Aerial Ladders

Department of Fire Services
Massachusetts Firefighting Academy
Aerial Ladders

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Goal

The student will actively participate in classroom and practical evolutions designed to identify basic aerial ladder operations through the Massachusetts Firefighting Academy Aerial Ladder Program

Objectives

- Develop an understanding of the components of an aerial ladder
- Identify the different construction types of aerial ladders
- Recognize the specialized equipment needed for aerial ladder operation
- Analyze the positioning for aerial ladder operations
- Explain the need for the importance of stabilization of the aerial ladder
- Indicate the control devices necessary for aerial ladder deployment
Objectives (con't)

- Describe the strategies and tactics for aerial ladders
- Analyze the components of an aerial ladder through an inspection program
- Review the types of communication available for use during aerial ladder operations
- Demonstrate positioning for operations, climbing techniques, and aerial ladder inspection and equipment checks through a series of practical evolutions

Aerial Ladder

Follow the guidelines of Chapter 20 of NFPA 1901, Standard for Automotive Fire Apparatus, 2003 Edition

Aerial Ladder Definition

A self-supporting, turntable-mounted, power-operated ladder of two or more sections permanently attached to a self-propelled automotive fire apparatus and designed to provide a continuous egress route from an elevated position to the ground
History of the Aerial Ladder

The first successful aerial ladder was patented by Daniel Hayes in 1888.

It was made of wood and required several firefighters to raise by a hand operated screw system.

The rights to this patent were eventually sold to American LaFrance.

Hayes Aerial Ladder
Hand operated screw system at the base of the ladder required several firefighters to raise the wooden ladder out of the bed

Seagrave developed a spring-assisted raising mechanism in 1902 that enabled the aerial ladder to be raised swiftly from the bedded position.

All aerial ladder makers developed their own hoisting systems in the early 1900's.

Dahill Spring Loaded Hoist
By the early 1920’s, the quad began to appear

The quad combined the functions of a triple-combination pumper carried on a stretched chassis capable of carrying the equipment from a city service truck

The quad allowed departments to provide limited ladder company functions while saving on manpower and equipment costs

Quad
A hydraulic-mechanical aerial ladder mechanism was introduced by Pirsch in 1931.

For the first time, all three aerial ladder functions, raise, rotate and lower could be performed by a single firefighter.

Hydraulic lifting cylinders were used to raise the ladder from its bedded position while the turntable was rotated and the aerial extended mechanically.

The first three section 100' aerial ladder was produced by Pirsch in 1935.

In 1929, Mack Trucks introduced an aerial ladder that was raised and lowered through a power take-off mechanism from the motor.

This type of aerial ladder operation, with additions and modifications, would become standard.
American LaFrance started offering 4 section 100' aerials in 1938

This design permitted a shorter overall apparatus length and a permanently fixed tiller seat, tiller wheel and windshield

This design was far more efficient and became an industry standard

The quint appeared in the late 1930's
This added an aerial ladder to the quad

This vehicle provides a degree of ladder company functions in less active areas that were remote from conventional ladder companies

1941 City Service Ladder Truck
1940's Seagrave

Seagrave Rear Admiral

Types & Construction of Aerial Ladders
Tiller Aerial Ladder

Parts of an Aerial Ladder

Ground Ladders for Aerial Apparatus

- Minimum 115 feet of ground ladders
- Ground ladders must meet NFPA 1931, Standard on Design of and Design Verification Tests for Fire Department Ground Ladders
Voice Communications System

A weather-resistant two-way voice communication system shall be provided between the aerial ladder operator's position and the tip of the ladder.

The speaker/microphone at the tip shall allow for hands-free operation.

Quint

Hose Storage

Apparatus with fire pump and water tank will be equipped with:
- Minimum storage area for one 2-1/2 inch or larger fire hose
- Two areas to accommodate 1-1/2 inch or larger preconnected fire hose lines
Suction Hose
- 15 feet of soft suction hose or 20 feet of hard suction hose
- Suction strainer
- Soft suction application will have adapters for local hydrant outlet connection and pump intake connection
- Meet NFPA 1961, Standard for Fire Hose

Ground Ladder Requirements
- Minimum 85 feet of ground ladders
  - One extension ladder
  - One straight equipped with roof hooks
  - One attic ladder
- All ground ladders must meet NFPA 1931

Other Equipment for Quint
Positioning Fundamentals

- Follow the orders of Incident Commander
  - Rescue (victims and firefighters)
  - Ventilation (coordinated fire attack)
  - Extinguishment (ladder pipe operations)
  - Exposures
- Imminent danger of collapse of structure
  - Type of construction
  - Size of fire
  - Read the smoke
  - Location of fire in building
  - COLLAPSE ZONE
Rescue: Building Access

- Corner positioning allows access from two sides
- Try not to block intersection

Wind Direction and Speed
105 foot Aerial Ladder

<table>
<thead>
<tr>
<th>Wind Direction</th>
<th>0 to 5 MPH</th>
<th>5 to 10 MPH</th>
<th>10 to 15 MPH</th>
<th>15 to 20 MPH</th>
<th>20 to 25 MPH</th>
<th>25 to 30 MPH</th>
<th>30 to 40 MPH</th>
<th>40 to 50 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>East</td>
<td>50 mph</td>
<td>60 mph</td>
<td>70 mph</td>
<td>80 mph</td>
<td>90 mph</td>
<td>100 mph</td>
<td>110 mph</td>
<td>120 mph</td>
</tr>
<tr>
<td>North</td>
<td>50 mph</td>
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<td>70 mph</td>
<td>80 mph</td>
<td>90 mph</td>
<td>100 mph</td>
<td>110 mph</td>
<td>120 mph</td>
</tr>
<tr>
<td>South</td>
<td>50 mph</td>
<td>60 mph</td>
<td>70 mph</td>
<td>80 mph</td>
<td>90 mph</td>
<td>100 mph</td>
<td>110 mph</td>
<td>120 mph</td>
</tr>
<tr>
<td>West</td>
<td>50 mph</td>
<td>60 mph</td>
<td>70 mph</td>
<td>80 mph</td>
<td>90 mph</td>
<td>100 mph</td>
<td>110 mph</td>
<td>120 mph</td>
</tr>
</tbody>
</table>

Building Height

- Angle
- Height
ACCESS TO UPPER LEVELS

A position opposite the fire allows interior attack from the unburned side.

Aerial Ventilation

Fire Suppression
Spotting Considerations & Weather Conditions

Wind Conditions

<table>
<thead>
<tr>
<th>Wind Speed (mph)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 ft Aerial Ladder</td>
<td>Pierce</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>105 ft Aerial Ladder</td>
<td>Pierce</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Potential Electrical Contact Points

- Ladder with power lines within the field, not just contact
- Voltage ≠ distance
- New standard, stay on apparatus until the power can be tuned off
### Positioning on Hills and Slopes

<table>
<thead>
<tr>
<th>Ground Slope</th>
<th>Truck Slope</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8%</td>
<td>8%</td>
<td>OK</td>
</tr>
<tr>
<td>12%</td>
<td>12%</td>
<td>OK</td>
</tr>
<tr>
<td>16%</td>
<td>16%</td>
<td>OK</td>
</tr>
</tbody>
</table>

### Grade and Slope

12% Maximum Grade

12% Maximum Slope

### Positioning for Hazards
Collapse zone equals 1-1/2 times the height of the building

Always leave a quick escape route when operating at large fires.

Emergency Vehicle Safety
Chapter 89 MGL
- 89:7 - Right of way of fire engines, patrol vehicles and ambulances; penalty
- 89:7A - Restrictions on use of ways upon approach of emergency vehicles
- 89:7B - Operation of emergency vehicles

Chapter 90 MGL
M.G.L. CHAPTER 90:7E
- Display of red or blue lights on vehicles; permits; revocation; violations

Emergency Vehicle Driver Training Program
- Appendix A of the NFPA #1002 publication entitled Fire Department Vehicle Driver/Operator Professional Qualifications
- Competency course is designed to duplicate eight situations in which the driver’s skill, judgment, and knowledge of the limitations of the emergency vehicle, are required for effective maneuvering
Operations

Manufacturers provide copies of manual or CDs with information on care, maintenance and safe operations.

These manuals offer details on particular specifications and operations for maximum safety and efficiency.

*Study the manual completely!*

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Stabilization

- The stability requirements shall be met by the apparatus on which the aerial device is mounted when that apparatus is in a service-ready condition but with all normally removable items such as water, hose, ground ladders, and loose equipment removed (20.21.1).

- Items mounted on the aerial device by the manufacturer shall remain mounted (20.21.1.1).
Stabilization  (cont.)

- Stabilizers shall be provided, if required, to meet the stability requirements (20.21.1.2)
- Capable of sustaining a static load 1-1/2 times its rated capacity in every position in which the aerial device can be placed when the apparatus is on a firm and level surface (20.21.1.2)
Stabilizing Starts in the Cab

Chock Blocks

Stabilizing the Aerial Ladder
THE ACADEMY DOES NOT RECOMMEND OR TEACH SHORT JACKING!

IF YOU DECIDE TO DO IT, PLEASE FOLLOW THE MANUFACTURER'S RECOMMENDATIONS
**Longitudinal Grade**

5° grade = 8.7% downward direction

<table>
<thead>
<tr>
<th>Safe Operating Angles at Full Load When the Unit is Set Up</th>
<th>Pierce</th>
</tr>
</thead>
<tbody>
<tr>
<td>7° to 12°</td>
<td>Front, Rear, Side</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safe Operating Angles at Full Load Capacity</th>
<th>Pierce</th>
</tr>
</thead>
<tbody>
<tr>
<td>7° to 12°</td>
<td>Front, Rear, Side</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safe Operating Angles at 80% Load Capacity</th>
<th>Pierce</th>
</tr>
</thead>
<tbody>
<tr>
<td>7° to 12°</td>
<td>Front, Rear, Side</td>
</tr>
</tbody>
</table>

**Grade and Slope**

12% Maximum Grade

12% Maximum Slope

**Operating on a Longitudinal Grade**

- Aerial ladder may be operated over the front or rear of truck
- Is one way safer than the other?
Manage the Incident: Don’t let the Incident Manage You!

- Use ICS
- One Person in Charge
- Size-up
- Strategic Considerations
- Tactical Response
- Truck Company Responsibilities
Size-Up

Apparatus Placement
- Offensive Operations
- Defensive Operations
- Initial Attack and Exposure Operations

Prioritize Considerations
- Life Safety
- Incident Stabilization
- Property Conservation
- Offensive vs. Defensive
- Initial Companies Responding
- Personnel, Resources, and Equipment
Accountability

- Personnel
- Strategies and Tactics
- Decision-making
  - Backdraft
  - Flashover
  - Thermal Layering
  - All Other Indicators
- Escape Routes

80-80-80 Rule of Thumb

- 80 – 80° Elevation
- 80 – 80% Extension
- 80 – 800 GPM Flow Solid Stream
  (No More Than)

Rescue Priorities

- Occupants on or Just Above Fire Floor
- Multiple Victims
- Remaining People in Fire Area
- Aerial Ladder Tip Roof Rescue
- Aerial Rail Window Rescue
Parapets
Laddering a Roof Parapet

- It may be necessary to ladder a tall roof parapet
- Do not support the aerial on the parapet

Unsupported Aerial Ladder Tip

Supported Aerial Ladder Tip

- The supported aerial tip rests on its target
- Not to be supported if the aerial is a freestanding aerial
- This can cause the aerial ladder to fail
Extinguishment

- Blitz Attack
- Bed Ladder Piped / Aerial Waterway
- Telescoping Piped / Aerial Waterway
- Aerial Ladder Water Delivery System

Instruction Plates and Signs
Preventive Maintenance for Aerial Ladders

Certification Tests

- The completed apparatus with the aerial device shall be tested to the criteria defined in this section and the test results certified by an independent third-party certification organization annually.
- The aerial device shall be inspected and tested in accordance with the requirements of NFPA 1914, Standard for Testing Fire Department Aerial Devices, including all nondestructive testing.

Specialized Equipment
Disclaimer

While we appreciate the information provided by the participating companies, the Department of Fire Services / Massachusetts Firefighting Academy does not endorse any particular product.

Special thanks to the following manufacturers who contributed information for this program:
- American LaFrance
- Crimson Aerial Ladders
- E-One
- Ferrara
- Metz
- Pierce
- RK Aerials
- Seagrave
- Smeal

For more information, contact:
The Department of Fire Services
Massachusetts Firefighting Academy
PO Box 1025
State Road
Stow, Massachusetts 01775
Phone: 978-567-3200
Fax: 978-567-3229
Website: mass.gov/dfs

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