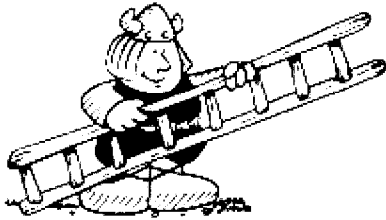


# Ladder Safety--Compliments of DUO Safety Ladder Corp.

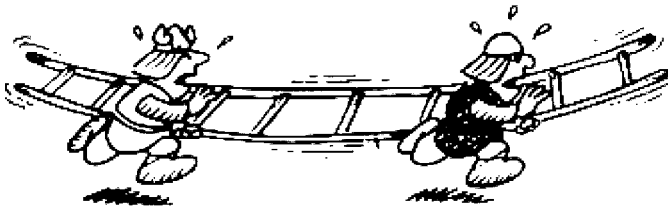


## GENERAL CONSTRUCTION

Ladders are a simple tool for gaining access to higher levels. When properly used and cared for, they will provide many years of useful service. Ladders are built of several different materials and in various designs. The merits of these types are as follows:

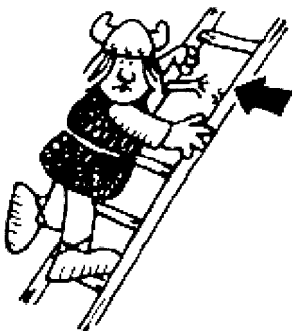
### Solid Beam: Wood

These types of wood ladders consist of solid wood side rails with connecting wood rungs at regular intervals. The rungs are generally round and made of dense hardwood such as Hickory or Oak. The solid wood side rails are made of a lighter or soft wood, such as Fir or Hemlock. These side rails must be straight with a tight grain and no flaws in the rail. Because of simple engineering facts, these side rails must increase in size as the ladder gets longer, just to be able to support the same load that short, smaller rails would do in short ladders. Hence, solid beam wood ladders are generally not found in common usage in longer lengths *They are too heavy.*



### Truss Beam: Wood

Wood truss ladders are similar to solid beam models except the side rails are not a single, solid beam of wood. This design uses a top and bottom strip of wood with rung holding wood blocks at regular rung spacing intervals. The run blocks are then glued and bolted through the top and bottom strips to provide a solid base for the rungs to be glued and nailed into. The truss construction is generally only used in longer lengths where the extreme weight of the large beam rails become just plain too heavy **Again, remember:** The size of the side rail must increase as the length increases--just to carry an equal load.



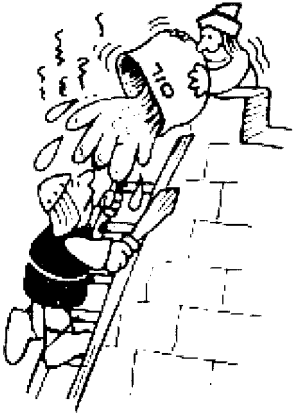
### Wood Rungs

The rungs in most wood ladders are made of wood. This wood is normally a dense hardwood such as Hickory or Oak. hardwoods are used because of their natural great strength. Ref: Ax and hammer handles are all hardwoods. The solid wood rungs are then press fit into the side rails or truss blocks, using glue and a nail to double lock the rung from becoming loose. **Remember:** The rung to side rail joint is the only connection that keeps the ladder together. If you find any loose rungs in any ladder remove the ladder from service at once, and **get it fixed.**

### Advantages of Wood Ladders

Wood ladders are a non-conductor of electricity when dry. Because of this fact, wood or fiberglass ladders are normally used when electrical hazards are likely. Wood is also the best natural insulator against heat of all

materials presently used for ladders. Even though wood burns readily, it only can burn on the outer surface where the oxygen is available. The centre of the wood remains solid and strong for a considerable time even when it is burning on the surface. This is why many fire departments prefer wood ladders.

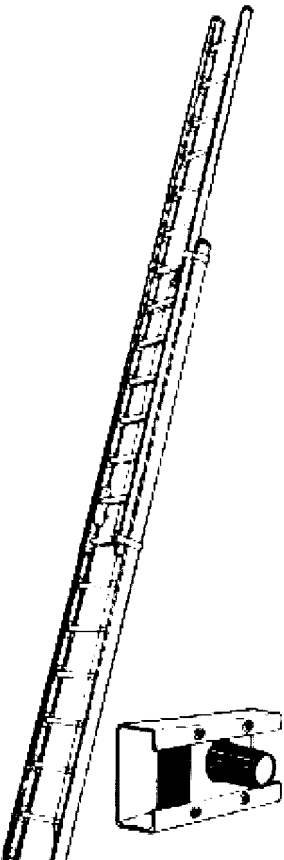


### **Disadvantages of Wood Ladders**

Wood ladders age very fast. Wood is very susceptible to drying and splitting with age. Wood ladders need some type of protective, clear finish to preserve and extend the useful life of the wood. This protective clear finish is normally a type of varnish. Varnish is generally the most acceptable type of protective finish because it is very dry finish. Some wood ladders are coated with oil to preserve the wood. This oil process does a good job of preserving the wood, but unfortunately the oil finish can conduct electricity. This defeats a basic advantage of wood ladders.

**Remember:** The varnish finish is only good as long as it remains intact. When the varnish becomes damaged, the wood is now open to the elements and drying and splitting can start. We recommend the varnish finish to be checked at least every six months and redone annually to preserve the wood. The useful life span of a wood ladder can be as short as a few years or as long as ten years or more--depending upon its usage and the maintenance it receives. Wood ladders stored near a heating source or in the direct rays of the sun, even though inside a building, should be very carefully checked and refinished at least annually.

**Note:** Your health and life are at stake when you use any ladder. Be sure the ladder is fit to use before you use it.



## **FIBERGLASS**

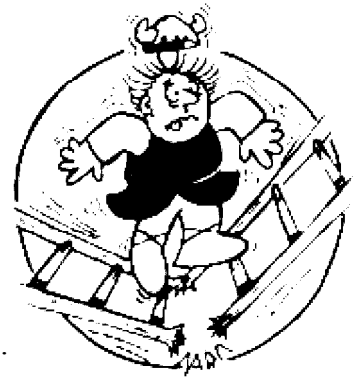
Fiberglass ladders are a recent addition to the ladder market. Fiberglass is a man made material that does not conduct electricity when dry. For this reason it is generally compared to wood models. Fiberglass ladders are generally all of the solid beam type with connecting rungs of fiberglass or aluminum at regular intervals. These rungs are jointed to the side rails either by rivets or expansion plugs through the side rails in most cases. Fiberglass ladders generally are not readily available in longer lengths due to the weight involved, as fiberglass is more dense and therefore heavier than the equal size wood construction.

### **Advantages of Fiberglass**

Fiberglass is a man made product and therefore very little difference can be found between any given equal size piece of glass ladder rail, i.e. it is a controllable material unlike wood which is naturally occurring. When dry it is a non-conductor of electricity. Fiberglass does not dry out and split when left in sunlight or is stored near a heat source. Fiberglass is a dense material and is slower to conduct heat than metals. It can withstand short exposure to high temperatures without greatly weakening its structure, and it will regain almost all of its strength after returning to room temperature, unless it gets burned. If the glass used contains a self extinguishing resin it will only burn as long as direct flame is applied and will self extinguish itself when the flame is removed. This burning process will leave a tell tale scar as on wood

models and should signal you of a weakened ladder. **Remove from Service.**

Generally, glass ladders do not require a protective finish to preserve them. The worst that normally occurs with age is a slow fading of colour and ultra-violet erosion of the surface, similar to surface deterioration found on fiberglass boats. Even though most fiberglass ladders use aluminum rungs, you will not find any connection of metal between the rungs. Therefore it is still a non-conductor of electricity.



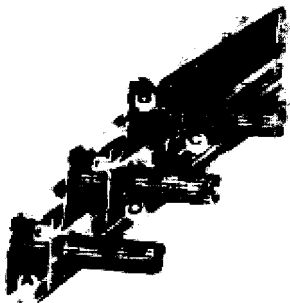
### **Disadvantages of Fiberglass**

Glass models in general are heavier than aluminum or wood models. Fiberglass tends to chip and crack under severe impact, or when dropped upon solid objects. Fiberglass is not a malleable material like metal and therefore is similar to wood when overloaded. It will not bend and relieve itself when overloaded, but rather it will crack and fail suddenly.

**Remember:** Be sure you know the limits of the ladder you use and be sure of its condition. Your life and health are at stake.

## **ALUMINUM LADDERS**

Aluminum ladders are again divided into the two basic types of construction as wood models, i.e. solid beam and truss construction.



**Solid Beam Aluminum Construction:** These types of ladders use a solid side rail beam with aluminum rungs connecting at regular intervals. The aluminum rungs generally connect to the side rails either by a welded joint between rung and side rails, or by an extension plug pinching the rung tightly to the side rails and internal back-up plates. The expansion plug method makes rung replacement very easy and also provides an easy method by which to tighten any rungs that have loosened by wear or tear. The welding method always requires re-welding when rung replacement is necessary, but with welded rungs there never is a loose rung problem unless the side rails are torn through a rung. In this case we recommend replacement of the entire section of ladder. **Remember:** As with wood or fiberglass models, even aluminum

side rails must increase in size as the ladder length gets longer. **Without** this increase in side rail size, the load capacity will decrease as the length of the ladder increases.

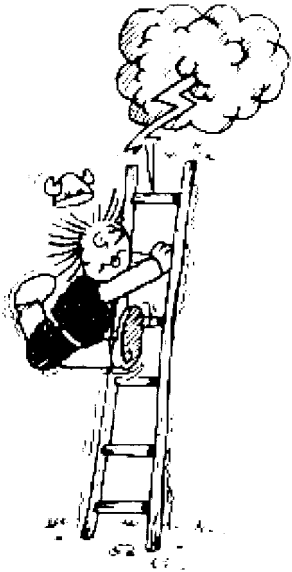
### **Aluminum Truss Construction**

Aluminum truss design follows wood truss design very nearly, with the only basic exception being the top and bottom strips or rails are connected to rung assemblies or rung blocks by rivets instead of glue and bolts. The rungs again are either welded or expansion plugged to the rung plate assemblies which are supported by the top and bottom rails of the truss side beams. This construction allows greater side beam heights for greater carrying capacities without requiring massive solid side rails that add to the overall weight of the ladder. On ladders of more than two sections, the third and/or fourth section are generally operated by a cable assembly that activates by raising the second section with the rope. On some of the extremely heavy three section wood models this is not possible and two completely separate rope hoist systems are used. On the rope and cable models it is imperative that the cable has a slight tension on it when all sections are fully closed or at rest in its

bedded position. If the cable is too tight or too loose the sections will not lock at the same time. This is unsafe and adjustment is necessary. Be sure to check the cable for excessive wear and be sure it has the proper adjustment.

### Advantages of Aluminum Ladders

Aluminum ladders in general are tough. They are made of high tensile metal which can take general day to day wear and tear very well. They will dent and not chip or crack when subjected to severe impact. They do not need a protective finish as they will not dry out or weather with age or sunlight exposure. The worst that happens with age is a slow oxidizing of the surface which can be polished off.



### Caution: Aluminum Ladders Conduct Electricity

This fact, along with the fact that aluminum ladders conduct heat very rapidly, is their major drawback. **Note:** Aluminum alloys used in ladders are high tensile alloys for lighter weight and greater strength. Because of this, these alloys must be heat treated when manufactured. This heat treating is done at approximately 600F. to get the aluminum to its final tensile strength.

**Beware:** If your aluminum ladder has been subjected to extreme heat exposure at a fire even for a brief period, it may have become annealed and no longer has the load capacity it had even minutes ago. Once aluminum ladders have been exposed to extreme heat they probably have lost their heat treatment and have become annealed. This means the load capacity may be greatly reduced even though the metal shows no sign of any change. We recommend the purchase and placement of heat sensing labels on the upper section of your aluminum ladders. These labels turn colour when the temperature gets to their pre-set heat range. After every use these labels should be checked to be sure the aluminum has not weakened. If a heat sensing label had

changed colour after usage, we suggest you remove same from service and replace.

**Beware:** When a fire crowns on the lower floor and your aluminum ladder is engulfed in flame, this ladder probably will no longer support even one man.

**Remember:** The ground ladders on your fire truck may be, and often are, the only means of escape for both the private citizen who is trapped and the fireman who is attempting to do his job.

## GENERAL PARTS

Ladders in general have only a few working parts other than the multiple sections that comprise the entire ladder. Pulleys are found on all extension ladders of two or more sections. These pulleys are normally supplied with a ball bearing centre which requires a small drop or two of oil approximately once a year to remain smoothly operational. The ropes that are supplied on extension ladders are generally pure Manila of sufficient size to raise the sections. When the rope becomes frayed or twisted from usage, it should be replaced. Manila rope is used for its overall characteristics of soft and strong material without excessive stretch or shrinkage under temperature extremes. When an extension ladder is raised, it is recommended that the rope be tied off to the lower section of the ladder as a safety measure to insure the ladder locks are not accidentally unlocked by a pull on the rope.

## LADDER LOCK ASSEMBLIES

Lock assemblies are commonly of two types:

**Gravity Locks** are normally used on industrial ladders and depend entirely on the force of gravity to lock on to the rungs. Do not use this type of lock with the fly section down.

**Mechanical Lock Assemblies** are used extensively on fire service ladders as they are positive action locks and if in good condition will work and lock in fly up or fly down position. It is not recommended that even these types of ladders be used with the fly section down, as this position allows the sections to fall apart to their maximum clearance and causes the lock assemblies to tend to pull away from the lower sections. The fly up position puts the sections as close as possible to each other and makes the lock assemblies tighten their hold on the lower sections.

The above facts plus the fact that all pulleys and cables are always strung from a lower section to a fly section, makes it clear that not only are the lock assemblies given a better chance to work in the fly up position, but there is simply less things to trip over in the fly up position, but there is simply less things to trip over in the fly up position. Use the ladder as it was designed to be used, not what ever way is the easiest. Mechanical lock assemblies are generally spring loaded devices. These springs have been known to break or rust off. It is recommended that lock assemblies be kept clean and oiled, not only to save your own life and limb, but to make sure your equipment has the best possible chance of proper function when it is assumed to be ready to function. We suggest you request a lock housing repair kit from the ladder manufacturer whenever you are going to repair and/or recondition your lock assemblies. This kit gives complete information on how to remove, rebuild and install the assemblies so proper lock action is maintained.

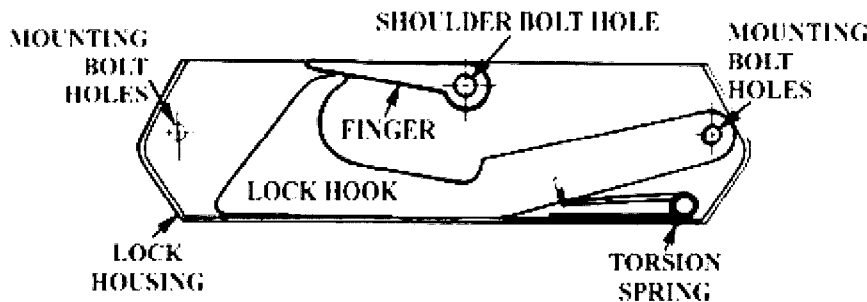
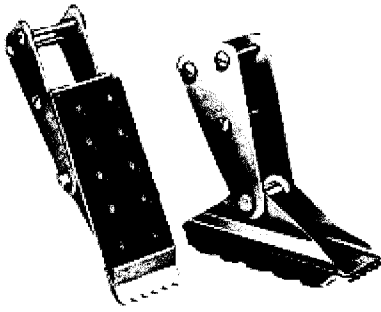


FIG. A--View of Lock Housing Showing Parts

## ROOF HOOKS

These are spring loaded and covered assemblies to insure operation even under freezing conditions. It is recommended that once rust is noted on these assemblies they are taken apart and cleaned, painted and oiled so proper function can occur. Roof hooks in general are used to secure the ladder over the peak of a roof or to hang from a wall edge or window opening. Be sure the bolts are secure on the roof hooks and the hooks have not been accidentally bent open.



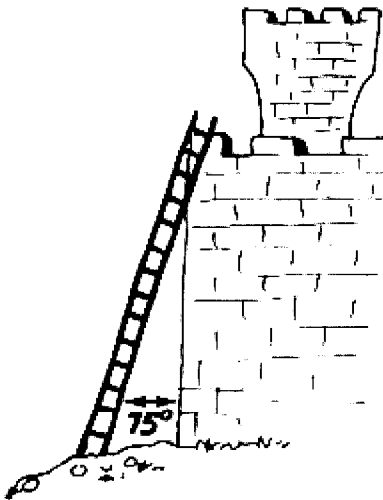


## PRONG FEET OR SAFETY SHOES

A double edge steel prong foot is supplied on all ground ladders to prevent slippage when the ladder is in use. The prong foot has double edges so the ladder may be used with either surface up. It is recommended that a rubber safety shoe also be used if the ladder is to be positioned on a hard surface such as concrete. Steel prong feet simply do not hold well on hard surfaces. In any case, for fire or rescue work it is recommended that an extra person be used to foot the ladder to insure it remains standing without slippage.

## TOP END CAPS

Round steel end caps are provided on the top end of all sections of all ladders to provide a rounded surface so the tip of the ladder may be slid up a wall without damage to the ladder section. **Note:** It is not recommended that a multiple section ladder be lowered to a lower level by pulling the base section further away from the building. Not only does this reduce the load capacity as the angle becomes more shallow, but there is a great possibility of having unlocked the lock assemblies in the upper sections. Always withdraw the sections below the lower level and re-raise the sections to insure a safe approximately 75° climbing angle and insure proper locking action of the lock assemblies.



## LADDER CLIMBING ANGLE

Proper climbing angle for a ground ladder is approximately 75°. Place the base of the ladder a distance of  $\frac{1}{4}$  the length extended. Less than this angle lowers the capacity of the ladder, and a closer position increases your chances of falling off as the angle is too steep.

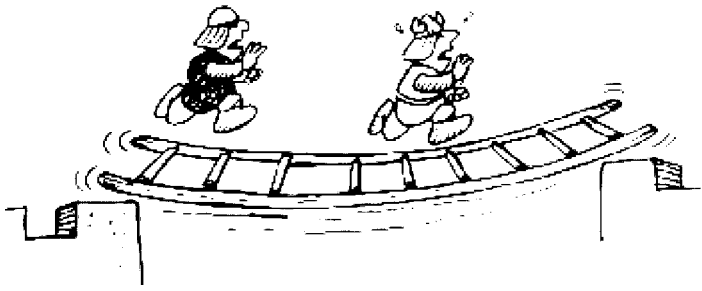
## PROPER SLIDING OF LADDER SECTIONS

The only proper substance used to make ladder sections properly slide upon each other is candle wax or grease. Grease is normally only used for internally guided aluminum truss models and should be cleaned of and recoated every year. In all cases, plain candle wax applied every six months or so to all contacting surfaces between multiple section ladders is a must for smooth operation. Any wax that is thinner than candle wax is either absorbed by the ladder material or rubbed off almost immediately. The net result is no lubrication and the sections do not slide easily. If candle wax will not make your sections slide, we suggest you check your ladder for damages and/or alignment of sections.

## GENERAL COMMENTS

Ladders are designed for climbing and for any usage other than this, we suggest you contact the manufacturer for their recommendations. Multiple section models in general are not made to be taken apart and used as single section ladders. The upper sections normally are not furnished with any type of safety foot, and because of this are very prone to slip when used as a single ladder. Ladders should never be used with the round ends

down. as this is upside down and not only will the ladder slip on the ground, but the lock assemblies cannot possible function properly.



## BRIDGING WITH LADDERS

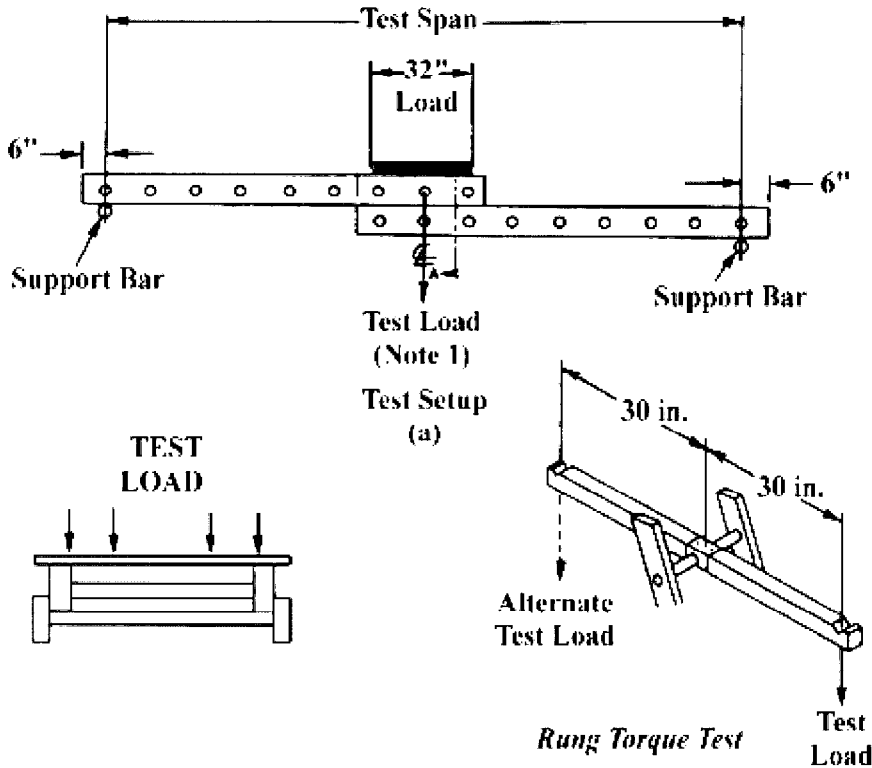
If your department may ever have the possibility of using their ground ladders to bridge two buildings, we suggest they first test the load carrying ability of the ladders they might have to use. Simply set up a pair of saw horses approximately three feet high and fully extend the questioned ladder. Carefully put your man in the centre and let him try the ladder for its feel. **Remember:** It is better to find your problems three feet above the ground rather than three stories up.

## TESTING

We recommend any fire department that is considering testing their ground ladders to secure a copy of NFPA specs on ground ladders for reference on their test requirements. The following factory recommended tests are general ladder strength tests as performed at our factory at random to spot check our production models.

## CAUTION

Be careful when testing ladders to avoid shock loads when loading test weights/or falling weights when a ladder fails. We suggest 50 lb. sand bags for test loads as sand bags will not crush toes when dropped. We recommend ladders to be tested annually and test records be kept permanently. All ladders, except folding and pompier ladders, shall be placed as in diagram A (fully extended).



## PRE-LOAD

- The ladder shall be pre-loaded with 350 lbs. of weight applied equally to a centre span covering 16" each side of the centre of the ladder span applied from rail to rail.
- This load shall remain for at least one minute to "set" the ladder prior to test.
- Remove pre-load and measure from bottom of rail to floor at centre of ladder and record.
- Load ladder with test load of 500 lbs of weight applied equally to the centre span covering 16" each side of the centre inclusive (rail to rail). This is a 3 rung span.
- After 5 minutes remove test load and wait for 5 more minutes after removal and measure bottom of rail at centre to floor and record. Any difference in measurements shall not exceed  $\frac{1}{2}$ " for ladders 25' or less and shall not exceed 1" for ladders over 25'. Any ladder not meeting this test shall not be used for fire service use.

## RUNG TORQUE TEST

With the ladder in any convenient position any rung shall pass the following:

## RUNG TORQUE TEST

With the ladder in any convenient position any rung shall pass the following:

- A test load of 30 lbs. shall be applied by a test arm 30 inches long to any rung by means of  $\frac{1}{2}$ " wide gripping area on the centre of the rung.

- This test shall be repeated two times clockwise and counter-clockwise.
- There shall be no movement of the rung to rail joint.

## ROOF HOOK TEST

- The ladder shall be hung solely by the roof hooks, with the points of the hooks being the only contact area.
- A test load of 1,000 lbs. shall be placed equally over both beams. The test load may be split up as convenient and hung from as many rungs as needed.
- The ladder and roof hooks shall not disengage point contact and shall remain fully functional after the test.

There are many more tests possible, but for the sake of reliable service life of the aforementioned tests cover the major areas of concern. Other tests beyond this scope are better left to factory or professional testing personnel. If your service ladders can pass these tests you can be sure at that point in time your ladders have a minimum 500 lb. load capacity with a 4:1 safety factor.

**REMEMBER**, if you get in trouble with or on a ladder, chances are very good you will be hurt. We feel it makes a lot of sense to be knowledgeable concerning ladders as you risk your life and limb every time you use a ladder. Choose your ladders to fit your needs and know all the regulations that cover the usage of these ladders. If your only ladder need is to store feathers on the top shelf, get a step ladder. If you need a ladder for more than one person at a time, and it must be able to operate in all weather conditions at any time of the day or night, get a fire and rescue ladder. Check with the manufacturer to find out at what load the ladder will fail, and be sure your needs never exceed the rating of the ladder. Everyone gets hurt when a ladder is not used properly.

## FOLDING LADDERS

These models are made in wood and aluminum, and normally are never over 14 feet in length. They have hinges on the rungs so the side rails can be folded together and carried up stairways, etc. **Be careful** these are narrow and light models and are never meant for more than one person at a time (and not heavy people). These should always be equipped with rubber safety shoes because they are meant for indoor use.

## TRUCK MOUNTING

If your ladders are mounted on a truck be sure the brackets fit the ladders. The brackets should hold the ladders tightly and support them at regular intervals so they will not take a set from long periods of non-usage. If your ladders slide into any type of internal racks, be sure there is enough clearance for easy removal and nothing is cutting into any surface of the ladders. **REMEMBER**, if the ladder brackets fail, you need a new bracket. If the brackets are cutting into the ladders and the ladder fails, you just got hurt.

**NOTE:** Ladder brackets should have some type of soft material as a liner so the ladders are not cut into by the movement against the bracket as the truck rolls.

## LADDER TIPS

1. Secure the top of your ladder with a line on your way up--it has a better chance of still being there when you want to come down.
2. Secure the extension rope to the lower section as a back-up for the lock assemblies.
3. Use rubber safety shoes on hard surfaces/or have a man foot the ladder while in use.
4. Never adjust extension ladders from the top end--the locks may unlock.
5. Be sure the ground is solid and level for the ladder before you climb.
6. Avoid all contact with power lines--but if you must be close to power lines at least use a non-conductive ladder.
7. Stay in the centre of the ladder as much as possible and do not reach far off the sides unless the top is secured.
8. Never use the top three feet or so of your ladder--you have nothing to hold onto.
9. Be sure the ladder is fit for service and be sure you are fit to climb.

We suggest all ladder users also consult current ANSI standards covering ladders and also current NFPA-1931 on fire department ground ladders for further helpful information on ladders. When in doubt, write directly to the ladder manufacturer for all current information.

We feel our best suggestion to a ladder user is to be sure your ladder is made to do the work you expect it to do. Be sure it is kept in the best possible working condition by proper and frequent inspection and maintenance.

We hope we have been of some help.

*Compliments of DUO-SAFETY LADDER CORPORATION*

[Back to Top](#)



Copyright © WFR Wholesale Fire & Rescue Ltd.