There are many different types of forms for reporting inspections, maintenance, and tests that could be used in connection with a fire apparatus preventive maintenance program. Resources for forms other than those shown in this annex are the local or state fire apparatus mechanics association, apparatus manufacturers, or the Apparatus Maintenance Section of the International Association of Fire Chiefs.

Annex D Guidelines for First-Line and Reserve Fire Apparatus

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

D.1 General. To maximize fire fighter capabilities and minimize risk of injuries, it is important that fire apparatus be equipped with the latest safety features and operating capabilities. In the last 10 to 15 years, much progress has been made in upgrading functional capabilities and improving the safety features of fire apparatus. Apparatus manufactured prior to 1991 usually included only a few of the safety upgrades required by the 1991 and subsequent editions of the NFPA fire department apparatus standards or the equivalent Underwriters' Laboratories of Canada (ULC) standards. Because the changes, upgrades, and fine tuning to NFPA 1901, *Standard for Automotive Fire Apparatus*, since 1991 have been truly significant, especially in the area of safety, fire departments should seriously consider the value (or risk) to fire fighters of keeping pre-1991 fire apparatus in first-line service.

The 1991 edition of the NFPA fire department apparatus standards included, among other provisions, requirements for fully enclosed driving and riding areas, auxiliary braking systems, reflective striping, improved warning lights, and prohibition of roof-mounted audible warning devices. The minimum tip load for an aerial ladder was set at 250 lb (114 kg), and other requirements, such as a minimum rail height, were added to make the aerial ladder safer for fire fighters to use. The 1991 editions have been recognized as the benchmark from which improved and safer fire apparatus have evolved. It is recommended that only apparatus that were designed and manufactured to meet the 1991 or later editions of the NFPA fire apparatus standards, or apparatus that have been refurbished in accordance with NFPA 1912, *Standard for Fire Apparatus Refurbishing*, to meet the 1991 or later editions of the NFPA fire apparatus standards, be permitted to operate in first-line service. This will ensure that, while the apparatus might not totally comply with the current edition of the automotive fire apparatus standards, many of the improvements and upgrades required by the standards since 1991 are available to the fire fighters who use the apparatus.

It is recommended that apparatus manufactured prior to 1991 that is less than 25 years old, that has been properly maintained, and that is still in serviceable condition should be placed in reserve status and upgraded to incorporate as many features as possible of the post-1991 fire apparatus *(see Section D.3)*. Apparatus that was not manufactured to the applicable NFPA fire apparatus standards or that is over 25 years old should be replaced.

D.2 How the Standards Have Changed. It is a generally accepted fact that fire apparatus, like all types of mechanical devices, have a finite life. The length of that life depends on many factors, including vehicle mileage and engine hours, quality of the preventative maintenance program, quality of the driver training program, whether the fire apparatus was used within the design parameters, whether the apparatus was manufactured on a custom or commercial chassis, quality of workmanship by the original manufacturer, quality of the components used, and availability of replacement parts, to name a few. In the fire service, there are fire apparatus with 8 to 10 years of service that are simply worn out. There are also fire apparatus that were manufactured with quality components, that have had excellent maintenance, and that have responded to a minimum number of incidents that are still in serviceable condition after 20 years. Most would agree that the care of fire apparatus while being used and the quality and timeliness of maintenance are perhaps the most significant factors in determining how well a fire apparatus ages.

Prior to 1991, the single fire department apparatus standard was NFPA 1901. It was basically a "reactive standard." If something worked well in field use for a few years, it might have been suggested for inclusion in NFPA 1901. It was a very basic standard. In the late 1980s, the Technical Committee on Fire Department Apparatus decided to become proactive and to greatly enhance the value of the standard for the fire service. Task groups were appointed to develop reasonable requirements for the various components that made up a fire apparatus, and a safety task group was charged with looking at issues across the board that would improve the safety of fire fighters who use the apparatus.

The completely revised 1991 edition of NFPA fire department apparatus standards was the result of these efforts and the full committee's strong desire to make the automotive fire apparatus standards not only more safety oriented but also more user friendly. In 1991, four standards were issued: NFPA 1901, *Standard for Pumper Fire Apparatus*; NFPA 1902, *Standard for Initial Attack Fire Apparatus*; NFPA 1903, *Standard for Mobile Water Supply Fire Apparatus*; and NFPA 1904, *Standard for Aerial Ladder and Elevating Platform Fire Apparatus*.

Contained within the 1991 editions of the fire department apparatus standards were requirements for such items as increased battery capacity to ensure starting under most conditions, intersection lights for increased visibility, removal of all roof-mounted audible warning devices to reduce hearing problems, a flashing light in the cab to warn if a cab or body door is open, a backup alarm, an automatic transmission to make it easier to drive (unless the purchaser has a specific reason for a manual transmission), fully enclosed riding areas with reduced noise (dBA) levels to keep crew members safe and informed, seats and seat belts for all crew members riding on the apparatus, fail-safe door handles so the sleeve of a coat does not inadvertently catch a handle and open a door, and signs requiring everyone to be seated and belted.

In the pump area, the standard specified that 3 in. (75 mm) or larger valves be "slow close," that caps on intakes and discharge outlets be tested to 500 psi (3400 kPa), that an intake relief valve be provided to help manage incoming pressure, that 30-degree sweep elbows be provided on the discharges to eliminate hose kinking, and that all 3 in. (75 mm) and larger discharges be eliminated from the pump panel to reduce the possibility of injuries to the pump operator.

Fire apparatus equipped with electronic or electric engine throttle controls were required to include an interlock system to prevent engine speed advancement, unless the chassis transmission is in neutral with the parking brake engaged or unless the parking brake is engaged, the fire pump is engaged, and the chassis transmission is in the correct pumping gear.

In the body area, the minimum step surface size and load-carrying capabilities were increased, handrails were required

to be slip resistant, and reflective striping was required on all four sides of the apparatus. Electrical system requirements for line voltage systems were added to include the use of listed components that were grounded.

Many requirements were added to increase the operating capabilities of all aerial devices. For aerial ladders, the minimum design strength of the rungs was increased, a height requirement for the handrails was specified, a minimum load-carrying requirement for folding steps was specified, and the aerial ladder had to have a minimum carrying capacity of 250 lb (114 kg) at the tip when the aerial ladder is at zero degrees elevation and maximum extension. Where a water tower is equipped with a ladder, the same requirements that applied to an aerial ladder were required of the ladder on the water tower.

The carrying capacity of elevating platforms at zero degrees elevation and maximum extension was raised to 750 lb (340 kg). Elevating platforms were also required to have handrails, breathing air available in the platform (with low-air warning capability) for at least two fire fighters, and a water curtain cooling system under the platform.

All aerial devices had to be capable of supporting a static load of one and one-half times their rated capacity in any position. A requirement for a stabilizer movement alarm and reflective striping with warning lights was added. Interlocks to prevent inadvertent movement to an unsupported side and to prevent raising the aerial device prior to the stabilizers being deployed were specified. One hundred percent nondestructive tests (NDT) became a requirement. All these requirements were included in the 1991 editions of the NFPA fire department apparatus standards.

In 1996, the four fire department apparatus standards (NFPA 1901, NFPA 1902, NFPA 1903, and NFPA 1904) were recombined into a single standard that was designated as NFPA 1901, *Standard for Automotive Fire Apparatus*. This edition further enhanced the safety and operating characteristics of all the apparatus.

The 1999 edition included chapters on quints and mobile foam apparatus, further defined slip resistance of stepping and walking surfaces, required better mounting of equipment in the driving and crew compartments, required predelivery testing of foam systems, and specified that fill stations for breathing air cylinders be designed to totally contain a rupturing cylinder.

The 2003 edition continued to refine the requirements in the driving and crew riding areas with increased head height requirements at seating positions and additional requirements for storage of SCBAs in seat backs, both aimed at reducing fire fighter injuries. The test protocol for slip resistance of standing and walking surfaces was better defined. There was a general cleanup of the requirements throughout the document to enhance the operational usefulness of the apparatus.

D.3 Upgrading Fire Apparatus. Any apparatus, whether in first-line or reserve service, should be upgraded in accordance with NFPA 1912 as necessary to ensure that the following features are included as a minimum:

(1) Fully enclosed seating is provided for all members riding on the fire apparatus.
(2) Warning lights meet or exceed the current standard.
(3) Reflective striping meets or exceeds the current standard.
(4) Slip resistance of walking surfaces and handrails meets the current standard.
(5) A low voltage electrical system load manager is installed if the total connected load exceeds the alternator output.
(6) The alternator output is capable of meeting the total continuous load on the low voltage electrical system.
(7) Where the gross vehicle weight rating (GVWR) is 36,000 lb (16,000 kg) or more, an auxiliary braking system is installed and operating correctly.
(8) Ground and step lighting meets or exceeds the current standard.
(9) Noise levels in the driving and crew compartment(s) meet the current standard, or appropriate hearing protection is provided.
(10) All horns and sirens are relocated to a position as low and as far forward as possible.
(11) Seat belts are available for every seat and are new or in serviceable condition.
(12) Signs are present stating no riding on open areas.
(13) A pump shift indicator system is present and working properly for vehicles equipped with an automatic chassis transmission.
(14) For vehicles equipped with electronic or electric engine throttle controls, an interlock system is present and working properly to prevent engine speed advancement at the operator's panel, unless the chassis transmission is in neutral with the parking brake engaged; or unless the parking brake is engaged, the fire pump is engaged, and the chassis transmission is in pumping gear.
(15) All loose equipment in the driving and crew areas is securely mounted to prevent its movement in case of an accident.

D.4 Proper Maintenance of Fire Apparatus. In addition to needed upgrades to older fire apparatus, it is imperative that all fire apparatus be checked and maintained regularly to ensure that they will be reliable and safe to use. The manufacturer's instructions should always be followed when maintaining the fire apparatus. Special attention should be paid to ensure that the following conditions exist, as they are particularly critical to maintaining a reliable unit:

(1) Engine belts, fuel lines, and filters have been replaced in accordance with the manufacturers' maintenance schedule(s).
(2) Brakes, brake lines, and wheel seals have been replaced or serviced in accordance with the manufacturers' maintenance schedule.
(3) Tires and suspension are in serviceable condition, and tires are not more than 7 years old.
(4) The radiator has been serviced in accordance with the manufacturer's maintenance schedule and all cooling system hose are new or in serviceable condition.
(5) The alternator output meets its rating.
(6) A complete weight analysis shows the fire apparatus is not over individual axle or total gross vehicle weight ratings.
(7) The fire pump meets or exceeds its original pump rating.
(8) The water tank and baffles are not corroded or distorted.
(9) If equipped with an aerial device, a complete test to original specifications has been conducted and certified by a certified testing laboratory.
(10) If so equipped, the generator and line voltage accessories have been tested and meet the current standard.

D.5 Refurbishing or Replacing Fire Apparatus. Fire department administrators and fire chiefs should exercise special care when evaluating the cost of refurbishing or updating an apparatus versus the cost of a new fire apparatus. Apparatus

that are refurbished should comply with the requirements of NFPA 1912. A thorough cost-benefit analysis of the value of upgrading or refurbishing a fire apparatus should be conducted. In many instances, it will be found that refurbishing costs will greatly exceed the current value of similar apparatus. Experience has also shown that refurbishing a fire apparatus that is over 20 years old, other than to paint or repair the apparatus, is a very poor investment.

Some factors to consider and evaluate when considering whether to refurbish or replace a fire apparatus include the following:

(1) What is the true condition of the existing apparatus? Has it been in a major accident, or has something else happened to it that would make spending significant money on it ill advised?
(2) Does the current apparatus meet the program needs of the area it is serving? Is it designed for the way the fire department operates today and is expected to operate into the foreseeable future, or is the apparatus functionally obsolete? Can it carry everything that is needed to do the job without being overloaded?
(3) If the apparatus is refurbished, will it provide the level of safety and operational capability of a new fire apparatus? Remember, in many cases, refurbishing does not mean increasing the GVWR, so it is not possible to add a larger water tank or additional foam agent tanks or to carry massive amounts of additional equipment. Enclosing personnel riding areas might add enough weight to the chassis that existing equipment loads need to be reduced to avoid overloading the chassis. An aerial ladder that does not have a 250 lb (114 kg) tip load rating at zero degrees elevation and maximum extension cannot be made stronger.
(4) What is the anticipated cost per year to operate the apparatus if it were refurbished, and what would the cost per year be for a new apparatus? Do not forget insurance costs, downtime costs, maintenance costs, depreciation, reliability, and the safety of the users and the public. At what rate are those costs rising each year? Are parts still readily available for all the components on the apparatus? A refurbished 15-year–old apparatus still has 15-year–old parts in it. How long could the fire department operate without the apparatus if it suddenly needed major repairs?
(5) Is there a current trade-in value that will be gone tomorrow? Most apparatus over 12 years old have little trade-in value. Are there creative financing plans or leasing options that can provide a new fire apparatus for little more than the cost of refurbishing or maintaining an older apparatus?

D.6 Conclusion. A fire apparatus is an emergency vehicle that must be relied on to transport fire fighters safely to and from an incident and to operate reliably and properly to support the mission of the fire department. A piece of fire apparatus that breaks down at any time during an emergency operation not only compromises the success of the operation but might jeopardize the safety of the fire fighters relying on that apparatus to support their role in the operation. An old, worn out, or poorly maintained fire apparatus has no role in providing emergency services to a community.

Annex E Informational References

E.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

E.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2005 edition.

NFPA 1002, *Standard for Fire Apparatus Driver/Operator Professional Qualifications*, 2003 edition.

NFPA 1150, *Standard on Foam Chemicals for Fires in Class A Fuels*, 2004 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2003 edition.

NFPA 1912, *Standard for Fire Apparatus Refurbishing*, 2006 edition.

NFPA 1961, *Standard on Fire Hose*, 2007 edition.

NFPA 1962, *Standard for the Inspection, Care, and Use of Fire Hose, Couplings, and Nozzles and the Service Testing of Fire Hose*, 2003 edition.

E.1.2 Other Publications.

E.1.2.1 American Association of Motor Vehicle Administrators Publications. American Association of Motor Vehicle Administrators, P.O. Box 79702, Baltimore, MD 21279-0702.

Vehicle Inspection Handbook, Passenger Vehicles & Light Trucks, 1999.

Vehicle Inspection Handbook, Trucks, Buses, & Trailers, 1999.

E.1.2.2 ASME Publications. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ASME B40.100, *Pressure Gauges and Gauge Attachments*, 2005.

E.1.2.3 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 29, Code of Federal Regulations, Section 1910.177, "Servicing multi-piece and single piece rim wheels" Mar. 7, 1996.

E.2 Informational References. (Reserved)

E.3 References for Extracts in Informational Sections.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2003 edition.