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# NFPA 1914 Testing Fire Department Aerial Devices 1988 Edition

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

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### Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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### Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

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NATIONAL FIRE PROTECTION ASSOCIATION

**NFPA 1914**

**Standard for**

# Testing Fire Department Aerial Devices

**1988 Edition**

This edition of NFPA 1914, *Standard for Testing Fire Department Aerial Devices*, was prepared by the Technical Committee on Fire Department Equipment, and acted on by the National Fire Protection Association, Inc. at its Annual Meeting held May 16-18, 1988, in Los Angeles, California. It was issued by the Standards Council on June 8, 1988, with an effective date of June 28, 1988 and supersedes all previous editions.

The 1988 edition of this document has been approved by the American National Standards Institute.

## Origin and Development of NFPA 1914

NFPA 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 at the 1958 Annual Meeting.

In 1959, a new section covering specifications for aluminum ground ladders for fire department use was adopted by the Association. No other change was made.

In May 1972, a complete revision of the 1959 edition of NFPA 193 was approved. During 1974 and 1975, NFPA 193 was studied in detail by a subcommittee of the 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 new *Recommended Practice for the Maintenance, Care, Testing, and Use of Fire Department Aerial Ladders and Elevating Platforms* was designated as NFPA 1904 and approved by the NFPA membership at the 1975 NFPA Fall Meeting.

During 1978 and 1979 the committee studied NFPA 1904 and decided that the document would better serve the fire service as a standard. A complete revision was undertaken and the document renamed NFPA 1904, *Standard for Testing Fire Department Aerial Ladders and Elevating Platforms*. This edition was approved at the 1980 Fall Meeting.

This current edition is again a complete revision to add more detail on required inspection, to require nondestructive testing of critical components on a periodic basis, and to include testing for water towers. The document has been renumbered NFPA 1914 and renamed *Testing Fire Department Aerial Devices* to better describe its broader scope.

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NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

## Contents

# NFPA 1914

## Standard for

# Testing Fire Department Aerial Devices

## 1988 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.

Information on referenced publications can be found in Chapter 5.

## Chapter 1 Administration

**1-1 Scope.** This standard shall apply to the examination and testing of fire apparatus equipped with aerial ladders, elevating platforms, and water towers as specified in NFPA 1901, *Standard on Automotive Fire Apparatus*.

**1-2 Purpose.** This standard specifies minimum inspection and testing requirements for aerial devices in an effort to ensure at least a minimum degree of safety under continued use. Because aerial devices may be misused and thereby overstressed, all aerial devices shall be periodically inspected and tested to determine continued serviceability.

**1-3 Definitions.**

**A-Frame.** A type of outrigger system that, when the jacks are extended, forms an "A" with the torque box or frame.

**Acoustic Emission Testing.** A method of nondestructive testing (NDT) that utilizes acoustic or sound waves.

**Aerial Device.** Any device, extensible, articulating, or both, that is designed to position personnel, handle materials, and/or discharge water.

**Aerial Ladder.** An aerial device consisting of a single or multiple-section runged ladder.

**Aerial Ladder Sections.** The structural members consisting of the base and fly sections of aerial ladders.

**American Society for Nondestructive Testing (ASNT).** A professional organization devoted to promoting knowledge of nondestructive testing.

**American Welding Society (AWS).** An association that provides codes, guidelines, and standards utilized to evaluate weld structures and components in welded structures.

**Annealing.** A change in the internal structure of a metal caused by heating and cooling that results in a change of tensile strength.

**Approved.** Acceptable to the "authority having jurisdiction."

NOTE: The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

**Articulating Boom.** An aerial device consisting of two or more folding boom sections whose extension and retraction modes are accomplished by adjusting the angle of knuckle joints.

**Authority Having Jurisdiction.** The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the "authority having jurisdiction." In many circumstances the property owner or his designated agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

**Authorized Person.** A person approved or assigned to perform specific types of duty or to be at a specific location at the job site.

**Auxiliary Hydraulic Power.** A small gasoline or diesel engine or electrically driven hydraulic pump used to operate aerial devices in an emergency or in lieu of the main hydraulic system.

**Auxiliary Outrigger Plates.** The heavy metal or wood plates inserted beneath outrigger pads to give greater surface bearing area.

**Base Rail.** The lower chord (rail) of an aerial ladder to which rungs and reinforcements are attached.

**Base Section.** The first or bottom section of an aerial device.

**Bearing Raceway.** The track in which the bearings are held between the upper and lower halves of a turntable rotation bearing.

**Boom.** An assembled section of an aerial device. The boom construction can be of either the stressed-skin box beam or the truss-lattice type.

**Boom Boost Cylinders.** The hydraulic cylinders located on the upper boom of an articulating boom aerial device that help lift the upper boom from the lower boom.

**Boom Support.** A structural component attached to the chassis frame and used to support the aerial device when it is in the cradled position.

**Bow.** The distance the end of an aerial ladder or boom deviates from a straight line extension of the base section.

**Bull Gear.** See rotation gear.

**Burst Pressure.** The pressure, measured in psi or pascals, at which a hydraulic component fails due to stresses induced as a result of the pressure.

**Cable.** A wire rope used to transmit forces from one component to another for the purpose of extending or retracting an aerial device.

**Cable Separation Guide.** The mechanism that aligns and separates the cable when it is wound on the drum of the extension winch of an aerial ladder.

**Cantilever Position.** The use of an aerial device supported only at the base by the turnable, elevation, cylinders, chassis, and outriggers.

**Chassis.** The basic vehicle frame consisting of main frame rails, reinforcements, crossmembers, fasteners, bracket for suspension, suspension members (springs), axles, tires and wheels, cab, and power train.

**Collector Rings.** A means of transmitting electrical power to the turntable from the main power supply; usually concentric rings made of brass that are contacted by brushes to make the transfer to the specific electrical functions.

**Control Valve.** A main hydraulic valve that controls the elevation, extension, and rotation of an aerial device.

**Creep.** The time-dependent movement that occurs under an applied load that can occur during exposure to high temperatures or during hydraulic fluid leakdown.

**Cylinder Links.** The mechanisms that may be used in connecting an articulating boom to the end of the upper elevating cylinders or to the lower and upper booms.

**Defect.** A discontinuity in a part or a failure to function that interferes with the service or reliability for which the device was intended.

**Deflection.** The deviation from a straight course or fixed direction.

**Discontinuity.** A change in the normal physical structure of a material that may affect its serviceability.

**Diverter Valve.** A valve that, when actuated, diverts hydraulic fluid to one function or another or from a hydraulic system to another; in aerial devices, it is one valve that diverts oil from the outriggers when the aerial device is in use and vice versa.

**Drift.** A time-dependent movement away from an established position.

**Ductility.** The ability of metal to stretch and become deformed without breaking or cracking.

**Dynamic Loading.** The application of load in motion, such as a climbing fire fighter or a water stream, to an aerial device.

**Eddy Current.** A nondestructive test method where a standard pattern of electrical impedance is established for standard materials. Similar test materials then receive the same electrical impulse. Any variation from the standard pattern indicates either a flaw in the test material or a change in hardness or metallurgical characteristics.

**Effective Aerial Height.** The vertical distance measured by a plumb line from the rated working height to the ground. For an aerial ladder, it is measured from the top rung of the fly section; for an aerial with an elevating platform, it is measured from the top of the platform handrails to the ground; and for a water tower, it is measured from the discharge end of the water monitor nozzle. All measurements are taken at the maximum elevation allowed by the OEM and published in the operator's manual.

**Elasticity.** The ability of a solid body to return to its original dimensions after application of a load that induces a stress less than the elastic limit.

**Elastic Limit.** The least stress that will cause permanent set or permanent deformation.

**Elevating Platform Apparatus.** A fire apparatus equipped with permanently mounted, power-operated booms of articulating or telescoping construction, or a combination thereof, and with a passenger carrying platform attached to the uppermost boom.

**Elevation Cylinder.** The hydraulic component(s) consisting of a cylinder barrel, cylinder rod, and related hardware that are used to vary the angle of the ladder or booms.

**Elevation Indicator.** An instrument on an aerial device that shows the angle of elevation of the aerial ladder or boom.

**Elevation Lock.** A manual or positive locking device (holding valve) that can be actuated to indefinitely maintain a desired angle or elevation without dependence upon engine power. Manufacturers may utilize the locks to make the ladder a rigid structure.

**Elongation.** The stretching of a material by which any straight line dimension increases.

**Emergency Hand-Crank Control.** An auxiliary or supplemental control with which the operator can manually operate select functions of the aerial device.

**Extensible-Boom Aerial Device.** An aerial device, except the aerial ladder type, with a telescopic boom.

**Extension Cylinders.** The hydraulic component(s) consisting of a cylinder barrel, cylinder rod, and related hardware that are used to vary the length of extension of a telescoping aerial device.

**Extension Indicator.** A device on an aerial ladder or extensible boom aerial device that indicates the number of feet the device has been extended.

**Extension Locks.** See Ladder Locks.

**Extension Sheave.** A pulley through which an extension cable operates.

**Fastener.** A mechanical device, such as a rivet, bolt, screw, or pin used to fasten two or more components securely together.

**Fatigue Crack.** A crack that results from the application, removal, and reapplication of loads. It begins as a small crack and becomes progressively larger under repeated stress cycles.

**Ferromagnetic Materials.** Materials that can be magnetized and strongly attracted to a magnetic field such as iron, steel, cobalt, and nickel.

**Fly Locks.** See Ladder Locks.

**Fly Section.** The upper or top sections of an aerial ladder.

**Hardness Gauge.** An instrument for testing hardness that relates the depth of an impression caused by a specific known force to the hardness of a material.

**Heat-Treated Bolts.** Bolts that have been exposed to a specific heat treatment process to increase hardness and/or tensile strength.

**Hinge Pins.** Pins used at either the swivel or point of articulation of an aerial device.

**Holding Valve.** A one-way valve that maintains hydraulic pressure in a cylinder until it is activated to release.

**Instability.** A condition of a mobile unit in which the sum of the moments tending to overturn the unit exceeds the sum of the moments tending to resist overturning.

**Ironing.** A term used for the damage caused to the bottom of a base rail by misalignment or malfunction of the rollers, which causes wear or indentation of the base rail material.

**Jacks.** See Outriggers.

**K-Bracing.** An added brace from the base rail to a rung and back to the base rail that is used by some manufacturers to add lateral stability to an aerial ladder.

**Knuckle.** A point of connection between upper and lower booms of an articulating device; the point at which lower and upper booms are hinged together.

**Labeled.** Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**Ladder Cradle.** A structural component that supports an aerial ladder when it is bedded.

**Ladder Locks.** The mechanical locks or pawls that prevent movement of the sections of an aerial device when the power is shut off or in the event of loss of pressure in hydraulic circuits; some manufacturers utilize the locks to make the aerial device act as a rigid structure.

**Level.** An indicating device that is affixed to a turntable or truck body and is used to verify the levelness of a turntable prior to operating an aerial device.

**Leveling Linkages.** The components and controls for achieving a level position of the elevating platform basket.

**ASNT Level II.** A tested and experienced level of proficiency for a nondestructive testing technician.

**Liquid Penetrant Inspection.** A nondestructive inspection method used to locate and determine the severity of surface discontinuities in materials based on the ability of a liquid to penetrate into small openings, such as cracks.

**Listed.** Equipment or materials included in a list published by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

**Load Limit Indicator.** A load indicator or an instruction plate visible from the operator's station that shows the recommended safe load at any condition of ladder elevation and extension.

**Magnetic Particle Inspection.** A nondestructive inspection method used to locate discontinuities in ferromagnetic materials by magnetizing the material then applying an iron powder in order to mark and interpret the patterns that form.

**May.** This term is used to state a permissive use of an alternative method to a specified requirement.

**Midsection.** A middle section of an aerial ladder. On a four section aerial ladder, the first midsection is referred to as the inner mid and the second midsection (or that section closest to the fly section) is referred to as the outer mid.

**Mobile Unit.** A combination of an aerial device, its vehicle, and related equipment.

**NDT.** Nondestructive Testing; one of several methods used to inspect a structural component without physically altering or damaging the materials.

**Neutral Position.** The position of operating controls where the controls are not engaged.

**Nonferrous Material.** Any material that cannot be magnetized and, thus, is not affected by magnetic fields. An example is aluminum.

**Nozzle Reaction.** The force that occurs when a water stream is discharged from the nozzle of a water monitor on an aerial device. The force of reaction is a function of the nozzle size and the nozzle pressure. The formula for calculating the reaction force is $F = 1.5D^2 P$, where F is the reaction force in lb, P is the discharge pressure in psi at the nozzle, and D is the diameter of the nozzle in inches.

**Operator.** A person qualified to operate an aerial device.

**Outriggers.** Devices that are used to stabilize the aerial device. Outriggers may be either of the manual or hydraulic type.

**Outrigger Pads.** The structural components of the outriggers that make contact with the ground; they are attached to the outrigger and must be capable of swiveling in at least one direction.

**Override.** The takeover of all aerial device movement control functions by an operator at the lower control station.

**Payload.** The weight specified by the manufacturer, that can be safely supported and moved via the aerial device.

**Piston Rod.** The movable shaft of a hydraulic cylinder.

**Piston Pins.** See Hinge Pins.

**Plastic Flow.** A continuing change in the deformation of a stressed member without any additional load.

**Platform.** The structure attached to the tip of a boom or aerial ladder for carrying personnel and equipment. The platform is comprised of a support structure, floor, railings, and an operator control station for controlling the aerial device from the platform position.

**Platform Load Capacity.** The amount of weight that the platform can safely support. Load capacity is dependent upon added equipment weight on the platform, personnel, and the nozzle reaction force when the water system is discharging water.

**Pneumatic Lines.** The lines that supply air, normally for a breathing system or for pneumatic power tools, to an elevating platform or the tip of an aerial ladder.

**Properly.** As recommended by the manufacturer.

**PTO (Power Takeoff).** A separate gearbox attached to the transmission used as a means of utilizing some portion of the main engine power to operate an aerial device or other equipment.

**Qualified Person.** A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems relating to the subject matter, the work, or the project.

**Quintuple Truck.** A five-function fire apparatus designed to be equipped with an aerial device, standard fire pump, hose load, water tank, ground ladders, and standard truck equipment.

**Radiography.** A nondestructive inspection method that uses X-rays, nuclear radiation, or both, to detect discontinuities in material, and to present their images on a recording medium.

**Relief Valve.** A pressure controlling device that allows the bypass of hydraulic fluids to limit the hydraulic pressures in a hydraulic system.

**Rotation Gear.** The main gear of an aerial device that is used for the rotation of the turntable.

**Rotation Gear Reduction Box.** The mechanism of an aerial device that transfers hydraulic and/or electric power to the rotation gear creating the torque necessary to actuate the rotational movement of the turntable.

**Rotation Lock.** A strong friction or other positive locking device (holding valve) that retains the turntable in any desired position.

**Rung Cap Casting.** A casting that may be riveted to the outside of the base rail over the ends of each rung on an aerial ladder.

**SAE Torque Value.** The standards published by the Society of Automotive Engineers for the torque values of specific diameter heat-treated bolts.

**Safety Stop Mechanism.** A device located on the aerial device that prevents raising elevating platform booms or sections beyond safe operating horizontal or vertical angles.

**Shall.** Indicates a mandatory requirement.

**Should.** Indicates a recommendation or that which is advised but not required.

**Side-to-Side Backlash.** The free movement in a turntable rotation gear train; exhibited when the turntable is stopped during rotation.

**Slide Blocks.** Blocks made of a variety of materials (i.e., brass, nylatron) that act as spacing devices, wear strips, or wear pads.

**Stability.** The truck is considered to be in a state of stability when no sign of overturning is evident with the aerial ladder or elevating platform in operation. The lifting of a tire or outrigger on the opposite side of the vehicle from the load does not necessarily indicate a condition of instability. Instability occurs when an aerial device can no longer support a given load and overturning is imminent.

**Static Loading.** The total loading on an aerial device due to its own weight and applied, nonmoving loads.

**Stress Raiser.** A design feature such as a sharp corner or an abrupt section change in a structural component that raises the stress in a localized region above the nominal stress in the area.

**Stressed-Skin-Type Boom Section.** A boom framework fabricated by the welding of metal into full box sections with internal torsional members.

**Stroke.** The distance that a piston rod travels when it is extended from the cylinder.

**Telescopic.** Extended or retracted by sliding of the overlapping sections.

**Thickness Gauging.** A method of inspection that indicates the thickness of a material; it operates on the principles of ultrasonic and returned sound waves to measure distance or thickness.

**Torque Box (also known as Torsion Box or Mainframe).** A structural component placed between the turntable and the chassis of an aerial device to absorb the stresses of operation. It may be integrated into the chassis frame design.

**Torque Value.** A measure of tightness or the amount of stress that is put on a fastening device (bolt) to properly secure it.

**Trunnion.** The attachment device welded to a hydraulic piston rod for connection of an anchor ear to a heel pin.

**Truss-Lattice-Type Boom Section.** A open truss boom framework with vertical and diagonal braces fastened to horizontal beams of the frame.

**Turntable.** A rotating structural component that allows rotation of an aerial device through a rotating bearing and that connects the aerial device to the chassis and stabilization system. It is normally designed to permit continuous 360-degree rotation and may or may not contain an operator's control station.

**Turntable Alignment Indicator.** An indicator that facilitates alignment of the aerial device with the cradle for bedding purposes.

**Turret Nozzle.** A water stream nozzle mounted on an aerial device and permanently connected to the waterway.

**Twist.** The degree of rotational movement from a given position.

**Ultimate Strength.** The ultimate strength of a material in tension, compression, or shear, respectively is the maximum tensile, compressive, or shear stress that the material can sustain, calculated on the basis of the ultimate load and the original or unrestrained dimensions.

**Ultrasonic Inspection.** A nondestructive method of inspection in which high-frequency vibrations are injected through the surface of the test material and bounced back to their source from the opposite surface; if a flaw exists, signals return in a different pattern, revealing the location and extent of the flaw.

**Visual Inspection.** Inspection by the eye without recourse to any optical devices, except prescription eyeglasses.

**Watertower.** An articulating or telescoping boom with a fixed waterway capable of providing a minimum 500-gpm elevated stream.

**Yield Strength.** The stress at which a material exhibits a specified permanent deformation or set.

## 1-4 General.

**1-4.1** The visual inspections, operational tests, and load tests specified in this standard shall be conducted at least annually; after major repairs or overhaul; following the use of the aerial device when the aerial device may have been subjected to unusual operating conditions of stress or load; or when there is reason to believe that usage has exceeded the manufacturer's recommended aerial device operating procedures.

**1-4.2*** The complete inspections and tests including the nondestructive testing (NDT) defined in this standard shall be done at least every 5 years. Nondestructive testing shall be conducted whenever visual inspection or load testing indicates a potential problem or there is a desire to further confirm continued operational safety.

**1-4.3** If the aerial device is involved in a situation that produces any structural damage, the aerial device shall be placed out of service, and the condition shall be reported, in writing, to the manufacturer. The aerial device shall be repaired to an acceptance level in accordance with the manufacturer's standard and tested to the full operational load and NDT of this standard before it is placed back in service.

**1-4.4*** The inspection and tests specified herein shall be used to supplement, not to replace or modify, any instructions recommended by the manufacturer's maintenance manuals. Since each manufacturer's unit will be somewhat different, specific attention shall be given to the manufacturer's instructions concerning periodic maintenance and inspection checks.

**1-4.5*** Only qualified persons, acceptable to the authority having jurisdiction, shall be allowed to operate the apparatus during testing procedures or to conduct any load tests.

**1-4.6** Tests of aerial ladders specified in Chapter 2 of this standard shall apply only to metal aerial ladders.

**1-5 Inspection Personnel.** Most of the inspections and tests outlined in this standard are intended to be performed by qualified fire department personnel. However, if the department prefers, the inspections and tests may be performed by a third-party testing company or the manufacturer. The person actually performing the nondestructive test work shall be certified as an ASNT Level II NDT technician in the test method used, as specified in the American Society for Nondestructive Testing ASNT SNT-TC-1A, *Recommended Practice,* No. 2025.

If a third-party test company is employed to do NDT, that company shall comply with the American Society for Testing and Materials Standard ASTM E543, *Standard Practice for Determining the Qualifications for Nondestructive Testing Agencies.*

**1-6 Visual Inspection.** A visual inspection, prior to any operational or load testing, is a very important part of this procedure and shall be carried out in a systematic sequence with proper attention to detail. This visual inspection of the equipment shall be for the detection of any visible defects, damage, or improperly secured parts.

**1-7 Weld Inspection.** When the inspections as required by 1-4.1 are performed, all accessible structural welds shall be visually inspected for fractures. When the nondestructive testing as required by 1-4.2 is performed, all accessible structural welds shall be inspected by ASNT Level II NDT technicians certified in the test methods used. All accessible structural welds shall be inspected in accordance with the appropriate provisions of the American Welding Society (AWS) Standard AWS D14.4, *Classification and Application of Welded Joints for Machinery and Equipment.* All structural welds shall comply with a Class IV weld quality as outlined in Table 7-17.4 of AWS D14.4.

**1-8 Nondestructive Testing Procedure.**

**1-8.1** All ultrasonic inspections shall be conducted in accordance with the following American Society for Testing and Materials (ASTM) standards:

(a) ASTM E114, *Practice for Ultrasonic Pulse-Echo Straight-Beam Examination by the Contact Method.*

(b) ASTM E797, *Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method.*

(c) ASTM E500, *Standard Terminology Relating to Ultrasonic Examination.*

**1-8.2** All magnetic particle inspections shall be conducted in accordance with the following American Society for Testing and Material (ASTM) standards:

(a) ASTM E709, *Practice for Magnetic Particle Examination.*

(b) ASTM E269, *Definitions of Terms Relating to Magnetic Particle Examination.*

**1-8.3** All liquid penetrant inspections shall be conducted in accordance with the following American Society for Testing and Material (ASTM) standards:

(a) ASTM E165, *Practice for Liquid Penetrant Inspection Method.*

(b) ASTM E270, *Definitions of Terms Relating to Liquid Penetrant Inspection.*

**1-8.4** All radiographic inspection shall be conducted in accordance with the following American Society for Testing and Materials (ASTM) standards:

(a) ASTM E1032, *Method for Radiographic Examination of Weldments;*

(b) ASTM E586, *Standard Definitions of Terms Relating to Gamma and X-Radiography.*

**1-8.5** All electrical conductivity measurements shall be conducted in accordance with the following American Society for Testing and Materials (ASTM) standards:

(a) ASTM E1004, *Test Method for Electromagnetic Measurements of Electrical Conductivity.*

(b) ASTM E268, *Definitions of Terms Relating to Electromagnetic Testing.*

**1-8.6** All hardness readings shall be conducted in accordance with the following American Society for Testing and Materials (ASTM) standards:

(a) ASTM E6, *Standard Definitions of Terms Relating to Methods of Mechanical Testing.*

(b) ASTM E10, *Test Method for Brinell Hardness of Metallic Materials.*

(c) ASTM E18, *Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials.*

(d) ASTM E92, *Test Method for Vickers Hardness of Metallic Materials.*

(e) ASTM B647, *Test Method for Indentation Hardness of Aluminum Alloys by Means of a Webster Hardness Gauge.*

(f) ASTM B648, *Test Method for Indentation Hardness of Aluminum Alloys by Means of a Barcol Impressor.*

**1-8.7** All acoustic emission inspections shall be conducted in accordance with the following American Society for Testing and Materials (ASTM) standards.

(a) ASTM E569, *Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation.*

(b) ASTM E610, *Definitions of Terms Relating to Acoustic Emission.*

(c) ASTM E650, *Guide for Mounting Piezoelectric Acoustic Emission Sensors.*

**1-8.8** The application of a particular nondestructive weld inspection technique shall be as recommended by the American Welding Society (AWS) Standard AWS B1.10, *Guide for the Nondestructive Inspection of Welds.*

## Chapter 2 Testing Metal Aerial Ladders

**2-1 General.** In addition to the manufacturer's recommendations, the inspections and tests detailed below shall be performed. An inspection preceded by a plus sign ( + ) indicates an appropriate nondestructive test (NDT) shall be conducted as required by Section 1-4.2 of this standard.

Problems that affect the structural integrity of the aerial

shall be called immediately to the attention of the manufacturer or the manufacturer's authorized representative.

Hydraulic components shall show no signs of hydraulic fluid leakage. A component shall be considered leaking if oil droplets are forming on the component. A film of oil on the component shall not be considered severe enough to categorize the component as leaking.

**2-2 Service Records.** The aerial ladder's service records shall be checked for any reports that may indicate defective conditions.

**2-3 Turntable and Torque Box Inspection and Test.** The turntable and torque box components, where applicable, shall be inspected on all aerial ladders in accordance with 2-3.1 through 2-3.25.

**2-3.1 Rotation Bearing Mounting Bolts.** The rotation bearing mounting bolts shall be inspected as follows:

(a) Inspect all accessible bolts for proper grade and fit as specified by the apparatus manufacturer.

(b) Using a properly calibrated torque wrench, verify that the bolt torque on all accessible bolts meets the apparatus manufacturer's specifications.

(c) ( + ) Inspect all accessible bolts for internal flaws.

**2-3.2 Torque Box Mounting to Frame.** The torque box mounting to frame shall be inspected as follows:

(a) If the torque box is bolted to the frame, inspect all accessible bolts for proper grade and fit as specified by the apparatus manufacturer.

(b) Using a properly calibrated torque wrench, verify that the torque on all accessible bolts meets the apparatus manufacturer's specification, if the torque box is bolted to the frame.

(c) If the torque box is welded to the frame, visually inspect all accessible attaching welds for fractures.

(d) ( + ) If the torque box is bolted to the frame, inspect all bolts for internal flaws.

(e) ( + ) If torque box is welded to frame, inspect all accessible attaching welds.

**2-3.3 Rotation Gear and Bearing.** The rotation gear and bearing shall be inspected as follows:

(a) Inspect the rotation gear for missing or damaged teeth, pinion-to-gear alignment, proper lubrication, and backlash.

(b) Record the inner bearing race to outer bearing race clearance, if accessible, in accordance with the bearing manufacturer's procedures and compare the clearance to the bearing manufacturer's specifications.

**2-3.4 Rotation Gear Reduction Box Mounting.** The rotation gear reduction box mounting shall be inspected as follows:

(a) If reduction box is bolted to turntable, inspect all bolts for proper grade and fit as specified by the apparatus manufacturer.

(b) Using a calibrated torque wrench, verify that the torque on all bolts meets the apparatus manufacturer's specification, if the reduction box is bolted to the turntable.

(c) Visually inspect all accessible weldments and welds for defects.

(d) ( + ) If the reduction box is bolted to the turntable, inspect all bolts for internal flaws.

(e) ( + ) If the reduction box is welded to the turntable, inspect all reduction box attaching welds.

**2-3.5 Turntable Structural Components.** The turntable structural components shall be inspected as follows:

(a) Visually inspect all accessible turntable structural components and welds for defects.

(b) ( + ) Inspect all accessible turntable structural component welds.

**2-3.6 Rotation Hydraulic Swivel.** Inspect the swivel for external hydraulic fluid leakage.

**2-3.7 Hydraulic Lines and/or Hoses in Turntable.** Inspect all hydraulic lines and/or hoses for kinks, cuts and abrasions, and hydraulic fluid leakage at connectors and fittings.

**2-3.8 Elevation, Extension, and Rotation Lock.** The elevation, extension, and rotation lock shall be inspected as follows:

(a) Inspect the manual valve elevation, extension, and rotation lock for external hydraulic fluid leakage.

(b) Test the manual valve elevation lock for proper operation by engaging the lock and then attempting to raise and lower the ladder with the main hydraulic system operating. No detectable movement shall occur as determined by visual inspection.

(c) Test the manual valve extension lock for proper operation by engaging the lock and then attempting to extend or retract the ladder with the main hydraulic system operating. No detectable movement shall occur as determined by visual inspection.

(d) Test the manual valve rotation lock for proper operation by engaging the lock and attempting to rotate the turntable clockwise and counterclockwise with the main hydraulic system. The movement shall not exceed the manufacturer's specification.

**2-3.9* Hydraulic Oil.** After the operational tests have been performed, remove a sample of the hydraulic oil from the hydraulic reservoir and subject the sample of the hydraulic oil to spectrochemical analysis.

**2-3.10 Power Takeoff.** Inspect the power takeoff for external hydraulic fluid leakage and proper operation (engagement and disengagement).

**2-3.11 Hydraulic Pump.** Inspect the hydraulic pump for external hydraulic fluid leakage.

**2-3.12 Collector Rings.** The collector rings shall be inspected as follows:

(a) Inspect the collector rings for foreign material buildup on rings, if accessible.

(b) If accessible, inspect the collector ring terminals for damage.

(c) Conduct tests to ensure the proper operation of the

collector rings by rotating the aerial device while electric-powered devices are in operation.

**2-3.13 Elevation Cylinder Anchor Ears and Plates.** The elevation cylinder anchor ears and plates shall be inspected as follows:

(a) Visually inspect elevation cylinder anchor ears and plates and attaching welds for discontinuities.

(b) ( + ) Inspect the elevation anchor ears and plate attaching welds for discontinuities.

**2-3.14 Elevation Cylinder Pins.** The elevation cylinder pins shall be inspected as follows:

(a) Inspect cylinder pins for alignment, proper installation, lubrication, operation, and retention.

(b) ( + ) Inspect cylinder pins for internal flaws.

**2-3.15 Elevation Cylinders.** The elevation cylinders shall be inspected as follows:

(a) Inspect cylinder rods for pitting, scoring, and other discontinuities.

(b) Subject the cylinders to a drift test by placing the aerial device at a 60-degree elevation, full extension, marking the cylinder position, closing manually operated locking valves, and allowing the device to stand for 1 hour with the engine off. The results of such a test shall not exceed the manufacturer's specifications for allowable cylinder drift.

**2-3.16 Holding Valves on Elevation Cylinders.** Inspect the holding valves for external and internal hydraulic fluid leakage.

**2-3.17 Operating Controls.** The operating controls shall be inspected as follows:

(a) Inspect the operating controls for missing or damaged control handles, proper identification, and hydraulic fluid leakage.

(b) Verify that the controls operate smoothly, return to neutral position when released, and do not bind during operation.

**2-3.18 Load Limit Indicators.** Inspect the load limit indicators for proper operation.

**2-3.19 Emergency Hand Crank Controls.** Inspect the hand crank control for proper operation.

**2-3.20 Auxiliary Hydraulic Power.** Inspect the auxiliary hydraulic power for proper operation.

**2-3.21 Turntable Alignment Indicator.** Verify the presence of a turntable alignment indicator.

**2-3.22 Throttle Control.** Verify that the throttle control is operable, and record the operating RPM using a tachometer or a revolution counter (if so equipped) and a stopwatch.

**2-3.23 Communication System.** Verify the proper operation of the turntable to the top of the aerial device communication system.

**2-3.24 Relief Hydraulic Pressure.** Verify that the main pump relief hydraulic pressure does not exceed the manufacturer's specifications.

**2-3.25 Unit Main Frame.** The unit main frame shall be inspected as follows:

(a) Visually inspect the main frame for any weldment defects and other defects such as weld cracks, bends, dents, or twists.

(b) ( + ) Inspect the main frame for any weldment discontinuities.

**2-4 Outrigger Examination and Test.** The outrigger components, where applicable, shall be inspected on all aerial ladder apparatus in accordance with 2-4.1 through 2-4.13.

**2-4.1 Outrigger Structural Components.** The outrigger structural components shall be inspected as follows:

(a) Visually inspect all outrigger components for defects such as dents or bends.

(b) ( + ) Inspect all outrigger components for any weldment and/or weld discontinuities.

**2-4.2 Outrigger Plates.** Verify that the outrigger plates are present, of proper construction, and in serviceable condition.

**2-4.3 Outrigger Mounting to Frame or Torque Box.** The outrigger mounting to the frame or torque box shall be inspected as follows:

(a) Visually inspect the outrigger to frame and/or torque box attachment for defects such as weld cracks, dents, and bends.

(b) ( + ) If welded, inspect the outrigger to frame and/or torque box mounting for any weld discontinuities.

(c) If bolted, inspect all bolts for proper fastener grade and fit as specified by the apparatus manufacturer.

(d) Verify that the torque on all bolts meets the apparatus manufacturer's specification using a properly calibrated torque wrench.

(e) ( + ) Inspect all bolts for internal flaws.

**2-4.4 Hydraulic Lines and/or Hoses in Outrigger System.** Inspect the hydraulic hose lines for kinks, cuts and abrasions, and leakage at connectors and fittings.

**2-4.5 Outrigger Interlock and/or Warning Device.** Verify that the interlock system is operating properly.

**2-4.6 Outrigger Extension Cylinder Pins and Hinge Pins.** The extension cylinder pins and hinge pins shall be inspected as follows:

(a) Inspect all outrigger cylinder pins and hinge pins for proper installation, lubrication, operation, and retention.

(b) ( + ) Inspect all outrigger pins and hinge pins for internal flaws.

**2-4.7 Outrigger Extension Cylinder.** The outrigger extension cylinder shall be inspected as follows:

(a) Inspect the outrigger extension cylinder rods for pitting and scoring.

(b) With the outrigger's cylinders properly set, measurements shall be taken to determine the amount of drift present in 1 hour with the engine off. The results shall not exceed the manufacturer's specifications for allowable outrigger cylinder drift.

**2-4.8 Holding Valves on Extension Cylinders.** Inspect the holding valves for external and internal leakage of hydraulic fluid.

**2-4.9 Operating Controls.** Verify that the controls operate smoothly, return to the neutral position when released, do not bind during operation, and are free of hydraulic fluid leakage.

**2-4.10 Diverter Valve.** Inspect the diverter valve for external hydraulic fluid leakage.

**2-4.11 Positive Stops and Alignment.** Inspect the mechanical outriggers for proper operation of the positive stops to prevent overextension.

**2-4.12 Manual Spring Locks.** Inspect the condition and operation of outrigger manual spring locks for stowed position.

**2-4.13 Tractor Spring Lockout Device.** Inspect the spring lockout device for any discontinuities and for proper operation.

**2-5 Aerial Ladder Inspection and Test.** The aerial ladder shall be inspected in accordance with 2-5.1 through 2-5.28.

**2-5.1 Aerial Ladder Weldments.** All aerial ladder weldments shall be inspected as follows:

(a) Visually inspect all accessible aerial ladder weldments for fractures.

(b) ( + ) Inspect all welds of ladder weldments.

**2-5.2 Aerial Ladder Fasteners.** All aerial ladder structural fasteners and fastened connections shall be visually inspected for cracked fasteners and material cracks around the fasteners.

**2-5.3 Ladder Section Alignment.** Measurements shall be taken to determine the amount of ladder section twist and/or bow in the aerial ladder. Results shall not exceed manufacturer's specifications for allowable ladder section twist and/or bow.

**2-5.4 Hydraulic Lines and Hoses in Ladder Sections.** Inspect all hydraulic hoses or lines for kinks, cuts, wear and abrasions, and leakage.

**2-5.5 Modifications or Unauthorized Repairs.** Inspect the aerial ladder for modifications or repairs unauthorized by the manufacturer.

**2-5.6 Handrail.** The handrails shall be inspected as follows:

(a) Inspect the handrails for straightness or any signs of misalignment.

(b) ( + ) Conductivity and hardness readings shall be taken at intervals of 28 in. (71 cm) or less along the entire length of both handrails of ladders constructed of aluminum. Results are to be compared to manufacturer's specifications. Exposure to heat will alter these values.

**2-5.7* Base Rails.** The base rails shall be inspected as follows:

(a) Inspect the base rail for straightness and any signs of wear, ironing, and corrosion.

(b) ( + ) Inspect the bottom of all hollow I-beam base rails to determine the thickness of the rail. Results shall not be less than the manufacturer's minimum specifications.

(c) ( + ) Conductivity and hardness readings shall be taken at intervals of 28 in. (71 cm) or less along the entire length of both base rails of ladders constructed of aluminum. Results are to be compared to the manufacturer's specifications.

**2-5.8 Rungs.** Inspect all rungs of the aerial ladder for straightness, signs of fly lock damage, damaged or loose rung covers and rung cap castings, and signs of cracks and/or missing rivets, if applicable.

**2-5.9 Folding Steps.** The folding steps shall be inspected as follows:

(a) Visually inspect folding steps and folding step mounting brackets for defects.

(b) ( + ) Inspect all welds on the folding step and folding steps mounting brackets of ladders.

**2-5.10 Rollers.** Inspect all rollers for proper lubrication, operation, and any signs of wear.

**2-5.11 Guides, Babbits, Wear Strips, Pads, and Slide Blocks.** Visually inspect the guides for cracked welds, loose rivets, alignment, and any irregularities. Inspect babbits for signs of wear. Inspect wear strips, pads, and slide blocks for wear, gouging, and proper mounting.

**2-5.12 Extension Sheaves.** The extension sheaves shall be inspected as follows:

(a) Inspect extension sheaves for signs of wear, free movement during operation, proper retainers, and lubrication.

(b) Visually inspect all extension sheave mounting brackets for defects.

(c) ( + ) Inspect all welds of extension sheave mounting brackets.

**2-5.13 Extensions Cables.** Inspect extension cables for compliance with Appendix A of the Society of Automotive Engineers Standard SAE J959, *Lifting Crane, Wire-Rope Strength Factors.*

**2-5.14 Extension/Retraction Motor.** Inspect the extension/retraction motor for signs of external hydraulic fluid leakage and, where applicable, brake wear, and brake alignment with the shaft.

**2-5.15 Cable Separation Guide.** During operation of the aerial, visually inspect the cable separation guide for free travel and any signs of misalignment.

**2-5.16 Winch Holding Capacity.** Inspect the winch for holding capacity by fully elevating the aerial ladder and extending it 10 ft (3 m). The winch shall not slip unless it is designed to.

**2-5.17 Brake Holding Capacity.** Inspect the brake holding capacity of the extension motor by fully elevating the aerial ladder and extending it 10 ft (3 m). The brake shall not slip.

**2-5.18 Extension and Elevation Indicators.** Inspect the elevation and extension indicators for legibility, clarity, and accuracy.

**2-5.19 Fly Locks.** Inspect the fly lock mechanisms for proper mounting, alignment, lubrication, and operation.

**2-5.20 Ladder Cradle.** Inspect the aerial ladder cradle for wear and proper alignment.

**2-5.21 Ladder Bed Lock.** Inspect the ladder bed lock mechanism and hydraulic lines for proper mounting, signs of wear, and hydraulic fluid leakage at fittings.

**2-5.22 Stop Mechanism.** Inspect the stop mechanisms to ensure they prevent overextension or overretraction of the aerial ladder.

**2-5.23 Maximum Extension Warning Device.** During operation of the aerial ladder, verify the proper operation of the audible device to warn of the approach to maximum extension.

**2-5.24 Ladder Illumination.** Inspect the operation of the lights that are used to illuminate the ladder.

**2-5.25 Extension Cylinder Anchor Ears and Plates.** The extension cylinder anchor ears and plates shall be inspected as follows:

(a) Visually inspect the extension cylinder anchor ears and plates and attaching welds for defects and discontinuities.

(b) ( + ) Inspect the extension cylinder anchor ears and plate attaching welds for discontinuities.

**2-5.26 Extension Cylinder Pins.** The extension cylinder pins shall be inspected as follows:

(a) Inspect the cylinder pins for proper installation and retention.

(b) ( + ) Inspect the cylinder pins for internal flaws.

**2-5.27 Extension Cylinder.** The extension cylinders shall be inspected as follows:

(a) Inspect the cylinder rods for pitting, scoring, and other discontinuities.

(b) Subject the cylinder(s) to drift by placing the aerial device at full elevation, 10-ft (3-m) extension, marking the cylinder piston or the second section in relation to the base section, and allowing the ladder to stand for 1 hour with the engine off. The results shall not exceed the manufacturer's specifications for allowable cylinder drift.

**2-5.28 Holding Valves on Extension Cylinder.** Inspect the holding valves for external and internal hydraulic fluid leakage.

### 2-6 Operating Test.

**2-6.1** A complete cycle of aerial ladder operation shall be carried out after starting the engine, setting the jacks, and transmitting power to the ladder. The ladder shall be fully elevated out of the bed, rotated 90 degrees, and extended to full extension.

**2-6.2** A ladder without permanent waterways shall complete this test smoothly and without undue vibration in not over 60 seconds. A ladder with permanent waterways shall complete this test smoothly and without undue vibration or jerking in not over 105 seconds.

**2-6.3** The ladder shall be retracted, the turntable rotation completed through 360 degrees, and then the ladder lowered to its bed, after which a thorough inspection shall be made of all moving parts. Special attention shall be given to the security and adjustment of the ladder cables or chains.

**2-6.4** The test shall demonstrate successful operation of all ladder controls.

### 2-7 Load Testing.

**2-7.1*** Tests shall be conducted when wind velocity is less than 10 mph (16 kmh).

**2-7.2** A close watch shall be maintained during all load tests. Only those personnel essential to conduct the test shall be permitted near the apparatus during the test. If the ladder shows any twist at any time, the test shall be discontinued immediately and the aerial ladder shall be placed out of service, and the condition shall be reported in writing to the manufacturer. The aerial ladder shall be repaired in accordance with the manufacturer's written recommendations and fully tested before it is placed back in service.

#### 2-7.3 Horizontal Load Test.

**2-7.3.1** The aerial turntable shall be level. The aerial apparatus vehicle shall be on a firm, level surface or road. All ground jacks shall be down and have a firm footing on the ground.

**2-7.3.2*** A test cable hanger shall be attached to the top rung of the top ladder section and properly centered. (*See Figure A-2-7.3.2.*)

**2-7.3.3** The maximum rated live load in the horizontal position shall be determined from the manufacturer's load chart or operator's manual. If full extension is not permitted in the horizontal position with a specified live load, then the maximum permissible extension with a specified live load shall be used for the purpose of this test.

**2-7.3.4** For single chassis apparatus, the ladder shall be rotated, if necessary, until the ladder is positioned over the

rear and parallel to the vehicle centerline. For tractor-drawn apparatus, the ladder shall be positioned in the most stable position as recommended by the manufacturer.

**2-7.3.5** The ladder shall be placed in the horizontal position and extended to full extension or maximum permitted extension as determined in 2-7.3.3. The base section shall not be allowed to rest in the bed.

**2-7.3.6** The ladder section locks, either manual pawls or hydraulic holding valves, shall be properly applied.

**2-7.3.7** The elevation cylinder integral holding valve or shutoff safety valve shall be properly closed or applied.

**2-7.3.8** The ladder section rung rails' or beams' twist shall not exceed the manufacturer's tolerance for twist.

**2-7.3.9*** A weight equal to the manufacturer's specified rated live load, determined in 2-7.3.3, shall be gradually applied to the top rung of the aerial ladder by utilizing the test weight container or other suitable means of applying the weight.

NOTE: The total weight of the supporting hangers, containers, etc., and test weight shall be taken as a whole and shall not exceed the rated live load. Dropping the weights and shock loading the ladder shall not be permitted.

**2-7.3.10** The test weight shall be sustained by the unsupported aerial ladder for 5 minutes.

**2-7.3.11** The test weight shall hang freely from the tip of the aerial ladder. If the test weight hanger and ladder deflection are such that the test weight comes to rest on the ground, it shall be permissible to raise the ladder elevation slightly above the horizontal position.

WARNING: At no time during the load test shall the ladder be moved with the test weight applied.

**2-7.3.12** After removal of the test weight, a complete visual inspection shall be made of all load-supporting elements. Any visually detectable signs of damage or permanent deformation shall constitute noncompliance with the load test requirements. The aerial device shall also meet the requirements of Section 2-6 after the load test.

### 2-7.4 Maximum Elevation Load Test.

**2-7.4.1** The aerial turntable shall be level. The aerial apparatus vehicle shall be on a firm, level surface or road. All ground jacks shall be down and have a firm footing on the ground.

**2-7.4.2** A test cable hanger shall be attached to the top rung of the top ladder section and properly centered. (*See Figure A-2-7.3.2.*)

**2-7.4.3** The maximum rated live load in the maximum elevated position at full extension shall be determined from the manufacturer's load chart or operator's manuals.

**2-7.4.4** The ladder shall be rotated, if necessary, until the ladder is positioned over the rear and parallel to the vehicle centerline.

**2-7.4.5** The ladder shall be elevated to maximum elevation and fully extended.

**2-7.4.6** The ladder section locks, either manual pawls or hydraulic holding valves, shall be properly applied.

**2-7.4.7** The elevation cylinder integral holding valve or shutoff safety valve shall be properly closed or applied.

**2-7.4.8** The ladder section rung rails or beams shall be parallel to each other and without twist prior to adding any test weight.

**2-7.4.9** A weight equal to the manufacturer's specified rated live load, determined in 2-7.4.3, shall be gradually applied to the top rung of the aerial ladder by utilizing a test weight container or other suitable means of applying the weight. The weight shall be suspended by cable and shall be not more than 3 ft (1 m) above the ground.

NOTE: The total weight of the supporting hangers, containers, etc., and test weight shall be taken as a whole and shall not exceed the rated live load. Dropping the weights and shock loading the ladder shall not be permitted.

**2-7.4.10** The test weight shall be sustained by the unsupported aerial ladder for 5 minutes.

**2-7.4.11** The test weight shall hang freely from the tip of the aerial ladder.

WARNING: At no time during the load test shall the ladder be moved with the test weight applied.

**2-7.4.12** After removal of the test weight, a complete visual inspection shall be made of all load-supporting elements. Any visually detectable signs of damage or permanent deformation shall constitute noncompliance with the load test requirements. The aerial device shall also meet the requirements of Section 2-6 after the load test.

### 2-8 Water System Test.

**2-8.1** The following examination and test shall apply only to permanently piped aerial ladder pipes.

**2-8.2** The waterway and system shall be inspected for proper operation of all components. It shall be free of rust, corrosion, or any sign of deterioration or blockage.

**2-8.3** The waterway attaching brackets shall be inspected as follows:

(a) Inspect the brackets for loose bolts, cracked welds, or other discontinuities.

(b) ( + ) Inspect all attaching welds.

**2-8.4** The water system shall be pressure tested as follows:

**2-8.4.1*** The discharge end of the water system shall be equipped with a valve. The water system shall be filled with water and the valve closed.

NOTE: For safety reasons, all air must be removed from the system.

**2-8.4.2** The aerial lader shall be positioned for maximum extension of the permanently piped waterway.

**2-8.4.3** The pressure on the water system shall be raised to 200 psi (1379 kPa). Care shall be taken during the test not to overheat the pump.

**2-8.4.4*** The pressure shall be sustained on the system without leaks for two minutes.

**2-9* Records.** A proper record shall be completed for all tests of the aerial ladder by the person responsible for the test.

## Chapter 3 Testing Elevating Platforms

**3-1 General.** In addition to the manufacturer's recommendations, the inspections and tests detailed below shall be performed. An inspection preceded by a plus sign ( + ) indicates an appropriate nondestructive test (NDT) shall be conducted as required by 1-4.2 of this standard.

Any problems detected during the examination shall be corrected prior to proceeding to subsequent tests. Such problems that affect the structural integrity of the elevating platform shall be called immediately to the attention of the manufacturer or the manufacturer's authorized representative.

Hydraulic components shall show no signs of hydraulic fluid leakage. A component shall be considered leaking if oil droplets are forming on the component. A film of oil on the component shall not be considered severe enough to categorize the component as leaking.

**3-2 Service Records.** The elevating platform's service records shall be checked for any reports that may indicate defective conditions.

**3-3 Turntable and Torque Box Inspection and Test.** The turntable and torque box components, where applicable, shall be inspected on all elevating platforms in accordance with 2-3.1 through 2-3.12 and 2-3.21 through 2-3.25.

**3-4 Outrigger Examination and Test.** The outrigger components, where applicable, shall be inspected on all elevating platform apparatus in accordance with 2-4.1 through 2-4.13.

**3-5 Elevating Platform and Boom Inspection and Test.** All platforms and booms shall be inspected in accordance with 3-5.1 through 3-5.13.

**3-5.1 Platform Mounting Brackets.** The platform mounting brackets shall be inspected as follows:

(a) Visually inspect all platform mounting brackets for defects such as weld cracks, dents, or bends.

(b) ( + ) Inspect all welds in the platform mounting brackets.

(c) ( + ) Inspect all bolts and pins structurally involved with the platform mounting to the ladder or boom for internal flaws.

**3-5.2 Platform.** The platform shall be inspected as follows:

(a) Visually inspect platform for defects, such as weld cracks, dents, or bends.

(b) ( + ) Inspect all welds on platforms.

**3-5.3 Hydraulic, Pneumatic, and Electrical Lines in Platform.** Inspect all lines for proper mounting, wear, cracking, kinks, and abrasions.

**3-5.4 Auxiliary Winch Mounting.** The auxiliary winch mounting shall be inspected as follows:

(a) Inspect all mounting bolts for proper grade and fit as specified by the apparatus manufacturer.

(b) Using a calibrated torque wrench, verify that the torque on all winch mounting bolts meets the apparatus manufacturer's specifications.

(c) If welded, visually inspect the winch mounting for weld defects.

(d) ( + ) Inspect the mounting bolts for internal flaws.

(e) ( + ) If brackets are welded, inspect all welds on mounting brackets.

**3-5.5 Winch Controls.** The winch controls shall be inspected as follows:

(a) Inspect controls for proper identification as to function and operation.

(b) Verify smooth operation of the winch controls.

**3-5.6 Platform Load Capacity Identification.** Verify that the proper platform capacity identification plate exists and is legible.

**3-5.7 Platform Gate Latches and Hinge Points.** Inspect the platform gate latches for proper alignment and the latch and hinges for smooth operation.

**3-5.8 Platform Hinge Pins.** The platform hinge pins shall be inspected as follows:

(a) Inspect platform hinge pins for proper installation, lubrication, and any irregularities.

(b) ( + ) Inspect the platform hinge pins for internal flaws.

**3-5.9 Platform Controls.** The platform controls shall be inspected as follows:

(a) Inspect the platform operating controls for identification of functions, posted operating instructions, and warnings.

(b) Verify that the controls operate smoothly, return to neutral when released, and do not bind during operation.

(c) Verify that the turntable or lower controls will override the platform controls.

**3-5.10 Communication System.** The communication system shall be inspected as follows:

(a) Inspect the communication system for proper installation.

(b) Verify that the communication system operates properly from both the platform and the turntable.

**3-5.11 Unauthorized Modifications and Added Weight.** Verify that no unauthorized modifications or extra equipment have been added to the platform without subtracting the weight of such from the platform net operating capacity.

**3-5.12 Platform Turret Nozzle.** The platform turret nozzle shall be inspected as follows:

(a) Inspect the complete operation of the platform turret and nozzle.

(b) Inspect the nozzle's mounting brackets for any discontinuities.

**3-5.13 Boom Illumination.** Verify the operation of spotlights used to illuminate the boom.

**3-6 Articulating Boom — Lower Boom Examination and Test.** For apparatus equipment with an articulating boom, the lower boom shall be inspected and tested in accordance with 3-6.1 through 3-6.13.

**3-6.1 Hinge Pins.** The hinge pins shall be inspected as follows:

(a) Inspect the boom hinge pins for proper installation, lubrication, operation, and any discontinuities.

(b) ( + ) Inspect the boom hinge pins for internal flaws.

**3-6.2 Lower Boom Elevation Cylinder Anchor Ears and Plates.** The lower boom elevation cylinder anchor ears and plates shall be inspected as follows:

(a) Visually inspect the anchor ears and plates and attaching welds for defects.

(b) ( + ) Inspect all welds of anchor ears and plates.

**3-6.3 Lower Boom Elevation Cylinders.** The boom elevation cylinder shall be inspected as follows:

(a) Inspect the boom elevation cylinders for internal and external hydraulic fluid leakage.

(b) Raise the lower boom to a 30-degree elevation and the upper boom to maximum elevation. Measurements shall be taken to determine the amount of drift present in the boom elevation cylinders in 1 hour. Results of this test shall not exceed the manufacturer's specifications for allowable lower boom cylinder drift.

**3-6.4 Holding Valves on Boom Elevation Cylinder.** Inspect the holding valves for signs of external or internal hydraulic fluid leakage.

**3-6.5 Boom Assembly.** The lower boom assembly shall be inspected as follows:

(a) Visually inspect the boom for defects such as weld cracks, dents, or bends.

(b) Visually inspect all structural fasteners and fastened connections for cracked fasteners and material cracks around the fasteners.

(c) ( + ) Inspect all welds on the boom for any structural discontinuities.

(d) ( + ) Conductivity and hardness readings shall be taken at intervals of 28 in. (71 cm) or less on booms constructed of aluminum. Results of this test shall be compared with the manufacturer's specifications concerning conductivity and hardness readings of the material used for construction of the lower boom.

**3-6.6 Cylinder Link Pins.** The cylinder link pins shall be inspected as follows:

(a) Inspect the cylinder link pins for proper installation, lubrication, operation, and any discontinuities.

(b) ( + ) Inspect the cylinder link pins for internal flaws.

**3-6.7 Platform Leveling Linkages.** The platform leveling linkages shall be inspected as follows:

(a) Visually inspect linkages for defects such as weld cracks, dents, and bends.

(b) ( + ) Inspect all welds of the leveling assembly.

(c) ( + ) Inspect all leveling linkage pins for any internal flaws.

**3-6.8 Hydraulic Lines and/or Hoses in Lower Boom.** Inspect all hydraulic lines in the lower boom for proper mounting, abrasion, hydraulic fluid leakage, and wear.

**3-6.9 Hydraulic Lines in Knuckle.** Inspect all hydraulic lines in the knuckle for hydraulic fluid leakage, abrasion, and any signs of wear.

**3-6.10 Cables, Chains, and Rods.** Inspect all cables, chains, and rods for signs of wear and for proper adjustment.

**3-6.11 Sprockets, Pulleys, and Hooks.** Inspect all sprockets, pulleys, and hooks for proper lubrication, signs of wear, distortion, and proper operation.

**3-6.12 Boom Support.** The boom support shall be inspected as follows:

(a) Visually inspect the boom support for defects such as weld cracks, dents, or bends.

(b) ( + ) Inspect the boom support welds and bracket attachment.

**3-6.13 Lower Boom Angle Indicator Lights.** Verify the proper operation of the lower boom angle indicator lights.

**3-7 Articulating Boom — Upper Boom Examination and Test.** For apparatus equipment with an articulating boom, the upper boom shall be inspected and tested in accordance with 3-7.1 through 3-7.11.

**3-7.1 Upper Boom for Alignment with Lower Boom.** Verify that the upper boom is aligned with the lower boom.

**3-7.2 Platform Leveling Linkages.** The platform leveling linkages shall be inspected as follows:

(a) Visually inspect linkages for defects such as weld cracks, dents, or bends.

(b) ( + ) Inspect all welds of leveling assemblies.

(c) ( + ) Inspect all leveling linkage pins for any internal flaws.

**3-7.3 Boom Boost Cylinder Brackets.** The boom boost cylinder brackets shall be inspected as follows:

(a) Visually inspect the boom boost cylinder brackets for defects such as weld cracks, dents, or bends.

(b) ( + ) Inspect the boom boost cylinder bracket welds.

**3-7.4 Boom Boost Cylinders.** Inspect the boom boost cylinders for any external hydraulic fluid leakage.

**3-7.5 Cylinder Link Pins.** The cylinder link pins shall be inspected as follows:

(a) Visually inspect the cylinder link pins for proper installation, lubrication, operation, and any irregularities.

(b) ( + ) Inspect the cylinder link pins for internal flaws.

**3-7.6 Boom Assembly.** The upper boom assembly shall be inspected as follows:

(a) Visually inspect the boom for defects such as weld cracks, dents, or bends.

(b) Visually inspect all structural fasteners and fastener connections for cracked fasteners and material cracks around the fasteners.

(c) ( + ) Inspect all welds on the boom for any structural discontinuities.

(d) ( + ) Conductivity and hardness readings shall be taken at intervals of 28 in. (71 cm) or less on booms constructed of aluminum. Results of this test shall be compared with the manufacturer's specifications concerning conductivity and hardness readings of the material used for construction of the lower boom.

**3-7.7 Hydraulic Lines and/or Hoses in Upper Boom.** Inspect all hydraulic hoses/lines in the upper boom for proper mounting, abrasions, hydraulic fluid leakage, and wear.

**3-7.8 Cables, Chains, and Rods.** Inspect all cables, chains, and rods for signs of wear and for proper adjustment.

**3-7.9 Sprockets, Pulleys, and Hooks.** Inspect all sprockets, pulleys, and hooks for proper lubrication, signs of wear, distortion, and proper operation.

**3-7.10 Upper Boom Hold-down Device.** The upper boom hold-down device shall be inspected as follows:

(a) Visually inspect the upper boom hold-down device for defects and for proper operation.

(b) ( + ) Inspect all welds of the upper boom hold-down device.

**3-7.11 Safety Stop Mechanism.** Verify that the safety stop mechanism operates properly.

**3-8 Telescoping Boom Examination and Test.** For platforms equipped with a telescoping boom, the boom shall be inspected and tested in accordance with 2-3.13 through 2-3.16, 3-6.10 through 3-6.12, and 3-8.1 through 3-8.13.

**3-8.1 Boom Assemblies.** The boom assemblies shall be inspected as follows:

(a) Visually inspect booms for defects such as weld cracks, dents, or bends:

(b) Visually inspect all structural fasteners and fastened connections for cracked fasteners and material cracks around the fasteners.

(c) ( + ) Inspect all welds on booms for any structural discontinuities.

(d) ( + ) Conductivity and hardness readings shall be taken at intervals of 28 in. (71 cm) or less on booms constructed of aluminum. Results of this test shall be compared with the manufacturer's specifications concerning conductivity and hardness readings of the material used for construction of the lower boom.

**3-8.2 Escape Ladder.** Inspect the escape ladder for any defects.

**3-8.3 Guides, Wear Strips and Pads, and Slide Block.** Inspect guides, wear strips and pads, and slide blocks for proper installation and signs of wear.

**3-8.4 Extension Sheaves.** The extension sheaves shall be inspected as follows:

(a) Inspect the extension sheaves for proper mounting, alignment, and signs of wear.

(b) ( + ) Inspect all welds of the extension sheave mounting brackets.

(c) ( + ) Inspect retaining bolt for internal flaws.

**3-8.5 Extension Cables.** The extension cables shall be inspected for frays, kinks, or abnormal wear.

**3-8.6 Elevation Indicator.** Inspect the elevation cylinder indicator for legibility and clarity.

**3-8.7 Maximum Extension Warning.** During operation, verify the proper operation of the audible device to warn of the approach to maximum extension, if so equipped.

**3-8.8 Platform Leveling Cylinders.** The platform leveling cylinders shall be inspected as follows:

(a) Visually inspect the platform leveling cylinders and the mounting of the leveling system for proper installation, defects, or discontinuities.

(b) ( + ) Inspect all welds for mounting of the leveling system.

(c) ( + ) Inspect all leveling cylinder pins for any internal flaws.

**3-8.9 Hydraulic Lines and/or Hoses in Boom Assemblies.** Inspect all hydraulic lines hoses in the boom assemblies for hydraulic fluid leakage, abrasions, and any signs of wear.

**3-8.10 Extension Cylinder Anchor Ears and Plates.** The extension cylinder anchor ears and plates shall be inspected as follows:

(a) Visually inspect the extension cylinder anchor ears and plates and attaching welds for defects and discontinuities.

(b) ( + ) Inspect the extension cylinder anchor ears and plate attaching welds for discontinuities.

**3-8.11 Extension Cylinder Pins.** The extension cylinder pins shall be inspected as follows:

(a) Inspect the cylinder pins for proper installation and retention.

(b) ( + ) Inspect the cylinder pins for internal flaws.

**3-8.12 Extension Cylinder.** The extension cylinders shall be inspected as follows:

(a) Inspect the cylinder rods for pitting, scoring, and other discontinuities.

(b) Subject the cylinder(s) to drift by placing the aerial device at full elevation, 10-ft (3-m) extension, marking the cylinder piston or the second section in relation to the base section, and allowing the ladder to stand for 1 hour with the engine off. The results shall not exceed the manufacturer's specifications for allowable cylinder drift.

**3-8.13 Holding Valves on Extension Cylinder.** Inspect the holding valves for external and internal hydraulic fluid leakage.

**3-9 Operational Tests from Lower Controls.**

**3-9.1** With engine speed set to allow maximum speed as permitted by the manufacturer, the elevating platform shall be operated in all positions, as allowed by manufacturer, using the lower or ground controls.

**3-9.2** The operation of the elevating platform shall include, but not be limited to, movement of the platform basket from ground to maximum elevation as well as revolving the platform basket 360 degrees to the left and to the right while the unit is at its maximum horizontal reach.

**3-9.3** The boom shall operate without any improper or unusual motion or sound.

**3-9.4** All safety devices shall operate properly.

**3-9.5** All controls shall operate smoothly, return to the neutral position when released, and not bind during operation.

**3-9.6** If equipped with a spirit level, check the level for accuracy and legibility.

**3-9.7** For telescoping elevating platforms, rollers, slides, and sheave wheels shall demonstrate proper alignment, function, and free operation.

**3-9.8** A complete cycle of elevating platform operation shall be carried out after starting the engine, setting the jacks, and transmitting power to the platform booms or sections.

**3-9.8.1** Operating the machine from the lower control station, the elevating platform shall be raised out of the bed, extended to full specified height, and rotated through a 90-degree turn. This shall be completed smoothly and without undue vibration within the manufacturer's recommended time.

**3-9.8.2** The elevating platform shall be retracted, then the turntable rotation completed through 360 degrees, and then the elevating platform lowered to its bed after which a thorough inspection shall be made of all moving parts. Special attention shall be given to the platform leveling system.

**3-9.8.3** The test shall demonstrate successful operation of all elevating platform controls.

**3-10 Operational Tests from Platform Controls.**

**3-10.1** With engine speed set to allow maximum speed as permitted by the manufacturer, the elevating platform shall be operated in all positions, as allowed by the manufacturer, with only one operator in the platform basket operating from the platform control station.

**3-10.2** The operation of the elevating platform shall include, but not be limited to, movement of the platform basket from ground to maximum elevation, as well as revolving the platform basket 360 degrees to the left and to the right while the unit is at its maximum horizontal reach.

**3-10.3** All safety devices shall operate properly.

**3-10.4** The platform basket deactivation control, from the ground or lower controls, shall be demonstrated to operate properly.

**3-10.5** The platform basket shall level properly as the booms are moved through all allowable positions.

**3-10.6** The mechanical override on a hydraulically leveled elevating platform basket shall operate properly during emergency lowering of the boom without hydraulic power.

**3-10.7** With the hydraulic pump stopped, pilot-operated holding valves on cylinders shall demonstrate their proper operation in holding the booms in position without power.

**3-11 Load Test.**

**3-11.1** With the unit located on a hard level surface and allowing sufficient room for unrestricted boom movements, a stability and structural test shall be performed. This test shall determine the elevating platform's ability to perform properly while carrying rated capacity loads in the platform basket. (*See NFPA 1901, Standard on Automotive Fire Apparatus.*)

**3-11.2** The unit shall be properly stabilized according to the manufacturer's recommendation.

**3-11.3** The platform basket shall be placed near the ground and loaded to the manufacturer's rated payload capacity. Care shall be exercised to assure that the weight of equipment added to the platform basket after delivery

is subtracted from the weight of the test load being added. The platform basket load shall be properly secured.

**3-11.4** The unit shall be operated from the lower controls through all allowable phases of operation. The manufacturer's operational limits shall not be exceeded.

**3-11.5** The outriggers shall show no evidence of any instability. If instability is observed, testing shall cease and the apparatus repositioned or the manufacturer notified.

**3-11.6** All boom movements shall exhibit no abnormal noise, vibration, or deflection.

**3-11.7** The platform basket shall level properly as the booms are moved though all allowable positions.

**3-11.8** At the conclusion of the load test, weld joints at outrigger structure, outriggers, frame, main frame, frame reinforcements, turntable, cylinder anchors, boom joints, leveling system, platform basket, and pivot pin bosses shall be inspected and shall show no signs of deterioration.

**3-12 Water System Examination and Test.**

**3-12.1** The waterway and system shall be inspected for proper operation of all components. It shall be free of rust, corrosion, or any sign of deterioration or blockage.

**3-12.2** The waterway attaching brackets shall be inspected as follows:

(a) Inspect the brackets for loose bolts, cracked welds, or other discontinuities.

(b) ( + ) Inspect all attaching welds.

**3-12.3 Pressure Test.** The water system shall be pressure tested as follows:

**3-12.3.1*** The water system shall be filled with water and the valve at the discharge end closed. If there is not a valve at the discharge end, a valve shall be attached for the purpose of this test.

NOTE: For safety reasons, all air must be removed from the system.

**3-12.3.2** The pressure on the water system shall be raised to 200 psi (1379 kPa). Care shall be taken during this test not to overheat the pump.

**3-12.3.3** The aerial platform shall be positioned at its maximum horizontal reach as permitted by the manufacturer and rotated through 360 degrees.

**3-12.3.4** The aerial platform shall be positioned at its maximum elevation as permitted by the manufacturer and rotated through 360 degrees.

**3-12.3.5*** The waterway shall operate properly and with an absence of leaks during this test.

**3-13* Records.** A proper record shall be completed for all tests of the elevating platform and signed by the person responsible for the tests.

## Chapter 4 Testing Water Towers

**4-1 General.** In addition to the manufacturer's recommendations, the inspections and tests detailed below shall be performed. An inspection preceded by a plus sign ( + ) indicates an appropriate nondestructive test (NDT) shall be conducted as required by Section 1-4.2 of this standard.

Any problems detected during this examination shall be corrected prior to proceeding to subsequent tests. Such problems that affect the structural integrity of the elevating platform shall be called immediately to the attention of the manufacturer or the manufacturer's authorized representative.

Hydraulic components shall show no signs of hydraulic fluid leakage. A component shall be considered leaking if oil droplets are forming on the component. A film of oil on the component shall not be considered severe enough to categorize the component as leaking.

**4-2 Service Records.** The water tower's service records shall be checked for any reports that may indicate defective condition.

**4-3 Turntable and Torque Box Inspection and Test.** The turntable and torque box components, where applicable, shall be inspected on all water tower apparatus in accordance with 2-3.1 through 2-3.25.

**4-4 Outrigger Examination and Test.** The outrigger components, where applicable, shall be inspected on all water tower apparatus in accordance with 2-4.1 through 2-4.12.

**4-5 Articulating Boom — Lower Boom Examination and Test.** For water tower apparatus equipped with an articulating boom, the lower boom shall be inspected and tested in accordance with 3-6.1 through 3-6.6 and 3-6.8 through 3-6.12, as applicable.

**4-6 Articulating Boom — Upper Boom Examination and Test.** For water tower apparatus equipped with an articulating boom, the upper boom shall be inspected and tested in accordance with 3-7.1 and 3-7.3 through 3-7.10, as applicable.

**4-7 Telescoping Boom Examination and Test.** For water tower apparatus equipped with a telescoping boom, the booms shall be inspected and tested in accordance with 3-6.10 through 3-6.12, 3-8.1 through 3-8.7, and 3-8.9 through 3-8.13, as applicable.

**4-8 Operating Test.**

**4-8.1** A complete cycle of water tower operation shall be carried out after starting the engine, setting the jacks, and transmitting power to the water tower. The water tower shall be fully elevated out of the bed, rotated 90 degrees, and extended to full extension.

**4-8.2** A water tower shall complete this test smoothly and without undue vibration in not over 105 seconds.

**4-8.3** The water tower shall be retracted, the turntable rotation completed through 360 degrees, and then the water

tower lowered to its bed, after which a thorough inspection shall be made of all moving parts.

**4-8.4** The test shall demonstrate successful operation of all water tower controls.

**4-9 Water System Examination and Test.**

**4-9.1** The waterway and system shall be inspected for proper operation of all components. It shall be free of rust, corrosion, or any sign of deterioration or blockage.

**4-9.2** The waterway attaching brackets shall be inspected as follows:

(a) Inspect the brackets for loose bolts, cracked welds, or other discontinuities.

(b) ( + ) Inspect all attaching welds.

**4-9.3 Pressure Test.** The water system shall be pressure tested as follows.

**4-9.3.1*** The discharge end of the water system shall be equipped with a valve. The water system shall be filled with water and the valve closed.

NOTE: For safety reasons, all air must be removed from the system.

**4-9.3.2** The pressure on the water system shall be raised to 200 psi (1379 kPa). Care shall be taken during the test not to overheat the pump.

**4-9.3.3** The water tower shall be positioned at its maximum horizontal reach as permitted by the manufacturer and rotated through 360 degrees.

**4-9.3.4** The water tower shall be positioned at its maximum elevation as permitted by the manufacturer and rotated through 360 degrees.

**4-9.3.5*** The waterway shall operate properly and with an absence of leaks during this test.

**4-10* Records.** A proper record shall be completed for all tests of the water tower by the person responsible for the test.

## Chapter 5 Referenced Publications

**5-1** The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**5-1.1 NFPA Publication.** National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 1901-1985, *Standard on Automotive Fire Apparatus.*

**5-1.2 ASTM Publications.** American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B647-1984, *Test Method for Indentation Hardness of Aluminum Alloys by Means of a Webster Hardness Gauge*

ASTM B648-1984, *Test Method for Indentation Hardness of Aluminum Alloys by Means of a Barcol Impressor*

ASTM E6-1986, *Standard Definitions of Terms Relating to Methods of Mechanical Testing*

ASTM E10-1984, *Test Method for Brinell Hardness of Metallic Materials*

ASTM E18-1984, *Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials*

ASTM E92-1987, *Test Method for Vickers Hardness of Metallic Materials*

ASTM E114-1985, *Practice for Ultrasonic Pulse-Echo Straight-Beam Examination by the Contact Method*

ASTM E165-1983, *Practice for Liquid Penetrant Inspection Method*

ASTM E268-1984, *Definitions of Terms Relating to Electromagnetic Testing*

ASTM E269-1984, *Definitions of Terms Relating to Magnetic Particle Examination*

ASTM E270-1984, *Definitions of Terms Relating to Liquid Penetrant Inspection*

ASTM E500-1986, *Standard Terminology Relating to Ultrasonic Examination*

ASTM E543-1987, *Standard Practice for Determining the Qualification of Nondestructive Testing Agencies*

ASTM E569-1985, *Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation*

ASTM E586-1987, *Standard Definitions of Terms Relating to Gamma and X-Radiography*

ASTM E610-1982, *Definitions of Terms Relating to Acoustic Emission*

ASTM E650-1985, *Guide for Mounting Piezoelectric Acoustic Emission Sensors*

ASTM E709-1985, *Practice for Magnetic Particle Examination*

ASTM E797-1987, *Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method*

ASTM E1004-1984, *Test Method for Electromagnetic Measurements of Electrical Conductivity*

ASTM E1032-1985, *Method for Radiographic Examination of Weldments*

**5-1.3 ASNT Publication.** American Society for Nondestructive Testing, Inc., 4153 Arlingate Plaza, Columbus, OH 43228.

ASNT SNT-TC-1A-1984, *Recommended Practice*, No. 2025.

**5-1.4 AWS Publications.** American Welding Society, Inc., 550 NW LeJeune Road, PO Box 351040, Miami, FL 33135.

AWS B1.10-1986, *Guide for Nondestructive Inspection of Welds*

AWS D14.4-1977, *Classification and Application of Welded Joints for Machinery and Equipment.*

**5-1.5 SAE Publication.** Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

SAE J959-1980, *Lifting Crane, Wire-Rope Strength Factors*

## Appendix A

*This Appendix is not part of the requirements of this NFPA document, but is included for information purposes only.*

**A-1-4.2** Full nondestructive testing may be desirable on a more frequent basis than every 5 years depending on the service the aerial device is subject to. Extensive use of the aerial device in urban environments would be a reason for more frequent testing. Many departments have found aerial devices damaged not by use but by transport over rough roads that rack the device in its bed.

**A-1-4.4** Specific written checklists should be developed by each fire department for their style and brand of apparatus, combining the manufacturer's recommended checks with the suggested inspection procedures of this standard and any other checks found desirable by the department, to assure a systematic and complete inspection.

**A-1-4.5** Qualified vehicle operators are those who have been schooled in the operation of the vehicle by the manufacturer or fire department instructors who have received special training in all phases of vehicle operations. Operators of fire department apparatus should complete a course in driver training and aerial ladder and/or elevating platform operational procedures, including positioning on the fireground. Specific training should be given in procedures to be followed should the hydraulic system fail. A thorough understanding of safe load capacity, stabilizing procedures, and operational limits is paramount. Safety procedures and proper shutdown and boom lowering procedures are also critical. Operators should be tested upon completion of training. Periodic retraining and retesting should also be required.

**A-2-3.9** Spectrochemical analysis of the hydraulic oil is intended to identify contaminants in the hydraulic system. Typically the analysis will identify contaminants in parts per million (PPM) or by percent. Many laboratories which perform analysis will provide service recommendations with their oil analysis report. In most cases, recommendations are limited unless a reference analysis has been performed. The reference analysis is an analysis of new oil from the oil manufacturer/supplier prior to being put into the aerial hydraulic system. Subsequent oil analyses are then compared to the reference analysis. By comparing the contaminant levels, trends can be identified and specific service recommendations given by the analyzing laboratory.

Typical recommendations are:

1. Service oil filters
2. Drain and replace oil
3. Excessive wear metal present.

**A-2-5.7** Some hollow I-beam aerial ladders base rails have an additional layer of sheet metal spot welded to the bottom of the base rail on the bed ladder section. This additional metal is commonly known as a "glove." Base rails constructed in this manner are susceptible to corrosion between the inside of the glove and the outside of the base rail when water is trapped in this area. This corrosion is not readily detectable as the area inside the glove cannot be visually inspected unless the glove is removed. If any corrosion or rust can be seen bleeding from the glove, the manufacturer should be contracted and the glove removed in order to determine whether corrosion has weakened the base rail.

**A-2-7.1** A strong wind action on the long cable and test load will introduce a pendulum action that will potentially add load to the ladder far beyond the test weight.

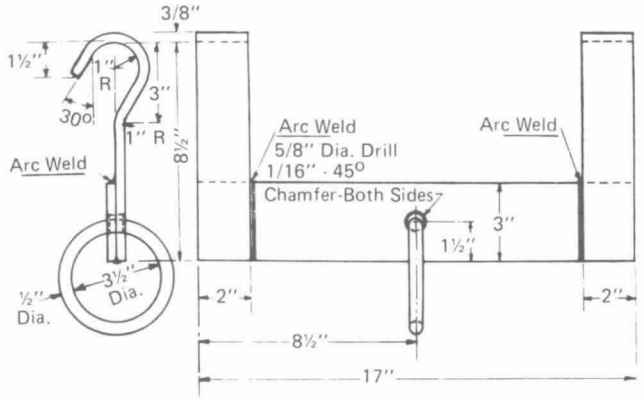


**Figure A-2-7.3.2 Hanger for Test Cable.**

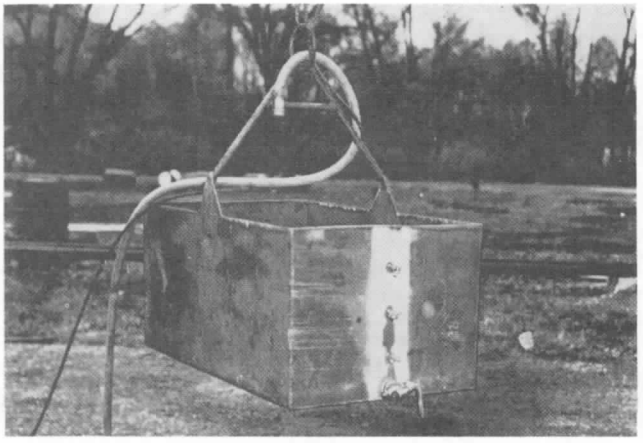

**Figure A-2-7.3.9 Test Weight Container.**

**A-2-8.4.1** It is recommended that a valve or restricting orifice plate be placed in the hose line where it connects to the ladder pipe intake to throttle the water entering the system. This allows only a controlled flow if something breaks during the test.

**A-2-8.4.4** It is recognized that fittings may drip slightly during the test and such dripping is acceptable. However, any excessive dripping or steady leak is a sign of a developing problem that should be corrected.

**A-2-9 Report Form.**

**Aerial Ladder Examination and Test Record**

Fire department company no. Test date

Manufacturer's name

Manufacturer's serial no.

Aerial ladder first placed in service (date)

Aerial ladder length Ladder material

Reason for test

Test location

Weather conditions at time of test

Temperature °F. Wind Velocity (estimate) MPH

Remarks

A. Visual Examination (attach copy of checklist)

Disposition of any problems:

B. Operational Examination

Disposition of any problems:

C. Load Test

Disposition of any problems:

D. Water System Test

Disposition of any problems:

Signed

**A-3-12.3.1** It is recommended that a valve or restricting orifice plate be placed in the hose line where it connects to the elevating platform intake to throttle the water entering the system. This allows only a controlled flow if something breaks during the test.

**A-3-12.3.5** It is recognized that fittings may drip slightly during the test and such dripping is acceptable. However, any excessive dripping or steady leak is a sign of a developing problem that should be corrected.

**A-3-13 Report Form.**

**Elevating Platform Examination and Test Record**

Fire department company no. Test date

Manufacturer's name

Manufacturer's serial no.

Elevating platform first placed in service (date)

Working height

Reason for test

Test location

Weather conditions at time of test

Temperature °F. Wind Velocity (estimate) MPH

Results:

A. Visual Examination (attach copy of checklist)

Disposition of any problems:

B. Operational Examination

Disposition of any problems:

C. Stability and Structural Examination:

Platform Basket Load Lb.

Disposition of any problems:

D. Water System Test

Disposition of any problems:

Signed

**A-4-9.3.1** It is recommended that a valve or restricting orifice plate be placed in the hose line where it connects to the water tower intake to throttle the water entering the system. This allows only a controlled flow if something breaks during the test.

**A-4-9.3.5** It is recognized that fittings may drip slightly during the test and such dripping is acceptable. However, any excessive dripping or steady leak is a sign of a developing problem that should be corrected.

**A-4-10 Report Form.**

**Water Tower Examination and Test Record**

Fire department company no. Test date

Manufacturer's name

Manufacturer's serial no.

Water tower first placed in service (date)

Working height

Reason for test

Test location

Weather conditions at time of test

Temperature °F. Wind Velocity (estimate) MPH

Results:

A. Visual Examination (attach copy of checklist)

Disposition of any problems:

B. Operational Examination

Disposition of any problems:

C. Water System Test

Disposition of any problems:

Signed

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