



Portable ladders

This data sheet covers the selection, maintenance and safe use of portable ladders in the service, manufacturing and construction industries. No scaffolds or power-driven telescoping devices are discussed. Although many industrial plants have their own fire departments, no consideration is given to the selection and use of fire ladders. Job-made ladders are discussed in National Safety Council Industrial Data Sheet 568.

1. Regulatory requirements, tests and specific dimensions for the various ladders are detailed in the ANSI and OSHA references provided at the end of this data sheet.
2. Ladder incidents usually result from faulty care or improper use of ladders and not from manufacturing deficiencies. Some of the most frequent causes of incidents are using a broken ladder, improper climbing procedure, failure to adequately secure the ladder, and selecting the wrong ladder for the task. Other specific causes of ladder incidents are: reaching too far to the side, hand-carrying loads and improper ladder positioning.
3. A ladder is a climbing device consisting of two side rails joined at regular intervals by crosspieces called steps, rungs or cleats on which a person may step while ascending or descending.
4. Ladders are constructed from five basic materials: aluminum, wood, glass fiber, reinforced plastic or steel. Although the price varies considerably with the construction material used, the primary consideration should be selecting the ladder best suited to the specifics of the job.
5. Portable rung ladders are available in many types, including single ladders, two and three section extension ladders, sectional ladders, trestle ladders and extension trestle ladders. The bases of these ladders have parallel or flared legs in accordance with commercial practice. The rungs are round or oval-shaped, parallel, level and uniformly spaced on 12-inch centers with the exception of step stools.
6. Non-slip bases must be securely bolted, riveted or attached by equivalent construction to the side rails. Non-slip bases are strongly recommended when there is any danger of the bottom of the ladder slipping or skidding during use and are particularly important on metal, glass fiber, reinforced plastic or epoxy resin ladders. If slip-resistant feet are used

on stepladders they should be attached to the bottom of all four rails.

7. Portable ladders are generally designed as “one-man” working devices with sufficient strength to support the person as well as any tools and materials.
8. Industry recognizes five general classes of ladders based on working load capacity:
 - Type IAA—Special duty for users requiring no more than a 375-pound working load capacity for maintenance, construction or heavy-duty work.
 - Type IA Industrial—Extra heavy-duty for users requiring no more than a 300-pound working load capacity for maintenance, construction or heavy-duty work.
 - Type I Industrial—Heavy-duty for users requiring no more than a 250-pound working load capacity for maintenance, construction or heavy-duty work.
 - Type II Commercial—Medium-duty for users requiring no more than a 225-pound load capacity for painting or other medium-duty work.
 - Type III Household—Light-duty for users requiring no more than a 200-pound load capacity for general household use. These are not for use with stages or planks.
9. Because this data sheet deals with the selection, care and use of ladders for industry and construction, it emphasizes Type I ladders. However, other types of ladders frequently used in stockrooms, mailrooms and offices also are discussed.

Selection of ladders

10. In many locations, the selection of ladders may be affected either by regulatory requirements or by specific company policies or procedures.
11. Each plant or location will have its own particular application requirements for ladders. The job to be done and the time required are

very important factors in ladder selection. For example, it may be extremely unwise for a supervisor to require a painter to paint ceilings all day long for several days from a Type III stepladder when a Type I platform stepladder would provide a more comfortable work surface on which to stand. Another unwise choice would be to have an electrician work from a conductive metal ladder.

12. The working load plays a critical role in ladder selection and should never be exceeded. For example, although a Type III ladder has a 200-pound working load, 200-pound persons should not be allowed to work from a Type III ladder because their body weight, combined with the additional weight of tools and materials, will induce a potential overload. In the case of a 200-pound worker, a Type II, or even better, a Type I ladder, should be furnished.
13. Although aluminum ladders are generally considered to be corrosion-resistant, they are not suitable for use in certain atmospheres due to severe corrosion problems. Two such atmospheres not suitable for aluminum ladders are in an acid plant or in a mixed fertilizer plant. An aluminum ladder would be suitable, however, for use in an ammonia plant.
14. Proper ladder selection is very important for safe and efficient completion of work tasks. Selection of the ladder type, group and construction best suited for the job is the first step in reducing the risk of incidents from falls, falling tools or equipment and electrical shock. Ladders selected for various tasks should always meet ANSI A14 design requirements. When choosing between a self-supporting and non-self-supporting ladder, consider bottom and top support conditions. Stepladders require a level supporting surface for all four rails. Where such support is unavailable or inconvenient, a non-self-supporting ladder might be a better choice. Once the proper ladder type is selected, training of workers to use ladders safely is the second step in minimizing the risk of incidents.



Figure 1. Three examples of folding stepladders.

Folding stepladders

- 15.** Stepladders (see Figure 1a) are self-supporting, non-adjustable and portable. They are not designed to be used as straight ladders. A tool tray or pail rest can be attached to the top. The ANSI A14.1 and A14.2 specify stepladders cannot be longer than 20 feet.
- 16.** Platform stepladders (see Figure 1b) are self-supporting, non-adjustable portable ladders. A platform stepladder is a modification of a portable stepladder, with a working platform provided near the top. ANSI requires platforms to be at least 20 inches below the top, with a platform area of not less than 200 square inches for Types IA, I and II ladders, and not less than 130 square inches for Type III ladders.
- 17.** Double stepladders (see Figure 1c) have side rails made of heavier material with steps on both sides. This allows the user to ascend or descend from either side of the ladder. Double stepladders do not normally have tool trays or pail rests near the top. These ladders are Type I only.
- 18.** Painter's stepladders—the top is omitted from these ladders. Painter's stepladders must be made in accordance with Type II stepladder requirements or stronger and cannot be longer than 12 feet.

Combination or convertible ladders

- 19.** Combination or convertible ladders have adjustable legs so by making the back legs a different length than the front legs, the ladder can be used to reach heights above stairways or platforms where the support surfaces are at two levels. These ladders also can be used as step or extension ladders.

Straight and extension ladders

- 20.** Single or straight ladders (see Figure 2a) are designed to lean against a wall or the edge of a roof, beam or other solid top support. These are neither self-supporting nor adjustable. Straight ladders are not supplied in lengths greater than 30 feet. Small variations in construction produce ladders known by various names such as mechanic's single, mason's single or builder's single ladder.
- 21.** Two-section or extension ladders (see Figure 2b) are not self-supporting and consist of two sections, one fitting within the side rails of the other and arranged in such a manner that the upper section can be raised and lowered. Two-section wood ladders are supplied in lengths up to 60 feet. Three-section metal and reinforced plastic ladders are supplied in lengths up to 72 feet.

22. Extension ladders may be equipped with a rope and pulley to facilitate extension and retraction. The rope must have a breaking strength of not less than 560 pounds and must be of sufficient length for the purpose intended.

23. Extension ladders are manufactured in the lengths shown for the following types:

- Type IA (Extra heavy-duty)—Two-section metal, wood or reinforced plastic up to and including 60 feet; three-section metal or reinforced plastic available up to and including 72 feet
- Type I (Heavy-duty)—Two-section metal, wood or reinforced plastic up to and including 60 feet; three-section metal or reinforced plastic available up to and including 72 feet
- Type II (Medium-duty)—Two-section metal, wood or reinforced plastic, up to and including 48 feet; three-section metal or reinforced plastic available up to and including 60 feet
- Type III (Light-duty)—Two-section only of metal, wood or reinforced plastic up to and including 32 feet.

24. Extension ladders should always be erected so the upper section is resting on the bottom and has sufficient overlap to transmit all forces safely from one section to the next. In accordance with OSHA requirements, two-section ladders up to and including 36 feet in length must overlap 3 feet; those over 36 feet and up to and including 48 feet must overlap 4 feet, and those over 48 and up to and including 60 feet must overlap 5 feet. ANSI overlap recommendations are slightly more conservative than OSHA as follows: ladders up to 32 feet should overlap 34 inches; ladders over 32 feet up to 36 feet should overlap 46 inches; ladders over 36 feet up to 48 feet should overlap 58 inches; and ladders over 48 feet up to 72 feet should overlap 70 inches. ANSI recommends that overlap for three-section ladders should approximately double the figures given for two-section ladders. For example, a three-section 72-foot metal extension ladder

must have 70 inches of overlap each between the first and second, and the second and third sections.

25. The top section of any extension ladder should not be used as a single ladder because the bottom ends are not equipped with non-skid feet and are less stable in comparison to lower sections.

26. In choosing an extension ladder for a specific application, the length should be such that allowances are made for both overlap and the additional 3 feet of length above the landing surface. For example, a 60-foot extension ladder of two 30-foot sections could reach a maximum support height of 52 vertical feet. This is calculated as follows: 60 feet – 5 feet (overlap allowance) – 3 feet (above landing surface).

27. Extension ladders have small variations in construction and design and are known variously as Eastern, Kentuckian, Mechanical, Western roller, Western suburban or push-up extension ladders.

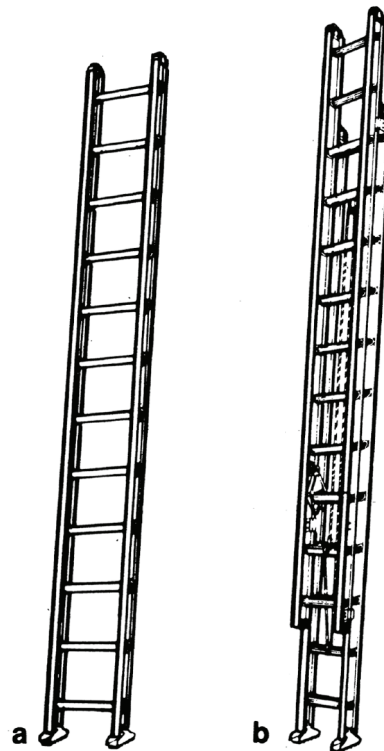


Figure 2 shows (a) a single or straight ladder and (b) an extension ladder.

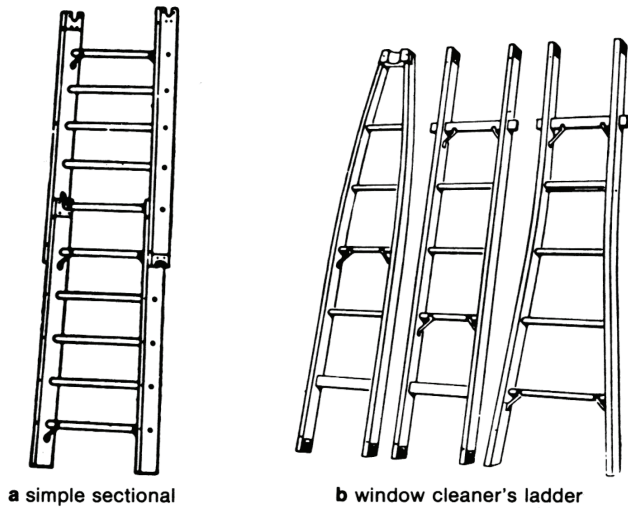


Figure 3 shows two types of sectional ladders.

Sectional ladders

- 28.** Sectional ladders (see Figure 3a) are rung-type, portable non-self-supporting ladders made in even-length sections (usually 6 feet) that are joined together for use at the desired height. The maximum height of sectional ladders is 30 feet.
- 29.** Window cleaners' sectional ladders (see Figure 3b) are special sectional ladders designed with extra heavy-duty side rails and continuous taper from the top to the bottom to reduce the tipping hazard. Window cleaners' sectional ladders join together in the same manner as do regular sectional ladders, by means of grooves or slots in the side rail ends that fit over rungs for strength and stability. Rung spacing must be even and 12 inches apart.

Trestle ladders

- 30.** Trestle ladders and extension trestle ladders (see Figures 4a and b) are not designed for climbing. They are self-supporting, non-adjustable rung ladders consisting of two similar sections of identical length hinged at the top to form an equilateral triangle when spread for use. Trestle ladders are designed to support planks or scaffold boards. The rungs are not wide enough to properly support the user's feet for climbing or working.

Office and stockroom ladders

- 31.** Shelf ladders (see Figure 5a) are designed especially for use against shelves. Shelf ladders are designed with flat steps, flared legs and a top cap similar to the climbing side of a stepladder. They are non-self-supporting and non-adjustable. They must lean against a solid side support in the same manner as straight or extension ladders.
- 32.** Stockroom ladders (see Figure 5b) are non-folding, self-supporting, non-adjustable commercial ladders with climbing steps on both sides. The spreaders are attached semi-permanently at a low level on both sides of the sections. Steps are parallel, level and evenly spaced 12 inches apart. Stockroom ladders may be equipped with casters.
- 33.** Trolley and side-rolling ladders are similar to the climbing half of a stepladder and designed to be supported at the top by wheel carriages. The wheel carriage and track must be fastened securely, designed with sufficient strength for the anticipated load, and so constructed wheels will not jump the track even if a wheel becomes loose or broken. Upper end wheels must have a minimum wheelbase of 8 inches. When wheels are used at the bottom of the ladder, there must be at least one wheel supporting each side rail. Running gear for ladder bottoms of both trolley and side-rolling ladders must be so designed and constructed that it will support any load to which it is subjected. These ladders are used for access to shelves, bins or other similar storage facilities requiring the quick availability of portable ladders in a specific area. Trolley and side rolling ladders must not be over 20 feet long or less than 12 inches wide (inside dimension of side rails).

Tubular metal ladders

- 34.** Tubular metal ladders are strong and usually have wide, stairway-like steps leading to a work platform when provided. These tubular metal ladders are designed especially for work areas where the job requires working from varying heights and frequent ascending and descending. These are non-folding,

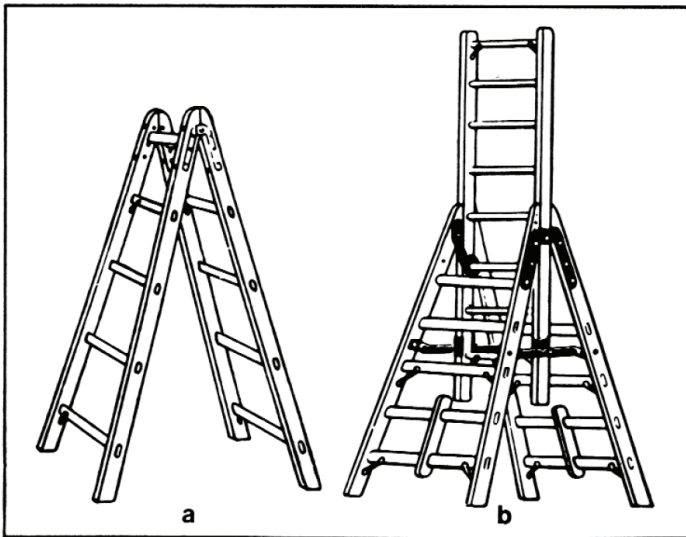


Figure 4 shows (a) plain trestle ladder and (b) an extension trestle ladder.

portable and non-adjustable ladder and work platform combinations for use in areas that do not require ladders be folded while not in use. They are narrow and very light with a tendency to tip.

- 35.** Single-step tubular metal step stools are used for access to shelves and cabinets where an elevation of about 1 foot is required for access. These stools may be fitted with spring-loaded casters so the weight of the user engages rubber leg tips with the floor surface for better traction.
- 36.** Rolling metal ladder stands are used for access to areas 20 - 24 inches above the floor. These ladders are usually constructed of lightweight tubular metal with wide treads and may or may not have spring-loaded casters that retract when the user puts their weight on the ladder. Two-step tubular metal ladders may be made with or without handrails.
- 37.** Similar tubular ladders, with or without handrails, are available with up to five steps. These two-to-five-step ladders may or may not be equipped with spring-loaded retracting casters.
- 38.** Tubular metal ladders of six steps or more should have handrails for the added protection of workers. If equipped with casters, these higher ladders

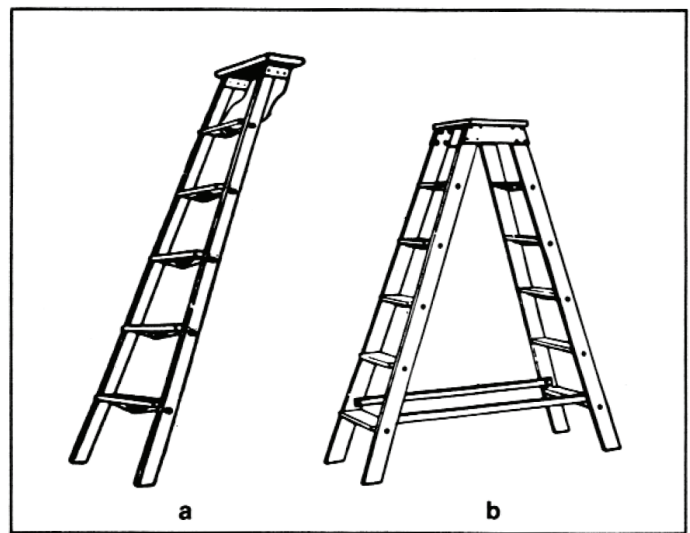


Figure 5 provides an example of (a) a shelf ladder and (b) a stockroom ladder.

should have positive-locking casters rather than the spring-loaded retractable type found on shorter tubular metal ladders. Handrails should be required on all ladders with four or more risers.

- 39.** The maximum working height for tubular stepladders is 5 1/2 feet above the work platform. Mobility and storage may be a problem with these ladders.
- 40.** Tubular metal A-frame ladders are similar to the other tubular metal ladders just described, except they have climbing steps on both sides. A-frame ladders may be useful in narrow aisles where access to both sides is required.
- 41.** Mobile ladder stands (see Figure 6a) are of similar design as other tubular metal ladders, with the addition of a heavy adjustable metal work shelf or tray for temporary storage of tools and material while the user is mounted.
- 42.** Cantilevered tubular metal ladders (see Figure 6b) are designed with a wide support base extending under the ladder. The ladder is supported in such a manner that it can extend above certain obstructions and still maintain a wide, firm base. Usually the support section under the cantilevered ladder is equipped with casters for

easy placement of the ladder. These ladders also are designed to fold, in order to pass beneath obstructions or to be stored under low shelves.

- 43. Tubular metal rolling service extension ladders are designed to do much of the same job as cantilevered tubular metal ladders, except they permit a higher reach. They also fold down for passage under obstructions and for storage under low shelves.

Hazards encountered when using ladders

- 44. There are many hazards associated with the use of ladders. Most of them can be predicted and prevented with planning, proper ladder selection, safe work practices, and vigilant ladder inspection and maintenance procedures. Some of the more common hazards in the use of ladders are instability, electrical shock and falls from one level to another.

- 45. Potential causes of ladder incidents can include: lack of non-skid feet or spurs that may allow a ladder to slip or skid on a slippery or smooth surface; damaged side rails may cause a ladder to give way; roof or cornice hooks may not be firmly anchored to the ladder or may not have a firm hold on a roof peak or cornice; straight or extension ladders may not be set at the proper 4:1 angle with the wall upon which they depend for support (Figure 7); stepladders may not be fully unfolded or the spreader hardware may be cracked, broken or not locked in place, which can make the ladder unstable; or the locks on an extension ladder may be broken or damaged, effectively letting the upper section rest on only one rail.
- 46. Electrical shock can be sustained by the user on a conductive metal ladder when working with electrical equipment. Not only is electrical shock dangerous in itself, but a subsequent fall off the ladder almost always results following the shock.

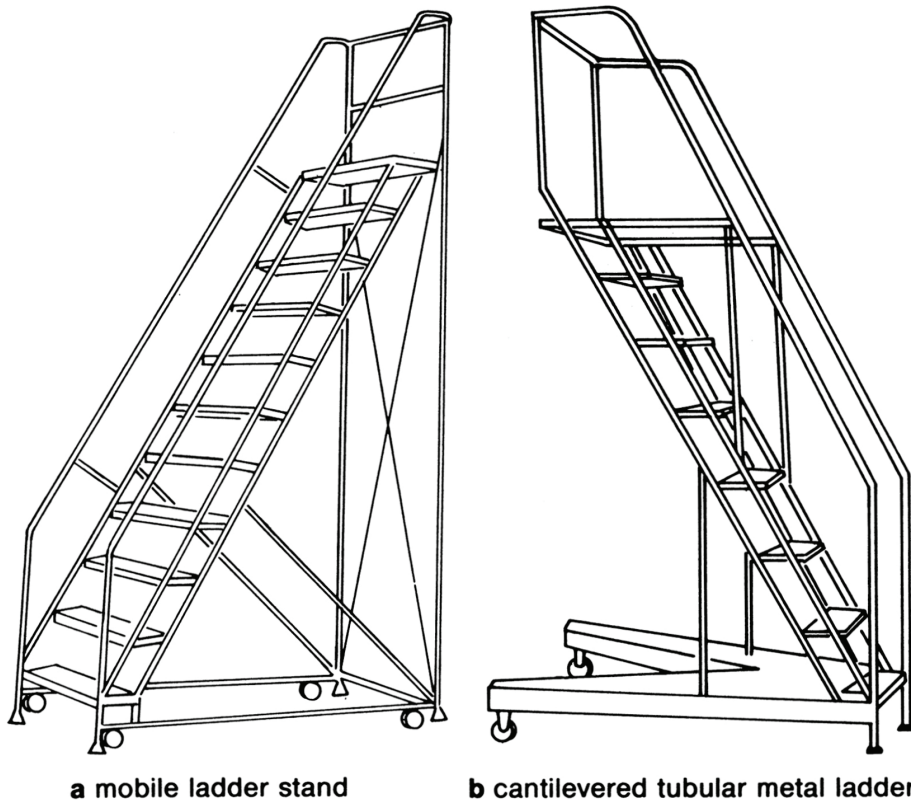


Figure 6 shows examples of tubular metal ladders.

For this reason, portable metal ladders should always be legibly marked with labels reading *Caution—Do not use around electrical equipment, or bear equivalent wording.*

47. Falls from ladders also can result from using weak, cracked or damaged ladders, improper ladder placement, over-reaching or overextending the body, or insufficient ladder allowance above a landing surface.

Using ladders

48. Employee training is a critical component of every ladder safety program and should include the following elements: the risk of fall hazards when using ladders; techniques for conducting ladder inspections; selection of the proper ladder for the job and any company-specific procedures for ladder use and care. A competent person should conduct employee training.
49. Ladders should be inspected carefully upon receipt and prior to each use. Test and inspect all working parts for proper attachment and operation, and lubricate moving parts in accordance with manufacturer's requirements. Check the rope and pulley of extension ladders for excessive wear. Never use a ladder after it has been dropped or tipped over until it has been inspected for damage and determined safe for reuse.
50. Ladders found to be defective are to be tagged out with *Defective—Do not use* tags and should not be used until repaired by a competent person. Ladders that cannot be repaired should be destroyed.
51. When using an extension or straight ladder, ensure it is of the proper length to reach the desired height. Some general guidelines when using extension or straight ladders include:
 - a. Ladders used to reach a walking/working surface or roof must extend at least 36 inches above the landing.
 - b. Never stand on the top three rungs of a straight ladder.

- c. When adjusting the length of an extension ladder, make sure the top or "fly section" of the ladder is above and rests on the bottom or "base section" with the rung locks fully engaged. Never use the ladder in reverse order with the fly section functioning as a base.

52. Place the ladder at the correct angle with the wall. The base of the ladder should be one-fourth of the ladder length between the ground and the top support (see Figure 7). If the base is too far out, the ladder may break or slip. If the base is too close to the wall, the ladder may tip backward.
53. Place the ladder base on a firm, level surface. Do not place ladders on boxes, barrels or other unstable bases to obtain additional height.
54. Both sides of the top section of a straight/extension ladder must be resting on a support.

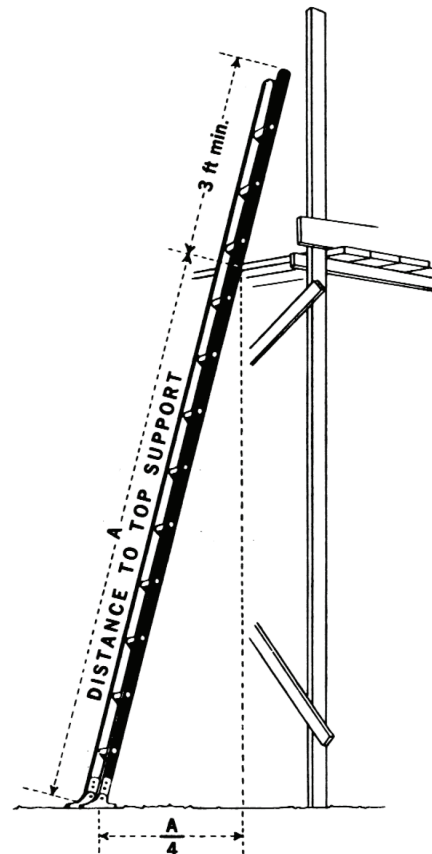


Figure 7 illustrates the correct or safe positioning of an extension ladder.

The top of the ladder then should be secured to the support by appropriate means, such as tie-off.

- 55.** Only one person should be on a ladder at one time unless it is designed for this purpose.
- 56.** Go up and down a ladder facing the ladder. Take one step at a time. Hold onto the side rails, not the rungs while ascending or descending, and maintain three points of contact at all times (i.e., two hands and one foot or two feet and one hand).
- 57.** To ensure both hands are free for safe ascent or descent of a ladder, carry small tools or other work materials in your clothing or attached to a belt. Never hand carry large objects up or down a ladder, use a hand line instead.
- 58.** Never overextend your body on a ladder as this can cause an imbalance resulting in the ladder and user falling. Instead, move the ladder to where the work can be completed without reaching too far to one side. A general rule of thumb is to always maintain the belt buckle between the ladder rails while working.
- 59.** Metal or wet wood ladders conduct electricity and should not be used when working on or near electrical equipment.
- 60.** Keep steps and rungs free from grease, oil, paint, snow, ice, mud or other slippery substances. A rag can be tied to a lower rung for use in wiping slippery substances from the user's shoes.
- 61.** Extension ladder locks must be securely hooked over rungs before climbing.
- 62.** When setting up a straight ladder or an extension ladder, use the following method to avoid muscle strain or losing control of the ladder:
 - a.** Brace the base of the ladder against a stationary object so it cannot slip. With a heavy ladder, have a helper brace the base with his feet (see Figure 8).
 - b.** Grasp the top rung with both hands.
 - c.** Raise the top end over your head and walk toward the base of the ladder, moving your hands to grasp the rungs in the center to maintain stability.
- d.** When the ladder is erect, move it to the desired location and lean it forward against the resting point.
- 63.** Be sure that a stepladder is fully opened and has its spreaders locked before you climb it. Never climb higher than the second step below the top of the stepladder. The top is not designed as a step and should never be used as such. Never "walk" a stepladder while standing on it. Never climb on the rear side of a stepladder, as it is not designed for such use. Do not use a folded stepladder as a straight ladder by leaning it against a wall.
- 64.** Be sure to extend fully and lock platform ladders in place before using them.
- 65.** All points of access to and from ladders should be kept clear of materials and debris to avoid slip and trip hazards.
- 66.** Ladders should never be placed in passageways, driveways or any location where they may be displaced by other work activities, unless protected by barricades or guards. Do not place ladders in front of doors unless the door can be locked or a sign is posted to stop traffic.
- 67.** The side rails, cleats and rungs of ladders must be kept clear and free of lines, hoses, cables, wires and other tripping hazards.
- 68.** Ladders should never be moved, shifted or extended when workers are on them.
- 69.** Never deface ladder markings or warning labels and ensure they remain legible at all times.
- 70.** A ladder should never be used as a brace, skid, lever, guy, gangway, platform, scaffold plank, material hoist or for any other use for which it was not intended, unless specifically recommended by the manufacturer. In addition, ladders should never be erected on scaffolds to gain additional height unless specifically designed for the application.

Inspection and maintenance of ladders

71. Glass fiber ladders should be inspected, cleaned and sprayed lightly with a clear or pigmented lacquer or paste waxed once every three months. If the ladder shows signs of blooming, wash the ladder with soap, rinse it and lightly hand sand it before applying lacquer or wax. Check all hardware such as nuts, bolts, spreaders and locks for tightness and good repair.
72. Metal ladders should be inspected for rough burrs; loose joints, bolts or rivets; insecure welds, and cracked or dented side rails or rungs. Make sure hooks, ropes, pulleys and locks on extension ladders are lubricated and in good operating condition.
73. Wood ladders should be protected with a clear sealer varnish, shellac or wood preservative. Wood ladders should not be painted, because the paint could hide defects. Check carefully for cracks, rot, shakes, splinters, broken rails or rungs, loose joints and bolts, and hardware in poor condition.
74. Replace worn or frayed ropes on extension ladders at once.

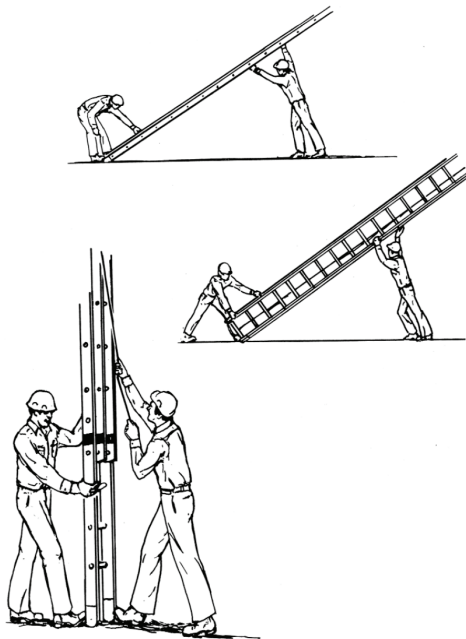


Figure 8 shows raising and extending a heavy ladder is a two-man job.

75. Ladders equipped with safety shoes or feet that are excessively worn should be removed from service until repaired.
76. Check the condition of a ladder that has been dropped or has fallen before it is used again. Cracked or rotten rungs of wood ladders should be replaced by a competent person only.
77. Ladders should be stored where they will not be exposed to the elements. Wood ladders should be kept in a well-ventilated location away from dampness, corrosive atmospheres and excessive heat. Store straight or extension ladders on flat racks or wall brackets. If long ladders are stored horizontally, use enough hangers to prevent sag and warp. Return ladders to storage after use.
78. Ladder repairs should only be made by a designated competent person with proper replacement parts. Do not make improvised or makeshift repairs. Never try to straighten, or allow to remain in use, a bent or bowed ladder.

Sources of information

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American National Standards Institute, 1899 L Street, NW, 11th Floor, Washington, DC 20036.

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Underwriters Laboratories Inc., 1559 King St, Enfield CT 06082.

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29 CFR Part 1910, Subpart D—” Walking-Working Surfaces,” Sections 1910.25 and 29 CFR 1910.26. Part 1926, Subpart L—” Ladders and Scaffolding,” Section 1926.450.

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