Chapter 10 Lesson Goal

- After completing this lesson, the student shall be able to safely and effectively select, carry, raise, and work from ladders following the policies and procedures set forth by the authority having jurisdiction (AHJ).
Specific Objectives

1. Describe parts of a ladder.
2. Describe types of ground ladders used in the fire service.
3. Discuss materials used for ladder construction.
Specific Objectives

4. Discuss ladder maintenance and cleaning.

5. Summarize items to check for when inspecting and service testing ladders.

6. Summarize factors that contribute to safe ladder operation.
Specific Objectives

7. Discuss selecting the proper ladder for the job.

8. Summarize items to consider before removing and replacing ladders on apparatus.
Specific Objectives

9. Describe proper procedures to follow when lifting and lowering ground ladders.

10. Describe various types of ladder carries.

11. Explain proper procedures for positioning ground ladders.
Specific Objectives

12. Explain precautions to take before raising a ladder.
13. Describe various types of ladder raises.
14. Describe procedures for moving ground ladders.
Specific Objectives

15. Describe heeling and tying in ground ladders.
16. List guidelines for climbing ladders.
17. Describe methods for lowering conscious or unconscious victims down ground ladders.

(Continued)
Specific Objectives

18. Clean, inspect, and maintain a ladder. (Skill Sheet 10-I-1)
19. Carry a ladder — One-firefighter low-shoulder method. (Skill Sheet 10-I-2)
20. Carry a ladder — Two-firefighter low-shoulder method. (Skill Sheet 10-I-3)
21. Carry a ladder — Three-firefighter flat-shoulder method. (Skill Sheet 10-I-4)

22. Tie the halyard. (Skill Sheet 10-I-5)

23. Raise a ladder — One-firefighter method. (Skill Sheet 10-I-6)
Specific Objectives

24. Raise a ladder — Two-firefighter flat raise. (Skill Sheet 10-I-7)
25. Raise a ladder — Two-firefighter beam raise. (Skill Sheet 10-I-8)
26. Raise a ladder — Three- or four-firefighter flat raise. (Skill Sheet 10-I-9)

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Specific Objectives

27. Deploy a roof ladder — One-firefighter method. (Skill Sheet 10-I-10)

28. Pivot a ladder — Two-firefighter method. (Skill Sheet 10-I-11)

29. Shift a ladder — One-firefighter method. (Skill Sheet 10-I-12)
Specific Objectives

30. Shift a ladder — Two-firefighter method. (Skill Sheet 10-I-13)

31. Leg lock on a ground ladder. (Skill Sheet 10-I-14)

32. Assist a conscious victim down a ground ladder. (Skill Sheet 10-I-15)

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Specific Objectives

33. Remove an unconscious victim down a ground ladder. (Skill Sheet 10-I-16)

34. Select, carry, and raise a ladder properly for various types of activities. (Skill Sheet 10-I-17)
Parts of a Ladder

- Beam
- Bed section
- Butt
- Butt spurs
- Dogs
- Fly section

- Footpads
- Guides
- Halyard
- Heat-sensor label
- Heel
- Hooks

(Continued)
Parts of a Ladder

• Locks
• Main section
• Pawls
• Protection plates
• Pulley
• Rails
• Rungs
• Shoes
• Stops
• Tie rods
• Tip
• Truss block

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Parts of a Ladder

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Parts of a Ladder
Single Ladders

- Wall ladders, straight ladders
- Consist of one section of fixed length
- Most often identified by overall length of beams
Single Ladders: Roof Ladders

- Equipped with folding hooks that provide means of anchoring ladder over ridge of pitched roof, other roof part
- Generally lie flat on roof surface so firefighter may stand on ladder for work
Single Ladders: Roof Ladders

- Distributes firefighter’s weight, helps prevent slipping
- May be used as single wall ladder
- Lengths range from 12 to 24 feet (4 to 8 m)
Single Ladders: Folding Ladders (Attic Ladders)

- Often used for interior attic access
- Have hinged rungs allowing to be folded so one beam rests against the other
- Common lengths from 8 to 16 feet (2.5 to 5 m); 10 feet (3 m) most common
- NFPA® 1931 requires footpads on butt
Extension Ladders

- Adjustable in length
- Base/bed section and one or more fly sections that travel in guides to permit length adjustment
- Size designated by full length to which can be extended

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Extension Ladders

- Can be adjusted to specific length needed to access windows, roofs
- Range from 12 to 39 feet (4 to 11.5 m)
- Pole ladders — Extension ladders with poles to be attached to top of bed sections for added leverage/stability
Combination Ladders

- Designed to be used as self-supporting stepladder (A-frame) and single or extension ladder
- Range from 8 to 14 feet (2.5 to 4.3 m) with most popular being 10 feet (3 m)
- Must be equipped with positive locking devices
Pompier Ladders

- Scaling ladders
- Single-beam ladders with rungs projecting from both sides of beam
- Have large metal “gooseneck” projecting at top for inserting into windows, other openings
Pompier Ladders

• Used to climb from floor to floor, via exterior windows, on multistory building
• Lengths from 10 to 16 feet (3 to 5 m)
Ladder Construction Materials

- Metal
- Wood
- Fiberglass
Metal Advantages/Disadvantages

- Good conductor of heat, cold, electricity
- Easy to repair
- Can suddenly fail when exposed to heat, flame
- Widest range of sizes
Wood Advantages/Disadvantages

- Highest cost of all ladders
- Heaviest per unit of length
- Retains strength when exposed to heat, flame
- Very durable
Fiberglass Advantages/Disadvantages

- Generally poor conductor of electricity
- Can suddenly crack/fail when overloaded
- Can burn when exposed to flame
Fire Service Ladder Requirements

- Must be able to withstand considerable abuse
- Must conform to NFPA® 1931
- All ladders meeting NFPA® 1931 require certification label affixed
- All ground ladders should be tested
Fire Service Ladder Maintenance and Repair

- Maintenance — Keeping ladders in state of usefulness or readiness
- Repair — To restore or replace that which is damaged/worn out
Fire Service Ladder Maintenance and Repair

• All firefighters should be capable of performing routine maintenance on ground ladders

• Any ladders in need of repair require trained ladder repair technician
General Maintenance for Ground Ladders

- Keep free of moisture
- Store away from vehicle exhaust or engine heat
- Store out of the elements
- Only paint top and bottom 18 inches (450 mm) for identification
Cleaning Ladders

- Recommended that ladders be inspected regularly and cleaned after every use
- Soft bristle brush, running water most effective tools
Ladder Inspection/Service Testing Requirements

- NFPA® 1932 requires ladders to be inspected after each use and on monthly basis
- Because they are subjected to harsh conditions, important that they are service tested
Ladder Inspection/Service Testing Requirements

- NFPA® 1932 serves as guideline for service testing
- Standard recommends only specified tests be conducted by fire department or approved organization
- Further recommends caution be used to prevent damage or injury
Items to Check on All Types of Ladders

- Heat sensor labels
- Rungs for damage, wear
- Rungs for tightness
- Bolts, rivets for tightness
- Welds for cracks, apparent defects
- Beams and rungs for any issues
Inspecting Specific Ladder Types

- Wooden ladders/wooden components
  - Areas where finish chafed/scraped
  - Darkening of varnish
  - Dark streaks in wood
  - Marred, worn, cracked, splintered parts
  - Rounded/smooth shoes
  - Water damage

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Inspecting Specific Ladder Types

- Roof ladders
  - Make sure roof hook assemblies operate with ease
  - Assembly should not show rust, hooks should not be deformed, parts should be firmly attached

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Inspecting Specific Ladder Types

- Extension ladders
  - Pawl assemblies
  - Halyard
  - Halyard cable
  - Pulleys
  - Ladder guides
  - Staypole toggles

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Inspecting Specific Ladder Types

- If any discrepancies found, ladder should be removed from service until it can be repaired/tested; ladders that cannot be safely repaired must be destroyed or scrapped for parts.
Ladder Safety Factors

- Developing/maintaining adequate upper body strength
- Wearing full body harness with belay line when training
- Operating ladders according to departmental training/procedures
Ladder Safety Factors

- Wearing protective gear
- Choosing proper ladder for job
- Using leg muscles when lifting ladders below waist
- Using adequate number of firefighters to carry or raise

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Ladder Safety Factors

- Not raising any ladder within 10 feet (3 m) of electrical wires
- Checking ladder placement for proper angle
- Being sure hooks of pawls seated over rungs

(Continued)
Ladder Safety Factors

- Being sure ladder is stable before climbing
- Being careful when moving sideways
- Heeling or securing at top
- Climbing smoothly, rhythmically
- Not overloading ladder

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Ladder Safety Factors

- Tying in to ground ladders with leg lock or ladder belt
- Not relocating positioned ladder unless so ordered
- Using for intended purposes only
- Inspecting for damage, wear after use
Selecting Proper Ladder

• Before raising ground ladders, first select proper ladder for given job and carry to intended location

• Selecting location may be affected by
  – Needs of situation
  – Ladders available
  – Wall heights/other building features

(Continued)
Selecting Proper Ladder

• Important that ladders be raised safely and smoothly
• Movements should be smooth, controlled
• Teamwork is important

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Selecting Proper Ladder

- Selection requires ability to judge distance
- Rules of thumb for ladder length
- Determine how far various ladders will reach
Mounting Ground Ladders

- Mounted in variety of ways depending on
  - Departmental requirements
  - Type of apparatus, body design
  - Type of ladder
  - Type of mounting bracket, rack used
  - Manufacturer’s preferences

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Mounting Ground Ladders

- No established standards for location/mounting on fire apparatus
- Differences in how mounted make it necessary to develop own procedures for removing/replacing on apparatus
Questions Before Removing Ground Ladders From Apparatus

- What ladders carried and where?
- Are ladders racked with butt toward front or rear of apparatus?
- Where nested together, can one be removed leaving other(s) securely in place?
Questions Before Removing Ground Ladders From Apparatus

- In what order do they nest in the rack?
- Is top fly of extension ladder on inside or outside when racked?
- How are ladders secured?
- Which rungs go in or near brackets when mounted?
Proper Lifting and Lowering Methods

- Have adequate personnel
- Bend knees and lift with legs
- When two or more lifting ladder, lift on command of firefighter at butt position
- Reverse procedure for lifting when necessary to place on ground before raising

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Ladder Carries — General Considerations

- Numerous ways ladder can be transported once removed from mounting
- Procedures for removing when mounted on flat ladder bed differ from removing when mounted on side/top of engine

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Ladder Carries — General Considerations

• Removal methods must reflect situation
• All carries in section demonstrated from ground
• In most cases, ladders carried butt forward
One-Firefighter Low-Shoulder Carry

- Some single/roof ladders may be safely carried and raised by one firefighter
- Involves resting ladder’s upper beam on firefighter’s shoulder, while firefighter’s arm goes between two rungs

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Two-Firefighter Low-Shoulder Carry

• May be used with single/roof ladders; most commonly used for 24-, 28-, and 35-foot (8, 9, and 11 m) extension ladders

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Two-Firefighter Low-Shoulder Carry

- Gives firefighters excellent control of ladder
- Forward firefighter places free hand over upper butt spur to prevent injury in case of collision
Three-Firefighter Flat-Shoulder Carry

- Typically used on extension ladders up to 35 feet (11 m)
- Uses two firefighters, one at each end on one side of ladder, and one more on other side in middle
Four-Firefighter Flat-Shoulder Carry

- Same as three firefighter, except change in positioning to accommodate fourth firefighter
- Two positioned at each end of ladder, opposite each other
Two-Firefighter Arm’s Length On-Edge Carry

- Best performed with lightweight ladders
- Based on fact that firefighters are positioned on bed section side of ladder when in vertical position
Special Procedures for Carrying Roof Ladders

- Procedures previously described are for carrying ladders butt forward
- Normally, roof ladder carried with hooks closed to foot of first ladder
- Or, hooks may be opened at apparatus before carry is begun
Responsibility for Positioning Ground Ladders

- Officer designates general location
- Personnel carrying ladder decide exact spot for butt to be placed
Factors Affecting Ground Ladder Placement

- Two objectives
  - Place properly for intended use
  - Place butt proper distance from building

- If ladder is to be used for positioning firefighter to break window for ventilation, place alongside window to windward side

(Continued)
Factors Affecting Ground Ladder Placement

- If ladder is to be used for entry/rescue from window, ladder tip usually placed slightly below sill
- Other ladder placement guidelines

(Continued)
Factors Affecting Ground Ladder Placement

- With exception of certain rescue situations, desired angle of inclination approximately 75 degrees
- Easy way to determine proper distance between heel and building is to divide working length of ladder by 4
Factors Affecting Ground Ladder Placement

• Proper angle can also be checked by standing on bottom rung and reaching for rung in front; should be able to grab rung while standing straight up, with arms extended straight out

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Factors Affecting Ground Ladder Placement

- New ladders equipped with inclination marking whose lines become perfectly vertical and horizontal when ladder properly set
Transition From Carry to Raise

- Methods/precautions for single and extension much the same
- Except pole ladders, not necessary to place ladder flat on ground before raising
- Transition from carrying to raise should be one smooth, continuous motion
Electrical Hazards

• Major concern when raising ladders is possible contact with live electrical wires/equipment
• To avoid, care must be taken BEFORE BEGINNING A RAISE
Position of Fly Section on Extension Ladders

- Each manufacturer specifies whether ladder should be placed with fly in or out
- Generally, modern metal and fiberglass ladders designed for FLY OUT use
- Wooden ladders designed with rungs mounted in top truss rail for FLY IN use

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Position of Fly Section on Extension Ladders

- Consult department’s SOPs or manufacturer of ladder to determine
- Some departments have ladders intended for fly out use but prefer firefighter extending halyard be on outside; pivot/roll ladder 180 degrees after extension
Tying Halyard

- Once extension ladder resting against building and before it is climbed, excess halyard should be tied to ladder with clove hitch and overhand safety
- Prevents fly from slipping; prevents tripping over rope
One-Firefighter Raises

- One-firefighter single ladder raise — Single and roof ladders generally light enough that one firefighter with upper body strength can usually place butt end at point where it will be located for climbing without heeling it against building

(Continued)
One-Firefighter Raises

- One-firefighter extension ladder raise
  - When using, placement of butt important
  - Building used to heel ladder to prevent ladder butt from slipping while being brought to vertical position
Two-Firefighter Raises

- Space permitting, makes little difference if ladder raised parallel with/ perpendicular to a building
- If raised parallel, ladder must be pivoted after in vertical position
Two-Firefighter Raises

- Heeler responsible for placing at desired distance from building, determining whether to raise parallel with or perpendicular to building
- Heeler gives commands during operation
Three-Firefighter Flat Raise

• As length of ladder increases, weight increases

• To raise using beam method with three firefighters, follow same procedure for two-firefighter flat raise

(Continued)
Three-Firefighter Flat Raise

- Only difference is that third firefighter is positioned along beam
- Once ladder has been raised to vertical, follow procedures for flat raise
Four-Firefighter Flat Raise

- When available, four can be used to better handle larger/heavier ladders
- Flat raise normally used, procedures similar to three-firefighter raise
- Firefighter at butt responsible for placing butt, determining whether parallel or perpendicular
Placing a Roof Ladder

- Once firefighter has carried roof ladder to location, can be placed by one or two firefighters
- Two methods of carrying to building: hooks-first and butt-first
Pivoting Ladders with Two Firefighters

- Occasionally, extension ladders are raised with fly in incorrect position for deployment
- When this happens, pivot ladder
- Any ladder flat-raised parallel to building requires pivoting to align against wall

(Continued)
Pivoting Ladders with Two Firefighters

- Use beam closest to building for pivot; when possible, pivot ladder before extending
- Two-firefighter pivot may be used on any ground ladder that two firefighters can raise
Shifting Raised Ground Ladders

- Circumstances may require ground ladders to be moved while vertical
- Because hard to control, should be limited to short distances

(Continued)
Shifting Raised Ground Ladders

- One firefighter can safety shift 20 foot (6 m) or shorter ladder
- Another way to shift a short distance is to lay ladder into building, slide top sideways, then pick up butt and move into position
Securing a Ground Ladder

- Make sure ladder locks are locked
- Tie halyard with clove hitch and overhand safety
- Prevent movement of ladder away from building by heeling and/or tying in
Heeling

• One method is for firefighter to stand beneath the ladder with feet shoulder-width apart

• Another method is for firefighter to stand on outside of ladder and chock butt end with one foot
Tying In

• When possible, ladder should be secured to fixed object
• Tying in is simple, can be done quickly, is strongly recommended to prevent ladder from slipping or pulling away from building
Tying In

- Frees personnel who would otherwise be holding ladder in place
- Rope hose tool or safety strap can be used between ladder and fixed object
Guidelines for Climbing Ladders

- Should be done smoothly and rhythmically
- Climb may be started after climbing angle has been checked and ladder properly secured
Guidelines for Climbing Ladders

• Practice climbing slowly to develop form rather than speed

• Firefighters often required to carry equipment up and down ladder during fire fighting
Securing While Working From a Ladder

- Must sometimes work with both hands while standing on a ground ladder
- Either ladder belt or leg lock can be used to safely secure firefighter to ladder
- If ladder belt used, must be strapped tightly around waist

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Using Ground Ladders for Rescue

• When intended to be used through window, ladder tip raised to just below sill

• Makes it easier for conscious victim to climb onto ladder and for firefighters to lift unconscious victim onto ladder
Using Ground Ladders for Rescue

- Ladder is heeled; all other loads/activity removed during rescue
- Even healthy, conscious occupants must be protected from slipping/falling
- To bring victims down, at least four firefighters needed
Lowering Conscious or Unconscious Victims

- Conscious victims can be lowered feet first onto a ladder
- Unconscious victims can be held on ladder in same way as conscious except body rests on rescuer’s supporting knee

(Continued)
Lowering Conscious or Unconscious Victims

• Another way for unconscious victim involves same hold but victim is turned to face rescuer

• Unconscious victim supported at crotch by one of rescuer’s arms and at chest by other arm
Lowering Conscious or Unconscious Victims

- Removing heavy victims requires two rescuers
- Small children who must be brought down ladder can be cradled across rescuer’s arms
Summary

- To be an effective and fully contributing member of the department, the firefighter must be able to safely carry, raise, extend, climb, and lower fire service ground ladders when needed. These ladders may be needed for fire fighting operations, rescues, or both.
Summary

• To use ladders safely and effectively, firefighters must know the types of ladders available to them, along with their capabilities and limitations.

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Summary

- Firefighters must know the parts of a ladder, the hazards associated with setting up ground ladders, what constitutes a stable foundation for ladder placement, proper angles for various ladder applications, safe limits related to degree of angulation, and what constitutes a reliable structural component against which a ladder can be placed.

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Summary

- Firefighters must have all of this knowledge in order to safely apply fire service ground ladders as well as how to clean and inspect them after use.
1. Describe the following types of ladders: roof ladders, folding ladders, extension ladders, combination ladders, and pompier ladders.

2. What are the advantages and disadvantages of metal, wood, and fiberglass construction for ladders?
Review Questions

3. List general maintenance guidelines that apply to all types of ground ladders.

4. What items should be checked when inspecting all types of ladders?

5. List four factors that contribute to safe ladder operation.

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6. What questions should firefighters be able to answer before removing ground ladders from apparatus?

7. What procedures should be followed when lifting and lowering ladders?

8. List three ladder placement guidelines.

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Review Questions

10. What is the proper procedure for climbing a ladder?
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