

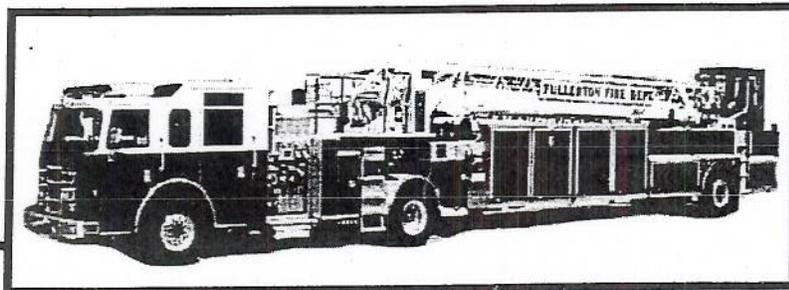
2007



Smeal



Aerial Ladders



Department of Fire Services
Massachusetts Firefighting Academy





Aerial Ladders



Department of Fire Services
Massachusetts Firefighting Academy

1

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

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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

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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

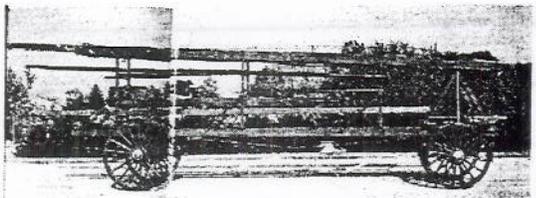


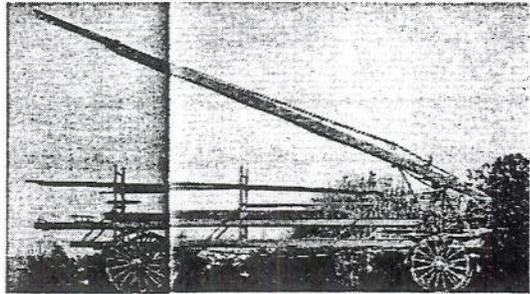
The first successful aerial ladder was patented by Daniel Hayes in 1868

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





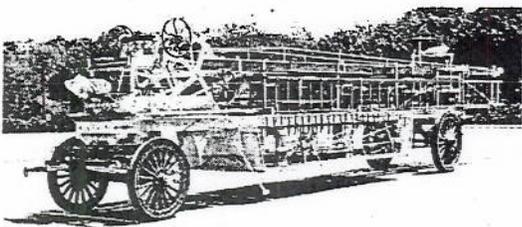
Hand operated screw system at the base of the ladder required several firefighters to raise the wooden ladder out of the bed

10

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

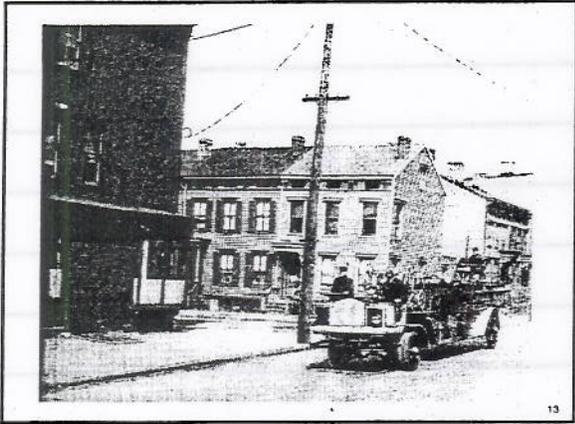
All aerial ladder makers developed their own hoisting systems in the early 1900's

11

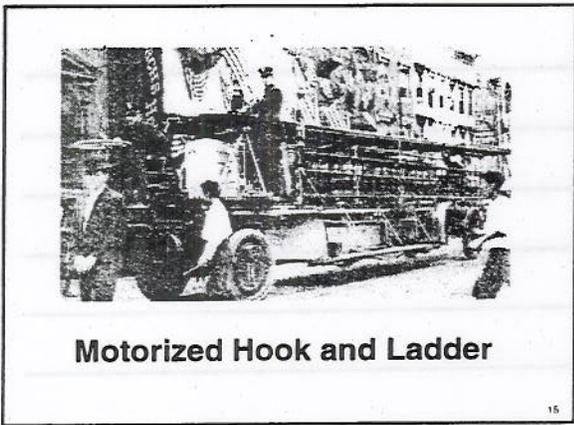


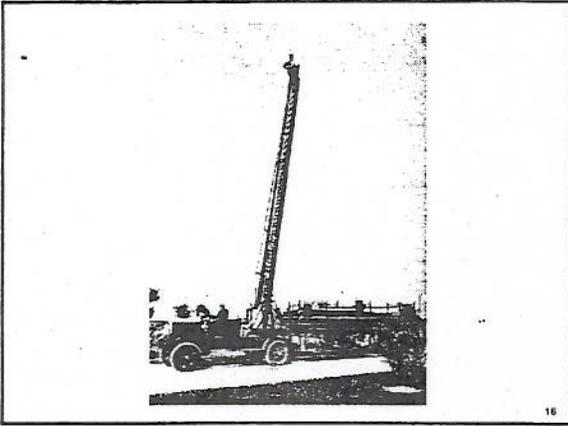
Dahill Spring Loaded Hoist

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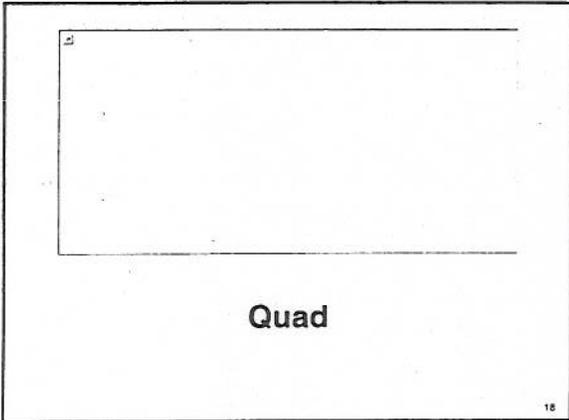


By the early 1920's, the quad began to appear

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

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Quad

18

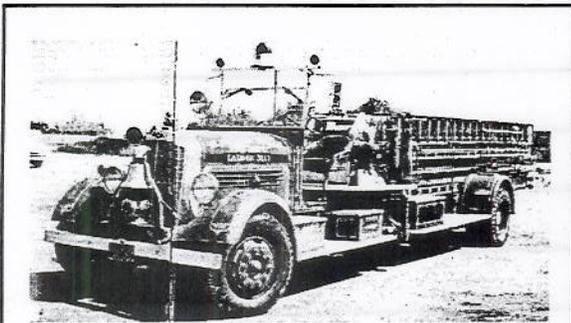
A hydraulic –mechanical aerial ladder mechanism was introduced by Pirsch in 1931

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

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Electric Aerial

20

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

21

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

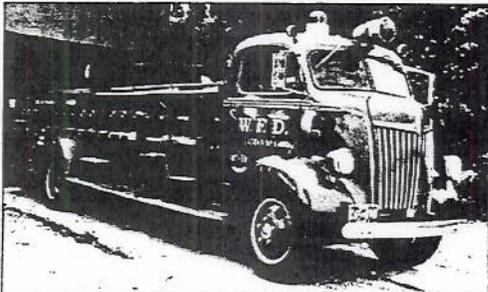
22

**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

23

**1941 City Service
Ladder Truck**



24



1940's Seagrave

25



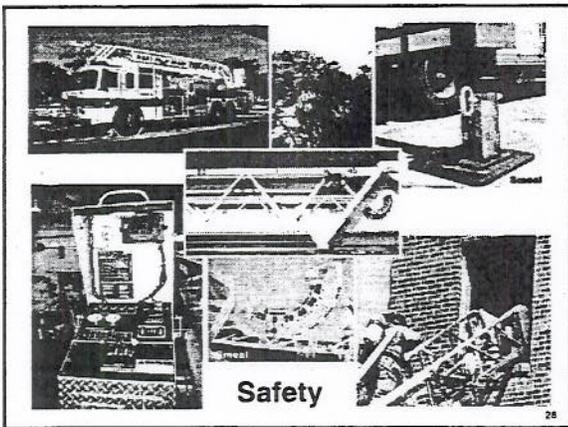
Seagrave Rear Admiral

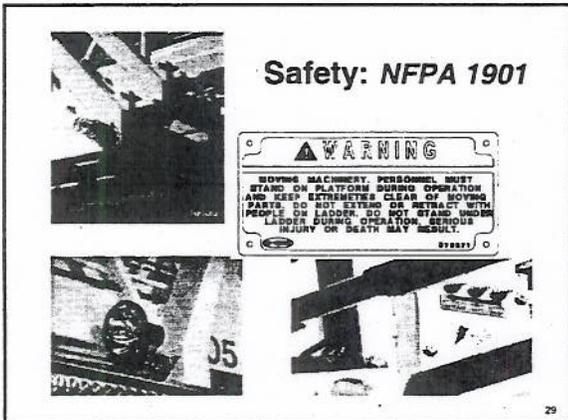
26

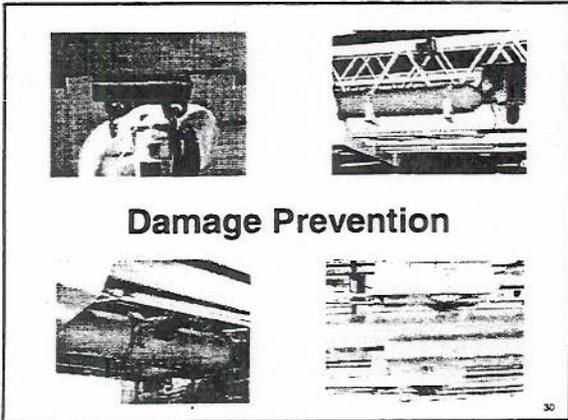


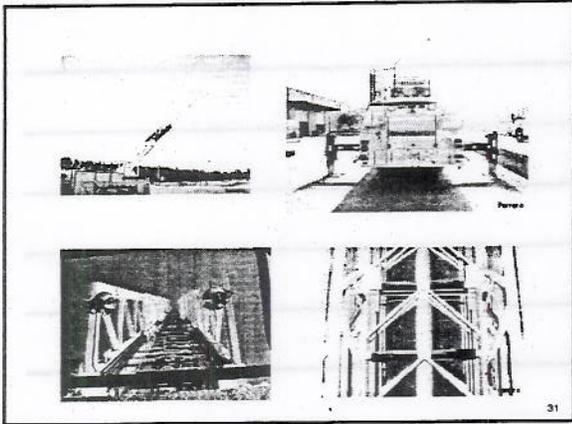
Types & Construction of Aerial Ladders

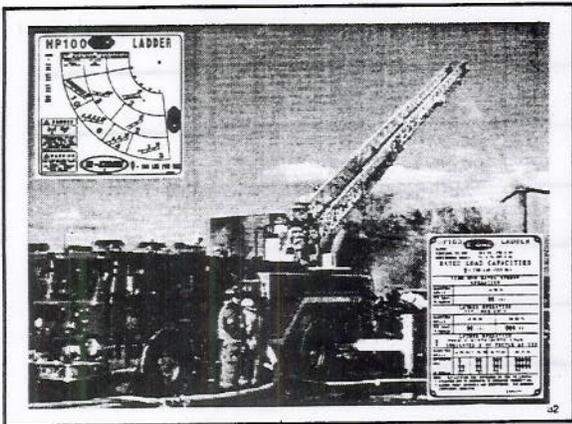
27

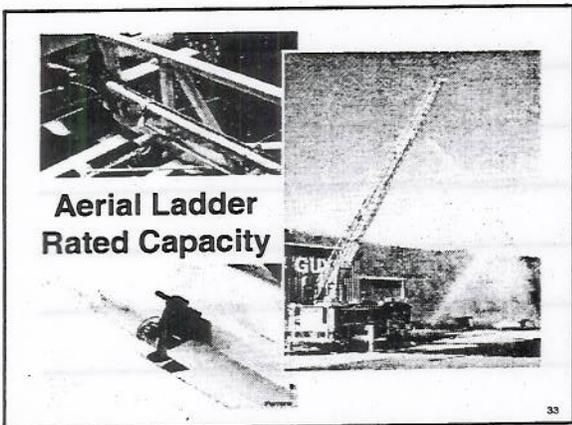




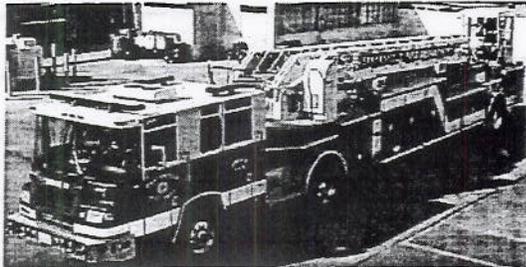






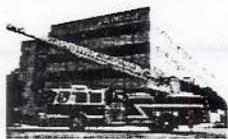
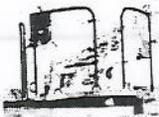


Tiller Aerial Ladder



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Parts of an Aerial Ladder

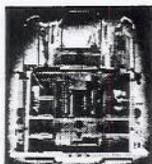


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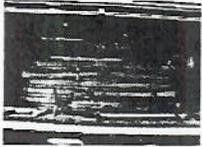
Ground Ladders for Aerial Apparatus



- 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*



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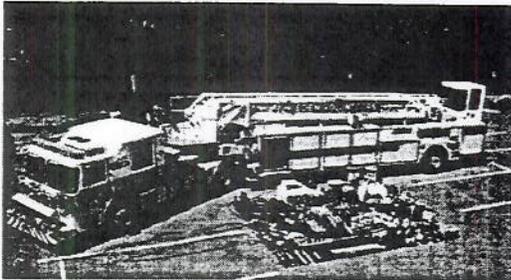


**Other Equipment
for Aerial Ladders**

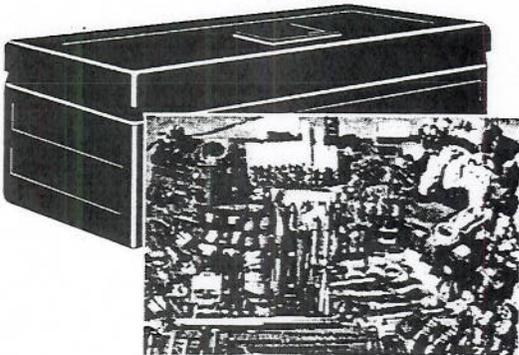


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**More Equipment
for Aerial Ladders**



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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

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Quint



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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



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Suction Hose

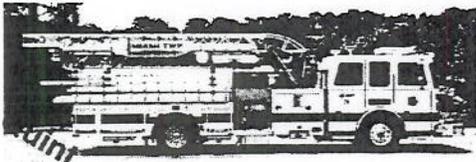
- 15 feet of soft suction hose or 20 feet of hard suction hose
- Suction strainer
- Soft suction application will have adapters for local hydrant outlet connection and pump intake connection
- Meet NFPA 1961, Standard for Fire Hose



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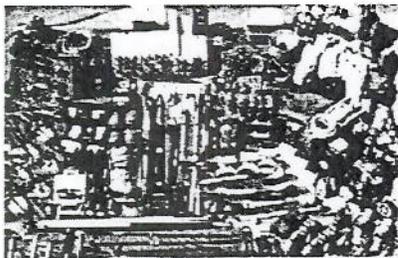
Ground Ladder Requirements

- 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*

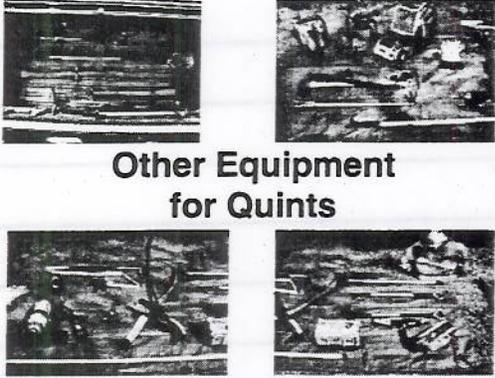


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Other Equipment for Quint



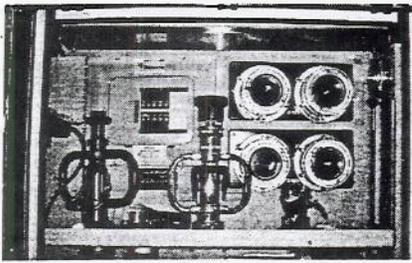
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**Other Equipment
for Quints**

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**Fire Hose and Nozzles
for Quints**



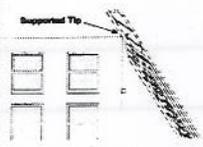
50

What type of ladder do you have?

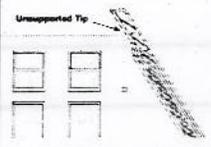
**SUPPORTED & UNSUPPORTED
AERIAL TIP** V2-13

Most modern aerials are designed to be operated
in the unsupported position.

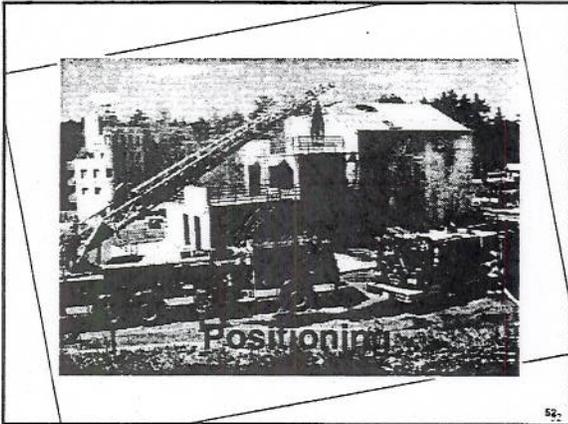
Supported Tip



Unsupported Tip



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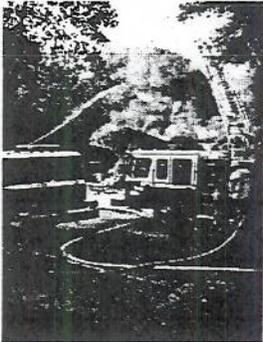


Positioning Fundamentals

- 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



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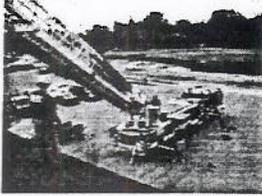


Develop Good Positioning Habits

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Rescue: Building Access

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



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Wind Direction and Speed

105 foot Aerial Ladder

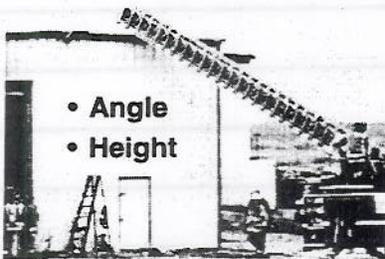
Degree of Extension	Waterway Dry and 26 inch Wind Condition							
	0° to 10°	10° to 30°	30° to 30°	30° to 40°	40° to 50°	50° to 60°	60° to 70°	70° to 75°
Expans	300	600	900	900	900	900	900	900
Fly	---	---	---	---	200	350	700	1000
Upper Mid	---	---	---	210	260	500	1000	1000
Lower Mid	---	---	200	260	300	750	1000	1000
Base	---	250	250	500	750	1000	1000	1000

Degree of Extension	Waterway Wet and 80 inch Wind Condition							
	0° to 10°	10° to 30°	30° to 30°	30° to 40°	40° to 50°	50° to 60°	60° to 70°	70° to 75°
Expans	500	600	900	900	900	900	900	900
Fly	---	---	---	---	---	200	500	750
Upper Mid	---	---	---	---	200	500	750	1000
Lower Mid	---	---	---	250	300	750	1000	1000
Base	---	---	500	500	750	1000	1000	1000

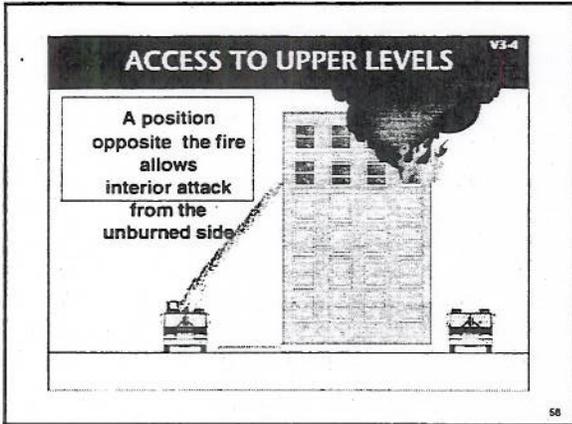
Pierce

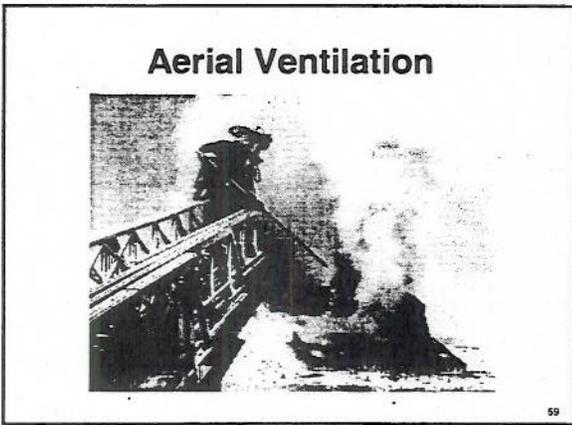
56

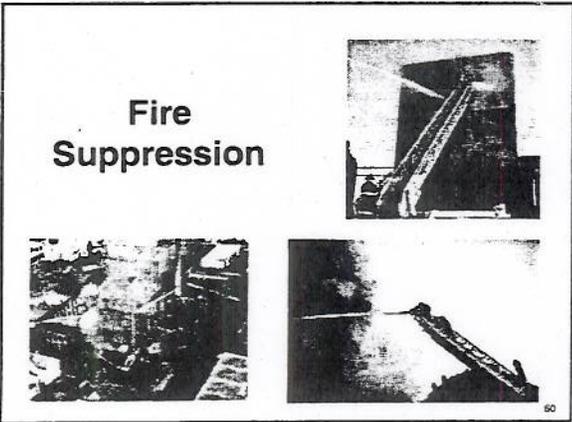
Building Height



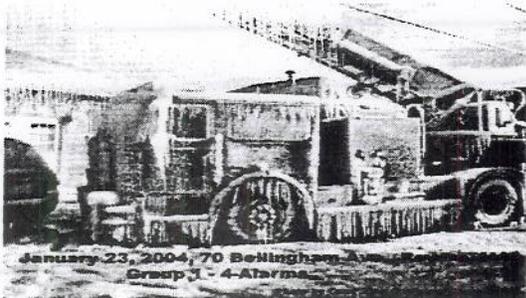
57







Spotting Considerations & Weather Conditions



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Wind Conditions

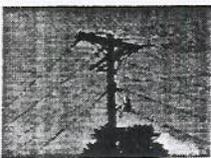
Wind Speed by Height										
Direction	10 ft	20 ft	30 ft	40 ft	50 ft	60 ft	70 ft	80 ft	90 ft	100 ft
North	10	12	14	16	18	20	22	24	26	28
South	10	12	14	16	18	20	22	24	26	28
East	10	12	14	16	18	20	22	24	26	28
West	10	12	14	16	18	20	22	24	26	28

75 foot
Aerial Ladder
Pierce

105 foot
Aerial Ladder
Pierce

Wind Speed by Height										
Direction	10 ft	20 ft	30 ft	40 ft	50 ft	60 ft	70 ft	80 ft	90 ft	100 ft
North	10	12	14	16	18	20	22	24	26	28
South	10	12	14	16	18	20	22	24	26	28
East	10	12	14	16	18	20	22	24	26	28
West	10	12	14	16	18	20	22	24	26	28

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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



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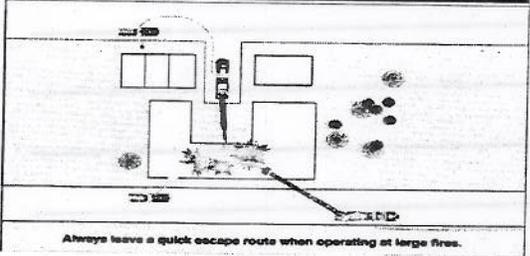
Collapse zone equals 1-1/2 times the height of the building



67

ESCAPE ROUTE

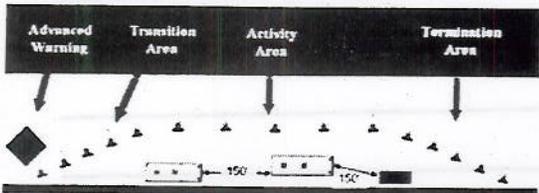
VS-15



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

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Emergency Vehicle Safety



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Chapter 89 MGL

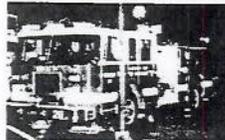
- 89:7 - Right of way of fire engines, patrol vehicles and ambulances; penalty
- 89:7A - Restrictions on use of ways upon approach of emergency vehicles
- 89:7B - Operation of emergency vehicles

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Chapter 90 MGL

M.G.L. CHAPTER 90:7E

- Display of red or blue lights on vehicles; permits; revocation; violations

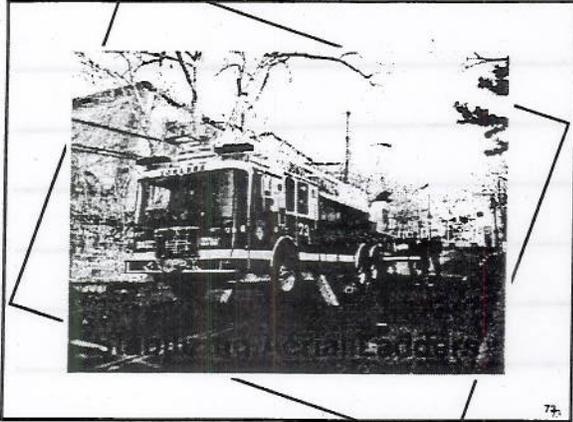


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Emergency Vehicle Driver Training Program

- 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

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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

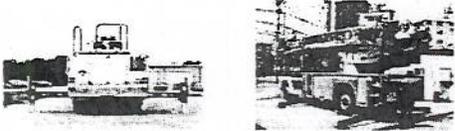
- The stability requirements shall be met by the apparatus on which the aerial device is mounted when that apparatus is in a service-ready condition but with all normally removable items such as water, hose, ground ladders, and loose equipment removed (20.21.1)
- Items mounted on the aerial device by the manufacturer shall remain mounted (20.21.1.1)

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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)

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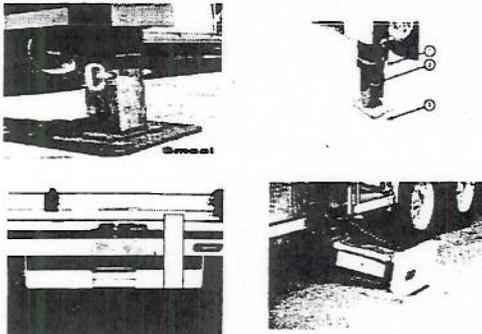


Stabilization



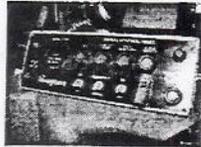
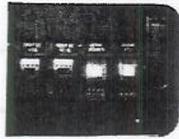
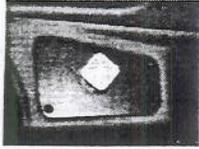
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Stabilizing the Aerial Ladder



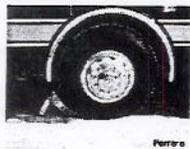
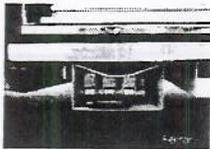
78

Stabilizing Starts in the Cab

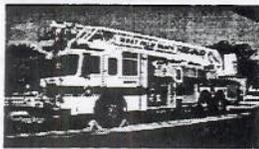


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Chock Blocks



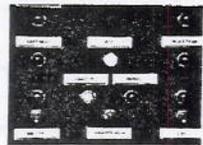
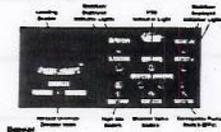
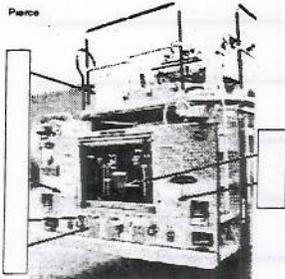
Pierce



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Stabilizing the Aerial Ladder

Pierce

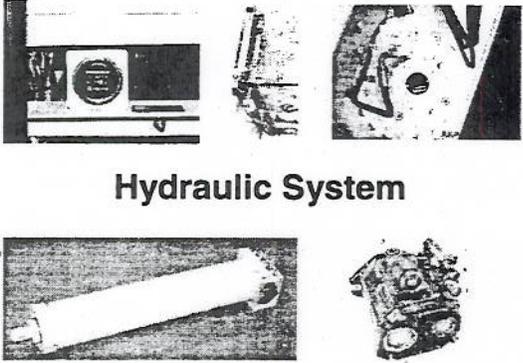


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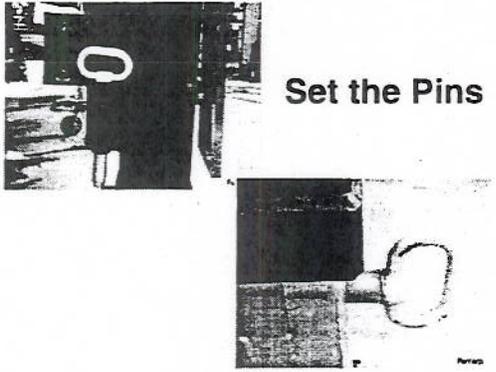
Stabilizing Indicators

82



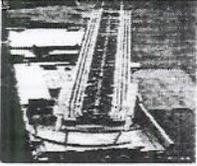
Hydraulic System

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Set the Pins

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**Apparatus
Center of
Gravity**



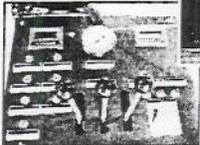
85

**THE ACADEMY DOES NOT
RECOMMEND OR TEACH
SHORT JACKING!**

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

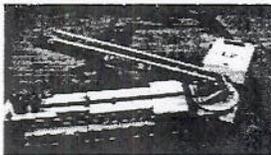
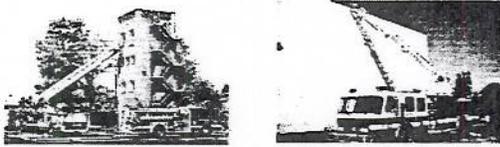
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Extended Aerial Ladder



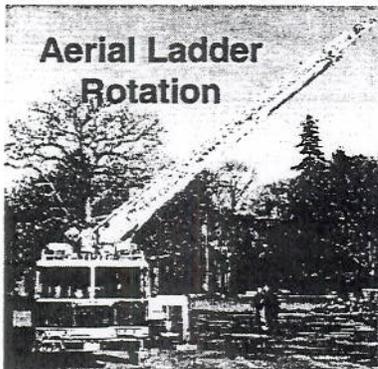
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Extended Aerial Ladder



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Aerial Ladder Rotation



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S l o p e s



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Longitudinal Grade

5° grade = 8.7% downward direction

Safe Operating Angles at Full Load When the Unit is Set Up	
0° to 3.5°	Side-to-Side (Slope)
0° to 5.5°	Front-to-Rear (Grade)

Pierce

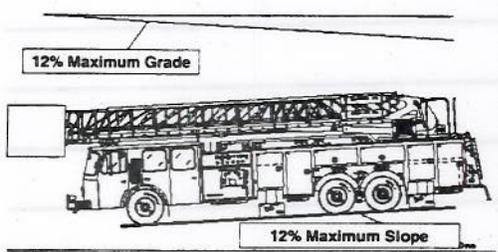
Safe Operating Angles at Full Load Capacity	
0° to 3.5°	Side-to-Side (Slope)
0° to 5.5°	Front-to-Rear (Grade)

Safe Operating Angles at 50% Load Capacity	
3.5° to 5.5°	Side-to-Side (Slope)
5.5° to 8.5°	Front-to-Rear (Grade)

Pierce

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Grade and Slope

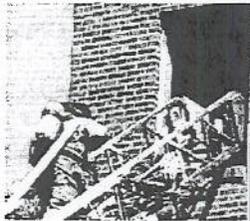


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Operating on a Longitudinal Grade

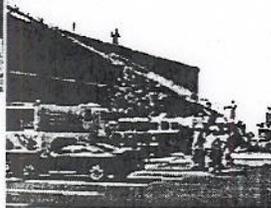
- Aerial ladder may be operated over the front or rear of truck
- Is one way safer than the other?

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Optimal

Twisting Force



Have to be Cautious

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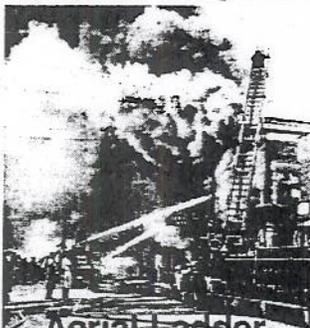


LOADING



LOADING

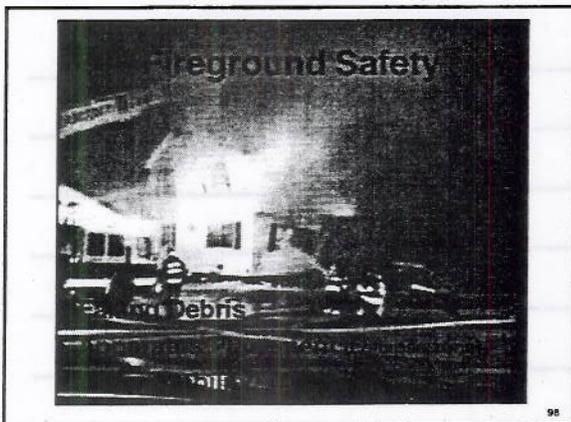
95



Aerial Ladder Strategy & Tactics

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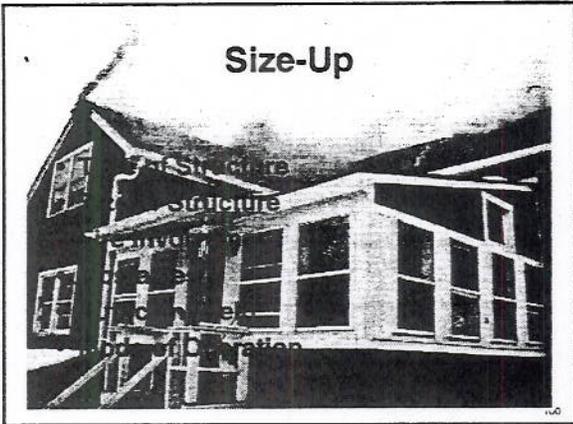


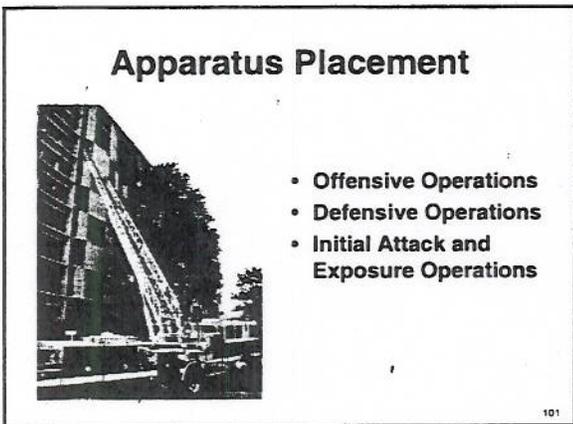
**Manage the Incident:
Don't let the Incident Manage You!**

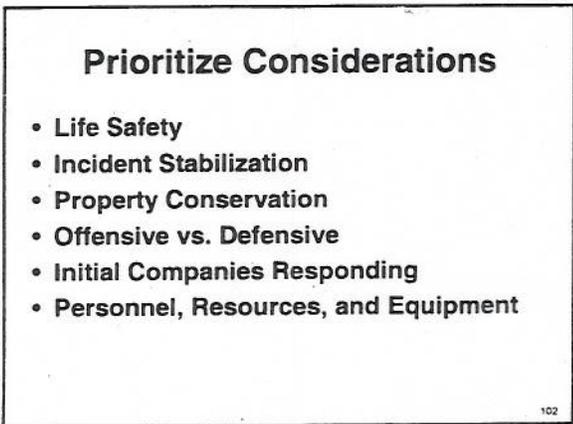
- Use ICS
- One Person in Charge
- Size-up
- Strategic Considerations
- Tactical Response
- Truck Company Responsibilities



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Accountability

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

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80-80-80 Rule of Thumb

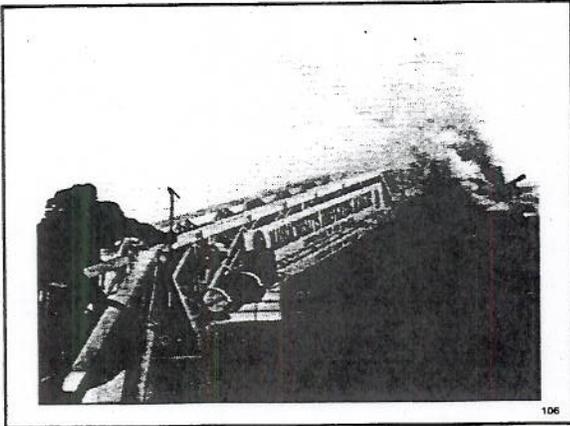
- 80 – 80° Elevation
- 80 – 80% Extension
- 80 – 800 GPM Flow Solid Stream
(No More Than)

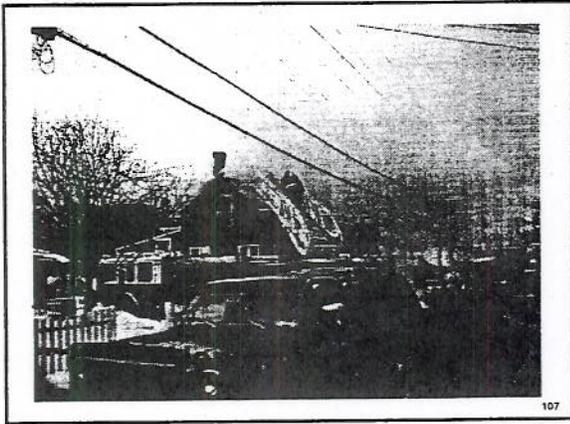
104

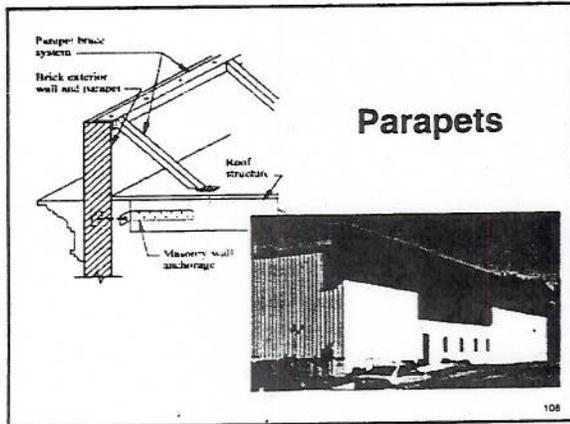
Rescue Priorities

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

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Laddering a Roof Parapet



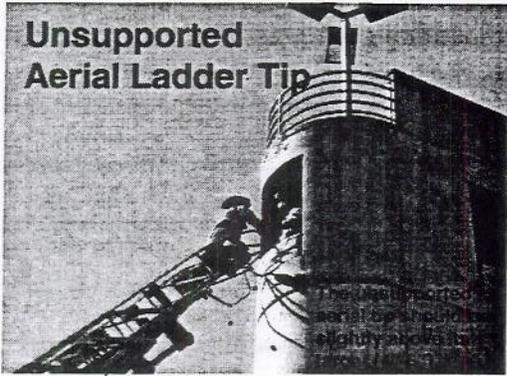
It may be necessary to ladder a tall roof parapet



- Do not support the aerial on the parapet

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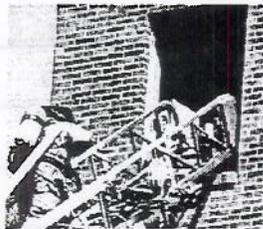
Unsupported Aerial Ladder Tip



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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

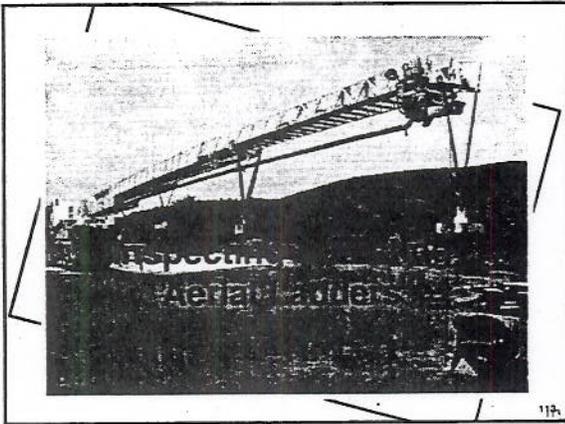


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Extinguishment

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

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Instruction Plates and Signs



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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.

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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

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