
  – Tip size and flow requirements
    • Fog nozzle 500 gpm—100 psi
    • Solid bore or straight tip—80 psi
      – 1 ½-inch—600 gpm
      – 1 ¾-inch—700 gpm
      – 1 ½-inch—800 gpm
      – 1 ⅞-inch—900 gpm
      – 2-inch—1000 gpm
Elevated Fire Streams

• Tip selection (continued)
  – Tip size and flow requirements
  • Hydraulics for elevated streams
    – Each 10 feet of elevation for head pressure—5 psi
    – Friction loss for ladder pipe assembly—10 psi
    – Friction loss for Siamese—10 psi

Elevated Fire Streams

• Tip selection (continued)
  – Friction loss for hose supplying ladder pipe (per 100 feet) with 2½-inch couplings

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Elevated Fire Streams

• Tactical considerations
  – Offensive operations/blitz attack
    • Attack the area of origin
    • Deflect off the ceiling
    • Flow water to blacken the fire
Elevated Fire Streams

Blitz Attack

• Tactical considerations
  – Defensive operations
    • Attack exterior and provide exposure protection
    • Contain the fire
    • Reach seat of fire with solid or straight stream
    • Do not push fire to uninvolved areas
    • Position apparatus on unburned side
    • Avoid stream striking another device

Defensive Operations
Elevated Fire Streams

Ventilation Disturbance
- Give constant attention to overall conditions

- An improperly directed stream can stop the ventilation process.
- Never direct an elevated master stream into a ventilation opening if interior attack is in progress.

Elevated Fire Streams

- Improvised standpipe operations
  - Eliminate difficult hose lays in stairwells
  - Work where standpipes do not exist or to increase gpm
  - Are effective for parking garages, building roofs, bridges, overpasses, and construction sites
  - Save set up time with pre-connected handlines

Elevated Fire Streams

- Foam streams
  - Basic principles
    - Do not discharge aerated foam through elevated master streams
    - Use aerial devices to discharge non-aerated foam
Elevated Fire Streams

• Foam streams (continued)
  – Application techniques
    • Roll-on method
      – Direct foam near the front edge; will roll across the surface
      – Apply until covered and extinguished
      – Move back and forth to cover

Elevated Fire Streams

Roll-on Foam Application

Elevated Fire Streams

• Foam streams (continued)
  – Application techniques
    • Bank-down method
      – Direct to roll onto the fuel
      – Direct off various points
      – Use in dike fires and around transport vehicles
Elevated Fire Streams
Bank-Down Foam Application

Rain-Down Foam Application

Elevated Fire Streams
• Foam streams (continued)
  – Application techniques
    • Rain-down method
      – Direct the stream into the air above the fire or spill and allow it to float gently down
      – Sweep the stream back and forth for small fires
      – Direct the stream at one location and work outward for large fires
Elevated Fire Streams
Rain-Down Foam Footprint

Student Performance Objective
Given information from discussion, handouts, and reading materials, describe aerial apparatus strategy and tactics and the steps to operate aerial apparatus for elevated streams. The student will perform to a written test accuracy of at least 70% and successfully complete the skills on a skills check-off sheet.

Review
- Rescues
- Exposure Protection
- Ventilation
- Elevated Fire Streams