

LADDER SAFETY

INTRODUCTION

Ladders are a necessary tool and every day millions of people use ladders at work and do so safely and without incident. But using a ladder requires a worker to be at height. A fall from what might seem to a short distance can be very serious and falls from ladders are one of the leading causes of occupational fatalities and injuries.

Many ladders falls are preventable as the great majority of them are caused by improper use. A ladder is a simple tool and the number of ladder-related accidents could be significantly reduced if workers conscientiously followed the basics of ladder safety. To use ladders safely and effectively, one must know the rules of ladder safety and observe these rules at all times.

Knowing how to properly and safely use ladders is of key importance in the workplace. Employers are required to train employees in the use of equipment such as ladders that have the potential to cause harm. However, it is the responsibility of the employee to retain and use this safety information.

OSHA AND LADDER SAFETY

The Occupational Health and Safety Administration (OSHA) is part of the US Department of Labor. OSHA establishes standards for workplace safety and establishes recommendations and requirements for the proper use of equipment. OSHA also requires employers to train employees in the proper and safe use of equipment.

Regarding ladders, OSHA states that:

“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: (OSHA, 2003)

- 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; and
- Maximum intended load-carrying capacities of ladders used.”

The OSHA standards and requirements for ladders are outlined in CFR 1926.1053 (CFR is an abbreviation for Code of Federal Regulations), and CFR 1926:1053 can be viewed on the OSHA website, 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 center lines of the rungs, cleats and steps.”

WHY IS LADDER SAFETY IMPORTANT?

Falls are a very 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 (2104) 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 involved 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 falls from ladders 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

WHAT CAUSES FALLS FROM LADDERS?

Ladder falls have many causes, including but not limited to: improper positioning of the ladder causing a lack of stability or the ladder to slip; improper support; overextending/overreaching by the user that causes the user to loss balance or the base of the ladder to slip; defective ladders; no assistance; poor or no inspection of the ladder prior to use; losing balance; slipping/losing footing; improper training, and; lack of awareness of the risks associated with using a ladder.

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 her/him 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, eg, 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; 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.

INJURIES AND LADDER FALLS

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 include, but are not limited to: Abrasions, contusions, dislocations, fractures, head injuries (brain contusion, intracranial hemorrhage), lacerations, neurologic complications/damage, sprains, traumatic spleen injury, and spinal injuries. Thoracic, spine, and head

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

THE PROCESS OF LADDER SAFETY

Ladder safety is a three part process that: 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 stepladders 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: step ladders, single ladders, extension ladders, and mobile ladders. Step ladders are also called folding or foldout 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 or portable, 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



Step Ladder



Extension Ladder

Figure 1

A step ladder is a portable, self-supporting ladder, and they are 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 so 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 will be discussed later in the module).

An extension ladder (and straight ladders) is a portable, non self-supporting ladder. Non-self supporting means that the stability of an extension ladders depends on the ladder being in contact with a surface, eg, 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 placed on the surface and does not move), 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 you are 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 very 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, do not use the ladder or correct the situation. A step ladder has four supporting rails not two, 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 shouldn't 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. Types IAA through 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.

- 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 maximum weight that the ladder can bear when it is for normal use, eg, and eight hour work day. In order to determine which type of a ladder is appropriate for a job, combine 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: 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.

Learning Break: 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 you to know at what height the work is; for example you will be painting a wall and the surface that needs paint starts at 15 feet and ends at 20 feet. . You will also need to know the maximum working height at which the ladder can be used and the proper set-up angle of the ladder of the straight or extension ladder. All of these, 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 inter-dependent.

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 your height plus

how far you 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-three feet below the top of the ladder, and so the maximum working height feet is approximately the height of the ladder minus two-three feet.

Example: 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 and 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 of the module.

Ladder Inspection

Always check a ladder before using it. Inspect wood ladders for cracks and splits in the wood. Check all ladders to see that cleats, steps, or rungs are tight, secure, and clean. Be sure that all hardware and fittings are properly and securely attached. Test movable parts to see that they operate without binding or without too much free play. Inspect metal and fiberglass ladders for bends and breaks. Also, 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 an employee'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

Never use a damaged ladder. Mark it as defective or tag it as "Do not use" and report it to your supervisor so that it may be removed from the area. The OSHA CFR 1926.1053 states:

- Ladders shall be inspected by a competent person for visible defects on a periodic basis and after any occurrence that could affect their safe use.
- 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

Place the ladder base firmly and evenly on the ground or floor. Before climbing make sure the ladder is set up at the proper angle and is secure. Do not try and extend the working height of a ladder by placing it on boxes, barrels, bricks, blocks or other unstable bases. Do not allow ladders to lean sideways. Brace the base of the ladder with stakes or place stout boards against the feet if there is any danger of slipping.

Never set up or use a ladder in a high wind, especially a lightweight metal or fiberglass type. Wait until the air is calm enough to insure safety. Never set up a ladder in front of a door unless the door is locked or a guard is posted. Do not use ladders on ice or snow unless absolutely necessary. If they must be used on ice or snow, use spike or spur-type safety shoes on the ladder feet and be sure they are gripping properly before climbing. Use safety shoes 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.

Extend an extension ladder only from the ground. Determine the needed height, extend and lock the fly section securely in place then set it up against the wall. Check for 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 ladders 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 20 foot ladder would be placed 5 feet from the supporting surface. Campbell et al (2014) evaluated six set-up methods:

1. Basic: The user evaluates the proper position of the ladder simply by visual estimation, aka “eyeballing.” The failure rate of this method was 9.8%.
2. 75 degree: The user places the ladder at what she/he perceives to be 75°. The failure rate of this method was 15.2%.
3. 4:1: This was previously explained. This was found to be the least accurate with a failure rate of 18.8%.
4. Stand-reach: Place the toes at the base of the ladder, extend the arms and see if the pals touch the rungs. The failure rate of the method was 3.3%.
5. 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%.
6. 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:

- When using a ladder where there is traffic, erect warning signs or barricades to guide traffic away from the foot of the ladder. If this is not possible, have someone hold and guard the bottom of the ladder.
- 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.”
- Clearance between the rungs and steps and 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.”
- 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).

- 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 CFR 1926.1053).

The Basic Process of Ladder Set-Up

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 your head and walk under the ladder to the wall, moving your hands from rung to rung as you go.

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. Remember that you will be walking backwards, so check for obstacles in your path before starting. Also be careful

to lower the ladder slowly so that you can keep it under control and prevent its falling on you.

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

Length of Ladder	Required Overlap
Up to 36 feet	3 feet
Over 36 to 48 feet	4 feet
Over 48 to 60 feet	5 feet

Ladder Use

Do not try to move a ladder while you are on it by rocking or pushing it away from a supporting wall. Never use a ladder when under the influence of alcohol, when you are in ill health, or if you are taking medications that can affect your balance and coordination or can make you dizzy. If you get sick, dizzy or panicky while on a ladder, do not try to climb down in a hurry. Drape your arms around the rungs; rest your head against the ladder until you feel better and then climb down slowly and carefully.

Do not leave tools or materials on top of ladders. If they fall, you or another worker can be injured. 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 you. Allow only one person at a time on a ladder unless the ladder is specifically designed for two people. Never use a ladder as a horizontal platform, plank, scaffold or material hoist.

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

Be cautious about homemade ladders. Never use ladders made by fastening cleats across a single narrow rail, post or pole and never use a ladder on a scaffold platform. If you need to reach higher, the scaffold should be higher. And never use a ladder for any purpose other than the one for which it was designed.

Ladders shall be maintained free of oil, grease, and other slipping hazards, and clean such debris off your 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). Ladders shall be used only for the purpose for which they were designed.

Clean debris off your shoes before climbing a ladder. When climbing use both hands and maintain a secure grip on the rails or rungs. When ascending or descending a ladder, the user shall face the ladder. Each employee shall use at least one hand to grasp the ladder when progressing up and/or down the ladder. Climb and stand on a ladder with your feet in the center of the steps or rungs. Do 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 your belt buckle inside the rails of a ladder. Work as far as you can reach comfortably and safely then move the ladder to a new position. Never climb onto a ladder from the side, from above the top or from one ladder to another, and never slide down a ladder.

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. Climb up yourself first, and then pull up the material with a rope.

LADDER CARE AND STORAGE

Maintain ladders in good condition. Keep all ladder accessories, especially safety shoes, 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. Never paint a wood ladder. 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.

Never sit on ladder side rails. Never use a metal or fiberglass ladder which has been exposed to fire or strong chemicals. Never store materials on a ladder.

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

SUMMARY

Ladders are a necessary tool but working at 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 three part process that includes: 1) ladder selection; 2) ladder inspection; 3) ladder set-up, and; 4) 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 is somewhat lengthy subject but information is not complex and the essence of ladder safety is safety is safety and stability. Of particular interest is the set-up angle of extension ladders, as slide-out failures are a common problem. Ladder use is in many ways a matter of common sense - Do not try to move a ladder while you are on it by rocking, jogging or pushing it away from a supporting wall. Never use a ladder when under the influence of alcohol, when you are in ill health, or if you are taking medications that can affect your balance and coordination or can make you dizzy. Do not use an aluminum ladder near a source of electricity. Use both hands and maintain a secure grip on the rails or rungs. When ascending or descending a ladder, the user shall face the ladder. Each employee shall

use at least one hand to grasp the ladder when progressing up and/or down the ladder.
OSHA CFR 1926.1053 provides specific guidelines for ladder use.

OSHA CFR 1926.1053 can be viewed on the OSHA website, www.OSHA.gov.

Another good source of information about ladder safety is the American Ladder Institute's Ladder Safety page which can be viewed at <http://laddersafetytraining.org/>

REFERENCES

Axelsson PO, Carter. Measures to prevent portable ladder accidents in the construction industry. *Ergonomics*. 1995;38:250-9.

Bedi HS, Goldbloom D. A review of non-occupational ladder-related injuries in Victoria: as easy as falling off a ladder. *J Trauma*. 2008;64:1608-12.

Campbell AO, Pagano CC. The effect of instructions on potential slide-out failures during portable extension ladder angular positioning. *Accid Anal Prev*. 2014;67:30-9.

Chang WR, Chang CC, Matz S. Available friction of ladder shoes and slip potential for climbing a straight ladder. *Ergonomics*. 2005;48:1169-82.

Con J, Friese RS, Long DM, Zangbar B, O'Keeffe T, Joseph B, et al. Falls from ladders: age matters more than height. *J Surg Res*. 2014;191:262-7.

Creighton University, 2003. Creighton University Portable Ladder Safety In Accordance with 29 CFR 1910.25/.27. Creighton University, Omaha, NE (2003) Retrieved Jan 5, 2007 from http://www2.creighton.edu/fileadmin/user/AdminFinance/Facilities/EHS/docs/Policies_and_Procedures/Ladder_-_printable.doc.

D'Souza AL, Smith GA, Trifiletti LB. Ladder-related injuries treated in emergency departments in the United States, 1990-2005. *Am J Prev Med*. 2007;32:413-8.

Driedger MR, Gupta A, Wells B, Dixon E, Ball CG. "Oh the weather outside is frightful": Severe injury secondary to falls while installing residential Christmas lights. *Injury*. 2015 Sep 28. pii: S0020-1383(15)00552-5. doi: 10.1016/j.injury.2015.09.014. [Epub ahead of print]

Francis D. Keys to preventing ladder falls. *Occ. Health Saf*. 2014;83:12-16.

Häkkinen, KK, Pesonen J, Rajamaki E. Experiments on safety in the use of portable ladders. *J Occup Accid*. 1988;10:1-9

Hammer W, Schmalz U. Human behavior when climbing ladders in varying inclinations. *Saf Sci*. 1992;15:21-38.

Hsiao H, Simeonov P, Pizatella T, Stout N, McDougall V, Weeks J. Extension-ladder safety: solutions and knowledge gaps. *Int J Ind Erg*. 2008;38:959–65

Nosaka N, Goda Y, Knaup E, Tsukahara K, Yumoto T, Ugawa T, et al. Characteristics and costs of ladder fall injuries: A report from a single emergency center in Okayama. *Acta Med Okayama*. 2015;69:275-8.

OSHA. (2003). Stairways and Ladders: A Guide to OSHA Rules. OSHA 3124-12R. Retrieved October 29, 2015 from <https://www.osha.gov/Publications/osh3124.pdf>.

OSHA. Ladders. CFR 1926.1053. Retrieved October 29, 2015 from https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10839.

O'Sullivan J, Wakai A, O'Sullivan R, Luke C, Cusack S. Ladder fall injuries: patterns and cost of morbidity. *Injury*. 2004;35:429-31.

Partridge RA, Virk AS, Antosia RE. Causes and patterns of injury from ladder falls. *Acad Emerg Med*. 1998;5:31-4.

Smith GS, Timmons RA, Lombardi DA, Mamidi DK, Matz S, Courtney TK, et al. Work-related ladder fall fractures: identification and diagnosis validation using narrative text. *Accid Anal Prev*. 2006;38:973-80.

Socias CM, Chaumont Menéndez CK, Collins JW, Simeonov P, Centers for Disease Control and Prevention. Occupational ladder fall injuries - United States, 2011. *MMWR Morb Mortal Wkly Rep*. 2014;63:341-6.