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FIRE DEPARTMENT GROUND LADDERS 1975

NFPA®

NATIONAL FIRE PROTECTION ASSOCIATION

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Standard on

Fire Department Ground Ladders

NFPA No. 1931 — 1975

1975 Edition of NFPA No. 1931

This 1975 edition supersedes the material previously printed in NFPA No. 193 and is a complete revision. It was prepared by a subcommittee of the NFPA Technical Committee on Fire Department Equipment and was approved by the NFPA membership at the NFPA Fall Conference in Pittsburgh, Pennsylvania on November 18, 1975.

Origin and Development

NFPA No. 193, *Standard on Fire Department Ladders, Ground and Aerial,* was first presented to the Association in 1954 and was tentatively adopted as a standard on aerial ladder testing. In 1955 it received final adoption.

In 1957 a subcommittee of the NFPA Committee on Fire Department Equipment prepared new material covering recommendations for portable ladders, ground ladders and aerial ladders; their use, maintenance and testing. In addition, revision was made in the section pertaining to testing aerial ladders. These changes were approved by the 1958 Annual Meeting and were adopted by the NFPA Board of Directors June 30, 1958.

In 1959, Article 100, covering specifications for aluminum ground ladders for fire department use was adopted by the Association on recommendations by the Committee on Fire Department Equipment. No other change was made.

In May 1972, a complete revision of the 1959 edition of NFPA No. 193 was approved. During 1974 and 1975, NFPA 193 was studied in detail by a subcommittee of the NFPA Technical Committee on Fire Department Equipment and it was felt that NFPA 193 should be separated into two documents since the conditions of use of ground ladders and aerial ladders were so widely divergent. The subcommittee also recommended that the material on aerial ladders be made a recommended practice rather than a standard.

Due to a renumbering of fire service standards, the new *Standard on Fire Department Ground Ladders* has been indicated as NFPA 1931.

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This represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

Interpretation Procedure of the Committee on Fire Department Equipment

Those desiring an interpretation shall supply the Chairman with five identical copies of a statement in which shall appear specific reference to a single problem, paragraph, or section. Such a statement shall be on the business stationery of the inquirer and shall be duly signed.

When applications involve actual field situations they shall so state and all parties involved shall be named.

The Interpretations Committee will reserve the prerogative to refuse consideration of any application that refers specifically to proprietary items of equipment or devices. Generally inquiries should be confined to interpretation of the literal text or the intent thereof.

Requests for interpretations should be addressed to the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

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Fire Department Ground Ladders

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Introduction

Ground ladders used in the fire service must be constructed to rigid standards of the highest quality. These ladders are often the only means of fire fighter entry into a building or portions of a building and may be the only means of egress for victims trapped by a fire within a building. Fire department ladders serve as a means of transporting people, equipment and extinguishing agents from one area to another. Since the lives of the fire fighters and fire victims often rely on the performance without failure of these valuable pieces of fire department equipment, these standards of performance must be such that they can be used with the maximum of ease and assurance at all times.

Chapter 1 Scope and Purpose

1-1 Scope. This standard shall prescribe minimum requirements for the construction, care and use of fire department ground ladders. This standard shall not be applied retroactively to ladders presently in use by fire departments or presently being constructed under purchase orders initiated prior to the official adoption of this standard by the membership of the National Fire Protection Association. (*See A-1-1.*)

1-2 Purpose. The purpose of this standard shall be to provide reasonable safety to fire fighters and rescue victims during the use of fire department ground ladders. This standard may also serve as a basis for purchase requirements and instructional material in the care, maintenance and use of fire department ground ladders. This standard shall also provide the manufacturer of fire department ground ladders with a set of performance and dimensional requirements against which the product may be checked. It is not the purpose of this standard to specify the details of construction. Limitations imposed are for the purpose of providing adequate general requirements and establishing acceptable test methods. (*See A-1-2.*)

Chapter 2 Definitions

Base Section. The largest section of an extension ladder which acts as the support for the upper section(s) when in the raised position.

Beam. The main structural side of the ladder.

Bedded Position. Position in which fly section(s) of extension ladders are stored in the nonextended position with the pawls resting on a rung of the supporting section.

Bed Section. Same as Base Section.

Butt. The end of the side rail placed on the ground or other place of support when ladders are in their raised position.

Butt Spurs. A protrusion of metal from the metal reinforcement or the ladder butt designed to minimize ladder slippage on the surface on which the butt rests when the ladder is raised for use.

Collapsible Ladder. A single ladder designed so that the rungs can be folded or moved in a manner to allow the side rails to be brought into a position of touching each other or nearly touching each other for storage or carrying purposes.

Designated Length. The length which a ladder is marked and marketed to be. (*See Section 3-12.*)

Extension Ladder. A ground ladder adjustable in length consisting of two or more sections travelling in guides or brackets and so arranged to permit length adjustment.

Fly Section. Upper section(s) of extension ladders designated to give reach advantage to a base section when the ladder is raised and extended into position for use.

Ground Ladder. Ladders not mechanically or physically attached permanently to fire apparatus or requiring mechanical power from the apparatus for the ladder's use and operation.

Halyards. Rope used on extension ladders for the purpose of raising fly section(s).

Ladder. An appliance consisting of two side rails joined at regular intervals by cross pieces called rungs which a person may use in ascending or descending from one level to another.

Ladder Dogs. See Pawls.

Ladder Nesting. The procedure whereby ladders of different sizes are positioned partially within one another to reduce the amount of space required for their storage on the apparatus.

Ladder Width. The distance measured from the outside edge of one beam to the outside edge of the other beam or the widest point of the ladder, whichever is greater.

Maximum Extended Position. The greatest extended length of an extension ladder for which the ladder retains the required strength characteristics.

Pawls. Devices attached to fly section(s) for the purpose of anchoring fly section(s) when extension ladders are used in the extended position. Pawls rest on ladder rungs near the side rails for anchoring purposes.

Roof Ladder. A single ladder equipped with hooks at the top end of the ladder.

Side Rail. Same as Beam.

Single Ladder. A ground ladder non-adjustable in length and consisting of only one section. Its size is designated by the overall length of one side rail.

Staypoles. Poles attached to each side rail of extension ladders and used to assist in the raising of the ladder and to help provide stability of the raised ladder. Staypoles are often called "tormentors."

Straight Ladder. Same as Single Ladder.

Test Failure. Failure of the ladder structure or components thereof to pass the prescribed tests.

Visible Damage. Damage clearly evident to the eye without recourse to optical measuring devices.

Wall Ladder. A single ladder without hooks.

Chapter 3 General

3-1 Application. This standard shall apply only to fire department ground ladders constructed or purchased after the official adoption of this standard by the membership of the National Fire Protection Association. It is recognized that special purpose ladders for specific needs are sometimes required and exceptions from the literal criteria of this standard should be requested only if reasonable safety is assured. (*See A-3-1.*)

3-2 Ladders shall be designed for the loads set forth in Chapter 8.

3-3 Ladders shall be tested in accordance with Chapter 8.

3-4 Materials used in ladder construction shall be of sufficient strength to meet the performance requirements of this standard. (*See A-3-4.*)

3-5 Ladders shall be constructed in a manner so as to ensure that structural defects do not exist. Structural defects include sharp edges, burrs or other defects which may cut or tear clothing or skin as well as inadequate structural strength.

3-6 Side Rails. The design of the side rails shall be such that the ladder will comply with all load and test conditions. Material used in side rail construction shall be such that maintenance requirements of this standard will be met.

3-7 Rungs.

3-7.1 Rungs shall be not less than 1¼ inches in diameter.

3-7.2 Rungs shall be securely and rigidly attached to side rails.

3-7.3 Rungs shall be spaced on 14-inch centers plus or minus ⅛ inch. (*See A-3-7.3.*)

3-7.4 Methods of connecting rungs to side rails shall be such that there is no appreciable decrease in the strength of the side rail or the ladder.

3-8 Hardware.

3-8.1 Hardware shall meet the minimum strength requirements of the ladder's component parts.

3-8.2 Hardware shall be corrosion resistant or protected against corrosion.

3-9. Extension ladder width shall be within the range of widths of Table 3-9. Ladder widths shall comply with Section 4-2 for wall ladders, Section 6-5 for roof ladders, and Section 7-2 for collapsible ladders.

Table 3-9 Range of Extension Ladder Widths

Range of Length	Ladder Width	
	Minimum	Maximum
28′ and under	18″	24″
30′ – 35′	22″	24″
40′ – 65′	23″	29″

NOTE: Indicated ladder width shall be that of the base section excluding staypoles, if provided.

Exception: Extension ladders of designated length of 16 feet or under, designed and labeled for inside use, shall be exempt from the above minimum width requirements.

3-10 A metal reinforcement with butt spurs or other means to prevent ladders slipping when in place shall be provided on the butt end of each side rail of each single ladder and the base section of extension ladders.

3-11 Metal Ladders.

3-11.1 Metal ladders shall be constructed of materials having a minimum ultimate tensile strength of 38,000 PSI and a minimum yield strength of 35,000 PSI. (*See A-3-11.1.*)

3-11.2 All riveting or welding on side rails shall not appreciably decrease the strength of the ladder or its component parts.

3-11.3 Rungs on metal ladders shall be constructed of a heavy duty corrugated, serrated, knurled or dimpled material or coated with a skid resistant material.

3-11.4 When varying types of metals are used in the construction of metal ladders, they shall be chosen or finished so as to avoid or minimize electrolytic action.

3-11.5 Welds used in the construction of metal ladders shall be free of defects. Welding shall be conducted according to commercially accepted good practices.

3-11.6 Rivets used in the construction of ladders shall be free of structural defects and set according to commercially accepted good practices.

3-12 The useable ladder length shall be marked within 12 inches of the butt of each side rail of single ladders and the base section of extension ladders. Such markings shall be visible when ladders are in the nested and stored position on fire apparatus.

3-13 Certification. The manufacturer shall certify that ladder(s) purchased under the specifications utilizing this standard meet the requirements of this standard. (*See A-3-13.*)

Chapter 4 Wall Ladders

4-1 The designated length of a wall ladder shall be the length of one side rail excluding any butt plate. The actual length of the side rail shall not be less than the designated length. Wall ladders shall not exceed 30 feet in length. (*See A-4-1.*)

4-2 The minimum clear width between side rails of wall ladders shall be at least 12 inches for wall ladders 10 feet and under, and shall increase 1/8 inch for each additional foot of length over 10 feet.

Chapter 5 Extension Ladders

(See A-5-0.)

5-1 Extension Ladder Size.

5-1.1 The designated length of an extension ladder shall be determined by measuring the maximum extended length along a side rail, excluding any butt plate. Minus tolerance is not to exceed six inches.

5-1.2 Extension ladders for fire department use shall not exceed 65 feet designated length.

5-2 The minimum clear width between the side rails of the uppermost fly section shall not be less than 12 inches.

Exception: Extension ladders of designated length of 16 feet or under, designed and labeled for inside use, shall be exempt from the above minimum width requirement.

5-3 Extension ladders shall be equipped with a stop installed by the manufacturer to prevent their over-extension. The manufacturer shall determine the location of this stop to assure that the test requirements of Sections 8-3 and 8-8 are met when the ladder is fully extended.

5-4 Extension Locking Devices.

5-4.1 Pawls shall be designed to withstand load tests.

5-4.2 Pawls shall be of a positive mechanical action type and shall engage a rung of the supporting section.

5-4.3 Pawls shall be fastened or secured to side rails in a manner such that vibration and use will not cause bolts and nuts to loosen.

5-4.4 Pawls shall be constructed such that the hook portion of the pawls that engages or rests on the rung shall have sufficient bearing surface or area so as to prevent the hook from cutting into the rungs when engaged.

5-4.5 The hooks on pawls shall be furnished in a manner to avoid sharp edges and points.

5-4.6 Pawls shall be designed and attached so that they will rest on the rungs as near the side rails as possible.

5-5 Extension ladders shall not be constructed in a manner or method which necessitates the elimination of a rung on any section.

5-6 Staypoles.

5-6.1 Staypoles shall be furnished on all extension ladders 40 feet or more designated length.

5-6.2 Staypole spikes shall not project beyond the butt of the base section when nested.

5-7 Halyard and Pulley.

5-7.1 Extension ladders shall be equipped with a halyard and pulley.

Exception: Extension ladders of designated length of 16 feet or under, designed and labeled for inside use, shall be exempt from the above requirements for halyard and pulley.

5-7.2 The pulley shall be attached to the ladder in a manner so as not to weaken either the rungs or the side rails.

5-7.3 The pulley shall be not less than 1 inch diameter measured at the base of the sheave.

5-7.4 The halyard shall be not less than $\frac{3}{8}$ inch in diameter having a minimum breaking strength of 825 lbs. and shall be of sufficient length for the purpose intended. (*See A-5-7.4.*)

5-7.5 On three and four section ladders the third and/or fourth fly section may be extended by wire rope. Such wire rope shall be not less than $\frac{3}{16}$ inch in diameter. When wire rope is used, a means for adjusting the length of the wire rope shall be provided. Splices shall not be allowed.

5-8 The top of each side rail of each section of extension ladder shall be rounded to allow the ladder to slide on irregular surfaces without catching or snagging during placement or operations.

5-9 Extension ladders shall be constructed in a manner such that rungs of each section shall align with the rungs of other sections when the ladder is extended and pawls are engaged.

Chapter 6 Roof Ladders

6-1 Roof ladders shall be provided with hooks. Hooks shall be capable of being turned in between the beams for nesting purposes. (*See A-6-1.*)

6-2 Hooks shall be securely fastened to side rails. The manner of attaching hooks to side rails shall be such that the original strength of the side rail is not appreciably weakened.

6-3 Hooks shall support a minimum load of 1,000 pounds when such load is imposed on a free hanging ladder.

6-4 The top of each side rail of roof ladders shall be rounded to allow the ladder to slide on irregular surfaces without catching or snagging during placement or operations.

6-5 The minimum clear width between side rails of roof ladders shall be at least 12 inches for roof ladders 10 feet and under, and shall increase $\frac{1}{8}$ inch for each additional foot of length over 10 feet.

Chapter 7 Collapsible Ladders

7-1 Collapsible ladders shall be equipped with foot pads to prevent slippage. The pads shall have a nonskid or skid reducing material on the bottom side of the foot pad.

7-2 The minimum clear width between side rails shall be $7\frac{1}{2}$ inches for collapsible ladders 14 feet and under.

Chapter 8 Inspection and Testing

8-1 General.

8-1.1 All ground ladders shall be thoroughly inspected at least annually and: (1) at any time that a ladder is suspected of being unsafe, (2) after it has been subjected to overloading (*see Section 8-1.3*), impact loading, or unusual conditions of use.

8-1.2 Ladders shall be tested whenever visual inspection indicates possible damage or when they have been exposed to direct flame contact or possible radiated heat exceeding temperatures of 300° F. (*See A-8-1.2.*)

8-1.3 For purposes of determining when a ladder may have been overloaded, Table 8-1.3 may be used as a guide. The loadings are the total weight on the ladder and include persons, their equipment and any other weight such as a charged fire hose.

Table 8-1.3 Maximum Ladder Loading

Collapsible Ladders	300 pounds
Roof Ladders	
hanging from hooks	500 pounds
when resting on roof	500 pounds
Wall Ladders	500 pounds
Extension Ladders	
26 feet or less	500 pounds
27 to 45 feet	600 pounds
over 45 feet	700 pounds

NOTE: These load limits assume that the ladder is properly positioned (See Section 10-4) with the top of the ladder leaning against the building. The above acceptable loads shall be reduced by 150 pounds when single and extension ladders are placed at angles of 45-65° with the horizontal. Ladders used at angles of less than 45° with the horizontal shall not have more than 250 pounds on the ladder at any one time.

8-2 Visual Inspection.

8-2.1 Check to see that all rungs are snug and tight.

8-2.2 Check all bolts and rivets for tightness.

8-2.2.1 Check to see that bolts on wood ladders are snug and tight without crushing the wood.

8-2.2.2 Check to see that rivets on metal ladders show no sign of looseness.

8-2.3 Check welds for any apparent defects.

8-2.4 **Side Rails.**

8-2.4.1 Inspect the side rails of metal ladders for cracks, breaks, gouges or deformation.

8-2.4.2 Inspect the side rails of wood ladders for cracks, splintering, breaks, gouges, checks, wavy conditions or discoloration.

8-2.5 Inspect halyards (ropes and cables) for signs of fraying, unraveling, cuts, broken strands or deterioration.

8-2.6 Inspect all components for cracks, cuts, gouges, or other deformation.

8-2.7 Any deficiencies noted in visual checks shall be corrected prior to testing.

8-3 **Horizontal Bending Test.** The ladder shall be placed in a flat horizontal position supported six inches from the ends of each side rail. Extension ladders shall be extended to the maximum extended position. The test load shall be applied across the center of the ladder. (*See A-8-3.*)

(a) Load center of ladder with 50-pound weights until a maximum of 200 pounds is reached. The load is to be placed on a flat base which is large enough to rest on both side rails and is capable of transferring the load to both side rails. Allow the weight to remain for at least one minute to "set" the ladder prior to completing the rest of the test.

(b) After removing this preload, measure the distance between the bottom edge of each side rail and the surface upon which ladder supports are placed.

NOTE: All measurements should be taken at a consistent location as near as practical to the side rail position where the load is applied.

(c) Load center of ladder with 50-pound weights until a maximum of 250 pounds is reached. Load is to be applied as in Step (a). (*See A-8-3.*)

(d) Allow 250-pound load to remain in place for five minutes.

(e) After five minutes remove test weight and again measure the distance between the bottom of each side rail and surface upon which ladder supports are resting. For wood ladders, wait five minutes before conducting this measurement.

(f) Differences between measurements taken in Steps (b) and (e) above shall not exceed 1/1000 of the distance between the ladder supports. Differences exceeding 1/1000 of this ladder span distance shall be considered evidence of failure of ladder and the ladder shall be discarded from fire service use.

(g) During the conduct of the test, there shall be no visible weakening or failure of any component of the ladder.

8-4 Hardware Test. The ladder shall be placed in a vertical position with the butt resting on a horizontal surface. Extension ladders shall be extended a minimum of one rung beyond the nested position.

(a) Place a downward load of 1,000 pounds equally over the ends of both side rails of the top end of the ladder.

(b) Test load shall be applied for a minimum of one minute.

(c) Ladders shall withstand this test with no deformation or other visible weakening of the structure.

8-5 Rung Bending Strength Test. The ladder shall be placed at an angle of 75½° to the horizontal.

(a) Measure the distance between the test rung and the next rung above.

(b) A load of 1,000 pounds shall be applied to the third or fourth rung from the butt of the ladder. Loads shall be distributed across 3½ inches of the rung as near the center of the rung as possible.

(c) Test load shall be applied for a minimum of one minute.

(d) After removing the test load, the permanent set shall not exceed 1/100 of the rung length. The rung length shall be the distance along the rung as measured between the inside of the side rails.

(e) Any set exceeding 1/100 of the rung length shall be deemed as a test failure and the ladder shall be removed from fire department service.

NOTE: Sections of an extension ladder shall be tested individually in a similar manner only when the fly sections can be disassembled from the other sections.

8-6 Rung to Side Rail Shear Strength Test.

(a) The ladder shall be placed at an angle of 75½° to the horizontal.

(b) A load of 1000 pounds shall be applied to the third or fourth rung from the butt of the ladder and as near the side rail as possible. Test load shall be evenly distributed over a 3½-inch wide area of the rung.

(c) Test load shall be applied for a minimum of one minute. Upon removing the load, the ladder shall show no indication of failure either in the fastening means of attaching the rung to the side rail or to the side rail itself.

(d) Any indication of failure shall require the ladder to be removed from service until repaired.

8-7 Rung Torque Test.

(a) A test load of 30 pounds shall be applied to a test bar with a 30-inch long lever arm, first in a counterclockwise direction. Test load shall be applied to a 3½-inch wide area of the center of the rung.

(b) This procedure shall be performed ten times alternating between the clockwise and counterclockwise directions.

(c) This alternating torque load test shall not cause any visible relative motion between the rung and the side rails.

(d) Any motion shall be deemed as a test failure and the ladder removed from service until repaired.

8-8 Deflection Test. The ladder shall be placed in a flat horizontal position supported 6 inches from the end of each side rail. When testing extension ladders, the extension ladder shall be extended to the maximum extended position.

(a) All measurements should be taken at a consistent location as near as practical to the side rail position where the load is applied.

(b) A test load of 60 pounds shall be suspended from one of the side rails. The test load shall be distributed over a 3½-inch length of the side rail midway between the ladder supports.

(c) Test loads shall be applied for a minimum period of one minute.

(d) Before removing the test load, measurements shall be taken from the top of the rail loaded during the test to the surface on which the ladder supports are resting.

(e) The angle α between the loaded and unloaded rails is to be calculated from the trigonometric method equation:

$$\text{Sin } \alpha = \frac{\text{difference between the two side rail deflections}}{\text{maximum ladder width}}$$

(f) Measurements taken in the deflection test shall agree with values in Table 8-8.

(g) Any deflection exceeding the Table value for the size of ladder involved shall be considered a test failure and the ladder shall be removed from fire department service.

(h) The test shall be repeated by loading the other rail.

Table 8-8 Deflection Test Values

Single and Extension Ladders — Size of Ladder in Feet	Maximum Deflection of Loaded Rail	Maximum Difference in Deflection Between Loaded and Unloaded Rail as Measured from the Horizontal	
		α	
(Feet)	(Inches)	(Degrees)	(Inches)
10	1.0	2.1	7/16
12	1-3/8	2.5	1/2
14	1-7/8	2.8	5/8
16	2-3/8	3.3	3/4
18	2-3/4	3.5	7/8
20	3-1/8	3.6	15/16
22	3-1/2	4.0	1
24	3-7/8	4.7	1-1/4
28	4-5/8	5.4	1-9/16
30	5-1/8	5.6	1-11/16
32	5-5/8	5.7	1-3/4
35	6-1/2	6.0	1-15/16
38	7-3/8	6.3	2-1/16
40	8.0	6.5	2-1/4
45	9-1/4	7.0	2-1/2
50	10-1/4	7.5	2-7/8
55	11.0	8.1	3-1/4
60	11-1/2	8.6	3-5/8
65	13.0	9.0	4-1/16

Chapter 9 Care of Ground Ladders

9-1 Ladders shall not be forced into brackets or slides on fire apparatus.

9-2 The rollers and other moving parts of the frame holding the ground ladders on the apparatus should be greased at least every six months. When regreasing rollers or moving parts, remove all grease with a solvent and regrease with a thin film of water-proof grease. If rollers and other moving parts are rusted, they shall be wire-brushed and cleaned to remove all loose scale and then painted before greasing.

9-3 Ladders are not intended to be used for purposes other than ascending or descending. When ladders are used for other purposes in an emergency, they shall be inspected and tested prior to further use.

9-4 Personnel raising fire department ground ladders should avoid raising ladders on the beam, if possible.

9-5 Raised ladders should not be slid along cornices.

9-6 Ladders should not be "rolled" beam over beam to reach a new position.

9-7 Ropes and wire cables on extension ladders shall be replaced when they become frayed or kinked.

9-8 Ladders shall be maintained as free of moisture as is possible and shall be wiped after being sprayed with water or used in the rain.

9-9 Wood ladders shall be protected by at least two coats of high quality clear spar varnish.

9-10 Wood ladders shall be stored away from steam pipes, radiators and out of the hot sun.

9-11 Wood ladders should not be stored in a low humidity atmosphere.

9-12 Ladders shall not be stored in an area where they are exposed to the elements.

9-13 Ladders stored in a horizontal position shall be supported at a sufficient number of points to avoid sagging and permanent set.

9-14 Fire department ground ladders shall not be painted *Exception: That area of the side rail used for identifying the ladder length or the marking itself.*

9-15 If the spar varnish coating becomes damaged, the following procedure shall be conducted to repair surface.

(a) Remove varnish in the area by scraping.

(b) Smooth rough spots with fine sand paper and steel wool.

(c) Apply one coat of shellac and two coats of high quality clear spar varnish.

9-16 Use solvent cleaners to remove oily or greasy surface substances.

9-17 A wax coating is recommended to be applied to all unpainted metal surfaces.

9-18 Ladders shall be visually inspected at least once in every six month period and after every emergency use or ladder training session.

9-19 Damaged Ladders. Ladders having defects are to be marked and taken out of service until repaired.