

## CHAPTER 21. LADDERS

### Section 21.1. Definitions.

The following words and terms, when used in this Chapter, shall have the following meanings, unless the context clearly indicates otherwise:

"A" ladder or trestle ladder--ladder that consists of two single ladders hinged at the top to form equal angles with the base.

Extension ladder--A ladder that consists of two or more sections traveling in guides or brackets so arranged that it may be adjusted to variable lengths.

Extension trestle ladder--A ladder that consists of an "A" or trestle ladder with an additional single ladder which is adjusted vertically and provided with a device to lock it into place.

Fire ladder--A ladder used exclusively for fire purposes, but it does not include equipment of organized fire departments.

Fixed ladder--A ladder which is substantially fastened to a structure in a permanent position.

Full working length--The length of the ladder extended in extension or sectional ladders and not the sum of the lengths of the individual sections.

Ladder--An appliance designed for use in ascending or descending at an angle with the horizontal, exceeding 50 degrees, usually consisting of two side pieces called side rails, joined at short intervals by cross pieces called steps.

Portable ladder--A ladder that may be used at various locations. This term includes single, extension, step, and trestle ladders.

Sectional ladder--A ladder consisting of two or more sections which when combined will function as a single ladder.

Side-rolling ladder--A ladder running on a guide rail, generally fastened to shelving, the plane of the ladder being also its line of motion.

Single or straight ladder--A ladder consisting of only one section.

Stepladder--A ladder which consists of self-supporting flat steps or treads.

Trolley ladder--A ladder running on or in a track, fastened overhead; the plane of the ladder being at right angles to the line of motion.

### **Section 21.2. Purpose.**

This Chapter sets forth requirements for the construction, use, and maintenance of ladders, and the safeguard of the lives, limbs, and health of employes in industries in which such ladders are used.

### **Section 21.3. Scope.**

This Chapter applies to every establishment within this Commonwealth, specifies the kinds of materials suitable for ladders, and divides the species of wood into four classes according to their strength as related to minimum dimensional requirements of ladder parts. The quality of wood materials specified in this Chapter shall be controlled by limiting the timber defects in ladders manufactured to the minimum dimensions. Where larger cross sections are employed, the timber requirements relating to the size of knots and slope of cross grain may be modified when and as the provisions of this Chapter provide the basis of modification being that the strength of each ladder part shall be equivalent to or greater than a similar part manufactured to the minimum dimensional requirements.

### **Section 21.4. Penalty.**

Any person who violates any of the provisions of this Chapter or any regulations of the Department or who interferes with the Department or its duly authorized representative in the enforcement of such provisions or regulations shall be penalized under the provisions of section 15 of act of May 18, 1937 (No. 174) (43 P. S. s 25-15).

### **Section 21.11. Timber defects.**

The term specifically referred to as "timber defects" shall include all of the following:

- (1) A knot which is a portion of a branch and which has become incorporated in the body of a tree. All provisions of this Chapter relating to the presence of knots apply only to the surface of the piece on which the knot appears, and all such provisions limiting the size of knots apply to the mean or average diameter as measured on the surface.
- (2) Cross-grained wood in which the fibres are not parallel with the axis or longitudinal edge of the piece. It is expressed in this Chapter as the slope of the grain with respect to the edges of the piece. For instance, one in 12 means that in a distance of 12 inches the grain deviates one inch from the edge. The presence in any surface of local discontinuity of grain or local deviations in the straightness of grain because of knots permitted in the piece shall be disregarded in applying the provisions of this Chapter.
- (3) A shake which is a separation along the grain, the greater part of which occurs between the rings of annual growth.
- (4) A check which is a separation along the grain, the greater part of which occurs across the

rings of annual growth.

(5) A pitch pocket which is an opening between the grain of the wood, containing more or less pitch or bark.

(6) Decay which is the destruction of the wood substance due to the action of wood destroying fungi.

(7) A cross-break which is a separation of the wood cells across the grain of the wood.

(8) A compression failure which is a deformation of the fibres due to excessive compression along the grain. This deformation takes the form of a buckling of the fibres.

(9) Compression wood, or proudwood, which is an abnormal growth occurring in conifers (softwood) and is characterized by relatively wide annual rings, usually eccentric, and a comparatively large proportion of summerwood, usually 50% or more, which merges into the springwood without exhibiting a marked contrast in color.

#### **Section 21.12. Low density wood.**

This type of wood is exceptionally light in weight for its species, due usually to abnormal growth conditions. It is frequently referred to as brashy wood and it breaks with a brittle fracture.

#### **Section 21.21. Wood side rails.**

(a) Wood side rails shall not be made from low density wood but shall be of thoroughly seasoned material free of any of the following defects:

(1) Shakes.

(2) Cross-breaks.

(3) Checks over six inches long or over 1/2 inch deep.

(4) Decay.

(5) Compression failures.

(6) Compression wood.

(b) Cross grain in wood side rails of the different types and sizes of ladders when measured over a distance which will assure the determination of the general slope of the grain, not influenced by short, local deviations shall not exceed the following:

(1) In side rails of portable ladders having rungs for steps such as in extension, straight, trestle, or

sectional ladders, when built to the minimum dimensions, the cross grain shall not exceed a slope of one in 15.

(2) In side rails of portable ladders over 12 feet in length, having treads or cleats for steps, and in side rails of fixed ladders, the cross grain shall not exceed a slope of one in 12 when built to minimum dimensions.

(3) In side rails of portable ladders under 12 feet in length, having treads for steps, the cross grain shall not exceed a slope of one in ten when built to minimum dimensions.

(4) For ladders used indoors or otherwise protected from the weather, cross grain greater than that provided in paragraph (3) of this subsection may be employed in side rails in accordance with the following schedule, if the size is increased to afford at least 15% greater strength than the minimum specified in s 21.32 of this Title (relating to side rails):

(i) One in 12 may be substituted for one in 15.

(ii) One in 10 may be substituted for one in 12.

(c) Knots shall not appear in the narrow faces of side rails.

(d) Knots in side rails shall not exceed one inch in diameter.

(e) Knots appearing in the wide faces of side rails of minimum dimensions adjacent to the edges shall not exceed in diameter  $\frac{1}{12}$  the width of the face. The size of knots in the wide faces may increase proportionately from the size allowed adjacent to the edge to  $2\frac{1}{2}$  times that size at the center line of the wide face. Knots appearing in side rails may be larger if compensated for by additional cross section and if the strength of the piece is equivalent to or greater than the strength of a similar piece of minimum dimensions. However, no knot, for which compensation for size is allowed, shall exceed, when located adjacent to the edge of the piece,  $\frac{1}{6}$  the width of the wide face.

(f) Knots adjacent to the edges shall not appear within  $1\frac{1}{2}$  inches, measured parallel to the length of the side rail, of the section occupied by a rung, tread, cleat, or other knot.

(g) Pitch pockets not exceeding  $\frac{1}{8}$  inch wide, two inches long and  $\frac{1}{2}$  inch deep are permitted in wood side rails if not more than one appears in each four feet of length.

(h) Wood side rails shall be dressed on all sides and free from sharp edges and splinters.

(i) Wood side rails shall be made from Eastern spruce or Sitka spruce or approved equivalent. Other woods may be suitable for ladder construction if so classified in ss 21.61--21.72 of this Title (relating to wood classification).

### **Section 21.22. Compensation for large knots.**

The method of calculating the depth of side rail to determine equivalent strength, assuming the thickness remains constant shall be as follows:

$$D_{\text{super1}} = (11D / 12) + K_e$$

Where  $D_{\text{super1}}$  = depth of side rail of equivalent strength.

$D$  = minimum depth permitted.

$K_e$  = size of knot adjacent to the edge of the wide face when larger than  $1/12$  the depth and not greater than  $1/6$  the depth.

### **Section 21.23. Wood steps.**

(a) Wood rungs, treads, and cleats shall not be made from low density wood, but shall be thoroughly seasoned material free of all of the following defects:

(1) Shakes.

(2) Pitch pockets.

(3) Cross-breaks.

(4) Injurious checks.

(5) Decay.

(6) Compression failures.

(7) Compression wood.

(b) Cross grain in rungs and cleats of minimum dimensions shall not exceed a slope of one in 15. If the size of rungs and cleats is increased to afford at least 15% greater strength than the minimum specified in s 21.33 of this Title (relating to steps), the maximum allowable slope of cross grain may be increased to one in 12.

(c) In ladders having treads for steps, cross grain in treads shall not exceed that permitted for side rails as specified in s 21.21 of this Title (relating to wood side rails).

(d) Knots over  $1/8$  inch in diameter shall not appear in rungs.

(e) Knots shall not appear in the narrow faces of treads and cleats.

(f) Knots appearing in the wide faces of treads and cleats adjacent to the edges shall not exceed in diameter  $\frac{1}{12}$  the width of the face. The size of knots in the wide faces may increase proportionately from the size allowed adjacent to the edge of two times that size at the center line of the wide face.

(g) Wood treads shall be made from the species of woods according to the specifications of s 21.21 of this Title (relating to wood side rails).

(h) Wood rungs and wood cleats shall be made from white ash or approved equivalent. Species listed in s 21.61 of this Title (relating to group one woods) with the exception of Douglas fir and Southern yellow pine may be substituted for white ash in like sizes. Douglas fir and Southern yellow pine shall not be used for rungs or cleats.

### **Section 21.24. Metal parts.**

Unless otherwise specified by the provisions of this Chapter, all metal parts or fittings shall be made of any of the following:

- (1) Steel.
- (2) Wrought iron.
- (3) Malleable cast iron.
- (4) Other equivalent metal.

### **Section 21.31. General.**

(a) Sides. Ladders may have either parallel or spreading straight sides unless otherwise specified in this section. Portable ladders may also have the sides flaring at the base to increase their stability and converging at the top where specific uses warrant.

(b) Distance. For ladders exceeding four feet in length, the inside width between side rails shall be not more than 32 inches except for bases flared as permitted in subsection (a) of this section and not less than ten inches except where rails are converged at the top, in which case this minimum width shall be obtained not more than four feet from the top. For ladders not exceeding four feet in length the minimum width between side rails shall be not less than eight inches.

(c) Spacing. A uniform step spacing shall be employed. It is recommended that this spacing be 12 inches except where specific uses require shorter spacing in which case it may not be less than eight inches.

(d) Fastening. All holes for wood rungs shall either extend through the side rail or be bored to within  $\frac{3}{16}$  inch of the outside face of the rail. In the former construction the rungs shall extend through to at least flush with the outside railsurface while in the latter the distance between the

end of the rung and the outside face of the rail shall not be greater than 5/16 inch.

(e) Holes. All holes for wood rungs shall be located on the center line of the wide face of the side rails. The size of holes shall be such as to insure a driving fit for the rung.

(f) Tenon. The shoulder of round wood rungs shall be forced firmly against the side rail and the tenon secured in place by a nail or the equivalent to prevent turning. Oval rungs shall be secured in place by two nails or equivalent in each rail.

(g) Treads. Wood treads shall be inset in the side rails not less than 1/8 inch, fastened to it by nails or screws, and secured by braces, bolts, tie rods, or the equivalent, except when ladders are built entirely of species listed in s 21.61 of this Title (relating to group one wood). In this latter case the treads may be fastened by two inch screws or equivalent and secured at intervals not greater than four feet apart along the length of the rail by braces, bolts, tie rods, or the equivalent.

(h) Cleats. Wood cleats shall be housed into side rails not less than 1/2 inch or equivalent construction. They shall be fastened to each rail by three 10d wire nails or equivalent.

(i) Wood steps. All wood steps 28 inches or more in length shall be reinforced by braces or supported by additional bearings.

(j) Metal rungs. Metal rungs shall be securely fastened to the side rails by riveting, bolting, or welding. Their position and method of attachment to the rail shall be such as to distribute uniformly the stresses transmitted to the side rail.

(k) Metal treads. Metal treads shall be flanged downward not less than two inches at each end of tread and secured to each side rail by two bolts or rivets.

(l) Old construction. "U" sections used as steps or rungs, on old construction may be fastened on the outside of the wall by using two 5/8 inch diameter through bolts on each end.

(m) New construction. "U" sections used as steps or rungs on new construction shall be built into the structure a minimum of eight inches with not less than three inches of the inner ends bent at right angles. "U" sections shall not be used on smoke stacks.

(n) Hardware and fittings. All hardware and fittings shall be securely attached by means of rivets, bolts, or the equivalent. The bolts or rivets shall make a close fit in the holes prepared to receive them.

(o) Movable parts. The construction and assembly of the movable parts of ladders shall be such that they operate freely without binding or unnecessary play.

(p) Slipping. Portable, extension, and sectional ladders shall be either equipped with approved devices or shall be so placed, fastened, or held as to prevent slipping.

(q) Portable ladder hooks. When service conditions warrant, hooks may be attached at or near the top of portable ladders to give added security.

(r) Hooks. Hooks shall be securely bolted or riveted to the side rails or equivalent construction, and shall be of such dimensions as to withstand the loads imposed upon them.

(s) Special ladders. Ladders of special design shall be of an approved type.

**Section 21.32. Side rails.**

(a) Unless otherwise specified in subsection (c) of this section or other provisions of this Chapter, wood side rails for all ladders shall have a minimum dressed cross section of the following dimensions:

Dimension of side rails at center

Full working length of ladder (feet)	Thickness (inches)	Depth (inches)
Up to and including 19	1-3/8	2-3/4
Over 19, up to and including 30	1-3/8	2-3/4
Over 30, up to and including 38	1-3/8	3
Over 38, up to and including 42	1-3/8	3-1/2
Over 42, up to and including 45	1-1/2	2-1/2
Over 45, up to and including 52	1-5/8	3-3/4
Over 52, up to and including 55	1-3/4	3-3/4

(b) The dimensions of subsection (a) of this section are based upon a 7/8 inch mortise, 1/8 inch gain, or equivalent for step attachments. Where the strength of side rails is reduced more than this by the step attachments or where it is desired to use a rail section, either dimension of which is less than that specified in subsection (a) of this section, such rail section shall develop an actual working stress for the wood listed in s 21.63 of this Title (relating to group three woods), not exceeding 1,600 pounds per square inch when computed by the following formula applying to rectangular sections:

<pre>

$$S = \frac{3LD(P + W/16)}{2B(D^3 - d^3)} + \frac{1.5LD(25 + W/16)}{B(D^3 - 0.67)}$$

</pre>

where

P = pounds, which is the normal component on each rail of a load of 200 pounds at the center of the ladder, equally distributed between the rails, when the foot of the ladder is moved out of the perpendicular by 1/4 of its length.

W = weight of ladder, in pounds.

L = length of ladder, in inches.



B = net thickness of each side rail, in inches (deducting depth of gain, if any, for flat treads).

D = depth of side rail, in inches.

d = diameter of hole drilled for rung (d shall be taken as not less than 0.67, regardless of the method of step fastening used).

(c) Wood side rails of ladders having cleat steps shall be not less than 3/8 inch greater in thickness and 1/2 inch greater in depth than is specified under subsection (a) of this section, but no such ladder shall be less than 1 5/8 inches thick and 3 5/8 inches in depth (two by four inches nominal).

(d) Metal side rails when made of mild steel or wrought iron shall be not less than 9/16 of a square inch in cross section for lengths 12 feet and under, and not less than 3/4 of a square inch in cross section for lengths over 12 feet with a minimum thickness not less than 3/8 inch. These dimensions are based upon the removal of not more than 1/2 inch of material for the attachment of the steps. When more material is removed from the side rails for step attachments or when side rails are made of other metal or shapes, they shall have the same strength.

(e) Except as otherwise provided in this Chapter, wood side rails shall not be spliced.

### Section 21.33. Steps.

(a) Except as otherwise provided in this Chapter, steps may be either rungs, treads, or cleats, and shall have the dimensions specified in this section or be of equivalent strength.

(b) Wood rungs shall have the following minimum dimensions, length of rung to be measured between supports:

Length of Rung (between side rails) (inches)	Center Diameter (inches)	Tenon Diameter (inches)	Tenon Length (inches)
Up to and including 24	1-1/8	7/8	13/16
Over 24, up to and including 32	1-3/16	7/8	13/16

(c) Oval wood rungs shall have at least the same strength and bearing as round rungs of the same length.

(d) Metal rungs of solid round steel stock shall have a minimum center diameter of 5/8 inch and tenon diameter of 1/2 inch.

(e) Metal rungs when made of pipe shall not be smaller than one inch standard steel pipe.

(f) Metal rungs when made of angle section shall have minimum dimensions of 3/4 by 3/4 by 1/8

inches.

(g) "U" sections shall, in general, be considered as the equivalent of a rung and shall meet all of the requirements of this Chapter relating to rungs.

(h) Wood treads shall have the following minimum dimensions:

Length of Treads (between side rails) (inches)	Thickness (inches)	Width (inches)
Up to and including 16	25/32	3
Over 16, up to and including 20	25/32	3-1/4
Over 20, up to and including 24	25/32	3-1/2
Over 24, up to and including 28	25/32	4
Over 28, up to and including 32	1	4-1/2

(i) Metal treads shall have a width as specified for wood treads. In cross section metal treads shall be a channel or equivalent section equal in strength to the specifications for wood treads.

(j) Wood cleats shall have the following minimum dimensions:

Length of Cleat (between side rails) (inches)	Thickness (inches)	Width (inches)
Up to and including 20	25/32	3
Over 20, up to and including 30	25/32	3-3/4

#### **Section 21.34. Fixed ladders.**

(a) Side rails and rungs. Minimum dimensions of side rails and rungs shall be in accordance with the provisions of ss 21.32 and 21.33 of this Title (relating to side rails; steps). Fixed ladders in other than vertical position shall have side rails increased in section to provide for possible increase in stress.

(b) Securement. Fixed ladders shall be firmly secured in position in accordance with other provisions of this Chapter.

(c) Splices. Splices for fixed ladders shall be of the same depth as the side rails. The length of splice plates for metal or wood side rails shall be four times the depth of the side rail. They shall be made of metal not less than 1/4 inch in thickness chamfered on the ends.

(d) Bolts and rivets. Heads of bolts and rivets shall be countersunk or of the button type. The heads shall be on the outside of the rail. Bolts or rivets shall not be less than 1/2 inch nor more than 5/8 inch in diameter. Bolt ends shall be chamfered and only the chamfered end shall extend beyond the nut. Rivet ends shall be finished in button shape like the heads. Washers shall be

placed under the nuts and rivet ends on wood side rails. On each side of the joint there shall be a minimum of three bolts or rivets for metal side rails and a minimum of four bolts or rivets for wood side rails. Bolts and rivets in both metal and wood side rails shall be staggered in position.

(e) Clearances. Distance from front of rungs to nearest permanent object on the climbing side of the ladder shall be not less than 30 inches. Distance from back of rungs to nearest permanent object shall be not less than 6 1/2 inches. There shall be a clear width of at least 15 inches from the center line of the ladder on either side across the front of the ladder. Ladders equipped with a cage, basket or the equivalent shall be excepted.

(f) Fastenings. Fastenings shall be made of material equivalent in strength to the rails and shall be of sufficient length to allow a minimum distance as required by subsection (d) of this section between buildings and rungs of the ladder. Fastenings shall be made to the permanent structure either by building in or by through bolts, rivets, or expansion bolts grouted, leaded, or the equivalent.

(g) Distance. The maximum distance between fastenings or braces shall not be in excess of ten feet in ladders over 15 feet in length unless other provisions giving equivalent security are provided.

(h) Pitch. The pitch of a fixed ladder shall not be such that the position of a person is necessarily below the ladder when climbing, unless a cage guard is provided.

(i) Cages. Ladders over 30 feet in length shall be provided with cages or wells of adequate dimensions except when the ladder is built in zigzag sections, and provided with platforms between sections.

(j) Bottom of cage. Cages when used shall extend from the top of the ladder to a point seven feet above the base, with the bottom flared not less than four inches, or the portion of the cage opposite the ladder shall be carried to the base.

(k) Construction. Cages shall be substantially built and securely fastened to the ladder. The inside shall be clear of projections. Materials used shall be of a cross section not less than that required for the side rails of a fixed ladder.

(l) Cage size. Cages shall not extend less than 24 inches nor more than 28 inches from the face of the ladder. The cage should not be less than 24 inches wide.

(m) Offset platforms. If fixed ladders are used to ascend to heights exceeding 30 feet, it is recommended that landing platforms be provided for each 30 feet and the ladder sections be offset, each from the others. When the installation condition requires offset sections of ladders, the sections shall be joined by a landing platform. Fire ladders and ladders equipped with cages may be excepted from this requirement.

(n) Above roof. The side rails of fixed ladders shall extend at least 3 1/2 feet above the roof or landing platform, preferably being goosenecked, unless other convenient and secure handholes are

fixed at such places. It is recommended that the rungs be omitted from the extension.

(o) Ladder to roof. When a man steps a distance greater than 18 inches from the ladder to the roof, tank, or the like, a landing platform is recommended.

(p) Railings and toeboards. All landing platforms shall be equipped with standard railings and toeboards so arranged as to give safe access to the ladder. Such platforms should not be less than 24 inches wide.

(q) Top rung. The top rung of any section of a fixed ladder shall be at the level of the adjacent landing platform served by such ladder.

(r) Safety devices. Approved ladder safety devices may be used on towers, water tanks, and chimney ladders over 30 feet in unbroken length in lieu of cage protection. All ladder safety devices such as those that incorporate life belts, friction brakes, and sliding attachments shall meet the design requirements of the ladders which they serve.

**Section 21.35. Single or straight ladders.**

(a) Single ladders over 30 feet in length shall not be used.

(b) The width between side rails at the base shall in no case be less than 11 1/2 inches for ladders up to and including ten feet in length. For longer ladders this width should be increased at least 1/4 inch for each additional foot of length.

(c) Rectangular wood side rails may have an end depth of not less than 2-1/4 inches and shall have center cross section to conform with the requirements of s 21.32 of this Title (relating to side rails). Rungs shall conform to the requirements of s 21.33 of this Title (relating to steps).

(d) Hooked tops which fit over shaftings, roofs, and other similar places shall be employed on single ladders where working conditions warrant.

**Section 21.36. Extension ladders.**

(a) Side rails of extension ladders when fully extended shall conform with the dimensions of s 21.32 of this Title (relating to side rails) for such extended length. On a two piece extension ladders it is recommended that allowance be made for a three foot lap up to approximately 38 feet, a four foot lap for 40 and 44 feet extended lengths, a five foot lap for 46 feet and up, and for three section ladders four feet at each lap for 46 feet and up of extended length. Rungs shall be according to the requirements of s 21.33 of this Title (relating to steps).

(b) The minimum distance between side rails of bottom section of extension ladders shall be as follows:

Full working length ladder	Minimum distance (between side rails)
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(feet)	(inches)
Up to and including 23	14 1/2
Over 23, up to and including 36	16
Over 36, up to and including 55	18

(c) Each ladder shall be equipped with two automatic locks of an approved type.

(d) Locks and guide irons shall be of such construction as to make the extension ladder equal in strength to a ladder constructed of continuous side rails.

(e) Locking devices other than as specified in this section may be used after they are approved for such service.

(f) Ladders over 30 feet in length shall be equipped with metal shackle, pulley, and rope for operation. It is recommended that ladders less than 30 feet in length be also so equipped.

**Section 21.37. Sectional ladders.**

(a) Sectional ladders over 31 feet in length shall not be used.

(b) The connection joint shall not be less than one foot and shall have a good fit without binding or unnecessary play. The grooved ends of the sections shall be reinforced with a metal plate of not less than No. 18 U.S. gauge properly secured on it and a rivet above the groove extending through the depth of the rail, or equivalent.

(c) The bottom and intermediate sections shall not exceed a length of six feet five inches. The top sections shall not exceed a length of nine feet.

(d) The minimum dimensions of side rails shall be as follows:

Length of Ladder (feet)	Thickness (inches)	Depth (inches)
Up to and including 21	1-1/8	2 3/4
Over 21, up to and including 31	1-1/8	3 1/8

(e) Sectional ladders may be made up either of sections having spreading sides so that the sections are not interchangeable in their position in the ladder, or of interchangeable sections with or without a top section having converging rails and a bottom section having flaring side rails. The top section having converging side rails shall have a width at the top of not less than four inches.

**Section 21.38. Trestle and extension trestle ladders.**

(a) It is recommended that trestle ladders over 20 feet in length not be used.

(b) Extension or base sections of extension trestle ladders over 20 feet in length shall not be used.

(c) The dimensions of side rails of trestle ladders or of the bases of extension trestle ladders shall not be less than the following:

Length of Side Rails (feet)	Thickness (inches)	Depth (inches)
Up to and including 12	1 5/16	2 1/2
Over 12, up to and including 16	1 5/16	2 3/4
Over 16, up to and including 20	1 5/16	3 1/4

(d) The extension section shall have parallel rails. The dimensions of side rails shall not be less than the following:

Length of Side Rails (feet)	Thickness (inches)	Depth (inches)
Up to and including 12	1 5/16	2 1/2
Over 12, up to and including 20	1 5/16	2 3/4

(e) Trestle ladders and base sections of extension trestle ladders shall be so spread that the width of the trestle at the bottom, inside to inside, is equal to or greater than 5 1/2 inches per foot of length of ladder.

(f) The minimum distance between side rails of trestle ladders and the extension sections of trestle ladders shall be not less than 12 inches. The spread of the side rails for trestle and base of extension trestle ladders shall not be less than one inch per foot of length of ladder.

(g) Bearings shall be equivalent in strength, wear, and construction to the specifications of s 21.33 of this Title (relating to steps). Bearings shall not exceed 18 inches on centers.

(h) The top of side rails of trestle and base sections of extension trestle ladders shall be cut on bevel, or other means shall be provided to prevent them from spreading. In addition a locking device or spreader to hold the front and back sections in an open position shall be a component of each ladder.

(i) The locking device for securing the extension to the base shall be of an approved design.

### **Section 21.39. Fire ladders.**

(a) Fire ladders shall be painted red and plainly marked "For fire purposes only."

(b) Fire ladders shall be built and installed according to the requirements of ss 21.34--21.36 of this

Title (relating to fixed ladders; single or straight ladders; and extension ladders).

**Section 21.40. Stepladders.**

(a) Stepladders over 20 feet in length shall not be used.

(b) Stepladders shall have side rails of the following solid cross section or a section which is equivalent in strength; the required thicknesses provide for the cutting of a gain not over 1/8 inch in depth and shall be increased when gains of greater depth are used:

Length of Side Rails (feet)	Thickness (inches)	Depth (inches)
Up to and including 10	25/32	2-3/4
Over 10, up to and including 12	25/32	3
Over 12, up to and including 16	25/32	3-1/4
Over 16, up to and including 20	1	3-1/4

(c) Stepladders shall be so constructed that when they are placed in the open position the front section shall have a minimum slope of 3 1/2 inches and the back section a minimum slope of two inches for each 12 inch length of side rail.

(d) Stepladders shall be so constructed that when they are placed in the open position all treads shall be level. Treads shall be in accordance with the requirements of s 21.33 of this Title (relating to steps).

(e) Except as specified in s 21.31(b) of this Title (relating to general) the minimum width between side rails at the top step, inside to inside, shall not be less than 12 inches with a spread of at least one inch for each foot of length of stepladder.

(f) A locking device or spreader to hold the front and back sections in open position shall be a component of each stepladder. This device shall have all sharp points covered or removed to protect the user.

(g) The back section of stepladders, if provided with steps, shall be built with side rails having a thickness not less than that specified for the front section in subsection (b) of this section and the depth of side rails shall be such that the section will not develop a working stress for woods listed in s 21.63 of this Title (relating to group three woods) greater than 1,600 pounds per square inch when tested by the formula in s 21.32 of this Title (relating to side rails). If not provided with steps, the back section shall be built with side rails and bracing necessary to provide for all probable stresses in the section.

**Section 21.41. Trolley and side-rolling ladders.**

(a) It is recommended that trolley ladders and side-rolling ladders over 20 feet in length not be used.

(b) The dimensions of side rails shall not be less than that shown in the following table; the required thicknesses provided for the cutting of a gain not over 1/8 inch in depth and shall be increased when gains of greater depth are used:

Length of Side Rails (feet)	Thickness(inches)	Depth(inches)
Up to and including 10	25/32	3
Over 10, and up to and including 20	25/32	3-1/4

(c) It is recommended that locking devices be provided on all trolley ladders.

(d) Tracks shall be of wood, or metal, except cast iron, or a combination of these materials.

(e) Tracks for the top end of ladders shall be fastened securely and so constructed that the wheels do not jump the track. Tracks shall be so designed as to provide for all probable strains to which they may be subjected.

(f) The supports shall be securely fastened by lag screws, machine, hook, or toggle bolts or their equivalent.

(g) Tracks for side-rolling ladders shall be supported by metal or wood brackets securely screwed or bolted to shelving or another permanent structure at not over three feet on centers.

(h) Wheel carriages shall be so designed as to provide for all strains to which they may be subjected. It is recommended that two point suspension be used. The wheel carriage for the top end of the ladder shall be securely fastened to the top of the ladder with metal brackets bolted either to the side rails or to the top step. When bolted to the top step this step shall be secured to the side rails with metal braces in addition to those otherwise provided. The wheel carriage shall be so designed that a loose or broken wheel does not allow the ladder to drop or become detached from the track.

(i) The wheel carriage for the bottom end of the ladder shall be securely fastened to the bottom of the ladder.

(j) The wheels at the upper end of the ladder shall have a minimum wheel base of eight inches. When wheels are used at the bottom of the ladder there shall be at least one wheel supporting each side rail.

(k) Running gear for bottoms of both trolley and side-rolling ladders shall be so designed and constructed as to provide for any strain to which they may be subjected.

### **Section 21.51. Care.**

(a) Maintenance. Ladders shall be maintained in good condition at all times, the joint between the steps and side rails shall be tight, all hardware and fittings shall be securely attached, and the



movable parts shall operate freely without binding or undue play.

(b) Lubrication. Metal bearings of locks, wheels, pulleys, and other such instruments shall be frequently lubricated.

(c) Rope. Frayed or badly worn rope is prohibited.

(d) Safety feet. Safety feet and other auxiliary equipment shall be kept in good condition to insure proper performance.

(e) Storage. Ladders should be stored in such a manner as to provide ease of access for inspection and to prevent danger of accident when withdrawing a ladder for use.

(f) Storage location. It is recommended that wood ladders, when not in use, be stored at a location where they are not exposed to the elements but where there is good ventilation. They shall not be stored near radiators, stoves, steam pipes, or other places subjected to excessive heat or dampness.

(g) Horizontal storage. It is recommended that ladders stored in a horizontal position be supported at a sufficient number of points to avoid sagging and permanent set.

(h) On vehicles. It is recommended that ladders carried on vehicles be adequately supported to avoid sagging and securely fastened in position to minimize chafing and the effects of road shocks.

(i) Preservation. It is recommended that ladders be kept coated with a suitable preservative material.

(j) Inspection. Ladders shall be inspected frequently and those which have developed defects shall be withdrawn from service for repair or destruction and tagged or marked "Dangerous, do not use".

(k) Slipping. It is recommended that rungs be kept free of grease and oil and metal rungs suitably roughened to prevent slipping.

#### **Section 21.52. Use.**

(a) Portable ladders shall, when possible, be used at such a pitch that the horizontal distance from the top support to the foot of the ladder is  $\frac{1}{4}$  the length of the ladder. The ladder shall be so placed as to prevent slipping, or it shall be lashed or held in position.

(b) Crowding on ladders is not permitted.

(c) Portable ladders shall be so placed that the side rails have a secure footing. The top rest for portable ladders shall be reasonably rigid and have ample strength to support the applied load.

(d) Ladders shall not be placed at the following:

(1) In front of doors opening toward the ladder unless the door is blocked open, locked, or guarded.

(2) On boxes, barrels, or other unstable bases to obtain additional height.

(e) It is recommended that a ladder be provided with a board across the top before placing it against window frames.

(f) It is recommended that ladders be faced when ascending or descending.

(g) Ladders with broken or missing steps, broken side rails, or other faulty equipment shall not be used.

(h) Short ladders shall not be spliced together to provide long sections.

(i) Ladders made by fastening cleats across a single rail shall not be used.

(j) In building construction, if warranted by height of operations or traffic conditions, separate ladders shall be designated for ascent and descent.

(k) Ladders shall not be used as a guy, brace, or skid or for other than their intended purposes.

### **Section 21.61. Group one woods.**

The following woods may not be more than 10% smaller than spruce in each cross section dimension

White ash	Fraxinus americana, biltmoreana, pennsylvanica lanceolata, pennsylvanica, quadrangulata.
Beech	Fagus grandifolia
Birch	Betula lenta, lutea, nigra.
Douglas fir(dense)	Pseudotsuga taxifolia
Rock elm	Ulmus racemosa
Hickory	Hicoria ovata, laciniosa, alba, glabra, ovalisi
Ironwood	Ostrya virginiana
Black locust	Robinia pseudacacia
Honey locust	Gleditsia triacanthos
Hard maple	Acer nigrum, saccharum
Red maple	Acer rubrum
Red oak	Quercus borealis maxima, borealis, velutina, shumardii texana, palustris, phellos, laurifolia, rubra, rubra pagodaefolia, nigra, ellipsoidalis, coccinea, marilandica, kelloggii, catesbaei

White oak	<i>Quercus alba, stellata, lyrata, bicolor, muehlenbergii, garryana, prinus, montana, macrocarpa, lobata, virginiana, douglasii, utahensis, emoryi, arizonica, oblongifolia</i>
Osage orange	<i>Toxylon pomiferum</i>
Pecan	<i>Hicoria pecan, cordiformis, cordiformis elongata, myristicaeformis, aquatica.</i>
Persimmon	<i>Diospyros virginiana</i>
Southern pine (dense)	<i>Pinus taeda, palustris, serotina, echinata caribaea, rigida, glabra</i>

### **Section 21.62. Group two woods.**

The following woods may not be more than 5.0% smaller than spruce in each cross section dimension:

Oregon ash - *Fraxinus oregona*.  
Pumpkin ash - *Fraxinus profunda*.  
Port Orford cedar - *Chamaecyparis lawsoniana*.  
Cucumber - *Magnolia acuminata*.  
Douglas fir (Coast region) - *Pseudotsuga taxifolia*.  
Soft elm - *Ulmus americana, fulva*.  
West Coast hemlock - *Tsuga heterophylla*.  
Western larch - *Larix occidentalis*.  
Oregon maple - *Acer Macrophyllum*.  
Norway pine - *Pinus resinosa*.  
Southern pine - *Pinus taeda, palustris, serotina, echinata, caribaea, rigida, and glabra*.  
Tamarack - *Larix laricina*.

### **Section 21.63. Group three woods.**

(a) The following woods may be substituted for spruce in required spruce sizes

Red alder - *Alnus rubra, rhombifolia*.  
Alaska cedar - *Chamaecyparis nootkatensis*.  
Red Cypress - *Taxodium distichum*.  
White cypress - *Taxodium distichum*.  
Yellow cypress - *Taxodium distichum*.  
Douglas fir (Rocky Mountain region) - *Pseudotsuga taxifolia*.  
Douglas fir (Inland Empire) - *Pseudotsuga taxifolia*.  
Noble fir - *Abies nobilis*.  
Silver fir - *Abies amabilia*.  
White fir - *Abies concolor, grandis*.  
Black gum - *Myssa sylvatica*.  
Red gum - *Liquidambar styraciflua*.  
Hackberry - *Celtis occidentalis, laevigata*.  
Holly - *Ilex opaca*.

Magnolia - Magnolia grandiflora.  
 Soft maple - Acer saccharinum.  
 Idaho white pine - Pinus monticola.  
 Yellow poplar - Liriodendron tulipifera.  
 Redwood - Sequoia sempervirens.  
 Eastern spruce - Picea glauca, rubra.  
 Sitka Spruce - Picea sitchensis.  
 Sycamore - Platanus occidentalis.  
 Tupelo - Myssa aquatica.

(b) All minimum dimensions of wood side rails specified in this Chapter are based on the species of woods listed under subsection (a) of this section.

**Section 21.64. Group four woods.**

The following woods shall not be less than 5.0% larger than spruce in each cross section dimension:

Aspen	Populas tremuloides, grandidentata
Basswood	Tilia glabra, heterophylla
Buckeye	Aesculus octandra, glabra
Butternut	Juglans cinerea
Incense cedar	Libocedrus decurrens
Western Red cedar	Thuja plicata
Chestnut	Castanea dentata, pumila
Cottonwood	Populas deltoides, deltoides virginiana, heterophylla, balsamifera, sargentii
Black cottonwood	Populus trichocarpa, trichocarpa hastata, macdougalii, fremontii.
Eastern hemlock	Tsuga canadensis
Lodgepole pine	Pinus contorta
Northern white pine	Pinus strobus
Ponderosa pine	Pinus ponderosa, Pinus jeffreyi, (Jeffrey Pine)
Sugar pine	Pinus lambertiana

**Section 21.65. Wood for ladder use.**

(a) The classification of wood into four groups as set out in ss 21.61--21.64 of this Title (relating to group one woods; group two woods; group three woods; and group four woods) is made on the basis of mechanical properties considered from the standpoint of use for ladder construction.

(b) The species of wood set out in ss 21.61, 21.62 and 21.64 of this Title (relating to group one woods; group two woods; and group four woods) may be substituted for those in s 21.63 of this Title (relating to group three woods) for side rails in the indicated sizes.

### **Section 21.66. Sapwood.**

The sapwood of all species is particularly nondurable and it is recommended that it not be used under conditions favorable to decay.

### **Section 21.67. Durability.**

The following species have the most durable heartwood and it is recommended that they be used where resistance to decay is required:

- (1) Black locust.
- (2) Osage orange.
- (3) Port Orford cedar.
- (4) Alaska cedar.
- (5) Red cypress.
- (6) Redwood.
- (7) Incense cedar.
- (8) Western red cedar.
- (9) Chestnut.

### **Section 21.68. Density.**

The following species meet the density requirements calling for at least 1/3 summerwood, as measured along an average radial line on one of the piece:

- (1) Douglas fir (dense).
- (2) Southern pine (dense).

### **Section 21.69. Names.**

The common and scientific names of species described in this Chapter conform to the American Lumber Standards nomenclature and in most cases to United States Department of Agriculture miscellaneous circular No. 92 entitled "Check list of the forest trees of the United States, their names and ranges".

### **Section 21.70. Strength tests.**

The following species are commonly associated with others of the same genus under the American Lumber Standards nomenclature but no strength tests have been made on them at Forest Products Laboratory:

Birch - *Nigra*.

Hickory - *Ovalisi*.

Red oak - *Quercus borealis maxima*, *shumardii*, *texana*, *palustris*, *rubra pagodaefolia*, *ellipsoidalis*, *coccinea*, *marilandica*, *kelloggii*, and *catesbaei*.

White oak - *Lyrata*, *muehlenbergii*, *garryana*, *lobata*, *virginiana*, *douglasii*, *utahensis*, *emozyi*, *arizonica*, and *oblongifolia*.

Pecan - *Cordi formis elongata*, *myristicaeformis*, and *aquatica*.

Red alder - *Rhombifolia*.

Hackberry - *Laevigata*.

Basswood - *Heterophylla*.

Buckeye - *Glabra*.

Chestnut - *Pumila*.

Cottonwood - *Deltoides virginiana*, *heterophylla*, and *sargentii*. *Populus trichocarpa*, *macdougalii*, and *fremontii*.

White ash - *Pennsylvanica*.

#### **Section 21.71. Soft maple.**

The following is included under soft maple in the American Lumber Standards nomenclature:

Red maple - *Acer rubrum*.

#### **Section 21.72. Pecan species.**

The following species are not included under the common name of pecan in the American Lumber Standards nomenclature, but strength data are available and they are accordingly included in this classification:

Pecan - *Myristicaeformis*, *aquatica*.