

# LADDER SAFETY

## Abstract

A ladder is a simple tool but a person using a ladder can be injured in an accident when using a ladder. The number of ladder-related accidents could be significantly reduced if workers conscientiously followed the basics of ladder safety. The Occupational Health and Safety Administration has established recommendations, requirements and employee training for the proper use of ladders with the goal to reduce the common causes of falls from ladders.

## Learning Objectives

1. Identify the common causes of ladder accidents
2. Identify the standards and specifications for ladders in the workplace.
3. Identify the Occupational Health and Safety Administration recommendations and requirements for ladder safety.
4. Describe the role of the employer for training an employee and the employee's obligation to learn and follow ladder safety procedures.

## **Introduction**

The ladder is an essential tool that is used every day at work by millions of people. Most workers use ladders safely and without incident but using a ladder requires a worker to work at heights. A fall from any height can be serious, and falls from ladders are one of the leading causes of occupational injuries and fatalities. Many falls from a ladder are preventable as the great majority of them are caused by improper use. The Occupational Health and Safety Administration has established recommendations, requirements and employee training for the proper use of ladders, as well as standards for the manufacture of ladders. The goal is to reduce the common causes of falls and injuries from ladder accidents.

## **OSHA and Ladder Safety**

A ladder is a simple tool that is frequently used in the workplace. Although ladders have considerable utility, their use can often lead to accidents that may result in injury or even death. The number of ladder-related accidents could be significantly reduced if workers conscientiously followed the basics of ladder safety. Knowing how to use ladders properly and safely is of key importance in the workplace. The Occupational Health and Safety Administration (OSHA) has promulgated rules for training workers in the proper, safe use of ladders.

The Occupational Health and Safety Administration is part of the U.S. Department of Labor and establishes standards for workplace safety and recommendations and requirements for the proper use of equipment. The Occupational Health and Safety Administration also requires employers to train employees in the proper and safe use of equipment. Regarding ladders, in 2003 OSHA provided the following statement:

“Employers must train all employees to recognize hazards related to ladders and stairways, and instruct them to minimize these hazards. Employers must retrain each employee as necessary to maintain their understanding and knowledge on the safe use and construction of ladders and stairs. Employers must ensure that each employee is trained by a competent person in the following areas, as applicable:

- Nature of fall hazards in the work area
- Correct procedures for erecting, maintaining and disassembling the fall protection systems to be used
- Proper construction, use, placement and care in handling of all stairways and ladders
- Maximum intended load-carrying capacities of ladders used.”

The OSHA standards and requirements for ladders are outlined in the Code of Federal Regulations (CFR) 1926.1053, and CFR 1926.1053 can be viewed on the OSHA website, [www.OSHA.gov](http://www.OSHA.gov). Examples of what CFR 1926.1053 contains are provided below.

- “Ladders shall be capable of supporting the following loads without failure: Each self-supporting portable ladder: At least four times the maximum intended load, except that each extra-heavy-duty type 1A metal or plastic ladder shall sustain at least 3.3 times the maximum intended load. The ability of a ladder to sustain the loads indicated in this paragraph shall be determined by applying or transmitting the requisite load to the ladder in a downward vertical direction. Ladders built and tested in conformance with the applicable provisions of appendix A of this subpart will be deemed to meet this requirement.”
- “Ladder rungs, cleats, and steps shall be parallel, level, and uniformly spaced when the ladder is in position for use. Rungs, cleats, and steps of

portable ladders (except as provided below) and fixed ladders (including individual-rung/step ladders) shall be spaced not less than 10 inches (25 cm) apart, nor more than 14 inches (36 cm) apart, as measured between centerlines of the rungs, cleats and steps.”

As set forth above, ladders used in the workplace must be manufactured to certain specifications set forth by OSHA. Employers are required to train employees in the proper and safe use of ladders. Additionally, it is the responsibility of the employee to learn, retain and use this safety information.

### **The Importance of Ladder Safety**

Falls are a common cause of work-related and non-occupational injury and death, and falls from ladders are particularly serious (Smith, *et al*, 2006). The Consumer Product Safety Commission (CPSC) estimated that in 2010 more than 724,000 people were injured while using a ladder or a stepstool, and Francis (2014) estimated that approximately one person a day will die as a result of a ladder fall.

Approximately 20% of all occupational fall injuries involve a ladder and 81% of fall injuries among construction workers treated in an emergency room involve a ladder (Socias, *et al*, 2014). A 2015 study by Canadian researchers noted that falls from ladders resulted in serious injuries that required a median hospital stay of greater than two weeks (Driedger, *et al*, 2015). Nosaka, *et al*. (2015) reported a fatality rate from ladder falls of 11% and a significant number of patients in this study developed neurological disabilities. Falls occurred from step ladders and extension ladders, the median height of the falls was only 2 meters/6.6 feet, and injuries occurred

after falls from as low as 1.5 meters/4.8 feet. Con, *et al.* (2014) reported a fatality rate of 3.8% in 340 patients who had a fall from a ladder.

A 2004 study by O'Sullivan, *et al.* (2004) found that falls from a ladder resulted in disability and unemployment for a median duration of six weeks. Bedi, *et al.* (2008) found that 24% of all people in their study who had suffered a ladder fall required hospitalization, and Axelsson and Carter (1995) reported that nearly 40% of workers with ladder-related injuries (93% of which were falls) were absent from work for more than a month, and half of those injured "... experienced continuing, possibly permanent disability."

A study published by Creighton University (2003), based on statistics from the Occupational Safety and Health Administration and the Bureau of Labor Statistics, revealed more than 15 percent of all worker compensation cases are related to ladder accidents

### **Causes of Ladder Falls**

Ladder falls have many causes, which may include the improper positioning of the ladder causing a lack of stability or the ladder to slip, improper support, overextending or overreaching by the person using the ladder, which causes the user to lose balance or the base of the ladder to slip. Additionally, defective ladders, no assistance, poor or no inspection of the ladder prior to use, losing balance, slipping or losing footing, improper training, and lack of awareness of the risks associated with using a ladder may lead to a ladder fall and serious injury.

Understanding ladder falls can be challenging because there are so many possible causes but all ladder falls can be classified into three categories:

1) improper use of the ladder, 2) failure of the ladder or of the surface it is supported on, and 3) improper ladder selection (Campbell, *et al*, 2014). Improper ladder selection frequently happens when a user selects a ladder that is too short, causing him or her to stand on the top rung or the top of the ladder. This is especially likely to occur if the proper ladder is too large or heavy and a lighter, smaller ladder is used instead for “convenience.” Failure of the ladder can be due to poor maintenance and/or neglecting to inspect the ladder prior to use.

Failure of the surface may involve a wet or slippery surface. Improper use involves poor set-up, for example, an uneven or slippery surface for the ladder base or overreaching (neglecting to keep the body between the rails) instead of climbing down and moving the ladder or failing to place the ladder at the proper angle, causing the ladder to slide from its base (Häkkinen, *et al*, 1988, and Hsiao, *et al*, 2008). These slide out failures are one of the most common causes of ladder falls (Chang, *et al*, 2005) and a literature review by Hsiao, *et al*, identified several factors affecting the likelihood of a ladder slide out failure including ladder angle, coefficient of friction, as well as type, location, and magnitude of the load.

### **Ladder Falls and Injuries**

The height of the fall, the landing surface, and the age of the person (increased age is associated with increased risk of injury) are factors that determine the severity of injury after a fall from a ladder. Injuries that are associated with ladder falls may include abrasions, contusions, dislocations, fractures, head injuries (brain contusion, intracranial hemorrhage), lacerations, neurologic complications or damage, sprains, traumatic spleen injury, and spinal injuries. Thoracic, spine, and head injuries or fractures are

the most likely injuries, but upper and lower extremity injuries or fractures are common, as well (Con, *et al*, 2014).

### **Ladder Safety: A Four-part Process**

Ladder safety is a four-part process that involves: 1) ladder selection, 2) ladder inspection, 3) ladder set-up, and 4) ladder use. Ladder safety begins with the selection of the proper ladder for the job and includes inspection, setup, proper climbing and standing, and the correct care, use and storage of ladders. In addition to the general safety rules for all ladders there are special rules for using step ladders and for single and extension ladders. These safety rules are a combination of OSHA regulations and proven common sense procedures. This combination of safe equipment and its safe use can eliminate most ladder accidents.

#### **Ladder Selection**

There are four basic types of ladders: 1) step ladders, 2) single ladders, 3) extension ladders, and 4) mobile ladders. Step ladders are also called folding or fold-out ladders and extension ladders and single ladders are also called leaning ladders. Another category is the articulated ladder, a portable, multi-use ladder with locking hinges that can be used in several different configurations. Ladders can also be categorized as fixed (for example, non-movable ladders) or portable (for example, self-supporting or non self-supporting). In the interest of simplicity, the two most commonly used ladders, portable step ladders and portable extension ladders will be discussed. Figure 1 shows these two types of ladders.

#### **Figure 1**



**Step Ladder**



**Extension Ladder**

A step ladder is a portable, self-supporting ladder, that is intended to be used by one person. Step ladders are typically manufactured in heights of 3 to 20 feet; anything less than 3 feet is considered a step stool. Step ladders can be made from aluminum, fiberglass, or wood. Step ladders are comprised of the rails, the steps (which are also called cleats or rungs), the top cap, and the hinges. Many step ladders also have a small extendable platform that is to be used to hold buckets or tools while the ladder is in use.

Fiberglass ladders are often equipped with "shoes," non-skid caps that are placed over the bottom of the four rails. Step ladders can be used anywhere an extension ladder can be used but there are two important considerations that are particular to the use of step ladders. First, a step ladder has four supporting rails, not two rails as with an extension ladder; the supporting surface must be chosen carefully with respect how level it is, the friction of the surface, and the available space. Step ladders require more space around them because of their configuration. Second, step ladders are

available in heights of up to 20 feet but as with all ladders there is a limit to the safe working height of a ladder This is discussed below.

An extension ladder (and straight ladders) is a portable, non self-supporting ladder. *Non-self supporting* means that the stability of an extension ladder depends on the top of the ladder being in contact with a surface, for example, leaning against the side of a building or a wall. Extension ladders can be made of aluminum, fiberglass or wood. Extension ladders are typically manufactured to heights of up to 60 feet. An extension ladder is comprised of the two rails, the steps (also called cleats or rungs), and the base (the part of the ladder that is set in place on the surface), the extendable part of the ladder, which is called the fly, ropes and pulleys that are used to extend the fly, and locking mechanisms that keep the fly in place once it has been extended.

Selecting the proper ladder for a job involves three considerations. The first consideration is the environment. If a person is working with electrical equipment or the ladder will be used near a source of electricity an aluminum ladder should not be used. The surface and the area on which the base of the ladder will be resting should be evaluated. The stability of an extension ladder is dependent on the surface its base is resting on and if that surface is wet or will not provide sufficient friction for the ladder base, an extension ladder should not be used or the situation should be corrected. A step ladder has four supporting rails, so the supporting surface must be chosen carefully to allow for a safe area around the base of the ladder and to ensure the ladder is evenly placed. Stability is also important for a step ladder and a step ladder should only be used if all four rails that form the base can be placed in a position so that the step ladder is level. Finally, if the

ladder is used inside or in an enclosed space the size of the ladder must not prevent it from being set up at the proper angle; it should not be too big.

The second consideration for ladder selection is the weight the ladder will need to bear. Ladders are rated for the amount of weight they can accommodate. This is called the *duty rating* and there are five categories of duty ratings: Type IAA, Type IA, Type I, Type II, and Type III.

Types IAA through Type I are considered to be industrial use ladders. Type II is considered to be a medium duty commercial ladder and Type III are light duty ladders suitable for home use.

The duty rating is the maximum weight that the ladder can bear for normal use, for example, an eight hour work day. In order to determine which type of a ladder is appropriate for a job, the user's weight, the weight of the user's clothing, and the weight of any equipment or tools that will be used or stored on the ladder should be combined; the total should be less than the duty rating of the ladder. The duty rating of a ladder is usually on a printed label that is affixed to one of the rails.

Type IAA: Special duty ladders. These ladders have a duty rating of 375 pounds.

Type IA: Extra heavy duty ladders. These ladders have a duty rating of 300 pounds.

Type I: Heavy duty ladders. These ladders have a duty rating of 250 pounds.

Type II: Medium duty ladders. These ladders have a duty rating of 225 pounds.

Type III: Light duty ladders. These ladders have a duty rating of 200 pounds.

The duty rating is the amount of weight load that a ladder can withstand during normal expected use. Ladders can hold more weight than their duty rating. For example, OSHA requires that a self-supporting, portable ladder (except for Type IA metal or plastic ladders) be able to withstand four times the maximum intended load. However, the duty rating of a ladder should never be exceeded.

The next consideration in ladder selection is the *size* of the ladder. Selecting the right size of ladder requires the user to know at what height the work is;

for example the user may be painting a wall and the surface that needs paint starts at 15 feet and ends at 20 feet. The user will also need to know the maximum working height at which the ladder can be used and the proper set-up angle of the straight or extension ladder. All of these factors, the ladder size, the height at which the work will be done the maximum working height of the ladder, and the proper set-up angle are interdependent.

As mentioned previously, ladders are typically 3-60 feet long. The highest standing point should be 2-3 feet down from the top of the ladder; this information should be on a label on one of the rails of the ladder. The maximum working height is the height plus how far the user will need to reach to do the job.

Most people work best at shoulder level. The average shoulder level is approximately five feet above where someone would stand on a ladder, the user should stand at least two to three feet below the top of the ladder, so the maximum working height feet is approximately the height of the ladder minus two to three feet.

The ladder is 20 feet from the base to the top. The user is standing three feet below the top, shoulder level is about five feet, so the maximum effective working height is 22 feet. The *set-up angle* is crucial because slipping of the ladder base, also referred to as a slide-out failure, is one of the most common causes of ladders accidents. The American National Standards Institute (ANSI) recommends a set-up angle of 75.5°. This can be reasonably estimated by placing the base of the ladder at distance from the supporting surface that is equal to one-fourth of the height of the ladder; the base of 20 foot ladder would be placed 5 feet from the supporting surface.

Set-up angle is obviously an important consideration when choosing ladder size; it will be discussed in the Ladder Set-Up section later on.

### **Ladder Inspection**

The ladder user should always check a ladder before using it. The user should inspect wood ladders for cracks and splits in the wood. All ladders should be checked to see that cleats, steps, or rungs are tight, secure, and clean. The user should be sure that all hardware and fittings are properly and securely attached.

The ladder user should always test movable parts of the ladder to see that they operate without binding or without too much free play. Metal and fiberglass ladders should be inspected for bends and breaks. Also, the ladder user should be sure that metal steps and rungs are grooved or roughened to prevent slipping. Ladder rungs, cleats, or steps must be parallel, level, and uniformly spaced when the ladder is in position for use. Rungs must be spaced between 10 and 14 inches apart and rungs must be so shaped that the user's foot cannot slide off, and must be skid-resistant. Step ladders must have a metal spreader or locking device to hold the front and back sections in an open position when in use. (See Figure 2 below)

### **Figure 2**



The ladder user should never use a damaged ladder. It should be marked as defective or tagged as *"Do not use"* and the user should report it to a supervisor so that it may be removed from the work area. The OSHA CFR 1926.1053 states that ladders shall be inspected by a competent person for visible defects on a periodic basis and after any occurrence that could affect safe use of a ladder. Portable ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps, broken or split rails, corroded components, or other faulty or defective components, shall either be immediately marked in a manner that readily identifies them as defective, or be tagged with "Do Not Use" or similar language, and shall be withdrawn from service until repaired.

Fixed ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps, broken or split rails, or corroded components, shall be withdrawn from service until repaired. The requirement to withdraw a defective ladder from service is satisfied if the ladder is either immediately tagged with "Do Not Use" or similar language, or is marked in a manner that readily identifies it as defective.

### **Ladder Set-Up**

The ladder user should place the ladder base firmly and evenly on the ground or floor. Before climbing the user should make sure the ladder is set up at the proper angle and is secure. The ladder user should never try and extend the working height of a ladder by placing it on boxes, barrels, bricks, blocks or other unstable bases. The ladders should be allowed to lean sideways. The user should brace the base of the ladder with stakes or place stout boards against the feet if there is any danger of slipping.

A ladder should never be set up in a high wind, especially a lightweight metal or fiberglass type. The ladder user should wait until the air is calm enough to insure safety. A ladder should never be set up in front of a door unless the door is locked or a guard is posted. Ladders should not be used on ice or snow unless absolutely necessary. If they must be used on ice or snow, a spike or spur-type safety shoes should be used on the ladder feet and the user should be sure they are gripping properly before climbing. Safety shoes should be used if there is any possibility of slipping.

Top support for a ladder is as important as good footing. The top should rest evenly against a flat, firm surface. If a ladder is to be leaned against roof gutters, the strength and stability of the gutters should first be tested. When a ladder is used for access to an upper landing surface, it must extend three rungs, or at least three feet above the landing surface.

A ladder used for access to an upper landing surface should be secured against sideways movement at the top or held by another worker whenever it is being used. The ladder user should extend an extension ladder only from the ground. The height needed should be determined, and the ladder user should extend and lock the fly section securely in place then set it up against the wall.

The ladder user should always check for ladder stability and support before climbing. If possible, the base of a long ladder should be secured to the ground and the top should be tied to the upper landing surface.

The *set-up angle* is crucial because slipping of the ladder base, also referred to as a slide-out failure, is one of the most common causes of ladder accidents. The ANSI recommends a set-up angle of 75.5°. This can be reasonably estimated by placing the base of the ladder at distance from the supporting surface that is equal to one-fourth of the height of the ladder; the base of a 20 foot ladder would be placed 5 feet from the supporting surface. Campbell, *et al.* (2014) evaluated six set-up methods:

Basic:

The basics of ladder use involves evaluation of the proper position of the ladder simply by visual estimation, or “eyeballing.” The failure rate of this method has been reported to be 9.8%, and the following statistics indicate relative failure rates based upon ladder position and user activity.

- 75 degree: The user places the ladder at what is perceived to be 75°. The failure rate of this method was 15.2%.
- 4:1: This method was previously explained, and was found to be the least accurate with a failure rate of 18.8%.
- Stand-reach: The user places the toes at the base of the ladder, extends the arms and sees if the palms touch the rungs. The failure rate of the method was 3.3%.
- L-sticker: Some ladders have a sticker on a rail in the shape of an L. The user aligns the upright part of the L with the surface the ladder is supported by. The failure rate of this method was 3.3%.

- Bubble level: The bubble level was found to be the most accurate, with a failure rate of 1.1%

Other considerations for ladder setup include the following: 1) When using a ladder where there is traffic, the user should erect warning signs or barricades to guide traffic away from the foot of the ladder. If this is not possible, someone should be assigned to hold and guard the bottom of the ladder. 2) There needs to be clearance between the rungs and steps and the supporting surface. OSHA CFR 1926.1053 requires a " ... minimum perpendicular clearance between fixed ladder rungs, cleats, and steps, and any obstruction behind the ladder shall be 7 inches (18 cm), except in the case of an elevator pit ladder for which a minimum perpendicular clearance of 4 1/2 inches (11 cm) is required."

There needs to be clearance between the rungs and steps and from any obstruction on the climbing side of the ladder. OSHA CFR 1926.1053 requires a " ... minimum perpendicular clearance between the center line of fixed ladder rungs, cleats, and steps, and any obstruction on the climbing side of the ladder shall be 30 inches (76 cm), except as provided in paragraph (a)(15) of this section. When unavoidable obstructions are encountered, the minimum perpendicular clearance between the centerline of fixed ladder rungs, cleats, and steps, and the obstruction on the climbing side of the ladder may be reduced to 24 inches (61 cm), provided that a deflection device is installed to guide employees around the obstruction." The OSHA guidelines state that ladders placed in any location where they can be displaced by workplace activities or traffic, such as in passageways, doorways, or driveways, shall be secured to prevent accidental displacement, or a barricade shall be used to keep the activities or traffic

away from the ladder (OSHA CFR 1926.1053). Notably, the following guidelines should be followed.

- The area around the top and bottom of ladders shall be kept clear (OSHA CFR 1926.1053).
- The top of a non-self-supporting ladder shall be placed with the two rails supported equally unless it is equipped with a single support attachment (OSHA CFR 1926.1053).
- Ladders shall not be used on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental displacement. Slip-resistant feet shall not be used as a substitute for care in placing, lashing, or holding a ladder that is used upon slippery surfaces including, but not limited to, flat metal or concrete surfaces that are constructed so they cannot be prevented from becoming slippery (OSHA CFR1926.1053).

OSHA CFR 1926.1053 can be viewed on the OSHA website, [www.OSHA.gov](http://www.OSHA.gov). Another good source of information about ladder safety is the American Ladder Institute Ladder Safety page, which can be viewed at <http://laddersafetytraining.org/>.

### **Basics of Extension Ladder Set-Up**

The basic requirements of extension ladder set-up are as follows:

Step 1. Lay the ladder on the ground with the base resting against the bottom of the wall and the top pointing away from the wall.

Step 2. Starting at the top of the ladder, lift the end over the head and walk under the ladder to the wall, moving the hands from rung to rung while setting up the ladder.

Step 3. When the ladder is vertical, and the top touches the wall, pull out the base so that the distance away from the wall is about one-fourth of the height to the point of support or use another method for estimating the proper set-up angle.

Step 4. Reverse this process to take down the ladder. The user will be walking backwards and, therefore, will need to check for obstacles in his/her path before starting. Also, the user will need to be careful to lower the ladder slowly so that it is kept under control and to prevent the ladder from falling on top of the user.

Ladder users should remember that the sections of an extension ladder should overlap enough to retain the strength of the ladder using the following table:

| <u>Length of Ladder</u> | <u>Required Overlap</u> |
|-------------------------|-------------------------|
| Up to 36 feet           | 3 feet                  |
| Over 36 to 48 feet      | 4 feet                  |
| Over 48 to 50 feet      | 5 feet                  |

### **Ladder Use**

The ladder user should not try to move a ladder while on it by rocking or pushing it away from a supporting wall. Ladders should never be used when under the influence of alcohol, when in ill health, or if taking medications that can affect the user's balance and coordination or that can make the user dizzy. If the ladder user gets sick, dizzy or panicky while on a ladder, he/she should not try to climb down in a hurry. Instead, the ladder user

should drape the arms around the rungs, rest the head against the ladder until feeling better, and then climb down slowly and carefully.

Tools or materials should not be left on top of ladders. If they fall, the user or another worker can be injured. The ladder user should never push or pull anything sideways while on a ladder. This puts a side load on the ladder and can cause it to tip out from under the user. Only *one person at a time on a ladder* should be allowed unless the ladder is specifically designed for two people. A ladder should never be used as a horizontal platform, plank, scaffold or material hoist.

The ladder user should not stand higher than the second step from the top of a stepladder (see picture below). Especially, the ladder user should not stand or sit on the top cap, or stand on the pail shelf or on the back of a stepladder. The ladder user should not straddle the front and back of a stepladder.

Its important to be cautious about homemade ladders. Ladders made by fastening cleats across a single narrow rail, post or pole, should never be used. A ladder on a scaffold platform should also never be used. When needing to reach higher, the scaffold should be higher. A ladder should never be used for any purpose other than the one for which it was designed. Ladders need to be maintained free of oil, grease, and other slipping hazards, and ladder users should clean such debris off their shoes before climbing a ladder. They should not be loaded beyond the maximum intended load for which they were built, nor beyond their manufacturer's rated capacity (OSHA CFR 1926.1053). OSHA specifically states, as previously mentioned, that ladders shall be used only for the purpose for which they were designed.

Debris should be cleaned off a person's shoes before climbing a ladder. When climbing the ladder both hands should be used and a secure grip maintained on the rails or rungs. When ascending or descending a ladder, the user should face the ladder. Each employee shall use at least one hand to grasp the ladder when progressing up and/or down the ladder. The ladder user should climb and stand on a ladder with the feet in the center of the steps or rungs. The ladder user should not overreach from a ladder, or lean too far to one side.

Overreaching is probably the most common cause of falls from ladders. A good rule is to always keep the belt buckle inside the rails of a ladder. The ladder user should work as far as he/she can reach comfortably and safely, and then move the ladder to a new position. Ladder users should never climb onto a ladder from the side, from above the top or from one ladder to another, and never slide down a ladder.

OSHA states that an employee shall not carry any object or load that could cause the employee to lose balance and fall (OSHA CFR 1926.1053). Never carry heavy or bulky loads up a ladder. The ladder user should climb up first, and then pull up the material with a rope.

### **Ladder Care and Storage**

Ladders should be maintained in good condition. All ladder accessories, especially safety shoes, should be kept in good condition. Wood ladders, which are to be used outside, should be treated to prevent weather damage. A clear finish or transparent penetrating preservative should be used. Linseed oil is a good treatment for a wood ladder, although it does add some weight to the ladder. An oil treatment also helps to rustproof the metal parts

of a wood ladder. A wood ladder should never be painted. This will cover dangerous cracks or fill and hide them.

Metal bearings of extension ladder rung locks and pulleys should be lubricated periodically, and between regular maintenance periods whenever necessary. Ropes on extension ladders should be in good condition. If they become frayed or badly worn, they should be replaced.

A ladder user should never sit on ladder side rails, and should never use a metal or fiberglass ladder which has been exposed to fire or strong chemicals. Materials should never be stored on a ladder.

Wood ladders should be stored where they will not be exposed to excessive heat or dampness. Fiberglass ladders should be stored where they will not be exposed to sunlight or other ultraviolet light sources. Workers should be sure that ladders are properly supported and secured when in transit. Vibration and bumping against other objects can damage them. Ladders should be stored on racks, which give them proper support when not in use.

### **Case Study: Ladder Safety**

The following case study was obtained from the University of Iowa Public Health and Safety Report. The authors report on a 46-year-old construction worker who was fatally injured when he fell from a ladder onto a concrete block foundation retaining wall.

The ladder-fall victim worked as a driver and helper for his employer. He was reportedly part of a three-man work crew on the afternoon of the fatal incident. The victim and his work partners were removing shingles to re-roof a private facility. Late in the work day, possibly tired from hours of pulling

off shingles from the roof, the victim decided to carry a tarp up an extension ladder to the roof because there had been weather warnings of impending rain. While carrying the tarp up the ladder, the victim fell an estimated 10 to 12 feet to the foundation retaining wall located to the left of the ladder. There was no one who witnessed the fall.

During investigation of the incident, it was found that a stabilizer bar attached to the ladder had come apart from the ladder, and a nylon tie-down strap used to secure the stabilizer bar to the roof had broken when the ladder slid sideways. The owner of the business heard the victim fall and called 911.

When the local emergency responders arrived to scene the victim was found to be unconscious with multiple blunt force injuries to the head, neck, chest, waist area, and abdomen. After a half-hour ambulance transfer to the emergency department of the local hospital, the victim died approximately 4 hours later.

## **Recommendations**

The recommendations by local investigators for health and safety of this tragic incident were as followed:

1. Use a hoist or pulley to raise and lower the heavy or awkward objects to their destination. Do not carry any objects or loads up a ladder that would cause an employee to lose balance.
2. Set up non-self-supporting extension ladders on firm level footing so height-to-base ratio is 4:1. Assure both rails of the ladder maintain equal contact with the supporting structure. Tie or stake the ladder so the top and bottom are secure and unable to move laterally.

3. Train employees who use ladders to recognize all fall hazards at the worksite and the means to eliminate those hazards.
4. Regularly check ladders and ladder accessories, including straps, stabilizers, clips or bolts affixing stand-off bars or stabilizers – to assure they are intact and not missing, damaged, or worn.
5. Use ladders that are sized for the maximum load and capacity that will be needed. Do not load ladders beyond the manufacturer’s rated capacity.
6. Wear slip-resistant footwear when on ladders. Keep the midline of the body between the side rails of the ladder. Keep “three points of contact” on the ladder at all times.
7. Identify effective ways to effectively provide occupational safety resources and training to small special population business owners that may not have access to traditional safety resources such as trade organizations, insurance carriers, or OSHA consultation services.

### **Summary**

Ladders are a necessary tool but working from a height is inherently dangerous. Every year there are hundreds of thousands of ladder falls and ladder falls are a significant cause of serious injury, death, disability, and time lost from work. A fall from a height as low as 6 feet has the potential to cause significant harm.

Ladder falls happen because of improper use of the ladder, failure of the ladder or of the surface it is supported on, and improper ladder selection, and user error is typically the driving force behind all of these. OSHA requires employers to instruct employees in ladder safety but it is the employees’ responsibility to use ladder safety techniques.

Ladder safety is a four-part process that includes ladder selection, ladder inspection, ladder set-up, and ladder use. Ladder selection involves assessing the environment in which the ladder will be used, selecting a ladder with the proper duty rating, and choosing the correct sized ladder. Ladder inspection should be done before each use of a ladder and damaged ladders should be clearly marked as such and immediately removed from the workplace.

Ladder set-up information is generally basic and the essence of ladder safety is for the worker to know how to apply standards of safety checks and ladder stability. Of particular interest is the set-up angle of extension ladders, as slide-out failures are a common problem. Employees are guided to use at least one hand to grasp the ladder when progressing up or down the ladder. Ladder use is in many ways a matter of common sense. OSHA CFR 1926.1053 provides specific guidelines for ladder use.