

NFPA®

1917

**Standard for
Automotive Ambulances**

2019



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NFPA® 1917

Standard for

Automotive Ambulances

2019 Edition

This edition of NFPA 1917, *Standard for Automotive Ambulances*, was prepared by the Technical Committee on Ambulances. It was issued by the Standards Council on May 4, 2018, with an effective date of May 24, 2018, and supersedes all previous editions.

This edition of NFPA 1917 was approved as an American National Standard on May 24, 2018.

Origin and Development of NFPA 1917

In October 2008, the Standards Council, after receipt of a request from the Technical Committee on Automotive Fire Apparatus for the development of a standard for ambulances, approved the establishment of a Technical Committee on Automotive Ambulances. The Committee developed the first (2013) edition of NFPA 1917, *Standard for Automotive Ambulances*, which established the minimum requirements for the design, performance, and testing of new automotive ambulances used for out-of-hospital medical care and patient transport.

For the 2016 edition, the committee made several significant changes throughout the entire document as a result of many task group meetings with national stakeholder organizations as well as task groups from within the committee. When the 2013 edition was published, the document immediately went back into a revision cycle so as to include several crucial test results for the 2016 edition. The committee also heard from several national stakeholder organizations about concerns regarding some of the requirements within the document that might keep the document from being adopted. Based on the high level of interaction and involvement from the public, the committee made several significant changes to the document for the second edition. Before the document entered its revision cycle for the 2016 edition, the committee made changes to the document by utilizing the option of a Tentative Interim Amendment (TIA) to address some of the immediate concerns. Some of the areas in the document that were changed via a TIA included the deletion of Chapter 9 and additional referencing of the applicable AMD (Ambulance Manufacturers Division of the NTEA) testing standards. This was done largely to reduce confusion and any potential conflict between NFPA 1917 and the AMD testing standards. The committee also made changes to the Statement of Exceptions to make it easier for the document to be adopted. Other areas the committee made changes to included the maximum speed now being related to the rating of the tires on the vehicle rather than a specific speed limit, thus leaving it up to the AHJ to determine the maximum speed. The committee also made several changes to the requirements regarding the retroreflective materials used on the outside of the vehicle as well as the patterns that could be used on the outside of the vehicle. This change gave the AHJ the ability to determine what patterns or designs were on the vehicle, rather than there being one prescribed pattern. Altogether, for the 2016 edition, more than 300 changes were incorporated into the document to reflect the needs and demands of the first responder community in regard to the design, performance, and testing of new ambulances.

For the 2019 edition, the committee made many changes to meet the needs and demands of the users of NFPA 1917. Since there has been a demand for a safer ambulance, for the occupants and the public, many new crash tests have been developed that are included in the new edition. As a result of the new crash test standards, some AMD tests that had been referenced or used were replaced with these new tests from the Society of Automotive Engineers (SAE). With the inclusion of these tests, the committee revised text for third-party testing and certification and for self-certification by the final stage ambulance manufacturer (FSAM). The committee has specified where third-party testing and certification must occur and where self-certification can occur by the FSAM. Other subjects covered in the 2019 edition are remounts and refurbished ambulances. Chapter 10, a new chapter, and Annex C, a new annex, set forth requirements on these subjects to assist the AHJ in purchasing a remounted or refurbished ambulance. This addition is to solve the lack of standards to regulate or assist AHJs with remounts.

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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.

Committee Scope: This committee shall have primary responsibility for documents on the design and performance of ambulances used to provide patient care and transport under emergency conditions.

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A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex C. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex C.

Chapter 1 Administration

1.1* Scope. This standard shall define the minimum requirements for the design, performance, and testing of new and remounted automotive ambulances used for out-of-hospital medical care and patient transport.

1.2 Purpose. The purpose of this standard shall be to establish the minimum requirements for new and remounted automotive ambulances that are safe and reliable when properly maintained and used within their design parameters.

1.3 Application.

1.3.1 This standard shall apply to new and remounted ambulances that are contracted for on or after January 1, 2019.

1.3.2 This standard shall not apply to the following:

- (1) Vehicles that are used for transport of more than two stretcher-bound patients at the same time
- (2) Mass casualty vehicles
- (3) Military field ambulances
- (4) Vehicles intended for use as fire apparatus as specified in NFPA 1901 or NFPA 1906
- (5) Wheeled chair transport vehicles
- (6) Refurbished vehicles without a remount
- (7) Repairs

1.4* Retroactivity. This standard shall not be applied retroactively.

1.5 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction (AHJ) to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose by the AHJ.

1.6* Units and Formulas.

1.6.1 In this standard, values for measurement in U.S. customary units shall be followed by equivalents in SI units.

1.6.2 Either set of values can be used, but the same set of values (either U.S. customary units or SI units) shall be used consistently.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471, www.nfpa.org.

NFPA 70®, *National Electrical Code*®, 2017 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2016 edition.

NFPA 1906, *Standard for Wildland Fire Apparatus*, 2016 edition.

2.3 Other Publications.

2.3.1 AMECA Publications. Automotive Manufacturers Equipment Compliance Agency, 1025 Connecticut Avenue, NW, Suite 1012, Washington, DC 20036, www.ameca.org.

AMECA *Compliance Handbook*, 2012.

2.3.2 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036, www.ansi.org.

ANSI Z535.4, *Product Safety Signs and Labels*, 2011.

2.3.3 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, www.astm.org.

ASTM D4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, 2016a.

ASTM E661, *Standard Test Method for Performance of Wood and Wood-Based Floor and Roof Sheathing Under Concentrated Static and Impact Loads*, 2003 (2015).

2.3.4 IPC Publications. IPC, 3000 Lakeside Drive, 309 S, Bannockburn, IL 60015, www.ipc.org.

IPC A-610F, *Acceptability of Electronic Assemblies*, 2014, Amendment 1, 2015.

2.3.5 ISO Publications. International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva 20, Switzerland, www.iso.ch.net.

ISO/IEC 17020, *General Criteria for the Operation of Various Types of Bodies Performing Inspection*, 2012.

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, 2005.

▲ **2.3.6 National Truck Equipment Association (NTEA) Publications.** NTEA The Association for the Work Truck Industry, 37400 Hills Tech Drive, Farmington Hills, MI 48331-3414, www.ntea.com

AMD 001, *Static Load Test for Ambulance Body Structure*, 2014.

AMD 003, *Oxygen Tank Retention System Static Test*, 2014.

AMD 005, *Low Voltage Electrical System Test*, 2014.

AMD 006, *Patient Compartment Sound Level Test*, 2014.

AMD 008, *Handrail Static Load Test*, 2014.

AMD 010, *Water Leak Test*, 2014.

AMD 011, *Equipment Temperature Test*, 2014.

AMD 012, *Interior Climate Control Test*, 2014.

AMD 015, *Ambulance Main Medical Gas System Test*, 2014.

AMD 016, *Patient Compartment Lighting Level Test*, 2014.

AMD 018, *Rear Stepping Surface Load Test*, 2014.

AMD 021, *Aspirator System Test*, 2014.

AMD 024, *Perimeter Illumination Test*, 2014.

AMD 025, *Occupant Head Clearance Zones Test*, 2014.

AMD 027, *Line Voltage Electrical Systems Test*, 2014.

UltraMod Spreadsheet, 2002.

2.3.7 SAE Publications. SAE International, 400 Commonwealth Drive, Warrendale, PA 15096, www.sae.org.

SAE J156, *Fusible, Links*, 2010.

SAE J551/1, *Performance Levels and Methods of Measurement of Electromagnetic Compatibility of Vehicles, Boats (up to 15 m), and Machines (16.6 Hz to 18 GHz)*, 2010.

SAE J553, *Circuit Breakers*, 2004.

SAE J554, *Electric Fuses (Cartridge Type)*, 2010.

SAE J575, *Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width*, 2010.

SAE J576, *Plastic Material or Materials for Use in Optical Parts Such as Lenses and Reflex Reflectors of Motor Vehicle Lighting Devices*, 2010.

SAE J578, *Color Specification*, 2006.

SAE J595, *Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*, 2005.

SAE J683, *Tire Chain Clearance — Trucks, Buses (Except Suburban, Intercity, and Transit Buses), and Combinations of Vehicles*, 1985.

SAE J689, *Curbstone Clearance, Approach, Departure, and Ramp Breakover Angles*, 2009.

SAE J845, *Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*, 2007.

SAE J994, *Alarm — Backup — Electric Laboratory Performance Testing*, 2009.

SAE J1127, *Low Voltage Battery Cable*, 2010.

SAE J1128, *Low Voltage Primary Cable*, 2011.

SAE J1318, *Gaseous Discharge Warning Lamp for Authorized Emergency, Maintenance, and Service Vehicles*, 2009.

SAE J1330, *Photometry Laboratory Accuracy Guidelines*, 2007.

SAE J1849, *Emergency Vehicle Sirens*, 2008.

SAE J1888, *High Current Time Lag Electric Fuses*, 1990.

SAE J1889, *L.E.D. Signal and Marking Lighting Devices*, 2011.

SAE J2077, *Miniature Blade Type Electrical Fuses*, 1990.

SAE J2202, *Heavy Duty Wiring Systems for On-Highway Trucks*, 2004.

SAE J2420, *COE Frontal Strength Evaluation — Dynamic Loading Heavy Trucks*, 2003.

SAE J2422, *Cab Roof Strength Evaluation — Quasi-Static Loading Heavy Trucks*, 2003.

SAE J3026, *Ambulance Patient Compartment Seating Integrity and Occupant Restraint*, 2016.

SAE J3027, *Ambulance Litter Integrity, Retention, and Patient Restraint*, 2016.

SAE J3043, *Ambulance Equipment Mounts*, 2014.

SAE J3057, *Ambulance Modular Body Evaluation-Quasi-Static Loading For Type I and Type III Modular Ambulance Bodies*, 2017.

SAE J3058, *Ambulance Interior Storage Compartment Integrity*, 2016.

SAE J3102, *Ambulance Patient Compartment Structural Integrity Test to Support SAE J3027 Compliant Litter Systems*, 2017.

2.3.8 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, www.ul.com.

ANSI/UL 153, *Standard for Portable Electric Luminaires*, 2002, revised 2015.

ANSI/UL 498, *Standard for Safety Attachment Plugs and Receptacles*, 2012, revised 2016.

ANSI/UL 969, *Standard for Marking and Labeling Systems*, 1995, revised 2014.

ANSI/UL 1598, *Luminaires*, 2008, revised 2013.

ANSI/UL 2034, *Standard for Safety, Single and Multiple Station Carbon Monoxide Alarms*, 2008, revised 2016.

2.3.9 U.S. Government Publications. U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001, www.gpo.gov.

Title 49, Code of Federal Regulations, Part 571, Federal Motor Vehicle Safety Standards (FMVSS).

2.3.10 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 70®, *National Electrical Code*®, 2017 edition.

NFPA 1451, *Standard for a Fire and Emergency Service Vehicle Operations Training Program*, 2018 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2016 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is 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.

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

3.2.5 Shall. Indicates a mandatory requirement.

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

3.2.7 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Acceptance. An agreement between the purchasing authority and the contractor that the terms and conditions of the contract have been met. [1901, 2016]

3.3.2 Acceptance Tests. Tests performed on behalf of or by the purchaser at the time of delivery to determine compliance with the specifications for the ambulance.

3.3.3 Ambulance. A vehicle used for out-of-hospital medical care and patient transport that provides a driver's compartment; a patient compartment to accommodate an emergency medical services provider (EMSP) and at least one patient located on the primary cot positioned so that the primary patient can be given emergency care during transit; equipment and supplies for emergency care at the scene as well as during transport; safety, comfort, and avoidance of aggravation of the patient's injury or illness; two-way radio communication; and audible and visual traffic warning devices.

3.3.3.1* Substantially Similar Ambulance. An ambulance in which the relevant area or component that is being compared or considered is comparable. Applicable to the test being considered for an ambulance in which like areas are compared.

3.3.3.2 Type I Ambulance. An ambulance with a 10,001 lb (4536 kg) to 14,000 lb (6350 kg) gross vehicle weight rating (GVWR) constructed on a cab chassis with a modular ambulance body.

3.3.3.3 Type I-AD (Additional Duty) Ambulance. An ambulance with a 14,001 lb (6351 kg) or more GVWR constructed on a cab chassis with a modular ambulance body.

3.3.3.4 Type II Ambulance. An ambulance constructed on a van.

3.3.3.5 Type III Ambulance. An ambulance with a 10,001 lb to 14,000 lb GVWR constructed on a cutaway van chassis with integrated modular ambulance body.

3.3.3.6 Type III-AD (Additional Duty) Ambulance. An ambulance with a 14,001 lb or more GVWR constructed on a cutaway van chassis with integrated modular body.

3.3.4 Angle.

3.3.4.1 Angle of Approach. The smallest angle made between the road surface and a line drawn from the front point of ground contact of the front tire to any projection of the ambulance in front of the front axle.

3.3.4.2 Angle of Departure. The smallest angle made between the road surface and a line drawn from the rear point of ground contact of the rear tire to any projection of the ambulance behind the rear axle.

3.3.4.3 Ramp Breakover Angle. The angle measured between two lines tangent to the front and rear tire static loaded radius, and intersecting at a point on the underside of the vehicle that defines the largest ramp over which the vehicle can roll. [1901, 2016]

3.3.5 Automatic Electrical Load Management System. A device that continuously monitors the electrical system voltage and automatically sheds predetermined loads in a selected order to prevent overdischarging of the ambulance's batteries.

3.3.6 Bonded (Bonding). Connected to establish electrical continuity and conductivity. [1901, 2016]

3.3.7 Bulkhead. The partition dividing the driver compartment from the patient compartment.

3.3.8 Center of Gravity. The point at which the entire weight of the ambulance is considered to be concentrated so that, if supported at this point, the ambulance would remain in equilibrium in any position.

3.3.9* Chassis. The basic operating motor vehicle, including the engine, frame, and other essential structural and mechanical parts, but exclusive of the body and all appurtenances for the accommodation of driver, property, passengers, appliances, or equipment related to functions other than control.

3.3.10* Common and Critical Equipment and Supplies. Equipment and/or supply items that are frequently used for or are essential to providing patient care.

3.3.11 Compartment.

3.3.11.1 Exterior Compartment. A weather-resistant area designed to protect stored items from environmental damage that is confined on six sides and equipped with an access opening(s) that can be closed and latched.

N 3.3.11.2 Interior Storage Compartment. A cabinet, drawer, pouch style system, or other means used to contain and secure EMS supplies, tools, medical devices, or other equipment within an enclosed area.

3.3.11.3 Patient Compartment. The portion of the ambulance behind the cab.

3.3.11.3.1 Type I Patient Compartment. The modular body area added on behind the cab.

3.3.11.3.2 Type II Patient Compartment. The body area beginning immediately behind the forward bulkhead.

3.3.11.3.3 Type III Patient Compartment. The modular body area added on behind the cab.

3.3.12 Conductor.

3.3.12.1 Grounding Conductor. A non-current-carrying conductor used to connect equipment or the ground circuit of a wiring system to the power source grounding system. [1901, 2016]

3.3.12.2 Line Voltage Conductor. An ungrounded current-carrying conductor of a line voltage circuit. [1901, 2016]

3.3.12.3 Neutral Conductor. The conductor connected to the neutral point of a system that is intended to carry current under normal conditions. [1901, 2016]

3.3.13 Continuous Duty. Operation at a substantially constant load for an indefinitely long time. [1901, 2016]

3.3.14* Contractor. The person or company responsible for fulfilling an agreed upon contract. [1901, 2016]

3.3.15 Defect. A discontinuity in a part or a failure to function that interferes with the service or reliability for which the part was intended. [1901, 2016]

3.3.16 Documentation. Any data or information supplied by the manufacturer or contractor relative to the ambulance, including information on its operation, service, and maintenance.

3.3.17 Electrical Appliance. An electrical device or instrument designed to perform a specific function, such as scene lights, battery charger, medical equipment, and so forth.

3.3.18* Electronic Siren. An audible warning device that produces sound electronically through the use of amplifiers and electromagnetic speakers. [1901, 2016]

3.3.19 Exterior. A nonsheltered location exposed to the environment, either continuously or intermittently. [1901, 2016]

3.3.20 Federal Motor Vehicle Safety Standards (FMVSS). Regulations promulgated by the National Highway Traffic Safety Administration (NHTSA) of the United States under Public Law 89-563 that are mandatory and must be complied with when motor vehicles or items of motor vehicle equipment are manufactured and certified thereto.

3.3.21 Fixed Power Source. Any line voltage power source except a portable generator.

3.3.22 Fully Latched Position. The last or fully closed position on the striker of a 49 CFR 571, FMVSS 206 compliant door latch.

3.3.23 Gallon. United States gallon. [1901, 2016]

3.3.24 Gauge. A visual device that indicates a measurement. [1901, 2016]

3.3.25 GAWR. See 3.3.71.1, Gross Axle Weight Rating.

3.3.26 Generator. An electromechanical device for the production of electricity. [1901, 2016]

3.3.27* Grade. A measurement of the angle used in road design and expressed as a percentage of elevation change over distance. [1901, 2016]

3.3.28 Ground Clearance. The clearance under a vehicle at all locations except the axles and driveshaft connections to the axle or items designed to swing clear.

3.3.29 GVWR. See 3.3.71.3, Gross Vehicle Weight Rating (GVWR).

3.3.30 High-Idle Speed Control. A control or switch system that provides a means to increase the engine operating speed from an idle condition to a higher preset operating speed. [1901, 2016]

3.3.31 Instruction Plate. A visual indication whether in pictorial or word format that provides instruction to the operator in the use of a component on the ambulance.

3.3.32 Interior. A sheltered location not exposed to the environment. [1901, 2016]

3.3.33 Interlock. A device or arrangement by means of which the functioning of one part is controlled by the functioning of another. [1901, 2016]

3.3.34 Label. A visual indication whether in pictorial or word format that provides for the identification of a control, switch, indicator, or gauge, or the display of information useful to the operator. [1901, 2016]

3.3.35 Latch. A mechanical device used to position the door in a closed position relative to the body framework with provision for controlled release or operation.

3.3.36 Line Voltage Circuit, Equipment, or System. An ac or dc electrical circuit, equipment, or system where the voltage to ground or from line to line is equal to or greater than 30 volts rms (ac), 42.4 volts peak (ac), or 60 volts dc.

3.3.37 Load Distribution Plan. A drawing or spreadsheet of shelves, cabinets, drawers, compartment, or otherwise storage with a maximum weight attached to each location.

3.3.38* Loose Equipment. Equipment other than the occupants and the cot that is intended to be stored on the ambulance.

3.3.39 Low Voltage Circuit, Equipment, or System. An electrical circuit, equipment, or system where the voltage does not exceed 30 volts rms (ac), 42.4 volts peak (ac), or 60 volts dc; usually 12 volts dc in an ambulance.

3.3.40 Manufacturer. The person or persons, company, firm, corporation, partnership, or other organization responsible for turning raw materials or components into a finished product.

3.3.41 Optical Center. The point specified by the optical warning device manufacturer of highest intensity when measuring the output of an optical warning device. [1901, 2016]

3.3.42 Optical Power. A unit of measure designated as candela-seconds/minute that combines the flash energy and flash rate of an optical source into one power measurement representing the true visual effectiveness of the emitted light. [1901, 2016]

3.3.43* Optical Source. Any single, independently mounted, light-emitting component in a lighting system. [1901, 2016]

3.3.44 Optical Warning Device. A manufactured assembly of one or more optical sources. [1901, 2016]

3.3.45 Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front. [70:100]

3.3.46 Patient Cot. An elevating patient conveyance device upon which the primary patient is transported, which is also known as a transporter, gurney, and carrier.

3.3.47 Power Source. A device that produces line voltage electricity. [1901, 2016]

3.3.48 Power Supply Assembly. Any cord or distribution assembly that is partly comprised of the neutral conductor, grounding conductor, and line voltage conductors connected from the output terminals of the power source to the first main overcurrent protection device. [1901, 2016]

3.3.49 Primary Patient Care Seat. The seating position designated by the AHJ from which the EMSP is expected to provide primary patient care.

3.3.50 Proper(ly). In accordance with the manufacturer's specifications or as recommended by the manufacturer. [1901, 2016]

3.3.51 psi. Pounds per square inch.

3.3.52 PTO. Power takeoff.

3.3.53 Purchaser. The authority having responsibility for the specification and acceptance of the ambulance.

3.3.54 Purchasing Authority. The agency that has the sole responsibility and authority for negotiating, placing, and, where necessary, modifying each and every solicitation, purchase order, or other award issued by a governing body. [1901, 2016]

3.3.55 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 related to the subject matter, the work, or the project. [1451, 2018]

3.3.56 Readily Accessible. Able to be located, reached, serviced, or removed without removing other components or parts of the ambulance and without the need to use special tools to open enclosures.

N 3.3.57 Remounted Ambulance Patient Compartment. An ambulance patient compartment that has been removed from its original chassis and installed on a different chassis.

3.3.58 Reserve Capacity. The ability of a battery to sustain a minimum electrical load in the event of a charging system failure or a prolonged charging system deficit. [1901, 2016]

3.3.59 Seat.

3.3.59.1 Child Restraint Seat. A seat capable of transporting a child 66 lb (30 kg) or less in accordance with 49 CFR 571, FMVSS 213 and mounted in accordance with the seat manufacturer's recommendation.

3.3.59.2 Infant Restraint Seat. A seat capable of transporting an infant 22 lb (10 kg) or less in accordance with 49 CFR 571, FMVSS 213 and mounted in accordance with the seat manufacturer's recommendation.

3.3.60 Side Entry Door. The body door on the side of the ambulance body that provides entry into the patient compartment and through which patients can be loaded and unloaded.

3.3.61 Sign. A visual indication whether in pictorial or word format that provides a warning to the operator or other persons near the ambulance.

3.3.62 Stretcher. A transportation device also known as a cot, litter, or flat, designed to transport a supine patient.

3.3.63 Striker. A mechanical device with which the latch engages on the opposing member of the body framework.

3.3.64 Substantially Similar Ambulance. One or more components or systems that are the same and that perform the same functions in vehicles or equipment sold or offered for sale in the United States, regardless of whether the part numbers are identical.

3.3.65 Switch. Any set of contacts that interrupts or controls current flow through an electrical circuit. [1901, 2016]

3.3.66 Total Continuous Electrical Load. The total current required to operate all of the devices permanently connected to the ambulance that can be simultaneously energized excluding intermittent-type loads.

3.3.67 Turning Clearance Radius. One-half the larger of the left or right full circle wall-to-wall turning diameter. [1901, 2016]

3.3.68* Type Certificate. A document that is issued to certify the compliance of an ambulance design or component to a specific test.

3.3.69 Usable Payload. The weight of the loose equipment, occupants, and cot that can be carried in the ambulance without exceeding the GVWR.

3.3.70 Weight.

3.3.70.1* Curb Weight. The total weight of the complete ambulance less the payload.

3.3.71 Weight Rating.

3.3.71.1* Gross Axle Weight Rating (GAWR). The final-stage manufacturer's specified maximum load-carrying capacity of an axle system, as measured at the tire-ground interfaces.

3.3.71.2 Gross Combination Weight Rating (GCWR). The final-stage manufacturer's specified maximum loaded weight for a combination (articulated) vehicle consisting of a tow vehicle and one or more towed units.

3.3.71.3* Gross Vehicle Weight Rating (GVWR). The final-stage manufacturer's specified maximum load-carrying capacity of a single vehicle.

3.3.72 Wet Location (Related to Ambulances). A location on a nonenclosed, exterior surface of an ambulance body or driver and crew compartment or a nonsheltered location inside a compartment with a door or cover that, while open, exposes the enclosure or panelboard to the environment.

Chapter 4 General Requirements

4.1 General. All ambulances shall comply with Chapters 1 through 9.

4.2* Responsibility of the Purchaser.

4.2.1 It shall be the responsibility of the purchaser to consider the amount of equipment and the number of personnel that will be carried on the ambulance and to specify a minimum usable payload that will accommodate this weight once the ambulance is placed in service.

4.2.2 It shall be the responsibility of the purchaser to specify any details of the ambulance that would exceed the minimum specifications of this standard.

4.3 Responsibility of the Contractor.

4.3.1 The contractor shall provide a detailed description of the ambulance, a list of equipment to be furnished, and other construction and performance details to which the ambulance shall conform.

4.3.1.1 The detailed description of the ambulance shall include, but shall not be limited to, minimum usable payload, wheelbase, curb-to-curb turning clearance radius, principal dimensions, angle of approach, and angle of departure.

4.3.1.2 The purpose of these contractor specifications shall be to define what the contractor intends to furnish and deliver to the purchaser.

4.3.2 Responsibility for the ambulance and equipment shall remain with the contractor until they are accepted by the purchaser.

4.4 Ambulance Components.

4.4.1 All components shall be installed in accordance with the manufacturer's installation instructions or with the written approval of the component manufacturer.

4.4.2 All medical devices furnished shall comply with the U.S. Food and Drug Administration (FDA) regulatory requirements.

4.4.3 Vehicles shall be free from defects that could impair their reliability or serviceability.

4.4.4* All bodies, systems, equipment, and interfaces with the chassis not otherwise specified in this standard shall be maintained in accordance with the chassis original equipment manufacturer's (OEM) body builders' guidelines.

4.5 Legal Requirements. The ambulance shall comply with state regulations as specified by the purchaser.

4.6 Third-Party Certification of Test Results. The following type tests shall be required to be witnessed or performed by an independent third-party organization, that organization shall meet the requirements of this section:

- (1) AMD 001, *Static Load Test for Ambulance Body Structure*
- (2) AMD 006, *Patient Compartment Sound Level Test*
- (3) AMD 008, *Handrail Static Load Test*
- (4) AMD 011, *Equipment Temperature Test*
- (5) AMD 012, *Interior Climate Control Test*
- (6) AMD 016, *Patient Compartment Lighting Level Test*
- (7) AMD 018, *Rear Stepping Surface Load Test*
- (8) AMD 024, *Perimeter Illumination Test*
- (9) SAE J3026, *Ambulance Patient Compartment Seating Integrity and Occupant Restraint*
- (10) SAE J3027, *Ambulance Litter Integrity, Retention, and Patient Restraint*
- (11) SAE J3043, *Ambulance Equipment Mounts*
- (12) SAE J3057, *Ambulance Modular Body Evaluation-Quasi-Static Loading For Type I and Type III Modular Ambulance Bodies*
- (13) SAE J3058, *Ambulance Interior Storage Compartment Integrity*
- (14) SAE J3102, *Ambulance Patient Compartment Structural Integrity Test to Support SAE J3027 Compliant Litter Systems*

4.6.1 Testing shall be witnessed or performed by an organization that is accredited for inspection of ambulances in accordance with ISO/IEC 17020, *General Criteria for the Operation of Various Types of Bodies Performing Inspection*, or accredited for testing ambulances to this standard in accordance with ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

4.6.2 The certification organization shall not be owned or controlled by the final-stage ambulance manufacturer.

4.6.3 The certification organization shall witness all tests and shall refuse to certify any test results for a system if all components of that system requiring testing do not pass the testing required by this standard.

4.6.4 Conditional, temporary, or partial certification of test results shall not be permitted.

4.6.5 Forms or data sheets shall be provided and used during the testing. [1901:4.7.6]

4.6.6 Programs shall be in place for training, proficiency testing, and performance verification of any staff involved with certification. [1901:4.7.7]

4.6.7 Appeal Process.

4.6.7.1 The certification organization's operating procedures shall provide a mechanism for the manufacturer to appeal decisions.

4.6.7.2 The procedures shall include provisions for the presentation of information from representatives of both sides of a controversy to a designated appeals panel.

4.6.8 The third party that certifies any test results shall supply the following information on the certification organization letterhead:

- (1) Company or business for which the results are certified
- (2) Date of certification
- (3) Ambulance model, components, or equipment being certified
- (4) Certification organization and address
- (5) Date product tested
- (6) Model number and specification data
- (7) Applicable specification references and test requirement
- (8) Summary of the test report
- (9) A certifying statement with official signature

4.6.9* The testing facility for each certification shall supply the following supportive verification data and information on letterhead stationery in electronic format:

- (1) Name of company or business for whom ambulance product was tested
- (2) Report date
- (3) Name of sample product or device
- (4) Contractor's address
- (5) Serial and model number(s)
- (6) Specification referral and amendment number(s), and test requirement(s)
- (7) Test facilities used and location
- (8) Test equipment used
- (9) Test procedure
- (10) Test results
- (11) Verifying test data
- (12) Photographs
- (13) Drawings

- (14) Test conclusion(s)
- (15) Witness(es)
- (16) Authorized signature

4.7 Manufacturer Certification of Test Results.

4.7.1 The ambulance manufacturer shall test and certify each ambulance according to the following standards:

- (1) AMD 005, *Low Voltage Electrical System Test*
- (2) AMD 010, *Water Leak Test*
- (3) AMD 015, *Ambulance Main Medical Gas System Test*
- (4) AMD 021, *Aspirator System Test*
- (5) AMD 025, *Occupant Head Clearance Zones Test*
- (6) AMD 027, *Line Voltage Electrical Systems Test*

N 4.7.2 Where the standard requires a component to be tested, the ambulance manufacturer shall either test individual components themselves or rely on the component manufacturer's testing and certification on any individual component used in the ambulance.

4.7.3 A representative of the manufacturer shall witness all tests and shall refuse to certify any test results for a system unless all components of that system requiring testing pass the testing required by this standard. [1901:4.8.1]

4.7.4 Conditional, temporary, or partial certification of test results shall not be permitted.

4.7.5 The manufacturer shall have the facilities and equipment necessary to conduct the required testing, a program for the calibration of all instruments, and procedures to ensure the proper control of all testing. [1901:4.8.3]

4.7.6 Forms or data sheets shall be provided and used during the testing. [1901:4.8.4]

4.7.7 Programs shall be in place for training, proficiency testing, and performance verification of any personnel involved with certification. [1901:4.8.5]

4.7.8 An official of the company that manufactures or installs the product shall designate in writing who is qualified to witness tests and certify results. [1901:4.8.6]

4.7.9 Certification documentation shall be delivered with the ambulance, including results of the certification tests.

4.7.10 Certification tests performed on a substantially similar ambulance shall be valid for up to 7 years or until such time as the production product changes are so significant that they no longer meet the definition of a substantially similar ambulance.

4.8 Personnel Protection.

4.8.1* Guards, shields, or other protection shall be provided where necessary in order to prevent injury of personnel by hot, moving, or rotating parts during nonmaintenance operations. [1901:4.9.1]

4.8.2 Electrical insulation or isolation shall be provided where necessary in order to prevent electrical shock from onboard electrical systems. [1901:4.9.2]

4.8.3 Vehicular workmanship shall ensure an operating environment free of accessible sharp projections and edges. [1901:4.9.3]

4.8.4 Safety-related (caution, warning, danger) signs shall meet the requirements of ANSI Z535.4, *Product Safety Signs and Labels*.

4.9 Controls and Instructions.

4.9.1 Illumination shall be provided for controls, switches, gauges, and instruments necessary for the operation of the ambulance and the equipment on it.

4.9.2* All required signs, instruction plates, and labels shall be permanent in nature, securely attached, and meet the requirements of 4.9.2.1 and ANSI/UL 969, *Standard for Marking and Labeling Systems*.

4.9.2.1 The signs, instruction plates, and labels shall be resistant to damage from the following:

- (1) Fluids to which they will normally be exposed
- (2) Temperatures between -30°F (-35°C) and 176°F (80°C)
- (3) Ultraviolet radiation

4.9.2.2* The exterior-mounted labels relating to safety or critical operational instructions shall be reflective or illuminated.

4.9.2.3 Controls and Switches.

4.9.2.3.1* Controls and switches that are expected to be operated by the belted driver while the ambulance is in motion shall be visible and within reach.

4.9.2.3.2 Controls and switches that are expected to be operated by the belted emergency medical service provider (EMSP) while the ambulance is in motion shall be visible and within reach of the designated primary patient care position.

4.9.2.4 Marking of switches, indicators, and control devices shall be perceptively and permanently identified with at least 3 mm high letters and/or symbol at least 10 mm by 10 mm.

4.9.2.5 The identifications shall be contrasting colors etched or engraved in plastic or metal or printed and laminated translucent plastic, grouped according to function, and mounted in illuminated or backlit panel(s) or the console.

4.10 Component Protection.

4.10.1* Hydraulic hose lines, air system tubing, control cords, and electrical harnesses shall be mechanically attached to the frame or body structure of the ambulance.

4.10.2 The types of equipment described in 4.10.1 shall be furnished with protective looms, grommets, or other devices at each point where they pass through body panels or structural members or wherever they lie against a sharp metal edge.

4.10.3 A through-the-frame connector shall be permitted to be used in place of protective looms or grommets.

4.11* Ambulance Performance.

4.11.1* Where temperature requirements are not otherwise specified, the ambulance shall be designed to function in ambient temperature conditions between 0°F (-18°C) to 110°F (43°C).

4.11.1.1 All interior systems, components, and permanently attached equipment shall function satisfactorily over a temperature range of 32°F to 95°F (0°C to 35°C).

4.11.1.1.1 Compliance of the equipment function shall be validated by testing a substantially similar ambulance in accordance with AMD 011, *Equipment Temperature Test*.

4.11.1.1.2 The ambulance and all systems, components, and equipment shall be capable of being stored at an ambient

temperature between 32°F and 95°F (0°C to 35°C) without damage or deterioration.

4.11.2 The ambulance shall be capable of being driven for at least 250 mi (402 km) without refueling.

4.11.3 The vehicle shall be capable of three fordings without water entering patient and equipment compartments while being driven through a minimum of 8 in. (203 mm) of water, at speeds of 5 mph (8 km/hr), for a distance of at least 100 ft (30 m).

4.12 Road Performance.

4.12.1 When loaded to its gross vehicle weight rating (GVWR), the ambulance shall be capable of meeting the following performance criteria on dry, paved roads that are in good condition:

- (1) From a standing start, the ambulance shall be able to attain a speed of 55 mph (88 km/hr) within 25 seconds on a level road.
- (2) The ambulance shall be able to maintain a speed of at least 5 mph (8 km/hr) on any grade up to 35 percent.
- (3) The ambulance shall be able to maintain a speed of at least 55 mph (88 km/hr) on any grade up to 3 percent.

4.12.2 The determination of road performance shall be made by actual test or OEM-certified computer prediction.

4.12.3* The ambulance shall be capable of a sustained speed of not less than 65 mph (105 km/hr) over dry, hard-surfaced, level roads, at sea level, and a passing speed of 70 mph (112 km/hr) when tested under normal ambient conditions.

4.13 Serviceability.

4.13.1 Special Tools.

4.13.1.1 Where special tools are required for routine service on any component of the ambulance, such tools shall be provided with the ambulance.

4.13.1.2 Where the purchaser is purchasing multiple ambulances under the same contract, the purchaser shall specify the number of tools required.

4.13.2 Ambulance components that interfere with repair or removal of other major components shall be attached with fasteners, such as cap screws and nuts, so that the components can be removed and installed with ordinary hand tools.

4.13.3 These components shall not be welded or otherwise permanently secured in place.

4.14 Tests on Delivery.

4.14.1 If acceptance tests are conducted at the point of delivery, they shall not be performed in a manner that requires the ambulance or a component to operate outside its designed operating range.

4.14.2 Certification from OEM and individual equipment manufacturers are acceptable, provided they are not altered.

4.15* Documentation. Any documentation delivered with the ambulance shall be permitted to be in printed format, electronic format, audiovisual format, or a combination thereof.

4.16 Data Required of Contractor.

4.16.1 Ambulance Documentation. The contractor shall deliver with the ambulance at least one copy of the following documents:

- (1) The manufacturer's record of ambulance construction details, including the following information:
 - (a) Owner's name and address
 - (b) Ambulance manufacturer, model, and serial number
 - (c) Chassis make, model, and vehicle identification number (VIN)
 - (d) GAWR of front and rear axles and GVWR
 - (e) Front tire size and total rated capacity in pounds (kilograms)
 - (f) Rear tire size and total rated capacity in pounds (kilograms)
 - (g) Type of fuel and fuel tank capacity
 - (h) Electrical system voltage and alternator output in amps
 - (i) Paint manufacturer and paint number(s)
 - (j) Company name and signature of responsible company representative
 - (k) Documents from a certified scale showing curb weight on the front axle and rear axle(s) (without personnel and equipment)
- (2) Certification of compliance of the optical warning system (*see 7.9.16*)
- (3) Siren manufacturer's certification of the siren (*see 7.10.1.1*)
- (4) Written load analysis and results of the electrical system performance tests
- (5) Certification of slip resistance of all exterior stepping, standing, and walking surfaces

4.16.2 Operations and Service Documentation.

4.16.2.1 The contractor shall deliver with the ambulance at least one set of complete operation and service documentation covering the completed ambulance as delivered and accepted.

4.16.2.2 The documentation shall address at least the inspection, service, and operations of the ambulance and all major components thereof.

4.16.2.3* The contractor shall also deliver with the ambulance the following documentation for the entire ambulance and each major operating system or major component of the ambulance:

- (1) Manufacturer's name and address
- (2) Country of manufacture
- (3) Source for service and technical information
- (4) Parts replacement information
- (5) Descriptions, specifications, and ratings of the chassis
- (6) Wiring diagrams for low voltage and line voltage ambulance-specific systems to include the following information:
 - (a) Circuit logic for all electrical components and wiring
 - (b) Circuit identification
 - (c) Connector pin identification
 - (d) Zone location of electrical components
 - (e) Safety interlocks
 - (f) Alternator battery power distribution circuits

- (g) Input/output assignment sheets or equivalent circuit logic implemented in multiplexing systems
- (7) Lubrication charts
- (8) Operating instructions for the chassis and any major components
- (9) Instructions regarding the frequency and procedure for recommended maintenance
- (10) Overall ambulance operating instructions
- (11) Safety considerations
- (12) Limitations of use
- (13) Inspection procedures
- (14) Recommended service procedures
- (15) Troubleshooting guide
- (16) Ambulance body, chassis, and other component manufacturer's warranties
- (17) Special data required by this standard
- (18) Safety data sheet (SDS) for any fluid that is specified for use on the ambulance module

4.16.3 Certification and Payload Signage.

4.16.3.1* All ambulances shall have a certification and payload label as shown in Figure 4.16.3.1.

4.16.3.2 The label shall be mounted on the body (module) interior in a conspicuous location.

4.16.3.3 The calculation of the usable payload listed on the label shall also be provided with the ambulance.

4.17 Statement of Exceptions. The entity responsible for final assembly of the ambulance shall deliver with the ambulance a certification that the ambulance, at the time of delivery, complies with the minimum requirements of this standard or, when exceptions to this standard are required by the purchaser, a statement of exceptions shall be provided and attached to the owner's manual.

▲ **4.17.1** The statement of exceptions shall contain for each exception a separate listing of the section(s) of the applicable standard for which an exception has occurred.

Ambulance Data	
Manufactured by _____	Mo./Yr. _____
Address _____	
City _____	State _____ Zip _____
VIN _____	Job no. _____
Chassis model _____	Statement of exception applies _____
Vehicle type _____	
Usable cargo/equipment capacity (lb or kg)* _____	
Total occupant weight minus 175 times number of designated seating positions (lb or kg)	
This ambulance is certified by the manufacturer to conform to the edition of NFPA 1917, <i>Standard for Automotive Ambulances</i>, in effect on the date the ambulance is contracted for, subject to any applicable statement of exception as mandated by this standard.	
*Usable cargo/equipment capacity is the weight of the loose equipment and cot(s) as defined by NFPA 1917 that can be carried in this ambulance without exceeding the GVWR.	

▲ FIGURE 4.16.3.1 Certification and Payload Label.

Chapter 5 Chassis

5.1 Carrying Capacity.

5.1.1 The manufacturer shall design the ambulance so that the completed ambulance, when loaded to its required gross vehicle weight rating (GVWR) with all loose equipment distributed to its intended in-service configuration, does not exceed the GVWR or gross axle weight rating (GAWR) of the chassis using the method and values specified in Table 5.1.1.

5.1.2 The manufacturer shall establish the required GVWR during the design of the ambulance using the method and values specified in Table 5.1.1.

5.1.3 Label.

5.1.3.1 The ambulance manufacturer shall provide a high-visibility label in a location visible to the driver while seated.

5.1.3.2* The label shall show the height of the completed ambulance in feet and inches (meters) and the GVWR in tons and pounds (metric tons and kilograms).

5.2 Weight Distribution.

5.2.1 Longitudinal Weight Distribution. When the ambulance is loaded to its GVWR, the front-to-rear weight distribution and vertical center of gravity shall be within the limits set by the chassis manufacturer.

5.2.2* Lateral Weight Distribution. The vehicle, when loaded to its GVWR, shall have a side-to-side tire load variation of no more than 5 percent of the total tire load for that axle.

▲ Table 5.1.1 Required GVWR Calculation

Component	Specification	Weight (lb)
Chassis		
Ambulance body complete		
Automotive fluids		
Permanently mounted equipment		
Loose equipment (Use one of these values unless the required loose equipment is specified by the purchaser.)	Type I Type I-AD	750 1250
	Type II Type III Type III-AD	500 750 1250
Belted occupant seating positions	(No. seats) ×	171
Cot patient		171
Cot	Standard cot Power cot	100 250
Spare capacity		200
Minimum GVWR required		

For SI units, 1 lb = 0.45 kg.

5.2.3 The front axle loads shall not be less than the minimum axle loads specified by the chassis manufacturer under full load and all other loading conditions.

5.2.4 Vehicle and component ratings shall be the manufacturer's published ratings and shall not be modified without written authorization from the OEM.

• **5.2.5** Each ambulance's payload capacity (horizontal, lateral, and vertical center of gravity) shall be calculated.

• **5.2.5.1** Horizontal and vertical payload capacity shall be determined by completing a National Truck Equipment Association (NTEA) UltraMod spreadsheet (available at www.ntea.com).

• **5.2.5.2** A copy of the UltraMod spreadsheet and the lateral payload calculation shall be included with the ambulance documentation, along with the following calculations:

- (1) Completed vehicle at curb weight
- (2) 171 lb (78 kg) at the horizontal, lateral, and vertical center of each patient location and at the designated H-point of each seating position
- (3) The maximum remaining cargo/equipment capacity located at the horizontal, lateral, and vertical dimension center of the patient compartment that does not result in weights that exceed the vehicle's weight rating capacities

5.3 Engine and Engine System Design.

5.3.1 Cold Start Performance Requirements.

• **5.3.2** Indicators shall be provided to alert the driver to high engine temperature or low oil pressure conditions.

5.3.3 An engine hour meter shall be provided.

5.4 Engine Speed Auxiliary Control Device.

5.4.1* An engine speed auxiliary control device (high-idle switch, throttle, or automatic voltage monitor) shall be installed to allow an increase in the engine speed to no more than 1600 revolutions per minute when the ambulance is parked, unless the ambulance's patient compartment primary source of low voltage electrical power is an independent generator.

5.4.2 An interlock shall prevent the operation of the engine speed auxiliary control device unless the parking brake is engaged and the transmission is in neutral or park, or the parking brake is engaged and the engine is disengaged from the drive wheels.

5.5 Exhaust System.

• **5.5.1** The exhaust piping and discharge outlet shall be located or shielded so as not to expose any portion of the ambulance or equipment to excessive heating.

5.5.2 Where parts of the exhaust system are exposed so that they are likely to cause injury to operating personnel, protective guards shall be provided.

5.5.3 The tailpipe outlet shall not terminate within 12 in. (300 mm) of the vertical axis of the fuel fill opening, medical gas storage, or patient entry doors where these features are located on the same side of the vehicle.

5.6 Braking System.

5.6.1 Where air-actuated braking systems are provided, they shall include the following:

- (1) An automatic moisture ejector

- (2) An air dryer
- (3) A pressure protection valve to prevent all air-operated accessories from drawing air from the air brake system when the air system's pressure drops below a pressure setting no lower than 80 psi (550 kPa)

5.6.2* Any time a secondary braking device such as transmission retarders or exhaust restriction devices are used, they shall have a switch to turn them off during adverse road conditions.

5.7 Suspension.

5.7.1* With the exception of the OEM's furnished and **in-** **stalled** components, the ambulance shall provide not less than the following clearance, measured in accordance with SAE J689, *Curbstone Clearance, Approach, Departure, and Ramp Break-over Angles*:

- (1) Approach angle of 10 degrees
- (2) Ramp breakover of 10 degrees
- (3) Departure angle of 10 degrees

5.7.2* A traction control feature shall be provided.

5.7.3 Shock absorbers shall be furnished on the front and rear axles.

5.7.4 Any ambulance with an air-ride suspension shall include an air dryer and automatic heated moisture ejection device to ensure that the air system is provided with dry air to protect the suspension control components.

5.8 Wheels and Tires.

5.8.1 Hub caps or wheel covers shall be removable without loosening the lug nuts so that wheels can be observed for daily inspection.

5.8.2 Tires shall be matched to vehicle performance in terms of traction, load-carrying ability, rolling diameter, and speed rating.

5.8.3 Mud Flaps.

Δ 5.8.3.1 Mud flaps, at least as wide as the tire(s), shall be provided behind the front and rear wheels.

5.8.3.2 Mud flaps shall be permitted to be incorporated into the running boards.

5.8.4 Bodies designed with wheel openings shall have the rear wheels centered, within ± 2 in. (± 52 mm) of those openings.

5.8.5* Each tire shall be equipped with a visual indicator or monitoring system that indicates tire pressure.

5.9* Vehicle Stability. If the ambulance is equipped with a stability control system, the system shall have a steering wheel position sensor, a vehicle yaw sensor, a lateral accelerometer, and individual wheel brake controls.

5.10* Bumpers. The rear of the ambulance shall be furnished with a bumper that extends to within 6 in. (152 mm) of each side of the ambulance.

5.10.1 The rear bumper shall be secured to the vehicle's chassis frame.

5.10.2 The rear bumper of Type I and Type III vehicles shall be provided with an integrated step.

5.10.3 The step shall be designed to prevent the accumulation of mud, ice, or snow and shall be made of anti-skid open grating material.

5.10.4 The step shall not be located or exposed to the interior of the ambulance when the door(s) is closed.

5.10.5 The step shall be at least the width of the door opening for which it is provided.

5.10.6 The stepping surface shall have a minimum depth of 5 in. (127 mm) and a maximum depth of 10 in. (254 mm).

5.10.7 If the step protrudes more than 7 in. (178 mm) from the rear of the vehicle, a fold-up step shall be furnished.

5.10.8* Stepping Surface.

5.10.8.1 The rear stepping surface shall withstand a load of 500 lb (227 kg) with no more than 1.0 in. (25.4 mm) of deflection or 0.25 in. (6.4 mm) of permanent deformation.

5.10.8.2 Compliance of the rear step surface shall be validated by testing a substantially similar ambulance or bumper and step structure in accordance with Section AMD 018, *Rear Stepping Surface Load Test*.

5.10.8.3 The distance from the road surface to the top surface of the first step at the rear bumper shall not exceed 22 in. (559 mm) with the vehicle loaded to its GVWR and/or the suspension in the kneeling condition.

5.10.8.4 Steps shall be provided in the door openings.

5.10.8.5 Step wells shall be illuminated.

5.10.8.6 Step surfaces shall be constructed with anti-slip material.

5.10.8.7* All steps shall have a minimum area of 35 in.² (22,580 mm²) and shall be of such a shape that a 5 in. (125 mm) diameter disk does not overlap any side when placed on the step.

5.11 Cab Seal.

5.11.1 If the cab and the patient compartment are separate enclosures, the cab shall be provided with a sealing device.

5.11.2 The seal shall be fabricated from a material resistant to ozone, sunlight, oil, and fungus.

5.11.3 The seal shall remain flexible in temperatures between -20°F and 110°F (-29°C and 43°C).

5.11.4 The seal shall be designed for proper fit and finish and be able to absorb lateral, vertical, and torsional displacement due to body/cab movement.

5.12 Front Seats.

5.12.1 Front cab seating for the driver and at least one passenger shall be provided.

5.12.2 The driver's seat shall have the OEM's full, unobstructed seat track travel range of longitudinal adjustment and a minimum of 30 percent of the range of inclination, but not less than the angle furnished on the OEM's standard nonreclining high back seat.

5.13* Mirrors.

5.13.1 Dual side view mirrors having a combination flat and convex mirror system shall be furnished.

5.13.2 All primary side view mirrors used by the driver shall be adjustable from the driver's position.

5.13.3 Hardware and mirror heads shall have a corrosion-resistant exterior finish.

5.14 Cab Integrity. Cabs on ambulances with a GVWR greater than 26,000 lb (11,800 kg) shall meet the requirements of SAE J2420, *COE Frontal Strength Evaluation — Dynamic Loading Heavy Trucks*, and SAE J2422, *Cab Roof Strength Evaluation — Quasi-Static Loading Heavy Trucks*.

Chapter 6 Patient Compartment

6.1 Patient Compartment Configuration. The patient compartment shall provide a minimum of 275 ft³ (7.7 m³) of space, less volume for cabinets, while complying with 6.1.2 and 6.1.3.

6.1.1* Self-contained breathing apparatus (SCBA) mounts shall not be located in the patient compartment.

6.1.2 The distance from the rear door to the edge of the cot mattress shall be determined by the AHJ.

6.1.3* The compartment shall provide a clear aisle walkway on at least one side of the patient cot.

6.2 Mounting. If the body is of modular construction, it shall be mounted per the allowed and/or recommended methods of the chassis manufacturer.

6.3 Structural Integrity — Roof Loading.

Δ 6.3.1 Any Type I, Type I-AD, Type III, or Type III AD ambulance body shall meet the performance requirements of SAE J3057, *Ambulance Modular Body Evaluation-Quasi-Static Loading For Type I and Type III Modular Ambulance Bodies*.

Δ 6.3.2 Any Type II ambulance with a gross vehicle weight rating of 10,000 lb or less shall meet the performance requirements described in FMVSS 216a, *Roof crush resistance*.

Δ 6.3.3 Any Type II ambulance with a gross vehicle weight rating of greater than 10,000 lb shall meet the performance requirements described in AMD 001, *Static Load Test for Ambulance Body Structure*.

•

6.4 Body Sealing.

6.4.1 Sealing Out Water.

6.4.1.1 There shall be no water leakage into the cab, any exterior compartment, or the patient compartment.

6.4.1.2 Compliance of the body sealing out water shall be validated by the manufacturer by testing each finished ambulance in accordance with AMD 010, *Water Leak Test*.

6.4.2 Sealing Out Exhaust Gas.

6.4.2.1 The body shall be sealed and vented so that the interior carbon monoxide level does not exceed 10 ppm of carbon monoxide (CO).

6.4.2.2 The patient compartment shall include a listed CO detector in accordance with ANSI/UL 2034, *Standard for Safety, Single and Multiple Station Carbon Monoxide Alarms*.

6.5 Wheel Housings.

6.5.1 Wheel housings of modular bodies shall include splash shields between the body wheel housing and the wheels, extending over the top of the tires to the bottom of the body side skirting.

6.5.2 Wheel housing openings shall allow for tire chain usage and easy tire removal and service and conform to SAE J683, *Tire Chain Clearance — Trucks, Buses (Except Suburban, Intercity, and Transit Buses), and Combinations of Vehicles*.

6.5.3 The OEM's standard wheel housings on Type II ambulances shall be acceptable.

6.6 Patient Compartment to Cab Partition.

6.6.1 A bulkhead partition shall be provided between the cab and the patient compartment.

6.6.2 The partition(s) shall be located behind the driver's seat and the cab passenger seat when in the rearmost position and the seat back is reclined a minimum of 15 degrees.

6.6.3 The partition shall extend from the floor to the ceiling.

6.6.4 The partition shall be wide enough to cover the width of each cab seat excluding arm rests.

6.6.5* The cab and body bulkheads shall have an aligned window opening of at least 150 in.² (96,780 mm²) or other means of visual and hands-free audio communication.

6.6.6 If so equipped, a window in the cab or body shall be of the sliding type, aligned, and connected with the modular body window opening.

6.6.7 The window shall be a transparent, shatterproof panel, which is latchable from the cab side.

6.7 Access Handrails or Handholds.

6.7.1* Interior or exterior access handrails or handholds shall be provided at each entrance to a driving or crew compartment and at each position where steps or ladders for climbing are located.

6.7.2 An overhead handrail shall be provided on the ceiling of the patient compartment.

6.7.3 Exterior access handrails shall be between 1 in. and 1⅝ in. (25 mm and 42 mm) in diameter and have a minimum clearance between the handrails and any surface of at least 2 in. (50 mm).

6.7.4 All exterior and interior access handrails shall be designed and mounted to reduce the possibility of hand slippage and to avoid snagging of equipment or clothing.

6.7.5 Access handrails supplied by the chassis manufacturer on a commercial chassis shall be permitted to be used to meet the requirements of this section.

6.7.6 Handrail Testing.

6.7.6.1 Handrails shall withstand a force of 300 lb (136 kg) applied in any direction without detaching, loosening, or permanently deforming.

6.7.6.2 Compliance of the handrail shall be validated by testing a substantially similar ambulance or body structure in accordance with AMD 008, *Handrail Static Load Test*.

6.8 Patient Compartment Entry Doors.

6.8.1 The patient compartment shall be equipped with at least one primary access door opening with minimum dimensions of 44 in. (1117 mm) wide by 46 in. (1168 mm) high.

6.8.2 Door handles shall be designed and installed to protect against accidental or inadvertent opening.

6.8.3 Entry doors and door openings shall be designed to minimize inadvertent snagging of apparel.

6.8.4 Door latches, hinges, and hardware furnished by OEMs and final-stage ambulance manufacturers (FSAMs) shall meet the performance requirements of 49 CFR 571, FMVSS 206.

6.8.5 When doors are open, the hinges and latches shall not protrude into the access area.

6.8.6 Doors shall be equipped with a hold-open device.

6.8.7 One externally operated lock for each door opening shall be provided.

6.8.8* An internal lock on each patient compartment primary entry door shall be provided.

6.8.9 All patient compartment entry door locks shall be identically keyed.

6.8.10 Patient loading doors shall be equipped with not less than 250 in.² (161,300 mm²) of safety glass area per door.

6.8.11 Doors shall be designed to prevent leakage of exhaust fumes, dust, water, and air into the patient compartment.

6.9 Means of Egress.

6.9.1 Any interior area to be occupied by personnel shall have a minimum of two means of egress.

6.9.2* Each means of egress opening shall be a minimum of 30 in. (762 mm) by 46 in. (1168 mm).

6.9.3 Secondary egress doors shall not be blocked by patient compartment structures that would prevent the unloading of a patient on a backboard.

6.9.4 The egress and cot loading doors shall have a secondary emergency release mechanism.

6.10 Exterior Stepping Surfaces and Interior Steps.

6.10.1 All materials used for exterior surfaces designated as stepping, standing, and walking areas and all interior steps shall have a minimum slip resistance in any orientation of 0.68 when tested wet using the English XL tester in accordance with the manufacturer's instructions or 0.52 when tested wet using the Brungraber Mark II tester in accordance with the manufacturer's instructions.

6.10.2 A standard Neolite® test sensor shall be used with both the English XL tester and the Brungraber Mark II tester.

6.10.3 Sampling Strategy.

6.10.3.1 For uniformly patterned materials, at least 16 readings shall be taken on each sample.

6.10.3.1.1 Each reading shall be taken 90 degrees clockwise from the previous orientation, resulting in at least four readings in each orientation.

6.10.3.1.2 The readings shall be averaged and reported as the slip resistance for the material.

6.10.3.2 For directionally patterned materials, at least 32 readings shall be taken on each sample.

6.10.3.2.1 Each reading shall be taken 45 degrees clockwise from the previous orientation, resulting in at least four readings in each orientation.

6.10.3.2.2 The four readings in each direction shall be averaged and reported as the slip resistance for the material in that orientation.

6.11 Exterior Storage.

6.11.1 All exterior compartment doors shall have latches with locks that hold the door in a closed position.

6.11.2 All hinged doors wider than 14 in. (356 mm) and excluding battery compartments shall have positive hold-open devices that permit one-hand closure.

6.11.3 Hardware shall be rust resistant.

6.11.4 All primary exterior compartment doors shall have latches with locks.

6.11.5 The interior of all exterior compartments greater than 4 ft³ (0.11 m³) shall be automatically illuminated when a door is opened and meet the requirements of 7.11.7.1.

6.11.6 All surfaces shall be nonabsorbent.

6.12 Floor.

6.12.1* The patient compartment floor shall be flat, except where the area near the rear entrance door is sloped for a lower entering height.

6.12.2 With the exception of cot retention hardware, the floor shall be free of obstructions in the door(s) access and work area.

6.12.3 The floor shall be designed to eliminate voids or pockets where water or moisture can become trapped.

6.12.4 The subfloor construction shall cover the full length and width of the patient compartment.

6.12.5 If plywood is used in the subfloor, it shall be marine or exterior grade.

6.12.6 If the ambulance has a modular body, the subfloor shall be designed to prevent water penetration.

6.12.7 Body Floor Structural Integrity.

6.12.7.1 If the subfloor is constructed of plywood, the plywood shall have an American Plywood Association (APA) floor rating of 16 in. (406 mm) on center or better.

6.12.7.2 If the subfloor is constructed of other than plywood, it shall be tested using a 1 in. (25 mm) disk and have a maximum of 0.125 in. (3 mm) deflection at 200 lb (91 kg) force and a minimum ultimate load of 400 lb (181 kg) for a 16 in. (406 mm) on center load.

6.12.7.2.1 The maximum floor structure spacing shall be used for testing.

6.12.7.2.2 Compliance of the floor structural integrity shall be validated by testing the midpoint of the longest unsupported section of a substantially similar ambulance or floor structure in accordance with the concentrated static load test procedure in ASTM E661, *Standard Test Method for Performance of Wood and Wood-Based Floor and Roof Sheathing Under Concentrated Static and Impact Loads*.

6.12.7.2.2.1 If panel joints occur at the maximum span location, they shall be present in the test sample as a worst-case scenario.

6.12.7.3 A drawing of the floor structure and fastening schedule of the subfloor material to the structure shall be required in the certification report.

6.13 Floor Covering.

6.13.1 Floor covering shall be nonpermeable and seamless.

6.13.2 The floor covering shall cover the entire length and width of the compartment's exposed floor.

6.13.3 Joints where the floor covering meets the sidewalls shall be sealed and bordered with corrosion-resistant cove molding, or the floor covering shall extend at least 3 in. (76 mm) up the sidewalls.

6.14 Insulation.

6.14.1 Where the patient compartment is insulated, it shall be insulated with a nonsettling type, verminproof, mildewproof, nontoxic, and nonhygroscopic material that meets the requirements of 49 CFR 571, FMVSS 302.

6.14.2 If fiberglass insulation is used, it shall be protected from exposure to water.

6.15* Interior Storage.

6.15.1 The interior of the patient compartment shall provide enclosed storage space.

6.15.2 Compartment(s) under the floor that have opening panel(s) inside the patient compartment shall not be acceptable.

6.15.3 Where furnished, top-opening squad bench lids shall be fitted with an automatic hold-open device and a quick-release slam-type latching device when closed.

6.15.4 Storage compartment door handles, where provided, shall not protrude more than 1 in. (25 mm) if located 14 in. (356 mm) or higher above the floor and shall not protrude more than 2 in. (51 mm) if located lower than 14 in. (356 mm) or higher above the floor.

6.15.5 Doors shall be designed to remain closed during transport.

6.15.6* Storage compartments shall be fastened to the body structure.

6.15.7 The securing mechanism of those interior storage compartments, if provided, shall be capable of being accessed under the same reach condition.

6.15.8 Each interior storage compartment shall be permanently labeled with its maximum load capacity.

6.15.9 Each storage compartment shall be tested in accordance with the requirements described in SAE J3058, *Ambulance Interior Storage Compartment Integrity*.

6.16 Interior Surfaces.

6.16.1 Exposed edges on the interior of the patient compartment shall have a radius of curvature of not less than $\frac{3}{32}$ in. (2.5 mm).

6.16.2* The finish of the entire patient compartment and exterior storage, including interiors of storage cabinets, shall be as follows:

- (1) Impervious to soap, water, body fluids, and disinfectants
- (2) Mildew resistant
- (3) Fire resistant in compliance with 49 CFR 571, FMVSS 302
- (4) Able to be cleaned and disinfected

6.16.3 Countertop horizontal surface shall be seamless and impervious to contaminants.

6.16.4 All edges that meet vertical cabinets shall be sealed.

6.16.5 Countertop horizontal surfaces shall be surrounded by a lip of not less than $\frac{1}{2}$ in. (12 mm) in height.

6.17 Equipment Mounting.

6.17.1 Medical Supplies and Equipment Storage Mounting. Supplies, devices, tools, and other equipment shall be stored in enclosed compartments or fastened to secure them during vehicle motion.

6.17.2 Equipment weighing 3 lb (1.36 kg) or more stored in a driving or patient compartment shall be mounted or contained in an enclosed compartment.

6.17.2.1 Equipment mounts or retention devices shall meet the performance requirements of SAE J3043, *Ambulance Equipment Mounts*.

6.17.3 Built-in communication devices installed in the patient compartment shall be within reach of EMSPs while seated and restrained in the designated primary patient care seat.

6.18* Waste and Sharps Disposal. A receptacle for general waste and an OSHA-compliant container for sharps disposal shall be provided in the patient compartment.

6.18.1 Containers for contaminated sharps shall be within reach of EMSPs while remaining seated and restrained in the designated primary patient care seat.

N 6.19 Fire Extinguishers. One 5 lb ABC fire extinguisher shall be mounted in the vehicle using a SAE J3043, *Ambulance Equipment Mounts*, compliant quick-release bracket and be accessible within the patient compartment.

6.20 Holder for Intravenous Fluid Containers.

6.20.1 One mounted device specifically designed for holding and securing an IV fluid container against accidental release during normal transport activity shall be provided.

6.20.2 The device shall not protrude more than 1.0 in. (25 mm) in the closed position.

6.21 Patient Compartment Seats.

6.21.1* Seat Integrity. Any seat mounted in a patient compartment shall meet the performance requirements speci-

fied in SAE J3026, *Ambulance Patient Compartment Seating Integrity and Occupant Restraint*.

6.21.2 All seating in the patient compartment shall conform to all applicable 49 CFR 571, FMVSS requirements.

6.21.3* Occupant Crash Protection.

6.21.3.1* Each designated seating position shall be provided with occupant crash protection.

6.21.3.2 If the occupant crash protection is a seat belt system, the seat belt shall comply with 6.21.3.3.1 and 6.21.3.3.1.2.

6.21.3.3 Ambulances above 19,500 lb (8845 kg) GVWR shall provide seat belts in accordance with 6.21.3.3.1 and 6.21.3.3.1.2 in the cab.

6.21.3.3.1 The effective seat belt web length for a Type 1 lap belt for pelvic restraint shall be a minimum of 60 in. (1525 mm) with the seat adjusted all the way back and down when measured using the following procedure:

- (1) Locate an imaginary line where the plane of the center of the seat back surface intersects the plane of the center of the seat cushion surface (line 1 in Figure 6.21.3.3.1).
- (2) Locate point A on line 1 at the outside of the seat on the retractor side of the seat.
- (3) Locate point C on line 1 at the outside of the seat on the buckle side of the seat.
- (4) Locate point D at the tip of the buckle.
- (5) Pull the seat belt webbing entirely out of the retractor and measure along the webbing between point A and the seat belt latch plate (tongue). Record this length as AD.
- (6) Measure from point C to point D, and record this length as CD.
- (7) The effective seat belt web length equals AD + CD.

6.21.3.3.1.1 Effective seat belt web length for a single retractor Type 2 seat belt shall be measured according to the following procedure:

- (1) Locate an imaginary line where the plane of the center of the seat back surface intersects the plane of the center of the seat cushion surface (line 1 in Figure 6.21.3.3.1).

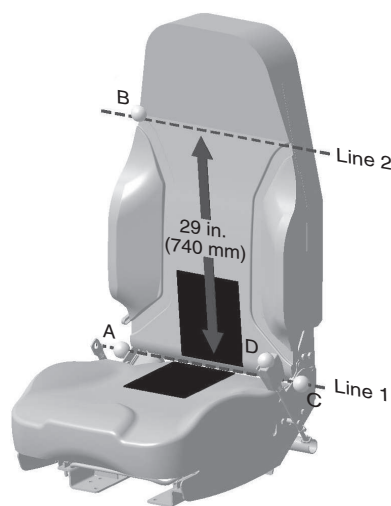


FIGURE 6.21.3.3.1 Dimension Lines for Measuring Seat Belt Effective Length.

- (2) Locate an imaginary line parallel with line 1 and lying on the center of the seat back surface 29 in. (740 mm) from line 1 (line 2 in Figure 6.21.3.3.1).
- (3) Locate point A on line 1 at the outside of the seat on the retractor side of the seat.
- (4) Locate point B on line 2 at the shoulder strap edge of the seat back.
- (5) Locate point C on line 1 at the outside of the seat on the buckle side of the seat.
- (6) Locate point D at the tip of the buckle.
- (7) Pull the seat belt webbing entirely out of the retractor, and measure along the webbing between points A and B. Record this length as AB.
- (8) Measure from point C to point D, and record this length as CD.
- (9) The effective lap belt web length equals AB + 2CD.

6.21.3.3.1.2 Effective seat belt web length for a dual retractor Type 2 seat belt shall be measured according to the following procedure:

- (1) Locate an imaginary line where the plane of the center of the seat back surface intersects the plane of the center of the seat cushion surface (*see line 1 in Figure 6.21.3.3.1*).
- (2) Locate point A on line 1 at the outside of the seat on the retractor side of the seat.
- (3) Locate point C on line 1 at the outside of the seat on the receiver side of the seat.
- (4) Locate point D at the tip of the buckle.
- (5) Pull the lap belt webbing entirely out of the lap belt retractor, and measure along the webbing between point A and the seat belt latch plate (tongue). Record this length as AD.
- (6) Locate an imaginary line parallel with line 1 and lying on the center of the seat back surface 29 in. (740 mm) from line 1 (line 2 in Figure 6.21.3.3.1).
- (7) Locate point B on line 2 at the shoulder strap edge of the seat back.
- (8) Pull the shoulder belt webbing entirely out of the shoulder belt retractor, and measure along the webbing between point B and the seat belt latch plate (tongue). Record this length as BD.
- (9) Measure from point C to point D, and record this length as CD.
- (10) The effective lap belt web length equals AD + CD.
- (11) The effective shoulder belt web length equals BD + CD.

6.21.3.3.2 A Type 2 seat belt shall have either a single retractor or dual retractors.

6.21.3.3.2.1 A single retractor Type 2 pelvic and upper torso restraint-style seat belt assembly shall have a minimum effective seat belt web length of 110 in. (2800 mm) with the seat adjusted all the way back and down and as measured in accordance with 6.21.3.3.1.1.

6.21.3.3.2.2 A dual retractor Type 2 pelvic and upper torso restraint-style seat belt assembly shall have a minimum effective shoulder belt web length of 50 in. (1270 mm) and a minimum effective lap belt web length of 60 in. (1530 mm) with the seat all the way back and down and as measured in 6.21.3.3.1.2.

6.21.3.3.3* In the case of a Type 2 seat belt, the distance from the buckle anchorage (point E in Figure 6.21.3.3.3) to the buckle tip (point D in Figure 6.21.3.3.3) shall be no more than 4 in. (102 mm) longer than the perpendicular distance from the buckle anchorage lateral axis through the H-point of the

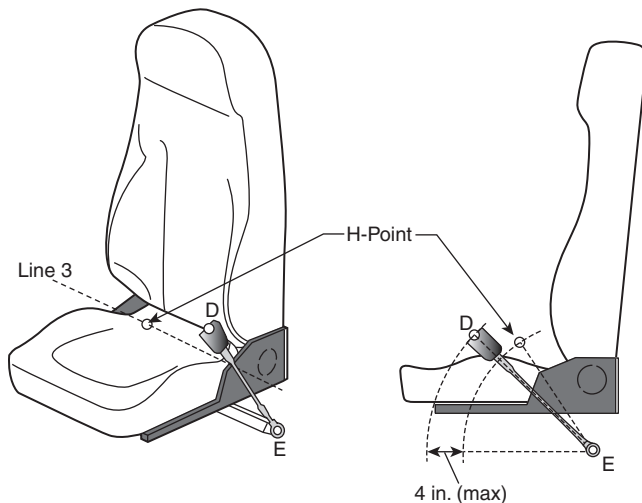


FIGURE 6.21.3.3.3 Dimension Lines for Measuring Buckle Length. [1901:Figure 14.1.3.2.3]

seat (line 3 in Figure 6.21.3.3.3) when the seat is adjusted to its lowest and most rearward position.

6.21.3.4 Signs that read “Occupants Must Be Seated and Belted When Ambulance Is in Motion” shall be visible from each seated position.

6.21.4 Seated Head Clearance.

6.21.4.1 The minimum seat-to-ceiling dimension from the top surface of the seat bottom cushion to the nearest overhead obstruction for each designated seating position shall be 43 in. (1092 mm).

6.21.4.2 The measurement shall be in accordance with AMD 025, *Occupant Head Clearance Zones Test*.

6.21.5 Seat Adjustment. Where independent horizontal seat adjustment is provided, it shall be fully adjustable within 10 seconds.

6.21.6 Seating Position Width. Each designated seating space shall have a minimum width of 24 in. (610 mm) measured from the seat surface to 43 in. (1092 mm) above the seating surface.

6.21.7 Seat Size.

6.21.7.1 The seat bottom cushion height shall be a maximum of 21 in. (533 mm) measured from the floor.

6.21.7.2 Seat bottom cushions shall be a minimum of 18 in. (460 mm) in width.

6.21.7.3* Seat bottom cushions shall be between 15 in. (380 mm) and 19 in. (483 mm) from the front of the cushion to the face of the seat back.

6.21.7.4* Each seat shall provide back and head support.

6.21.7.5 For any seat not covered by 49 CFR 571, FMVSS 202, the top of the seat back or head rest shall be a minimum of 10 in. (254 mm) in width.

6.21.8 Access to Patient.

6.21.8.1 If the primary patient care seat is at the patient torso position, it shall be capable of being adjusted such that the seat bottom cushion is within 6 in. (152 mm) of the patient cot.

6.21.8.2 If the primary patient care position is at the patient torso position, the fore-aft position of the seat shall be capable of lining up within 6 in. (152 mm) of the midpoint between the head end of the cot and the backrest hinge.

6.21.8.3 If the primary patient care seat is at the patient head position, it shall be capable of being adjusted such that the nearest edge of the seat bottom cushion is within 6 in. (152 mm) of the nearest edge of the patient cot.

6.21.8.4 If the designated primary patient care seat is at the patient head position, the longitudinal centerline of the seat shall line up within 11 in. (280 mm) of the longitudinal centerline of the cot.

6.21.9 Child Seating Restraints.

6.21.9.1 Any seat with a built-in system for transporting a child or an infant shall be designed for operation in a forward-facing or rear-facing direction during transport.

6.21.9.2 If the ambulance is designed to transport infants in a seat, the ambulance shall include an infant restraint seat or have provisions to accommodate an infant car seat.

6.21.9.3 If the ambulance is designed to transport children in a seat, it shall include a child restraint seat or have provisions to accommodate a child car seat.

6.21.10 Seatbelt Warning System.

6.21.10.1 An occupant restraint warning system shall be provided for each designated seating position in the patient compartment.

6.21.10.2 The warning system shall indicate if an occupant in the patient compartment is not belted or restrained.

6.21.10.3 The warning system shall consist of an audible and visual warning device that can be heard and seen by the driver and seen by the occupants of the patient compartment.

6.21.10.3.1 The audible portion of the warning system shall comply at a minimum with 49 CFR 571, FMVSS 208.

6.21.10.4 The warning shall be activated when the parking brake is released and the transmission is not in neutral or park.

6.21.10.5 The warning system shall not show an affirmative indication unless it has determined that the seat was occupied before the seat belt or restraint was buckled.

6.22 Patient Cot Retention.

6.22.1 Patient cots shall meet the performance requirements of SAE J3027, *Ambulance Litter Integrity, Retention, and Patient Restraint*.

6.22.2 The installed cot fastener device(s) for wheeled cots shall meet the performance requirements of SAE J3027, *Ambulance Litter Integrity, Retention, and Patient Restraint*.

6.22.3 A cot fastener assembly with a quick-release latch shall be furnished.

6.22.4 The cot fastener shall be installed according to the cot fastener manufacturer's directions.

▲ **6.22.5** The floor substructure shall be tested in accordance with SAE J3102, *Ambulance Patient Compartment Structural Integrity Test to Support SAE J3027 Compliant Litter Systems*.

6.22.6 Cot and infant transporters shall only be used with the required fastener assembly and occupant restraint systems as prescribed by the litter/transporter manufacturer.

6.23* HVAC. Connecting hoses for the heating and air-conditioning system shall be supported by rubber-insulated metal clamping devices at least every 18 in. (457 mm).

6.23.1 Heating.

6.23.1.1 A heating system shall be provided that is capable of raising the interior temperature from 32°F to 68°F (0°C to 20°C) within 30 minutes.

6.23.1.2 Compliance of the heating system shall be validated by testing a substantially similar ambulance in accordance with AMD 012, *Interior Climate Control Test*.

6.23.2 Air Conditioning.

6.23.2.1 An air-conditioning system shall be provided that is capable of lowering the interior temperature from 95°F to 78°F (35°C to 25°C) at a minimum of 40 percent relative humidity within 30 minutes.

6.23.2.2 Compliance of the air-conditioning system shall be validated by testing a substantially similar ambulance in accordance with AMD 012, *Interior Climate Control Test*.

6.23.3 Ventilation.

6.23.3.1 A patient care compartment air exhaust fan shall be provided.

6.23.3.2 Ventilation shall be separately controlled within the cab and the patient compartment.

6.23.3.3 Fresh air intakes shall be provided and shall not be located near the engine exhaust outlet.

6.24 Interior Noise.

6.24.1 The interior sound level in the patient compartment shall not exceed 80 decibels.

6.24.2 Compliance of the patient compartment interior sound level shall be validated by testing a substantially similar ambulance in accordance with AMD 006, *Patient Compartment Sound Level Test*.

6.25* Reflective Striping.

6.25.1* A retroreflective stripe, a combination of retroreflective stripes, or Battenburg markings shall be affixed to the ambulance in the following proportions:

- (1) 25 percent of the length of each of the cab side surfaces when approached from each side
- (2) 75 percent of the length of each patient compartment side surfaces when approached from each side

6.25.2 The stripe or combination of stripes shall be a minimum of 6 in. (152 mm) in total vertical width.

6.25.3 The 6 in. (152 mm) wide stripe or combination of stripes shall be permitted to be interrupted by objects (e.g., receptacles, cracks between slats in roll-up doors), provided the full stripe is conspicuous as the ambulance is approached.

6.25.4 A retroreflective graphic design shall be permitted to replace all or part of the required striping material on the front and sides of the vehicle if the design or combination thereof covers at least the same surface area as required by 6.25.1.

6.25.5 Any vertically hinged door shall have at least 60 in.² (38,710 mm²) of retroreflective material affixed to the inside of the door.

6.25.6* At least 50 percent of the rear-facing vertical surfaces other than glass and lenses, visible when facing from the rear of the ambulance, shall be equipped with retroreflective material.

6.25.6.1 Where chevrons are used, each stripe in the chevron shall be a single color alternating between two high-contrast colors.

6.25.6.2 Each stripe shall be 6 in. (152 mm) in width.

6.25.6.3 Where Battenburg markings are used, each box in the Battenburg markings shall be 144 in.² (92,903 mm²).

6.25.7 All retroreflective material shall conform to the requirements of ASTM D4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, Section 6.1.1, for Type I Sheeting.

6.25.8 All retroreflective materials that are colors not listed in ASTM D4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, Section 6.1.1, shall have a minimum coefficient of retroreflection of 10 with an observation angle of 0.2 degrees and an entrance angle of -4 degrees.

6.25.9 Any printed or processed retroreflective film construction shall conform to the standards required of an integral colored film as specified in ASTM D4956, *Standard Specification for Retroreflective Sheeting for Traffic Control*, Section 6.1.1.

6.26 Metal Finish. Where dissimilar metals that pose a galvanic corrosion or reactive threat are to be mounted together, the mounting base material shall have an isolation barrier prior to assembly to prevent dissimilar metal reaction.

6.27 Painting.

6.27.1 All exposed ferrous metal surfaces that are not plated or stainless steel shall be cleaned, prepared, and painted or coated.

6.27.2 The paint or coating, including any primer, shall be applied in accordance with the paint or coating manufacturer's recommendation.

6.28 Medical Gas — Main Supply and Installation.

▲ **6.28.1** The ambulance shall have a medical gas system capable of supplying a minimum of 793 gal (3000 L) of medical gas.

6.28.2 If a compressed gas cylinder is used, a cylinder-changing wrench shall be secured within the medical gas storage compartment.

6.28.3* All medical gas system controls shall be accessible from inside the vehicle.

6.28.4 A medical gas-capacity indicator shall be visible from the designated primary patient care seating position.

6.28.5 The medical gas port shall be accessible from the designated primary patient care seating position.

6.28.6 The purchaser shall specify the quantity and location of medical gas ports.

▲ 6.28.7 Medical gas system shall include the following:

- (1) A pressure regulator
- (2) Low pressure, electrically conductive hose and fittings approved for medical gas
- (3) Medical gas piping that is concealed and not exposed to the elements, securely supported to prevent damage, and readily accessible for inspection and replacement
- (4) Medical gas that is piped to a medical gas port with a minimum flow rate of 26.4 gpm (100 L/min) at the outlet
- (5) Outlet(s) that is marked and identified and does not interfere with the suction outlet

6.28.8 Medical gas and suction ports shall be within reach of EMSPs while remaining seated and restrained in the designated primary patient care position.

6.28.9 Medical Gas Pressure Regulator.

6.28.9.1 The medical gas pressure reducing and regulating valve system shall be provided with the following features:

- (1) An inlet filter at the cylinder
- (2) A line relief valve set at 200 psi (1380 kPa) maximum
- (3) A gauge or digital monitor with a minimum range of 0 psi to 2500 psi (0 kPa to 17,237 kPa) graduated in not more than 100 psi (690 kPa) increments
- (4) A locking adjustment preset at 50 psi $\pm$ 2 psi (345 kPa $\pm$ 14 kPa) line pressure

6.28.9.2 The regulator shall meet the performance required by 6.28.9.3 at an inlet pressure range from 150 psi to 2500 psi (1034 kPa to 17,237 kPa).

6.28.9.3 With the regulator set at 50 psi $\pm$ 2 psi (345 kPa $\pm$ 14 kPa), a 26.4 gpm (100 L/min) minimum flow rate shall be available at all medical gas ports.

6.28.10 Medical Gas Tank Storage.

6.28.10.1 Storage for an “M” or “H” size main medical gas cylinder shall be accessible for replacement from an outside position.

6.28.10.2 Any exterior medical gas compartment, if so equipped, shall be provided with at least 9 in.² (580 mm²) of open vent to dissipate or vent leaking medical gas to the outside of the ambulance.

6.28.10.3 Medical gas cylinder compartment shall not be utilized for storage of any other equipment and shall be labeled “Medical Gas Storage Only.”

6.28.11 Medical Gas Tank Retention.

6.28.11.1 A medical gas cylinder(s) shall be mounted with a restraining device(s) that meets the requirements of SAE J3043, *Ambulance Equipment Mounts*, in the lateral and longitudinal directions.

6.28.11.2 Compliance of the medical gas tank retention device, in the lateral and longitudinal directions, shall be validated by testing a sample retention device using a substantially similar ambulance or body structure in accordance with the testing requirements of SAE J3043, *Ambulance Equipment Mounts*.

6.28.11.3 A medical gas cylinder(s) shall be mounted with a restraining device(s) that meets the requirements of AMD 003, *Oxygen Tank Retention System Static Test*, in the vertical direction.

6.28.11.4 Compliance with the medical gas retention device in the vertical direction shall be validated by testing a sample retention device using a substantially similar ambulance or body structure in accordance with the testing requirements of AMD 003, *Oxygen Tank Retention System Static Test*.

6.28.12 Medical Gas System Integrity.

6.28.12.1 The medical gas system of each ambulance shall be tested prior to delivery in accordance with AMD 015, *Ambulance Main Medical Gas System Test*.

6.28.12.1.1 The medical gas system shall lose no more than 5 psi (34 kPa) of pressure in a 2-hour period.

6.28.12.1.2 Each port shall be capable of delivering at least 26.4 gpm (100 L/min) of medical gas.

6.28.12.2 A label shall be provided near the medical gas tank stating the following:

The integrity of this medical gas system was tested in accordance with NFPA 1917 and meets the requirements thereof.

6.28.12.3 The label shall be signed and dated by an authorized representative of the ambulance manufacturer or test agency.

6.29 Suction Aspirator.

6.29.1 A mountable battery-powered or electrically powered suction aspirator system shall be furnished.

6.29.2 The vacuum control, vacuum indicator, and collection bottle or bag shall be located so that it can be operated from a position near the head of the patient.

6.29.3 Any permanently mounted suction pump shall be located in an area that is accessible for service.

6.29.4 Any permanently mounted suction pump shall be vented to the vehicle's exterior.

6.29.5 A vacuum control and a shutoff valve, or combination thereof, shall be provided to adjust vacuum levels.

6.29.6 A vacuum indicator gauge graduated at least every 2 in. (51 mm) Hg and a minimum total range of 0 in. to 30 in. (0 mm to 762 mm) Hg shall be provided.

6.29.7 The collection bottle or bag shall be shatter resistant and transparent with a minimum 0.26 gal (1000 ml) capacity.

6.29.8 The minimum inside diameter for the suction tubing connectors shall be at least ¼ in. (6.4 mm).

6.29.9 Aspirator System Performance.

6.29.9.1 The aspirator system shall provide a free airflow of at least 1.06 ft³/min (30 L/min).

6.29.9.2 The aspirator system shall achieve a minimum of 5.8 psi (300 mm) Hg vacuum within 4 seconds after the suction tube is closed.

6.29.9.3 Compliance of the aspirator system shall be validated by the manufacturer by testing each individual aspirator system installed in accordance with AMD 021, *Aspirator System Test*.

Chapter 7 Low Voltage Electrical Systems and Warning Devices

7.1* General. Any low voltage electrical systems or warning devices installed on the ambulance shall be appropriate for the mounting location and intended electrical load and shall meet the specific requirements of Chapter 7.

7.1.1 Printed Circuits.

7.1.1.1 Where printed circuits are utilized, they shall conform to IPC A-610F, *Acceptability of Electronic Assemblies*.

Δ **7.1.1.2** Printed circuit assemblies installed by the FSAM shall comply with IPC A-610F, *Acceptability of Electronic Assemblies*, Classification 1.4.1.

7.1.2 Electrical System Performance Tests. The low voltage electrical system performance test shall be done in accordance with AMD 005, *Low Voltage Electrical System Test*.

7.2 Wiring.

7.2.1 All electrical circuit wiring supplied and installed by the ambulance manufacturer shall meet the requirements of 7.2.1.1 through 7.2.1.6.

7.2.1.1* The circuit feeder wire shall be stranded copper or copper alloy conductors of a gauge rated to carry 125 percent of the maximum current for which the circuit is protected. [1901:13.2.1]

7.2.1.2 Voltage drops in all wiring from the power source to the load shall not exceed 5 percent of the nominal source voltage.

7.2.1.3 The installation of star washers by the final-stage ambulance manufacturer for circuit ground connections shall not be permitted.

7.2.1.4 All circuits shall otherwise be wired in conformance with SAE J2202, *Heavy Duty Wiring Systems for On-Highway Trucks*.

7.2.1.5 Only electrical components directly related to the delivery of onboard medical gas and other circuits needed for required lighting or medical gas tank lifts shall terminate in the medical gas storage compartment.

7.2.1.6 Electrical harnesses or wires that pass through the medical gas compartment shall be enclosed in conduit.

7.2.2 Wiring and Wire Harness Construction.

7.2.2.1 All insulated wire and cable shall conform to SAE J1127, *Low Voltage Battery Cable*, or SAE J1128, *Low Voltage Primary Cable*, type SXL and/or GXL.

7.2.2.1.1 All conductors shall be constructed in accordance with SAE J1127 or SAE J1128, except where good engineering practice dictates special strand construction. [1901:13.2.2.1.1]

7.2.2.1.2 Conductor materials and stranding, other than copper, shall be permitted if all applicable requirements for physical, electrical, and environmental conditions are met as dictated by the end application. [1901:13.2.2.1.2]

7.2.2.1.3 Physical and dimensional values of conductor insulation shall be in conformance with the requirements of SAE J1127 or SAE J1128, except where good engineering practice dictates special conductor insulation. [1901:13.2.2.1.3]

7.2.2.2 The overall covering of conductors or jacketed cables shall be moisture-resistant loom or braid that has a minimum continuous rating of 300°F (149°C).

7.2.2.3 The overall covering of jacketed cables shall be moisture resistant and have a minimum continuous temperature rating of 300°F (149°C).

7.2.2.4 All wiring connections and terminations shall use a method that provides a positive mechanical and electrical connection. [1901:13.2.4]

7.2.2.4.1 The wiring connections and terminations shall be installed in accordance with the device manufacturer's instructions. [1901:13.2.4.1]

7.2.2.4.2 Wire nut, insulation displacement, and insulation piercing connections shall not be used. [1901:13.2.4.3]

7.2.2.5 All ungrounded electrical terminals and electrical panels shall have protective covers or be in enclosures.

7.2.2.6 A minimum 6 in. (152 mm) service loop of wire or harness shall be provided at all electrical components, terminals, and connection points.

7.2.2.7 Exterior connections for lights and fixtures shall utilize sealed connectors or sealed splices.

7.2.2.8 Wiring Protection.

7.2.2.8.1 Wiring shall be restrained to prevent damage caused by chafing or ice buildup and protected against heat, liquid contaminants, or other environmental factors. [1901:13.2.5]

7.2.2.8.2 Wiring shall not be secured to brake lines and/or fuel lines.

7.2.2.9* Wiring Identification. Wiring shall be uniquely identified at least every 4 in. (101 mm) by color coding or permanent marking with a circuit function code and the wire referenced on a wiring diagram as listed in 4.16.2.3(6).

7.2.2.10 Circuit Protection.

Δ **7.2.2.10.1** Circuits shall be provided with rated low voltage overcurrent protective devices.

7.2.2.10.2 Such devices shall be accessible and protected against heat in excess of the overcurrent device's design range, mechanical damage, and water spray.

7.2.2.10.3 Circuit protection shall be accomplished by utilizing fuses, circuit breakers, fusible links, or solid state equivalent devices. [1901:13.2.7.2]

Δ **7.2.2.10.4** If a mechanical-type device is used, it shall conform to one of the following SAE standards:

- (1) SAE J156, *Fusible Links*
 - (2) SAE J553, *Circuit Breakers*
 - (3) SAE J554, *Electric Fuses (Cartridge Type)*
 - (4) SAE J1888, *High Current Time Lag Electric Fuses*
 - (5) SAE J2077, *Miniature Blade Type Electrical Fuses*
- [1901:13.2.7.3]

7.2.2.11 Terminals.

7.2.2.11.1 All terminals shall be permanently numbered or coded.

7.2.2.11.2 A terminal strip(s) block(s) or a multi-pin connector(s) shall be accessible for checking and service.

7.2.2.12 Hard-wired patient compartment electrical systems shall incorporate a master circuit breaker panel with circuit breakers or other electronic nondisposable current protection devices, in each circuit, that comply with SAE J553, *Circuit Breakers*, Type I or Type III (if circuit breaker is accessible for resetting by the driver or EMSP).

7.2.2.12.1 Multiplexed patient compartment electrical systems shall incorporate centralized circuit protection devices on each power circuit supplying the multiplexing system's components.

7.2.2.13 One extra circuit, minimum 15 amperes, shall be provided for future use.

7.2.2.14 Grounding.

7.2.2.14.1 All electrical components or appliances shall be electrically grounded in accordance with the component manufacturer's recommendations.

7.2.2.14.2 The use of appliance mounting screws/hardware shall not be used for grounding purposes unless specifically designed for that purpose.

7.2.2.15 All switches, indicators, and controls shall be located and installed in a manner that facilitates easy removal.

7.2.2.16 Switches, relays, terminals, and connectors shall have a direct current (dc) rating of 125 percent of the maximum current for which the circuit is protected.

7.2.2.17 The patient compartment interior and exterior electrical circuits shall be powered by circuit(s) separate and distinct from vehicle chassis circuits, unless specific chassis circuits are supplied for that purpose by the chassis manufacturer.

7.3 Power Supply.

7.3.1 A 12 volt or greater electrical alternator shall be provided. [1901:13.3.1]

7.3.2* Low Idle Alternator Output.

7.3.2.1 The alternator shall have a minimum output at low idle to meet the minimum electrical load test conditions of the ambulance between 60°F and 110°F (15°C and 43°C) ambient temperature.

7.3.2.1.1 Minimum electrical load test conditions, which are tested under low-idle conditions, shall consist of the following:

- (1) The propulsion engine and transmission
- (2) All legally required clearance and marker lights, headlights, and other electrical devices except windshield wipers and four-way hazard flashers
- (3) The radio(s) at a duty cycle of 10-percent transmit and 90-percent receive (for calculation and testing purposes, a default value of 5 amperes continuous)
- (4) Cab air conditioning (at coldest setting with highest blower speed)
- (5) Patient compartment air conditioning (at coldest setting with highest blower speed)
- (6) The lighting necessary to illuminate walking surfaces at entry points

7.3.2.2 Compliance of the minimum electrical load test conditions shall be validated by testing each ambulance in accordance with the "Alternator Performance Test at Idle" as specified in AMD 005, *Low Voltage Electrical System Test*.

7.3.3 The alternator shall be provided with full automatic regulation.

7.3.4 High-Idle Alternator Output.

7.3.4.1 The alternator shall have a minimum output at high idle to power the operational electrical load test conditions between 60°F and 110°F (15°C and 43°C) ambient temperature.

7.3.4.2 Compliance of the high-idle alternator output shall be validated by the final-stage ambulance manufacturer by testing each ambulance in accordance with the "Alternator Performance Test at Idle" as specified in AMD 005, *Low Voltage Electrical Test*.

7.4 Operational Electrical Load Test Conditions.

7.4.1 The minimum continuous electrical load under operational electrical load test conditions shall consist of the total amperage required to simultaneously operate the following in a stationary mode during emergency operations:

- (1) The propulsion engine and transmission
- (2) All legally required clearance and marker lights, headlights, and other electrical devices except windshield wipers and four-way hazard flashers
- (3) The radio(s) at a duty cycle of 10-percent transmit and 90-percent receive (for calculation and testing purposes, a default value of 5 amperes continuous)
- (4) The lighting necessary to illuminate walking surfaces at entry points and 50 percent of the total compartment light load as required by this standard
- (5) The minimum optical warning system required in Section 7.8, where the ambulance is blocking the right-of-way
- (6) The continuous electrical current required to simultaneously operate an additional 20-ampere load
- (7) Cab air conditioning (at coldest setting with highest blower speed)
- (8) Patient compartment air conditioning (at coldest setting with highest blower speed)
- (9) Patient compartment dome lighting (in the high intensity setting)
- (10)* Other warning devices and electrical loads defined by the purchaser as critical to the mission of the ambulance

7.4.2 If the ambulance is equipped to tow a trailer, an additional 20 amperes shall be added to the minimum continuous electrical load to provide electrical power for the federally required clearance and marker lighting and the optical warning devices mounted on the trailer.

7.4.3* The condition of the low voltage electrical system shall be monitored by a warning system that provides both an audible and a visual signal to persons on, in, or near the ambulance of an impending electrical system failure caused by the excessive discharge of the battery set.

7.4.3.1 The charge status of the battery shall be determined either by direct measurement of the battery charge or indirectly by monitoring the electrical system voltage. [1901:13.3.4.1]

7.4.3.2 Voltage Alarm.

7.4.3.2.1 The alarm shall sound if the system voltage at the battery or at the master load disconnect switch drops below 11.8 volts for 12-volt nominal systems, 23.6 volts for 24-volt

nominal systems, or 35.4 volts for 42-volt nominal systems for more than 120 seconds.

7.4.3.2.2 Compliance of the voltage alarm shall be validated by testing each ambulance in accordance with the "Low Voltage Alarm Test" as specified in AMD 005, *Low Voltage Electrical System Test*.

7.4.4 A voltmeter shall be mounted on the driver's instrument panel to allow direct observation of the system voltage. [1901:13.3.5]

7.5 Load Management.

7.5.1* If the total continuous electrical load exceeds the minimum continuous electrical output rating of the installed alternator(s) operating under the conditions specified in 7.4.1, an automatic electrical load management system shall be required. [1901:13.3.6.1]

7.5.2 The minimum continuous electrical loads specified in 7.4.1 shall not be subject to automatic load management. [1901:13.3.6.2]

7.5.3 Engine Speed Auxiliary Control Device.

7.5.3.1 An engine speed auxiliary control device (high-idle switch or throttle) shall be installed to allow an increase in the engine speed, not to exceed the chassis manufacturer's recommendations, when the ambulance is in park or neutral with the parking brake applied.

7.5.3.2 An interlock shall prevent the operation of the engine speed auxiliary control device unless the parking brake is engaged and the transmission is in neutral or park, or the parking brake is engaged and the engine is disengaged from the drive wheels.

7.5.3.3 The engine shall be prevented from regulating its own engine speed during times when engine rpm control is critical for consistent ambulance functions.

7.6* Batteries.

7.6.1 Continuous Electrical Load.

7.6.1.1 With the engine off, the battery system shall be able to provide the minimum electrical load test conditions specified in 7.4.1 for 10 minutes and then be able to restart the engine.

7.6.1.2 Compliance of the battery system shall be verified on every ambulance prior to delivery in accordance with the "Reserve Capacity Test" as specified in AMD 005, *Low Voltage Electrical System Test*.

7.6.2 The battery system cold cranking amps (CCA) rating shall meet or exceed the minimum CCA recommendations of the engine manufacturer. [1901:13.4.3]

7.6.3 The batteries shall be mounted to prevent movement during ambulance operation and protected against accumulations of road spray, snow, and road debris.

7.6.3.1 The batteries shall be readily accessible for examination, testing, and maintenance.

7.6.3.2 Where an enclosed battery compartment is provided, it shall be ventilated to the exterior to prevent the buildup of heat and explosive fumes and separated from the occupant compartments.

7.6.3.3* The batteries shall be protected against vibration and temperatures that exceed the battery manufacturer's recommendation. [1901:13.4.4.4]

7.6.4 A means shall be provided for jump-starting the engine if the batteries are not accessible without lifting the cab of a tilt-cab ambulance.

7.6.5* An onboard battery conditioner or charger shall be provided for maintaining batteries in a fully charged condition.

7.6.5.1 The onboard charger shall be tested to the requirements of the "Onboard Battery Charger Test" as specified in AMD 027, *Line Voltage Electrical Systems Test*.

7.6.6 Any associated line voltage electrical power system shall be installed in accordance with Chapter 8.

7.6.7* A master load disconnect shall be provided between the main power source and the patient compartment electrical loads.

7.6.8 Starter Solenoid.

7.6.8.1 Electronic control systems and similar devices shall be permitted to be otherwise connected if so specified by their manufacturer. [1901:13.4.6.2]

7.6.9 Alternators shall not be wired through the master load switch.

7.6.10 A sequential switching device shall be permitted to energize the optical warning devices required in Section 7.9 and other high current devices, provided the switching device first energizes the electrical devices required in Section 7.9 within 5 seconds.

7.6.11 Two automotive power point-type connectors shall be furnished in the patient compartment.

7.6.11.1 The power point circuits shall prevent discharge of chassis batteries by permitting the charging of portable devices only when the vehicle's ignition is on or the automatic charger/conditioner is connected to shore power.

7.6.11.2 The power point circuits shall be protected by a minimum 10 amp circuit breaker.

7.6.11.3 The power point circuits shall include a (low voltage drop) Schottky diode or other solid-state equivalent devices to isolate medical equipment batteries from any electrical loads that the remainder of the ambulance electrical system could impose.

7.6.11.3.1 If a Schottky diode is used, it shall be heat-sink mounted, have an inverse voltage rating of at least 45 volts, and also be rated to carry the maximum short-circuit current until the circuit breaker opens.

7.6.11.3.2 If a Schottky diode is used, it shall be physically located in an accessible location and be electrically connected between the circuit breaker and the power point connectors.

7.7 Temperature Exposure. Any alternator, electrical starting device, ignition wiring, distributor, or ignition coil shall be moisture resistant and protected such that it is not exposed to a temperature that exceeds the component manufacturer's recommendations. [1901:13.6]

7.8* Electromagnetic Interference. Electromagnetic interference suppression shall be provided, as required, to satisfy the

radiation limits specified in SAE J551/1, *Performance Levels and Methods of Measurement of Electromagnetic Compatibility of Vehicles, Boats (up to 15 m), and Machines (16.6 Hz to 18 GHz)*. [1901:13.7]

7.9 Optical Warning Devices. Each ambulance shall have a system of optical warning devices that meets or exceeds the requirements of this section.

7.9.1* The optical warning system shall consist of an upper and a lower warning level. [1901:13.8.1]

7.9.2 The requirements for each level shall be met by the warning devices in that particular level without consideration of the warning devices in the other level. [1901:13.8.2]

7.9.3 For the purposes of defining and measuring the required optical performance, the upper and lower warning levels shall be divided into four warning zones. [1901:13.8.3]

7.9.3.1 The four zones shall be determined by lines drawn through the geometric center of the ambulance at 45 degrees to a line drawn lengthwise through the geometric center of the ambulance

7.9.3.2 The four zones shall be designated A, B, C, and D in a clockwise direction, with zone A to the front of the ambulance, as shown in Figure 7.9.3.2.

7.9.4 Each optical warning device shall be installed on the ambulance and connected to the ambulance's electrical system in accordance with the requirements of this standard and the requirements of the manufacturer of the device.

7.9.5 A master optical warning system switch that energizes all the optical warning devices shall be provided. [1901:13.8.5]

7.9.6 The optical warning system on the ambulance shall be capable of two separate signaling modes during emergency operations.

7.9.6.1 One mode shall signal to drivers and pedestrians that the ambulance is responding to an emergency and is calling for the right-of-way.

7.9.6.2 One mode shall signal that the ambulance is stopped and is blocking the right-of-way.

7.9.6.3 The use of some or all of the same warning lights shall be permitted for both modes provided the other requirements of this chapter are met. [1901:13.8.6.3]

7.9.7 A switching system shall be provided that senses the position of the parking brake or the park position of an automatic transmission. [1901:13.8.7]

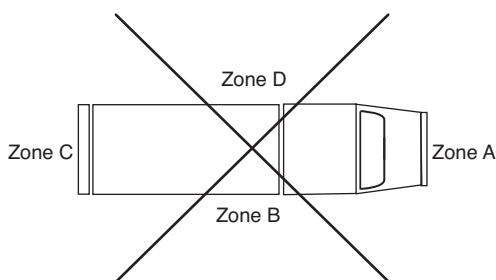


FIGURE 7.9.3.2 Warning Zones for Optical Warning Devices.

7.9.7.1 When the master optical warning system switch is enabled and the parking brake is released or the automatic transmission is not in park, the warning devices signaling the call for the right-of-way shall be energized.

7.9.7.2 When the master optical warning system switch is enabled and the parking brake is on or the automatic transmission is in park, the warning devices signaling the blockage of the right-of-way shall be energized.

7.9.7.3* The system shall be permitted to have a method of modifying the two signaling modes. [1901:13.8.7.3]

7.9.8 The optical warning devices shall be constructed or arranged so as to avoid the projection of light, either directly or through mirrors, into any driving or crew compartment(s). [1901:13.8.8]

7.9.9 The front optical warning devices shall be placed so as to maintain the maximum practical separation from the headlights.

7.9.10* Failure of a single optical device should not impede the visibility of the vehicle at 100 ft (30 m) from the geometric center of the ambulance.

7.9.11 Flash Rate.

7.9.11.1 The minimum flash rate of any optical source shall be 75 flashes per minute.

7.9.11.1.1 Steadily burning, nonflashing optical sources shall be permitted to be used. [1901:13.8.11.1.1]

7.9.11.1.2 Only the optical energy provided by flashing optical sources shall be included in the calculations of the zone's total optical power.

7.9.11.1.3 The minimum number of flashes at any measurement point shall be 150 flashes per minute.

7.9.12* Color of Warning Lights.

7.9.12.1 Permissible colors or combinations of colors in each zone, within the constraints imposed by applicable laws and regulations, shall be as shown in Table 7.9.12.1. [1901:13.8.12.1]

7.9.12.2 All colors shall be as specified in SAE J578, *Color Specification*, for red, blue, yellow, or white. [1901:13.8.12.2]

7.9.13* Requirements for Large Ambulances.

7.9.13.1 If the ambulance has a bumper-to-bumper length of 25 ft (7.6 m) or more or has an optical center on any optical warning device greater than 8 ft (2.4 m) above level ground, the requirements of 7.9.13.2 through 7.9.13.6 shall apply.

Table 7.9.12.1 Zone Colors

Color	Calling for Right-of-Way	Blocking Right-of-Way
Red	Any zone	Any zone
Blue	Any zone	Any zone
Yellow	Any zone except A	Any zone
White	Any zone except C	Not permitted

[1901: Table 13.8.12.1]

7.9.13.2 Upper-Level Optical Warning Devices.

7.9.13.2.1 The upper-level optical warning devices shall be mounted high and close to the corner points of the ambulance to define the clearance lines of the ambulance.

7.9.13.2.2 The upper-level optical warning devices shall not be mounted above the maximum height, specified by the device manufacturer, that gives an intensity value at 4 ft (1.2 m) above level ground and at 100 ft (30.5 m) from the optical warning device of less than 50 percent of that required at the optical center. [1901:13.8.13.2.2]

7.9.13.3 Lower-Level Optical Warning Devices.

7.9.13.3.1 To define the clearance lines of the ambulance, the optical center of the lower-level optical warning devices in the front of the vehicle shall be mounted on or forward of the front axle centerline and close to the front corner points of the ambulance.

7.9.13.3.2 The optical center of the lower-level optical warning devices at the rear of the vehicle shall be mounted on or behind the rear axle centerline and as close to the rear corners of the ambulance.

7.9.13.3.3 The optical center of any lower-level device shall be between 18 in. and 62 in. (460 mm and 1600 mm) above level ground. [1901:13.8.13.3.3]

7.9.13.4 Midship Optical Warning Devices.

7.9.13.4.1 A midship optical warning device shall be mounted on both the right and the left sides of the ambulance if the distance between the front and rear lower-level optical devices exceeds 25 ft (7.6 m) at the optical center.

7.9.13.4.2 Additional midship optical warning devices shall be required, where necessary, to maintain a horizontal distance

between the centers of adjacent lower-level optical warning devices of 25 ft (7.6 m) or less. [1901:13.8.13.4.2]

7.9.13.4.3 The optical center of any midship-mounted optical warning device shall be between 18 in. and 62 in. (460 mm and 1600 mm) above level ground. [1901:13.8.13.4.3]

7.9.13.5* For each operating mode, the combined optical power of all the optical sources shall meet or exceed the zone total optical power requirements shown in Table 7.9.13.5.

7.9.13.6 No individual measurement point shall be less than that shown in Table 7.9.13.5. [1901:13.8.13.6]

7.9.14* Requirements for Small Ambulances.

7.9.14.1 If the ambulance has a bumper-to-bumper length of less than 25 ft (7.6 m) and has the optical center of all optical warning devices at 8 ft (2.4 m) or less above level ground, the requirements of 7.9.14.2 through 7.9.14.5 shall apply.

7.9.14.2 Upper-Level Optical Warning Devices.

7.9.14.2.1 The upper-level optical warning devices shall be mounted as high as practical, but not over 8 ft (2.4 m), at the optical center. [1901:13.8.14.2.1]

7.9.14.2.2 The upper-level optical warning devices shall be permitted to be combined in one or more enclosures and shall be permitted to be mounted on the cab roof or any other convenient point. [1901:13.8.14.2.2]

7.9.14.3 Lower-Level Optical Warning Devices.

7.9.14.3.1 One or more lower-level optical warning devices shall be visible from the front and the side of the ambulance.

7.9.14.3.2 The optical center of the lower-level optical warning devices in the front of the vehicle shall be mounted on or forward of the front wheel centerline and as close to the front corner points of the ambulance.

Table 7.9.13.5 Minimum Optical Power Requirements for Large Ambulances

Mode of Operation							
Calling for Right-of-Way					Blocking Right-of-Way		
Zone	Level	H Total	At Any H Point	At Any Point 5 Degrees Up or 5 Degrees Down from H	H Total	At Any H Point	At Any Point 5 Degrees Up or 5 Degrees Down from H
A	Upper	1,000,000	10,000	3,500	400,000	10,000	3,500
B	Upper	400,000	10,000	3,500	400,000	10,000	3,500
C	Upper	400,000	10,000	3,500	800,000	10,000	3,500
D	Upper	400,000	10,000	3,500	400,000	10,000	3,500
A	Lower	150,000	3,750	1,300	150,000	3,750	1,300
B	Lower	150,000	3,750	1,300	150,000	3,750	1,300
C	Lower	150,000	3,750	1,300	150,000	3,750	1,300
D	Lower	150,000	3,750	1,300	150,000	3,750	1,300

H = Horizontal plane passing through the optical center.

Notes:

(1) All values are in candela-seconds/minute.

(2) The values in the H Total columns are the total of 19 data point values for each light, with data points on the boundary between zones counted in both zones.

7.9.14.3.3 The optical center of the device(s) shall be between 18 in. and 48 in. (460 mm and 1220 mm) above level ground. [1901:13.8.14.3.3]

7.9.14.4 For each operating mode, the combined optical power of all the optical sources mounted on both the upper and lower levels shall meet or exceed the zone's total optical power requirements shown in Table 7.9.14.4.

7.9.14.5 No individual measurement point shall be less than that shown in Table 7.9.14.4. [1901:13.8.14.5]

7.9.15 Tests of Optical Warning Devices.

7.9.15.1 Mechanical and Environmental Test.

7.9.15.1.1 All optical warning devices shall be tested to the requirements of SAE J595, *Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*; SAE J845, *Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*; SAE J1318, *Gaseous Discharge Warning Lamp for Authorized Emergency, Maintenance, and Service Vehicles*; or SAE J1889, *L.E.D. Signal and Marking Lighting Devices*.

7.9.15.1.2 Optical devices and components designed for mounting only in weatherproof, interior spaces shall be tested in conformance with the applicable SAE standard listed in 7.9.15.1.1 and shall comply with the vibration test and the warpage test for plastic components. [1901:13.8.15.1.2]

7.9.15.1.3 Optical devices and components designed for mounting on the exterior of the ambulance or in nonweatherproof interior spaces shall be tested in conformance with SAE J845, *Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*, and shall comply with the following performance requirements of that standard:

- (1) Vibration
- (2) Moisture
- (3) Dust
- (4) Corrosion
- (5) High temperature
- (6) Low temperature
- (7) Durability
- (8) Warpage

7.9.15.2 Photometric Test Procedures for Optical Devices.

7.9.15.2.1 Testing shall be performed by, or on behalf of, the device manufacturer to ensure compliance with the requirements of 7.9.15.2.2 through 7.9.15.2.5.2. [1901:13.8.15.2.1]

7.9.15.2.1.1 The results of the testing shall be used to determine compliance with this standard, and all required photometric data made available, upon request, from the optical warning device manufacturer.

7.9.15.2.1.2 The goniometer, integrating photometer, and other equipment used to take the test measurements shall meet the requirements of SAE J1330, *Photometry Laboratory Accuracy Guidelines*. [1901:13.8.15.2.1.2]

7.9.15.2.2 The optical source shall be mounted in a goniometer and operated as it would be in a normal system application. [1901:13.8.15.2.2]

7.9.15.2.2.1 The minimum distance between the light-emitting surface of the source being tested and the front face of the photometer detector shall be 59 ft (18 m). [1901:13.8.15.2.2.1]

7.9.15.2.2.2 The goniometer shall be oriented and the integrating photometer shall be set to integrate light pulses from the source for 20 seconds. [1901:13.8.15.2.2.2]

7.9.15.2.3 For all tests performed with the power applied, the lighting system, or component thereof, shall be operated at 12.8 volts $\pm$ 0.1 volt for 12-volt nominal equipment, 25.6 volts $\pm$ 0.2 volt for 24-volt nominal equipment, and 38.4 volts $\pm$ 0.3 volt for 42-volt nominal equipment. [1901:13.8.15.2.3]

7.9.15.2.3.1 If the equipment is rated for operation on multiple voltages, the tests shall be performed at each of the rated voltages used by the equipment. [1901:13.8.15.2.3.1]

7.9.15.2.3.2 Voltage shall be measured at a point 12 in. $\pm$ 1 in. (300 mm $\pm$ 25 mm) from the entry into the component. [1901:13.8.15.2.3.2]

7.9.15.2.4 The technique described in 7.9.15.2.2 through 7.9.15.2.2.2 shall be performed along the horizontal plane that passes through the optical center, beginning at the optical center and repeated at 5-degree intervals to the left and to the

▲ Table 7.9.14.4 Minimum Optical Power Requirements for Small Ambulances

Zone	Mode of Operation					
	Calling for Right-of-Way			Blocking Right-of-Way		
	<i>H</i> Total	At Any <i>H</i> Point	At Any Point 5 Degrees Up or 5 Degrees Down from <i>H</i>	<i>H</i> Total	At Any <i>H</i> Point	At Any Point 5 Degrees Up or 5 Degrees Down from <i>H</i>
A	1,000,000	10,000	3,500	400,000	10,000	3,500
B	200,000	8,000	3,500	200,000	8,000	3,500
C	400,000	10,000	3,500	800,000	10,000	3,500
D	200,000	8,000	3,500	200,000	8,000	3,500

Notes:

H = Horizontal plane passing through the optical center.

(1) All values are in candela-seconds/minute.

(2) The values in the *H* Total columns are the total of 19 data point values for each light, with data points on the boundary between zones counted in both zones.

right of the optical center throughout the active horizontal angle of light emission of the optical source. [1901:13.8.15.2.4]

7.9.15.2.5 Measurements shall be repeated at 5 degrees up and 5 degrees down from the horizontal plane that passes through the optical center, beginning at a point on the vertical plane passing through the optical center. [1901:13.8.15.2.5]

7.9.15.2.5.1 The measurements shall be repeated at 5-degree intervals to the left and to the right of this vertical plane throughout the active horizontal angle of light emission of the optical source. [1901:13.8.15.2.5.1]

7.9.15.2.5.2 If the optical warning device contains more than one optical source, the test shall be repeated for each optical source. [1901:13.8.15.2.5.2]

7.9.16* Compliance Documentation. The ambulance manufacturer shall demonstrate compliance of the warning system by one of the following methods:

- (1) Certification that the system was installed within the geometric parameters specified by the manufacturer of the system referencing the optical source test reports provided by the manufacturer of the system
- (2) Certification that a mathematical calculation based on test reports for individual optical sources provided by the manufacturer of the devices and performed by a qualified person demonstrates that the combination of individual devices as installed meets the requirements of this standard
- (3) Actual measurement of the lighting system after installation on the ambulance

7.9.17 Alternate Lighting Systems.

7.9.17.1 An emergency lighting system shall provide the ambulance with 360 degrees of conspicuity for safety during its missions.

7.9.17.1.1 The system shall display highly perceptible and attention-getting signals that function in a modal system and convey the following messages:

- (1) In the primary mode — “Clear the Right-of-Way”
- (2) In the secondary mode — “Hazard: Vehicle Stopped on Right-of-Way”

7.9.17.1.2 The warning light systems shall not impair the effectiveness of the legally required exterior lighting on the ambulance.

7.9.17.2 The ambulance standard emergency warning light system shall contain 12 fixed red lights, 1 fixed white light, and 1 or more fixed yellow lights.

7.9.17.2.1 These lights shall function in a dual mode system as shown in Figure 7.9.17.2.1 and meet the physical and photometric requirements.

7.9.17.2.2 The upper body warning lights shall be mounted at the extreme upper corner areas of the ambulance body.

7.9.17.2.3 The single white light shall be centered between the two front-facing, red, upper corner lights or in a dedicated housing mounted forward of the body on the cab roof.

7.9.17.2.4 Doors or other ancillary equipment shall not obstruct the standard warning lights.

7.9.17.2.5 The yellow light shall be symmetrically located between the two rear-facing red lights.

7.9.17.2.6 The red grille lights shall be located at least 30 in. (762 mm) above the ground and below the bottom edge of the windshield and be laterally separated by at least 18 in. (457 mm), measured from centerline to centerline of each lamp.

7.9.17.2.7 The lateral-facing intersection lights shall be mounted as close as possible to the front upper edge of each front fender and be angled forward between 0 and 30 degrees.

7.9.17.2.8 All warning lights furnished shall be mounted to project their highest intensity beams on the horizontal plane.

7.9.17.3 Photometric, Chromaticity, and Physical Requirements.

7.9.17.3.1 Each emergency light shall flash 75 to 125 times per minute.

7.9.17.3.2 The chromaticity values of the lights shall conform to SAE J578, *Color Specification*, for their respective colors, except for the red lights, which can conform to the expanded boundary limits of $y = 0.34$, $y = 0.32$, and $x = 0.62$.

7.9.17.3.3 All warning lights shall project a beam spread of at least 5 degrees up and 5 degrees down and at least 45 degrees left and right of horizontal and vertical (H-V).

7.9.17.3.4 Each light shall produce flash energy, measured in candelas per second (Cd-s), from the H-V to all the extreme test point coordinates and be tested at all 5-degree increments.

7.9.17.3.4.1 At no point shall the Cd-s values drop to less than the minimum values as shown in Figure 7.9.17.2.1 when tested at 14.2 volts.

7.9.17.3.4.2 Flash energy shall be determined in accordance with the SAE J845, *Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles*, method for determining the flash energy of a light.

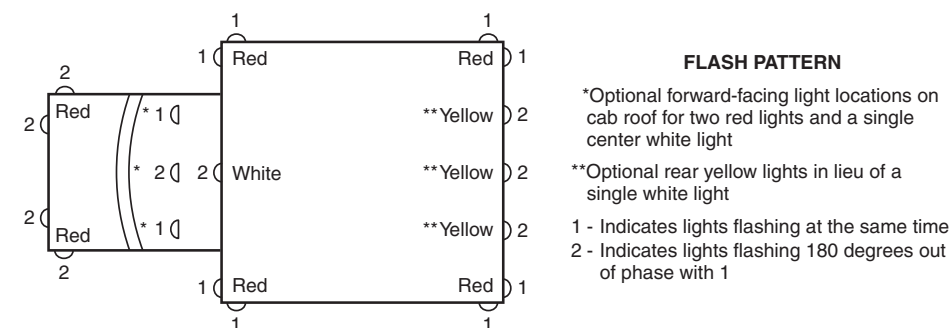
7.9.17.3.5 Testing shall be conducted on the device(s) as manufactured, including use of the actual light source and all other related system components.

7.9.17.4 The emergency light switches shall be wired and arranged to provide the warning light signal modes and combinations as specified.

7.9.17.4.1 All emergency light switches shall be labeled, each primary and secondary mode switch having an indicator light to show the driver which mode is activated.

7.9.17.5 The emergency lighting system shall be comprised of components and devices that comply with the general requirements and tests of SAE J575, *Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width*, SAE J576, *Plastic Material or Materials for Use in Optical Parts Such as Lenses and Reflex Reflectors of Motor Vehicle Lighting Devices*, SAE J578, *Color Specification*, and SAE J551/1, *Performance Levels and Methods of Measurement of Electromagnetic Compatibility of Vehicles, Boats (up to 15 m), and Machines (16.6 Hz to 18 GHz)*, as applicable for the unit.

7.9.17.5.1 Warning lights shall be fastened to reinforced body surfaces in accordance with the lighting manufacturer's requirements and recommendations and include aiming



MINIMUM FLASH ENERGY, Cd-S PER FLASH, PER FIXTURE

Color	Red		White	Yellow
Location	Grille and fenders	Upper body corners	Front center	Rear center*
Day	160 Cd-S @ HV	240 Cd-S @ HV	900 Cd-S @ HV	600 Cd-S @ HV
	80 Cd-S @ $\pm 5^\circ$ H points	120 Cd-S @ $\pm 5^\circ$ H points	450 Cd-S @ $\pm 5^\circ$ H points	300 Cd-S @ $\pm 5^\circ$ H points
	12 Cd-S @ all 5° V – 45° H points	32 Cd-S @ all 5° V – 45° H points	96 Cd-S @ all 5° V – 45° H points	72 Cd-S @ all 5° V – 45° H points
Night	10%–30% of the above			

* Single center rear or combined dual rear (optional).

MODAL EMERGENCY LIGHTING SYSTEM

Color & Location	Red	White	Yellow	Red
Mode of Operation	Front and rear corners	Front upper center	Rear center	Grille and fenders
Primary (Clear the right-of-way)	On	On	On	On
Secondary (Hazard: vehicle stopped on right-of-way)	On	Off	On	Off

▲ FIGURE 7.9.17.2.1 Emergency Lighting.

wedges to compensate for sloped body surfaces, grille, hood, and fender angles or mold release angles on roof caps.

7.9.17.5.2 The manufacturer shall aim the lights to ensure that all lighting performance requirements herein are met.

7.9.17.5.3 The lights shall be aimed either mechanically or optically on the horizontal axis with a tolerance of $+0$ degrees to -3 degrees.

7.9.17.5.4 All switches, connectors, and wiring shall be rated to carry a minimum of 125 percent of their maximum ampere load.

7.9.17.5.5 When halogen or another long-duty cycle light source is used, the duty cycle of any device shall not exceed 50 percent.

7.9.17.5.6 Where strobe lights are furnished, all high voltage leads and connections shall be insulated and enclosed or weatherproof connectors with the proper voltage rating.

7.9.17.6 Tests of Warning Light System.

7.9.17.6.1 The lighting manufacturers shall furnish and certify, or the ambulance manufacturer measure and record, the total average current load of the standard emergency warning light system on the vehicle as manufactured at the regulated voltage of 14.2 volts when operated in the mode that draws maximum current.

▲ **7.9.17.6.2** The warning light system and related components and devices shall be tested and approved by an Automotive Manufacturers Equipment Compliance Agency (AMECA) accredited laboratory independent from the lighting device manufacturer's own labs and listed with the AMECA for compliance with the requirements in the *AMECA Compliance Handbook*.

7.10 Audible Warning Devices.

7.10.1 Audible warning equipment in the form of at least one automotive traffic horn and one electric or electronic siren shall be provided. [1901:13.9.1]

7.10.1.1 The siren manufacturer shall certify the siren as meeting the requirements of SAE J1849, *Emergency Vehicle Sirens*. [1901:13.9.1.1]

7.10.1.2* A means shall be provided to allow the activation of the siren within convenient reach of the driver. [1901:13.9.1.2]

7.10.2 Where furnished, air horns, electric siren(s), and electronic siren speaker(s) shall be mounted low and far forward on the ambulance.

7.10.3 Audible warning equipment shall not be mounted on the roof, on the front of the module, or behind the ambulance operator.

7.11 Exterior and Interior Lighting.

7.11.1 All light level measurements shall be made with a light meter with a hemispherical light sensor held against the surface, facing perpendicular to the surface, and not deliberately pointed toward the light source.

7.11.2 Scene Lighting.

7.11.2.1 Scene lights shall be located on both the sides of the ambulance.

7.11.2.2 Scene lights shall be not less than 75 in. (1.9 m) above the ground and unobstructed by open doors.

7.11.2.3 Scene light switches shall be located on the cab console and shall control each side independently.

7.11.3 Load Lighting.

7.11.3.1 The loading area shall be illuminated to a level of at least 1 footcandle (fc) within the first 5 ft (1.5 m) from the vehicle and 0.3 fc up to 10 ft (3 m) from the vehicle.

7.11.3.2 Compliance of the load lighting illumination shall be validated by testing a substantially similar ambulance in accordance with AMD 024, *Perimeter Illumination Test*.

7.11.3.3 Load lights shall be not less than 75 in. (1.9 m) above the ground and unobstructed by open doors.

7.11.3.4 Load lights shall turn on whenever the rear patient entry doors are opened and the module power is on.

7.11.3.5 Load light switches shall allow for manual operation when the doors are closed.

7.11.4 Ambulance Exterior DOT Lighting. The exterior ambulance lighting shall include all required 49 CFR 571, FMVSS 108 lighting.

7.11.5 Ground Lighting.

7.11.5.1 The ambulance shall be equipped with lighting that is capable of providing illumination at a minimum level of 0.3 fc on ground areas within 30 in. (800 mm) of the edge of the ambulance in areas designed for personnel to climb into or onto the ambulance or descend from the ambulance to the ground level.

7.11.5.2 Lighting designed to provide ground illumination for safe egress as described in 7.11.5.1 shall be switchable but automatically activates when the exit doors are opened.

7.11.5.3 All other ground area lighting shall be switchable.

7.11.6 Interior Lighting.

7.11.6.1* The ambulance shall have sufficient lighting to provide an average level of 1 fc (10.764 lx) at each seating surface in the driving compartments.

7.11.6.2 Driving compartment lighting shall be designed and located so that no glare is reflected into the driver's eyes or line of vision from switch control panels or other areas that are illuminated while the vehicle is in motion.

7.11.6.3* Patient Compartment Illumination.

7.11.6.3.1 The ambulance interior lighting configuration shall be designed to minimize electrical loads.

7.11.6.3.2 Any lighting circuit shall have separately protected and controlled circuits.

7.11.6.3.3 All interior lighting fixtures shall not protrude more than 1½ in. (38 mm) from the mounting surface.

7.11.6.3.4 The patient compartment lighting shall have the two levels of lighting, high and low, at a minimum.

7.11.6.3.4.1 In the high setting, the patient compartment floor shall have a minimum of 15 fc of illumination, measured along the centerline of the clear floor.

7.11.6.3.4.2* In the high setting, the primary cot shall be provided with a minimum of 35 fc of illumination, measured on at least 90 percent of the cot's surface area.

7.11.6.3.4.3 In the low setting, the patient compartment floor shall have a minimum of 3.5 fc of illumination, measured along at least 85 percent of the centerline length.

7.11.6.3.4.4 In the low setting, the side entry step shall have a minimum of 2.0 fc of illumination, measured in the center of the step area.

7.11.6.3.4.5 Compliance of the requirements in 7.11.6.3.4.1 through 7.11.6.3.4.4 shall be validated by testing a substantially similar ambulance in accordance with AMD 016, *Patient Compartment Lighting Level Test*.

7.11.6.3.5 The patient compartment lighting shall be automatically activated when the side entry or rear entry patient compartment doors are opened and the module power is on.

7.11.7 Compartment Lighting.

7.11.7.1 Each exterior storage compartment that is greater than 4 ft³ (1.2 m³) and having an opening greater than 144 in.² (92,900 mm²) shall have compartment lighting to provide a minimum of 1 fc (10.764 lx) at any location on the floor of the compartment without any shelves, dividers, or equipment in the compartment.

7.11.7.2 Compartment lighting shall be automatically enabled when the compartment door is opened and module power is on.

7.11.7.3 The lights shall be arranged or protected to minimize accidental breakage.

7.11.8 Testing. All interior and exterior lights mounted in wet locations shall be tested in conformance with SAE J575, *Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width*, and shall comply with the following performance requirements of that standard:

- (1) Vibration
- (2) Moisture
- (3) Dust
- (4) Corrosion
- (5) High temperature
- (6) Low temperature
- (7) Durability
- (8) Warpage

7.12 Do-Not-Move Ambulance Light.

7.12.1* A red flashing or rotating light or electronic display within the forward view of the driver shall be illuminated automatically whenever the ambulance's ignition switch is in the run position, the parking brake is not fully engaged, and either of the following conditions exists:

- (1) Any passenger door, patient entry door, or equipment compartment door is not closed.
- (2) Any other device permanently attached to the ambulance is open, extended, or deployed in a manner that is likely to cause damage to the ambulance if the ambulance is moved.

7.12.2 Compartments meeting all the following conditions shall be permitted to be exempt from the requirements of 7.12.1:

- (1) The volume is less than or equal to 4 ft³ (0.11 m³).
- (2) The compartment has an opening less than or equal to 144 in.² (92,900 mm²).
- (3) The open door does not extend sideways beyond the mirrors or up above the top of the ambulance.

7.12.3 If the ambulance is equipped with a do-not-move ambulance light, the light shall be labeled to read "Do Not Move Unit."

7.13* Backup Alarm.

7.13.1 An electric or electronic backup alarm shall be provided that meets the Type D (87 dBA) requirements of SAE J994, *Alarm — Backup — Electric Laboratory Performance Testing*.

7.13.2 The backup alarm shall be enabled any time the vehicle is in reverse.

7.14 Stop, Tail, and Directional Lights.

7.14.1 The ambulance shall be equipped with all 49 CFR 571, FMVSS 108 legally required stop, tail, and directional lights.

7.14.2 Directional lights shall be visible according to 49 CFR 571, FMVSS 108.

7.14.3 On ambulances 30 ft (10 m) or longer in length, a turn signal shall be mounted approximately midway along the ambulance at running board height.

7.14.4 Equipment shall not be mounted in a manner that obscures the stop, tail, or directional lights.

7.14.5* Emergency warning lights shall not be used as brake lights, tail lights, or turn signals if they exceed the maximum candela output requirements in 49 CFR 571, FMVSS 108.

7.14.6 Warning lights that do not exceed the maximum candela rating in 49 CFR 571, FMVSS 108 and are used as primary or auxiliary brake lights shall not be mounted higher than 72 in. (1829 mm) above the ground nor lower than 15 in. (381 mm) from the ground.

7.15 Communications Equipment.

7.15.1 Any two-way radio equipment shall be installed in accordance with the requirements of the radio equipment manufacturer.

7.15.2* Ventilated space for a two-way radio, including convenience features, antenna openings, ground plane, terminal wiring for 12-volt power, and ground, shall be provided.

7.15.3 Built-in communication devices installed in the patient compartment shall be secured within maximum functional reach of EMSPs, from a 5th percentile female through a 95th percentile male, while seated and restrained.

Chapter 8 Line Voltage Electrical Systems

8.1 General. The ambulance shall be furnished with an alternating current (ac) line voltage electrical system consisting of a power source and a 2-wire plus ground wiring system that meets the applicable requirements of this chapter.

8.2 General Requirements.

8.2.1 Conformance with *National Electrical Code*. All components, equipment, and installation procedures shall conform to *NFPA 70*, except where superseded by the requirements of this chapter. [1901:22.2.3.1]

8.2.1.1* Where available, line voltage electrical system equipment and materials included on the ambulance shall be listed and used only in the manner for which they have been listed.

8.2.1.2 All equipment and materials shall be installed in accordance with the manufacturer's instructions. [1901:22.2.5]

8.2.2 Shorepower Inlet.

8.2.2.1* The ambulance shall be equipped with a line voltage power inlet known as a shorepower inlet.

▲ **8.2.2.2** The shorepower inlet shall be permanently mounted with a male recessed-type receptacle with cover, having a minimum rating of 15 amperes and conforming to the National Electrical Manufacturers Association (NEMA) configuration appropriate for the voltage rating.

8.2.2.3 The shorepower inlet shall be wired directly to the system or device to be powered or wired to a transfer switch as required in Section 8.8.

• **8.2.2.4** Where more than one shorepower inlet is provided on the same circuit, the unused shorepower inlet shall be de-energized.

8.2.2.5 A proper-mating, weatherproof, female connector body conforming to the NEMA configuration provided in 8.2.2.2 shall also be furnished without cable and labeled with the size, the type of wire necessary, and the polarity of the future hookup.

8.2.2.6 The connection shall be permanently labeled as shown in Figure 8.2.2.6.

• **8.2.2.7** The protective ground from the shorepower inlet shall be bonded to the vehicle frame.

8.2.3 Stability of Frequency and Voltage.

8.2.3.1 Any fixed line voltage power source producing alternating current (ac) shall produce electric power at 60 Hz

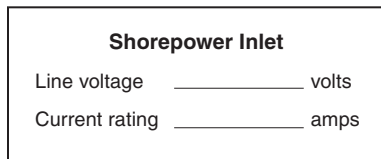


FIGURE 8.2.2.6 Shorepower Inlet Power Label.

± 3 Hz when producing power at all levels between no load and full-rated power.

8.2.3.2 Any fixed line voltage power source shall produce electric power at the rated voltage ±10 percent when producing power at all levels between no load and full-rated power.

8.2.3.3 Higher voltage shall be permitted only when used to operate fixed wired, permanently mounted equipment on the ambulance.

8.2.4 Location Ratings.

8.2.4.1 Any equipment used in a dry location shall be listed for dry locations. [1901:22.2.6.1]

8.2.4.2 Any equipment used in a wet location shall be listed for wet locations. [1901:22.2.6.2]

8.2.4.3 Any equipment, except a PTO-driven generator, used in an underbody or underchassis location that is subject to road spray shall be either listed as Type 4 or mounted in an enclosure that is listed as Type 4. [1901:22.2.6.3]

8.2.4.4* If a PTO-driven generator is located in an underbody or underchassis location, the installation shall include a shield to prevent road spray from splashing directly on the generator. [1901:22.2.6.4]

8.2.5 Line Voltage Electrical System Testing. Electrical system testing shall be performed according to AMD 027, *Line Voltage Electrical Systems Test*.

8.3 Grounding and Bonding.

8.3.1* Grounding.

8.3.1.1 Grounding shall be in accordance with 250.34(A) and 250.34(B) of *NFPA 70*. [1901:22.3.1]

▲ **8.3.1.2** Grounding shall be in accordance with 250.6, “Object-ionable Current,” of *NFPA 70*.

8.3.1.3 Ungrounded systems shall not be used. [1901:22.3.1.1]

8.3.1.4* Only stranded copper with green colored insulation or green with yellow tracer insulation or braided copper conductors shall be used for grounding and bonding.

8.3.1.5 The grounded current-carrying conductor (neutral) shall be insulated from the equipment-grounding conductors and from the equipment enclosures and other grounded parts. [1901:22.3.1.3]

8.3.1.6 The neutral conductor shall have white or gray colored insulation in accordance with 200.6, “Means of Identifying Grounded Conductors,” of *NFPA 70*.

8.3.1.7 Bonding screws, straps, or buses in the distribution panelboard or in other system components between the neutral and the equipment-grounding conductor shall be

removed and discarded, except for the ground-to-neutral bond at an onboard electrical power source.

8.3.2 Interior Equipment Grounding.

8.3.2.1 In the line voltage electrical system, all exposed metal components shall be bonded to the grounding terminals or enclosure of the distribution panelboard.

▲ **8.3.2.2** Grounding of electrical equipment shall be done in one of the following ways:

- (1) Connection to a metal raceway, conduit, or electrical metallic tubing
- (2) A connection between one or more equipment-grounding conductors and a metal box by means of a listed grounding device or a grounding screw that is used for no other purpose

8.3.2.2.1 The equipment-grounding conductor shall be permitted to be secured under a screw, other than a mounting screw or cover screw, that is threaded into the fixture canopy.

8.3.2.2.2 The equipment-grounding conductor and fixture attachment screws shall be permitted to be attached to a listed grounding means (plate) in a nonmetallic outlet box for fixture mounting.

8.3.2.2.3 A connection between the one or more equipment-grounding conductors brought into a nonmetallic outlet box shall be so arranged that a connection can be made to any fitting or device in that box that requires grounding.

8.3.2.2.4 Where more than one equipment-grounding conductor or branch circuit enters a box, all such conductors shall be in electrical contact with each other and the arrangement such that the disconnection or removal of a receptacle, fixture, or other device fed from the box will not interfere with or interrupt the grounding continuity.

8.3.2.2.5 Cord-connected appliances shall be grounded by means of an approved cord with an equipment-grounding conductor and grounding attachment plug, unless they are double-insulated tools or appliances supplied with an approved two-wire cord and plug.

8.3.3 Bonding.

8.3.3.1 The neutral conductor of the onboard power source shall be bonded to the vehicle frame.

8.3.3.2 The neutral bonding connection shall occur only at the onboard power source.

8.3.3.3 In addition to the bonding required for the low voltage return current, each body and each driving or crew compartment enclosure shall be bonded to the vehicle frame by a copper conductor. [1901:22.3.2.3]

8.3.3.3.1 The conductor shall have a minimum amperage rating, as defined in 310.15, “Ampacities for Conductors Rated 0–2000 Volts,” of *NFPA 70*, of 115 percent of the rated amperage on the power source specification label. [1901:22.3.2.3.1]

8.3.3.3.2 A single conductor that is sized to meet the low voltage and line voltage requirements shall be permitted to be used. [1901:22.3.2.3.2]

8.3.3.3.3 All exposed non-current-carrying metal parts that could become energized shall be bonded to the grounding terminal or enclosure of the distribution panelboard.

8.3.3.3.4 A bonding conductor shall be connected between the distribution panelboard and an accessible terminal on the chassis.

8.3.3.3.4.1 Aluminum or coppered aluminum conductors shall not be used.

8.3.3.3.4.2 Any ambulance that employs a unitized metal chassis-frame construction to which the distribution panel is fastened with a bolt and nut shall be considered to be bonded.

8.3.3.3.5 The ambulance body and exterior covering shall be considered bonded if the metal panels overlap or are welded to one another and are attached to the chassis frame by metal fasteners, metal straps, or welding.

8.3.3.3.6 Metal circulating air ducts shall be bonded to the chassis.

8.3.3.3.7 The compressed gas pipes shall be bonded to the chassis.

8.4* Ground-Fault Circuit Interrupters. All line voltage ac circuits and receptacles of the ambulance shall be protected by listed ground-fault circuit interrupters (GFCIs) in accordance with ANSI/UL 498, *Standard for Safety Attachment Plugs and Receptacles*.

8.5* Wiring Methods. Fixed wiring systems shall be limited to the following:

- (1) Metallic or nonmetallic liquidtight flexible conduit rated at temperatures not less than 194°F (90°C) with stranded copper wire rated for wet locations and temperatures not less than 194°F (90°C)
- (2) Type SOW, SOOW, SEOW, or SEOOW flexible cord rated at 600 volts and at temperatures not less than 194°F (90°C)

[1901:22.10]

8.5.1 Electrical cord or conduit shall not be attached to chassis suspension components, water or fuel lines, air or air brake lines, medical gas lines, hydraulic lines, exhaust system components, or low voltage wiring and shall be arranged as follows:

- (1) Separated by a minimum distance of 12 in. (300 mm) from exhaust piping or shielded from such piping
- (2) Separated from fuel lines by a minimum distance of 6 in. (152 mm)

8.5.1.1 Line voltage wiring shall not be routed through the medical gas compartment.

8.5.2 A means shall be provided to allow “flexing” between the driving and crew compartment, the body, and other areas or equipment whose movement would stress the wiring. [1901:22.10.2]

8.5.3 Electrical cord or conduit shall be supported within 6 in. (152 mm) of any junction box and at a minimum of every 24 in. (600 mm) of run. [1901:22.10.3]

8.5.3.1 Supports shall be made of nonmetallic materials or of corrosion-resistant or corrosion-protected metal. [1901:22.10.3.1]

8.5.3.2 All supports shall be of a design that does not cut or abrade the conduit or cord and shall be mechanically fastened to the ambulance.

8.5.4 Only fittings and components listed for the type of cord or conduit being installed shall be used. [1901:22.10.4]

8.5.4.1 Where rigid metal conduit or intermediate metal conduit is terminated at an enclosure with a lock nut and bushing connection, two lock nuts shall be provided, one inside and one outside the enclosure.

8.5.4.2 All cut ends of conduit shall be reamed or otherwise finished to remove rough edges.

8.5.5 Splices shall be made only in a listed junction box.

8.5.6 Additional Requirements for Flexible Cord Installations.

8.5.6.1 Where flexible cord is used in any location where it could be damaged, it shall be protected by installation in conduit, enclosures, or guards. [1901:22.10.6.1]

8.5.6.2 Where flexible cord penetrates a metal surface, rubber or plastic grommets or bushings shall be installed. [1901:22.10.6.2]

8.5.7 Wiring Identification.

8.5.7.1 Each line voltage circuit originating from the main panelboard shall be identified. [1901:22.10.7.1]

8.5.7.2 The wire or circuit identification either shall reference a wiring diagram or wire list or shall indicate the final termination point of the circuit. [1901:22.10.7.2]

8.5.7.3 Where prewiring for future power sources or devices exists, the unterminated ends shall be marked with a label showing their wire size and intended function. [1901:22.10.7.3]

8.6 Wiring System Components.

8.6.1 Only stranded copper conductors with an insulation rated for temperatures of at least 194°F (90°C) and wet locations shall be used. [1901:22.11.1]

8.6.1.1 Conductors in flexible cord shall be sized in accordance with Table 400.5(A) of *NFPA 70*. [1901:22.11.1.1]

8.6.1.2 Conductors used in conduit shall be sized in accordance with 310.15, “Ampacities for Conductors Rated 0–2000 Volts,” of *NFPA 70*. [1901:22.11.1.2]

8.6.1.3 Aluminum or copper-clad aluminum conductors shall not be used. [1901:22.11.1.3]

8.6.2 All boxes shall conform to and be mounted in accordance with Article 314, “Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Manholes,” of *NFPA 70*. [1901:22.11.2]

8.6.2.1 All boxes shall be accessible using ordinary hand tools. [1901:22.11.2.1]

8.6.2.2 Boxes shall not be permitted behind welded or pop-riveted panels. [1901:22.11.2.2]

8.6.2.3 The maximum number of conductors permitted in any box shall be in accordance with 314.16, “Number of Conductors in Outlet, Device, and Junction Boxes, and Conduit Bodies,” of *NFPA 70*. [1901:22.11.2.3]

8.6.3 All wiring connections and terminations shall provide a positive mechanical and electrical connection. [1901:22.11.3]

8.6.3.1 Connectors shall be installed in accordance with the manufacturer's instructions. [1901:22.11.3.1]

8.6.3.2 Wire nuts or insulation displacement and insulation-piercing connectors shall not be used. [1901:22.11.3.2]

8.6.4 Each switch shall indicate the position of its contact points (i.e., open or closed) and shall be rated for the continuous operation of the load being controlled. [1901:22.11.4]

8.6.4.1 All switches shall be marked with a label indicating the function of the switch. [1901:22.11.4.1]

8.6.4.2 Circuit breakers used as switches shall be “switch rated” (SWD) or better. [1901:22.11.4.2]

8.6.4.3 Switches shall simultaneously open all associated line voltage conductors. [1901:22.11.4.3]

8.6.4.4 Switching of the neutral conductor alone shall not be permitted. [1901:22.11.4.4]

8.6.4.5 Line voltage circuits controlled by low voltage circuits shall be wired through properly rated relays in listed enclosures that control all nongrounded current-carrying conductors. [1901:22.11.4.5]

8.6.5 Receptacles and Inlet Devices.

8.6.5.1 The patient compartment shall be furnished with a minimum of three line voltage duplex receptacles conforming to a minimum of a NEMA 5-15.

8.6.5.2 All interior outlets shall be installed in accordance with 210.7, Multiple Branch Circuits, of *NFPA 70*.

8.6.5.3 Any receptacle shall be at least 12 in. (300 mm) from any medical gas outlet.

8.6.5.4 An indicator shall be located within each line voltage receptacle as a line monitor indicating a live (hot) circuit.

8.6.5.5 Wet and Dry Locations.

8.6.5.5.1 All wet location receptacle outlets and inlet devices, including those on hardwired, remote power distribution boxes, shall be of the grounding type, provided with a wet location cover, and installed in accordance with 406.8, “Receptacles in Damp or Wet Locations,” of *NFPA 70*. [1901:22.11.5.1.1]

8.6.5.5.2 All receptacles located in a wet location shall be not less than 24 in. (600 mm) from the ground. [1901:22.11.5.1.2]

8.6.5.5.3 Receptacles on off-road ambulances shall be a minimum of 30 in. (760 mm) from the ground.

8.6.5.6 All receptacles located in a dry location shall be of the grounding type and shall be at least 12 in. (300 mm) above the interior floor height. [1901:22.11.5.2]

8.6.5.7 No receptacle shall be installed in a face-up position. [1901:22.11.5.3]

8.6.5.8 The face of any wet location receptacle shall be installed in a plane from vertical to not more than 45 degrees off vertical. [1901:22.11.5.4]

8.6.5.9 Receptacle Label.

8.6.5.9.1 Each receptacle shall be marked with a label indicating the nominal line voltage (120 volts or 240 volts) and the current rating in amps of the circuit. [1901:22.11.5.5.1]

▲ **8.6.5.9.2** If the receptacle is other than single phase, that information shall also be marked on the label.

8.6.5.10 All receptacles and electrical inlet devices shall be listed to ANSI/UL 498, *Standard for Safety Attachment Plugs and Receptacles*, or other recognized performance standards. [1901:22.11.5.6]

8.7 Cord Reels.

8.7.1 All permanently mounted cord reels shall be rated for continuous duty and installed to be accessible for removal, cord access, maintenance, and servicing. [1901:22.12]

8.7.2 The power rewind cord reel spool area shall be visible to the operator during the rewind operation or the reel spool encapsulated to prevent cord from spooling off the reel.

8.7.3 Rollers or guides shall be provided, where required, to prevent damage to the cord at reel spools or compartment openings. [1901:22.12.2]

8.7.4 Rewind Provision.

8.7.4.1 Manually operated reels shall have a hand crank. [1901:22.12.3.1]

8.7.4.2 Power rewind-type reels shall have the control in a position where the operator can observe the rewinding operation.

8.7.4.3 If a reel is in an enclosure or out of direct view, the cord entry point to the enclosure shall be visible to the operator of the reel control.

8.7.4.4 The rewind control or crank shall not be more than 72 in. (1830 mm) above the operator's standing position. [1901:22.12.3.3]

8.7.4.5 The rewind control shall be marked with a label indicating its function and shall be guarded to prevent accidental operation. [1901:22.12.3.4]

8.7.5 The reel shall be designed to hold 110 percent of the capacity needed for the intended cord length. [1901:22.12.4]

8.7.6 The wire size shall be in accordance with *NFPA 70*, Table 400.5(A), but in no case shall it be smaller than 12 AWG. [1901:22.12.5]

8.7.7 Electrical cord shall be Type SEOOW, Type SOOW, or Type STOOW. [1901:22.12.6]

8.7.8 A label that indicates the following information shall be provided in a visible location adjacent to any permanently connected reel:

- (1) Current rating
 - (2) Current type
 - (3) Phase
 - (4) Voltage
 - (5) Total cord length
- [1901:22.12.7]

8.7.9 Where a power distribution box is hardwired to the end of a cord that is stored on a fixed cord reel or other fixed storage means, the requirements in 8.7.9.1 through 8.7.9.6 shall apply. [1901:22.12.8]

8.7.9.1 The remote power distribution box shall be listed for use in a wet location. [1901:22.12.8.1]

8.7.9.2 The distribution box shall be as follows:

- (1) Protected from corrosion
- (2) Capable of being carried with a gloved hand

(3) Designed to keep the exterior electrical components above 2 in. (51 mm) of standing water [1901:22.12.8.2]

8.7.9.3 Inlets, receptacles, circuit breakers, or GFCI devices shall not be mounted on the top surface of the horizontal plane. [1901:22.12.8.3]

8.7.9.4 Branch circuit breakers shall be installed in the remote power distribution box if the overcurrent device protecting the feed cord to the box is too large to protect the wiring supplying the devices plugged onto the distribution box. [1901:22.12.8.4]

8.7.9.5 Remote power distribution boxes shall have a light on the box to indicate the power is on. [1901:22.12.8.5]

8.7.9.5.1 The light shall be visible in a 360-degree plane from a minimum of 200 ft (60 m) in complete darkness. [1901:22.12.8.5.1]

8.7.9.5.2 The light shall be mechanically protected to prevent damage. [1901:22.12.8.5.2]

8.7.9.6 The hardwired portable cord connection to the box shall have strain relief and meet the intended usage requirements. [1901:22.12.8.6]

N 8.8 Transfer Switch Applications.

N 8.8.1 A transfer switch shall be required to isolate one power source from another where a circuit(s) is intended to be supplied from more than one power source.

N 8.8.2 Transfer equipment, including transfer switches, shall operate such that all ungrounded connectors of one power source are disconnected before any ungrounded conductors of the second power source are connected.

N 8.8.3 The neutral connector shall be switched through the transfer switch.

8.9 Scene Lighting Systems.

8.9.1 Where fixed scene lights are supplied, the requirements in 8.9.2 through 8.9.5 shall apply.

8.9.2 All scene lights shall be provided with a lens or a means for preventing damage from water spray and shall be listed for wet location usage. [1901:22.13.1]

8.9.3 Handle on Lights.

8.9.3.1 If the light is adjustable, a handle shall be provided. [1901:22.13.2.1]

8.9.3.2 The design of the light shall not allow the temperature of the handle to exceed 131°F (55°C). [1901:22.13.2.2]

8.9.4 The manufacturer of the device shall have the scene light tested by a nationally recognized testing laboratory and listed to ANSI/UL 153, *Standard for Portable Electric Luminaires*, or ANSI/UL 1598, *Luminaires*. [1901:22.13.3]

8.9.5 If manually operated floodlights are not operable from the ground, access steps and handrails that meet the requirements of Chapter 6 shall be provided to allow the user to reach the floodlights.

8.10 Appliance Accessibility and Fastening.

8.10.1 All electrical appliances shall be accessible for inspection, service, repair, and replacement without removal of permanent construction.

8.10.2 Appliances shall be fastened in accordance with the manufacturer's directions.

Chapter 9 Line Voltage Power Source

9.1 Line Voltage Power Derived from an Inverter.

9.1.1 If the power source derives its input energy from an inverter, the power source shall meet the requirements of 9.1.2 through 9.1.4.

9.1.2 The low voltage power supply system shall be installed in compliance with the requirements of Chapter 7.

9.1.3 The alternator and the battery system shall be adequate to provide power for continuous operation for a minimum of 1 hour at nominal listed power output.

9.1.4 The inverter shall be tested to the requirements of the "Inverter Test" as specified in AMD 027, *Line Voltage Electrical Systems Test*.

9.2 Generators Rated Below 11 hp (8 kW) General Requirements.

9.2.1 If the power source is mechanically driven and mounted on the vehicle, it shall comply with NFPA 70, Article 445.

9.2.2 If the generator is less than 11 hp (8 kW), it shall meet the requirements of 9.2.2.1 through 9.2.2.8.

9.2.2.1 Access shall be provided to permit both routine maintenance and removal of the power source for major servicing. [1901:22.4.4]

9.2.2.2 The power source shall be located so that neither it nor its mounting brackets interfere with the routine maintenance of the ambulance.

9.2.2.3 If the power source is rated at less than 3 kW, a "Power On" indicator shall be provided. [1901:22.4.6.1]

9.2.2.4 If the power source is rated at 3 kW or more but less than 8 kW, a voltmeter shall be provided. [1901:22.4.6.2]

9.2.2.5 The rating on the power source specification label shall not exceed the declared rating from the power source manufacturer. [1901:22.4.3.2]

9.2.2.6 An instruction plate(s) that provides the operator with the essential power source operating instructions, including the power-up and power-down sequence, shall be permanently attached to the ambulance at any point where such operations can take place.

9.2.2.7 If there is permanent wiring on the ambulance that is designed to be connected to the power source, a power source specification label that is permanently attached to the ambulance at the operator's control station shall provide the operator with the information detailed in Figure 9.2.2.7.

9.2.2.8 The power source, at any load, shall not produce a noise level that exceeds 90 dBA in any driving compartment or patient compartment with windows and doors closed or at any operator's station on the ambulance.

9.3 Power Sources of 11 hp (8 kW) or Larger. Power sources of 11 hp (8 kW) or larger shall meet the requirements of NFPA 1901, 22.4.3.1.

Power Source Specifications	
Operational Category	Continuous Duty Rating
Rated voltage(s) and type (ac or dc)	
Phase	
Rated frequency	
Rated amperage	
Continuous rated watts	
Power source engine speed	

FIGURE 9.2.2.7 Power Source Specification Label.
[1901:Figure 22.4.9]

9.3.1 Instrumentation shall meet the requirements of NFPA 1901, 22.4.6.3 through 22.4.6.4.3.

9.3.2 Operation shall meet the requirements of NFPA 1901, 22.4.8.

9.3.3 Power Source–Type Specific Requirements.

9.3.3.1 Direct-Drive (PTO) Generators. If the generator is driven by any type of power takeoff (PTO), it shall meet the requirements of NFPA 1901, 22.5.1.

9.3.3.2 Hydraulically Driven Generators. If the generator is driven using hydraulic components, it shall meet the requirements of NFPA 1901, 22.5.2.

9.3.3.3 Fixed Auxiliary Engine–Driven Generators 11 hp (8 kW) and Larger. If the generator is driven by a fixed auxiliary engine, it shall meet the requirements of NFPA 1901, 22.5.3.

9.4 Wiring for Portable Generator. Installations shall meet the requirements of NFPA 1901, 22.6.3.

N Chapter 10 Remounted Ambulance Patient Compartments

N 10.1 Application.

N 10.1.1 This chapter is applicable to automotive ambulances contracted for remounting on or after January 1, 2019; however, nothing shall prevent the voluntary application of this chapter to ambulances contracted for remounting prior to January 1, 2019 if the purchaser and contractor agree to do so.

N 10.1.1.1 This chapter of the standard is not intended to be applied retroactively.

N 10.2 Equivalency. Nothing in this chapter is intended to prevent or discourage the use of any systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by the other chapters of this standard.

N 10.3 General.

N 10.3.1 The patient compartment shall be mounted in accordance with the allowed or recommended methods and practices established by the chassis manufacturer.

N 10.3.2 All new or upgraded components utilized in the remount shall meet the component requirements for a new automotive ambulance as outlined in other chapters of this standard, unless otherwise specified in this chapter.

N 10.3.3 Any upgraded system or component shall be compatible with its associated components.

N 10.3.4 Systems or components that are not compatible shall not be installed on the remounted automotive ambulance.

N 10.3.5 At a minimum, the remounted ambulance patient compartment and its components and systems shall comply with the functional requirements of the design standard or purchasing specification that was applicable to the patient compartment when it was originally constructed.

N 10.3.6 The entity performing the patient compartment remount is the final stage manufacturer (FSM) for that vehicle and shall comply with all NHTSA requirements applicable to a final stage vehicle manufacturer.

N 10.3.7 The remounted ambulance shall be fully compliant with all applicable state and federal laws and regulations.

N 10.4 Responsibility of the Purchaser.

N 10.4.1 The purchaser shall specify which components and systems of the ambulance are to be upgraded or replaced by the contractor during the remount process.

N 10.4.2 It shall be the responsibility of the purchaser to consider the amount of equipment and personnel that will be carried on the in-service ambulance and to specify to the contractor a minimum usable payload requirement that will accommodate the anticipated maximum in-service weight.

N 10.4.3 The purchaser shall specify the work to be performed by the contractor during the remount process, including any components to be supplied by the contractor, the construction and performance details, and any other work to be completed to address existing problems or deficiencies.

N 10.4.4 It shall be the responsibility of the purchaser to specify any aspect of the ambulance patient compartment remount project that is intended to differ from or exceed the minimum requirements of this standard.

N 10.4.5 Following acceptance of the remounted ambulance and thereafter, the purchaser shall be responsible for ongoing training of personnel to develop and maintain proficiency regarding the proper and safe use of the ambulance and its associated equipment, components, and systems.

N 10.5 Responsibility of the Contractor.

N 10.5.1 The contractor shall inspect the automotive ambulance to be remounted and provide a detailed description of the work to be performed, a list of components to be furnished, and other construction and performance details to which the ambulance shall conform, to the extent that any such information differs from that specified by the purchaser in compliance with 10.4.3.

N 10.5.1.1 The purpose of these contractor specifications shall be to define what the contractor intends to furnish and deliver to the purchaser when the project is completed.

N 10.5.2 The contractor shall notify the purchaser in writing of any additional problems, deficiencies, issues, or nonconformities discovered during inspection of the ambulance.

N 10.5.3 The contractor shall provide a detailed description of the remounted automotive ambulance, including, without limitation, wheelbase, curb-to-curb turning radius, principal dimensions, angle of approach, and angle of departure.

- N 10.5.4** Each ambulance's payload capacity and the horizontal and vertical center of gravity shall be calculated.
- N 10.5.4.1** Horizontal and vertical payload capacity shall be determined by completing an NTEA UltraMod spreadsheet (available at www.ntea.com).
- N 10.5.4.2** A copy of the UltraMod spreadsheet shall be included with the ambulance documentation, along with the following calculations:
- (1) Completed vehicle at curb weight
 - (2) Inclusion of an assumed occupant weight of 171 lb (77 kg) at the horizontal, lateral, and vertical center of each patient location and at the designated H-point of each seating position
 - (3) The maximum remaining cargo/equipment capacity located at the horizontal, lateral, and vertical dimension center of the patient compartment that will not exceed the vehicle's weight rating capacity.
- N 10.5.5 Longitudinal Weight Distribution.** When the ambulance is loaded to its GVWR, the front-to-rear weight distribution and vertical center of gravity shall comply with the axle weight distribution limits established by the chassis manufacturer.
- N 10.5.6 Lateral Weight Distribution.** The vehicle, when loaded to its GVWR, shall have a side-to-side tire load variation of no more than 5 percent of the total tire load for the affected axle.
- N 10.5.7** The front axle loads shall not be less than the minimum axle loads specified by the chassis manufacturer under full load and all other loading conditions.
- N 10.5.8** Chassis and component weight ratings shall be the manufacturer's published ratings, which shall not be modified or altered without written authorization from the chassis/component OEM.
- N 10.5.9** The contractor shall perform all of the AMD tests (other than type testing) for each remounted ambulance patient compartment and its associated components and systems using either the latest AMD standards or the AMD standards that were applicable to the ambulance patient compartment at the time that it was originally constructed.
- N 10.5.10** Documentation showing successful completion of all tests shall be furnished to the purchaser by the contractor.
- N 10.5.11** Responsibility for the remounted automotive ambulance and equipment shall rest with the contractor until transfer of such responsibilities are accepted by the purchaser.
- N 10.5.12** To the extent that any of the original configurations, components, or systems of the ambulance are changed or modified by the contractor during the remount process, the contractor shall supply to the purchaser, at the time of delivery, at least one copy of complete operation, service, and parts manuals covering any new or modified components or systems on the ambulance as delivered and accepted.
- N 10.5.13** The requirement for furnishing either complete or partial manuals shall be specified by the purchasing authority.
- N 10.6 Remounted Ambulance Components.**
- N 10.6.1** All components shall be installed in accordance with the manufacturer's published installation instructions, or as otherwise approved in writing by the component manufacturer.
- N 10.6.2** All medical devices furnished shall comply with all applicable U.S. Food and Drug Administration (FDA) or other governmental regulatory requirements.
- N 10.6.3** All connections to or interfaces with the ambulance chassis shall be made in accordance with the chassis OEM Body Builders Guidelines and OEM Incomplete Vehicle Manual unless otherwise specified in this standard.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1 The term *new* as applied in this standard is intended to refer to the original construction of an ambulance using all new materials and parts.

A.1.4 It is not intended that this standard be applied retroactively to existing ambulances. However, if major renovations are made to an existing ambulance, it is suggested that the ambulance be brought into line with this standard as closely as possible.

A.1.6 Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). The liter, a unit that is outside of but recognized by SI, is commonly used in international fire protection. Table A.1.6(a) and Table A.1.6(b) provide U.S.-to-SI conversion factors and SI-to-U.S. conversion factors as an aid to the user. Table A.1.6(c) provides other conversion factors that could be useful to the reader. Table A.1.6(d) provides a list of the abbreviations used in this standard and their meanings.

A.3.2.1 Approved. 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, 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 that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, 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, or 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 or her 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.

Table A.1.6(a) Conversion Factors: U.S. Customary Units to SI Units

U.S. Customary Units	SI Units
1 gallon per minute (gpm)	3.785 liters per minute (L/min)
1 imperial gallon per minute (igpm)	4.546 liters per minute (L/min)
1 pound per square inch (psi)	6.895 kilopascals (kPa)
1 inch of mercury (in. Hg) at 60°F (15.6°C)	3.377 kilopascals (kPa)
1 inch (in.)	25.40 millimeters (mm)
1 foot (ft)	0.305 meter (m)
1 cubic foot (ft ³)	0.0283 cubic meter (m ³)
1 square inch (in. ²)	645.2 square millimeters (mm ²)
1 mile per hour (mph)	1.609 kilometers per hour (km/hr)
1 pound (lb)	0.454 kilogram (kg)
1 horsepower (hp)	0.746 kilowatt (kW)
1 candlepower (cp)	12.566 lumens
1 pound per cubic foot (lb/ft ³)	16 kilograms per cubic meter (kg/m ³)
1 footcandle (fc)	10.764 lux (lx)
1 footlambert	3.427 candela/m ²

Table A.1.6(b) Conversion Factors: SI Units to U.S. Customary Units

SI Units	U.S. Customary Units
1 liter per minute (L/min)	0.264 gallon per minute (gpm)
1 liter per minute (L/min)	0.22 imperial gallon per minute (igpm)
1 kilopascal (kPa)	0.145 pound per square inch (psi)
1 kilopascal (kPa)	0.2962 in. Hg at 60°F (15.6°C)
1 millimeter (mm)	0.0394 inch (in.)
1 meter (m)	3.281 feet (ft)
1 cubic meter (m ³)	35.31 cubic feet (ft ³)
1 square millimeter (mm ²)	0.00155 square inch (in. ²)
1 kilometer per hour (km/hr)	0.6214 mile per hour (mph)
1 kilogram (kg)	2.2 pounds (lb)
1 kilowatt (kW)	1.34 horsepower (hp)
1 lumen	0.08 candlepower (cp)
1 kilogram per cubic meter (kg/m ³)	0.062 pound per cubic foot (lb/ft ³)
1 lux (lx)	0.092 footcandle (fc)
1 candela/m ²	0.292 footlambert

Table A.1.6(c) Other Useful Conversion Factors

U.S. Customary Units	SI Units
1 gallon per minute (gpm)	0.833 imperial gallon per minute (igpm)
1 imperial gallon per minute (igpm)	1.2 gallons per minute (gpm)
1 foot (ft) of water	0.433 pound per square inch (psi)
1 pound per square inch (psi)	2.31 feet (ft) of water
1 metric ton (mton)	1000 kilograms (kg)
1 kilopascal (kPa)	0.01 bar
1 bar	100 kilopascals (kPa)

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed

Table A.1.6(d) Abbreviations Used in This Standard

Abbreviation	Term
ac	alternating current
C	Celsius
cd	candela(s)
dc	direct current
EMSP	emergency medical services provider
F	Fahrenheit
fc	footcandle(s)
ft	foot (feet)
gpm	gallon(s) per minute
hp	horsepower
in.	inch(es)
in. Hg	inch(es) of mercury
kg	kilogram(s)
km/hr	kilometer(s) per hour
kPa	kilopascal(s)
kW	kilowatts(s)
L	liter(s)
L/min	liter(s) per minute
lx	lux
m	meter(s)
mm	millimeter(s)
mph	mile(s) per hour
NH	National Hose
psi	pound(s) per square inch
rms	root mean square
V	volt(s)

unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.3.1 Substantially Similar Ambulance. It is not practical to test every production vehicle to validate performance compliance. The term *substantially similar* allows those requirements that call for a test on a substantially similar ambulance to be performed once rather than on every production vehicle.

A.3.3.9 Chassis. Common usage might, but need not, include a cab (or cowl).

A.3.3.10 Common and Critical Equipment and Supplies. The specific list might differ between ambulance stations and/or by the particular needs of the call.

A.3.3.14 Contractor. The contractor might not necessarily manufacture the fire apparatus or any portion of the fire apparatus but is responsible for the completion, delivery, and acceptance of the entire unit. [1901, 2016]

A.3.3.18 Electronic Siren. Varied types of warning sounds can be produced by electronic sirens, such as a wail, yelp, or simulated air horn. [1901, 2016]

A.3.3.27 Grade. A 45-degree slope is equal to a 100-percent grade. [1901, 2016]

A.3.3.38 Loose Equipment. Such equipment can include, but is not limited to, medicines, first-aid supplies, medical gas tanks, child seats, and personal dunnage.

A.3.3.43 Optical Source. An optical source can consist of a single optical element or a fixed array of any number of optical

elements whose geometric positioning relative to each other is fixed by the manufacturer of the optical source and is not intended to be modified.

A.3.3.68 Type Certificate. A certificate is usually issued on a production sample and used on subsequent units that are substantially similar.

A.3.3.70.1 Curb Weight. The curb weight includes such items as the chassis, cab, body, batteries, spare tire, jack, tire changing tools, and any other permanently attached or dedicated equipment, along with a full complement of fuel, lubricants, and coolant.

A.3.3.71.1 Gross Axle Weight Rating (GAWR). It is a requirement of the National Highway Traffic Safety Administration (NHTSA) that the GAWR be posted in the vehicle on a permanently affixed label. The axle system includes, but is not limited to, the axle, tires, suspension, wheels, frame, brakes, and applied engine torque.

A.3.3.71.3 Gross Vehicle Weight Rating (GVWR). It is a requirement of the National Highway Traffic Safety Administration (NHTSA) that the GVWR of a vehicle be posted in the vehicle on a permanently affixed label. The GVWR can be equal to or less than the sum of the front GAWR and the rear GAWR. The in-service weight or gross vehicle weight should always be equal to or less than the GVWR.

A.4.2 The purchaser should be aware that training guidelines can be found in NFPA 1451 or might be found in training programs provided by other organizations.

A.4.4.4 Chassis OEM body builders' guidelines and incomplete vehicle manuals are provided by each chassis manufacturer. These documents provide guidance on how to mount bodies and equipment on each chassis, what types of modifications are allowed, and how to avoid defeating features that are required to comply with Federal Motor Vehicle Safety Standards (FMVSS).

Purchasers should consult these documents prior to creating a purchase specification to ensure they are not asking for features that would contradict the chassis OEM's guidance.

Certain chassis OEMs do allow an ambulance built on their chassis to be used to tow a trailer even though their product might have the features necessary to install a tow package. Purchasers who intend to tow a trailer with their ambulance should be aware of any chassis restrictions and the potential of voiding the warranty.

A.4.6.9 Drawings should be included in the test report if they will assist in documenting the configuration of the components or systems being tested. Drawing details can include views of the entire vehicle where appropriate as well as material sizes, thicknesses, welds, fasteners, adhesive coverage, and so forth, of the critical regions that would be established as "minimums" for the respective location and function of the tested component or system.

A.4.8.1 The engine compartment and the underside of the vehicle are not considered areas of normal nonmaintenance operation.

A.4.9.2 Labels should follow certain parameters:

- (1) They should be positioned horizontally to read left to right.

- (2) They should be located where a control or a user's normal hand, arm position, or any other item will not obscure the label or not where the label obscures any other information.
- (3) Where the ambient illuminance is above 10 lux [0.9 foot-candle (fc)], the label should be composed of black characters on a light background.
- (4) They should be composed of characters whose heights are between 0.12 in. and 0.20 in. times $D/28$ in. (between 3.0 mm and 5.0 mm times $D/710$ mm), where D is the viewing distance [in. (m)].
- (5) Alphanumeric characters should have a width-to-height ratio, where width should be 0.6 in. (15.24 mm) to 0.8 in. (20.32 mm) of the height except for single-stroke characters (e.g., I, l), which should be between 0.1 in. (2.54 mm) and 0.2 in. (5.08 mm) of the height, and the number 4, which should be 0.8 in. (20.32 mm) of the height.
- (6) They should be composed with characters that have stroke widths that meet the following parameters:
 - (a) *For normal characters.* For black characters on a white (or light) background, the stroke width should be 0.1667 in. (4.23 mm) to 0.1429 in. (3.63 mm) of the height. The stroke width should be the same for all letters and numerals of equal height.
 - (b) *For transilluminated characters.* The stroke width should be 0.1 in. (2.54 mm) of the height.
 - (c) *Ratio.* The stroke width ratios should apply regardless of how high characters are made for distance viewing. However, for certain applications characters with different stroke widths can be used on the same sign for emphasis. In this case, the thinnest character stroke should be no less than 0.125 in. (3.175 mm), and the thickest character stroke no greater than 0.2 in. (5.08 mm) of the respective character heights.
- (7) Composed with characters in a plain typeface without serifs (i.e., sans serif fonts) except as necessary to distinguish characters that could otherwise be confused [e.g., "l" (lowercase "ell"), "I" (uppercase "eye"), and "1" ("one"); "0" ("zero") and "O" (uppercase "oh")].
- (8) They should be easy to read accurately from operational reading distances and in the anticipated vibration, motion, and illumination environments.

A.4.9.2.2 Use of the "Star of Life" symbol must be in accordance with the purpose and use criteria set forth in published guidelines by the National Highway Traffic Safety Administration, an operating administration of the U.S. Department of Transportation.

Δ A.4.9.2.3.1 Determination of whether an item is within reach is not an exact science given the vast variability in human forms. Arm and torso length as well as flexibility will vary greatly between individuals. When making trade-offs between reach, comfort, convenience, and practicality, useful anthropometric and human factors data can be found in publications such as MIL-STD-1472, *Department of Defense Design Criteria Standard — Human Engineering*.

A.4.10.1 The attachment of electric, air, hydraulic, and other control lines and hoses should be with removable, mechanically attached fastening devices. The attachment of such equipment with adhesive or glue-on clamps or clips has been found to be inadequate for long-term performance on ambulances.

The use of plastic ties to bundle wire harnesses and hose is permissible, but ties should not be used to attach such items to a cab, body, frame, or other major structure.

A.4.11 This section describes a range of operating measures of the vehicle, and there may be different performance criteria specified for different tests. This section is not intended to prescribe test requirements for all ambulance characteristics. Refer to Chapter 9 for individual ambulance performance test requirements.

A.4.11.1 This standard specifies various temperature ranges for an ambulance or ambulance systems based on use. While the ambulance as a whole is required to operate satisfactorily in low temperatures, it is not crucial that the engine-starting capability be as low as the ambient temperature since most operations in cold climates will keep working ambulances in a garage or will use an engine block heater. Components or systems in the interior of the ambulance do not need to function at extremely low ambient temperatures since the interior of the ambulance will be maintained at higher temperatures by the HVAC system. The purchaser should consider the climate in which the ambulance will operate and specify temperatures outside minimum standard ranges if appropriate.

The interior of the ambulance patient compartment should be maintained at a minimum temperature of 50°F (10°C) when the ambulance is prepared for immediate response. The purchaser should consider how this will be accomplished. If the ambulance will not be housed in a heated facility, then other means could be required to ensure that this requirement is met. This requirement does not apply to ambulances that are fully operational but being held in reserve or ambulances that are not fully operational.

A.4.12.3 This standard does not specify a limit to the top speed of the ambulance. Purchasers might want to specify a speed limitation feature as a tool to augment their ambulance driver safety policy. Information and recommendations on ambulance operation training can be found in NFPA 1451. Information on ambulance crash statistics can be found in *Analysis of Ambulance Crash Data*, published by the NFPA Fire Protection Research Foundation.

A.4.15 It is important for the purchaser and the contractor to agree on the format in which the documentation is to be delivered. It is also important that the purchaser consider the long-term ramifications of changing media technology if electronic format is used for delivery of the documentation. Software and hardware will need to be maintained over the years to utilize electronic documentation.

A.4.16.2.3 Suppliers of components and equipment installed or supplied by the contractor often supply operations and maintenance documents with those components or equipment. This standard requires that the contractor deliver these documents to the purchaser. The purchaser should specify if multiple copies of these documents are required.

A.4.16.3.1 The label shown in Figure 4.16.3.1 is a suggested format. Deviations in dimensions are acceptable.

A.5.1.3.2 It is important for ambulance drivers to understand the height and weight of the vehicle compared to their personally owned vehicles. It is also important that this information be accurate. If anything is added above the roofline height as delivered, the plate should be changed to reflect the new

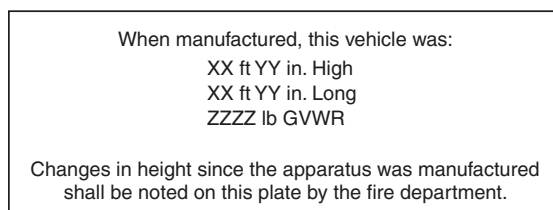


FIGURE A.5.1.3.2 Vehicle Height and Weight Plate.

height. Suggested wording for the plate is shown in Figure A.5.1.3.2.

- A.5.2.2** The projections of total equipment payload and mounting locations are essential for proper engineering of a new ambulance. The purchaser of the ambulance should maintain the side-to-side loading requirement in 5.2.2 as equipment is loaded or installed on the ambulance.

The percentage difference in side-to-side tire load should be calculated as shown in the following formula:

[A.5.2.2]

$$\frac{(\text{Heavier weight} - \text{Lighter weight})}{\text{Total weight}} \times 100 = \text{Percent difference}$$

A.5.4.1 An increase in engine speed provides increased alternator output, increased engine cooling, increased air conditioner output, and increased output or performance from other devices that derive their power from the chassis engine.

- A.5.6.2** Purchasers of ambulances should also consider equipping the ambulance with an auxiliary braking system. Ambulances commonly make repeated stops from high speeds that cause rapid brake lining wear and brake fade, sometimes leading to accidents.

Auxiliary braking systems are recommended on ambulances that are exposed regularly to steep or long grades, operate in congested areas where repeated stops are normal, or respond to a high number of emergencies.

Examples of auxiliary braking systems include engine retarders, transmission retarders, exhaust retarders, and driveline retarders. These devices have various levels of effectiveness on braking. In addition, the systems can be activated by various means and settings, both automatic and manual in operation. The purchaser should carefully evaluate all auxiliary braking systems based on vehicle weight, terrain, duty cycle, and many other factors.

Some auxiliary braking devices should be disconnected when the ambulance is operated on slippery surfaces. Follow the auxiliary braking device manufacturer's recommendations.

A.5.7.1 The angle of approach or departure affects the road clearance of the vehicle going over short, steep grades such as would be found in a driveway entrance, crossing a high crowned road at a right angle, or off-road service. Too low an angle of approach or departure will result in the vehicle scraping the ground. Figure A.5.7.1 shows the method of determining the angle of departure. The angle of approach (front of vehicle) is measured in the same fashion.

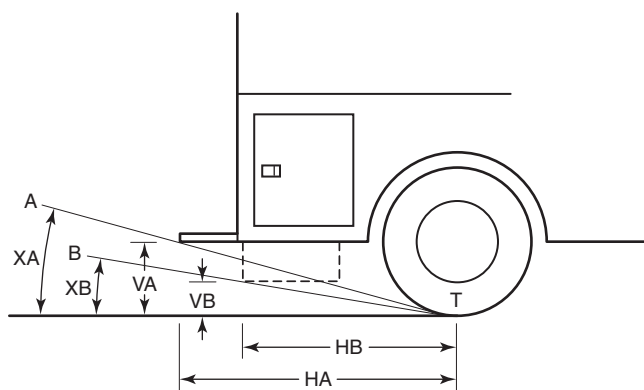


FIGURE A.5.7.1 Determination of Angle of Approach.

In Figure A.5.7.1, the line AT represents the circumstance in which the rear bumper is the determining lowest point. The line BT represents a circumstance in which the rear bumper is not the lowest point (in this case, the lowest point is a fuel tank). The angle of departure is shown as XA or XB. To determine the angle of departure, complete the following steps:

- (1) Place a thin steel strip against the rear of the tires where they touch the ground or stretch a string tight from one rear tire to the other at the rear of where they touch the ground.
- (2) Determine the lowest point (the bumper, fuel tank, or other equipment or component) that would make the smallest angle of departure.
- (3) Hang a plumb bob from the lowest point and mark the point on the ground where the point of the plumb bob touches.
- (4) Measure the vertical distance from the ground to the point where the plumb bob was hung (distance V).
- (5) Measure the horizontal distance from the plumb bob point to the front of the steel strip or to the string running from rear tire to rear tire (distance H).
- (6) Divide the vertical distance (V) by the horizontal distance (H).

The ratio of V/H is the tangent of the angle of departure. If this ratio is known, the angle of departure can be determined from a table of trigonometric functions of angles or from a math calculator.

A.5.7.2 Traction control features can include positive locking differential, limited slip differential, electronic traction control, and so forth.

A.5.8.5 Proper tire inflation is essential to the safe operation of any motor vehicle. Proper inflation improves the handling characteristics and minimizes the risk of rollover.

A.5.9 Electronic stability control (ESC) uses a steering wheel position sensor, a vehicle yaw sensor, a lateral accelerometer, and individual wheel brake controls in conjunction with the antilock brake system (ABS). The system tracks the direction that the driver intends to steer and uses brake application at individual wheels to help straighten out the vehicle. This system greatly enhances the safety of the vehicle, and the purchaser should consider adding ESC to the ambulance if it is available as an option or consider purchasing an ambulance configuration that offers ESC.

A.5.10 The purchaser might want to specify front and/or rear tow hooks or tow eyes be attached to the frame structure to allow towing (not lifting) of the ambulance without damage.

A.5.10.8 Steps at doorway entries and exits should be at least the width of the doorway opening.

A.5.10.8.7 The intent of step size and placement requirements is to ensure that the foot is supported when it is placed on the step in the normal climbing position. In some cases the most natural method of mounting a step might not be perpendicular to the leading edge (common on chassis where it would be natural to not open the door completely to the 90-degree point and to enter the door opening at a diagonal from the rear). In such cases, the clearance measurement can be taken diagonally across the step in the natural direction of climb.

A.5.13 Purchasers might want to consider specifying that all mirror head faces be independently adjustable from the driver's position (if this feature is available from the OEM). Medium- and heavy-duty vehicles (>14,400 lb GVW) should be equipped with a camera at the rear of the vehicle that can be seen and monitored by the driver when the vehicle is in reverse.

A.6.1.1 It is not recommended that SCBA packs be stored in the patient compartment because of the risk of contamination. The term SCBA as referenced in this section is defined in NFPA 1981.

A.6.1.3 While it is important that an EMT should be able to maneuver around the patient on the cot, the physical restraints of the vehicle when combined with other desirable features and tradeoffs might not allow for optimum clearance of 12 in. (300 mm) on all sides in all locations. Purchasers for whom complete access to the cot is critical to their patient care tactics might wish to consider specifying a minimum of 12 in. (300 mm) of clear aisle walkway between the edge of the primary patient cot and the base of the nearest vertical feature measured along the floor. In a similar fashion, if allowed by their desired EMSP seating configuration, purchasers might wish to specify that a minimum of 10 in. (254 mm) shall be provided from the nearest edge of the cot mattress to the loading door(s).

A.6.6.5 Unless otherwise specified by the purchaser to delete walkthrough or to specify or approve alternative door opening dimensions, the door opening should be at least 17 in. (43 cm) wide and 46 in. (117 cm) high and should provide an aisle between the compartments. The door should have at least a 150 in.² (968 cm²) transparent, shatterproof viewing panel in the center section at the driver's eye level. The door should be secured by a cab-side self-latching device in both the open and the closed positions.

A.6.7.1 Handrails that minimize striking hazards should be installed over each walking path.

A.6.8.8 The requirement of 6.8.8 does not apply to both rear doors, only the primary door.

A.6.9.2 Purchasers should consider specifying larger minimum egress openings if allowed by their cabinet configuration requirements.

A.6.12.1 The purchaser may wish to consider the rear maximum load height based on the primary stretcher being utilized. Current accepted maximum load heights as stated by the cot manufacturers are 34 in. to 36 in. (863.6 mm) to

914.4 mm). The load height is dependent on the chassis chosen. Chassis with four-wheel drive are traditionally 4 in. to 6 in. (101.6 mm to 152.4 mm) higher than a comparable 4 × 2.

A.6.15 The following measuring guidelines are for cabinets and compartments:

- (1) Cabinet depth: The dimension from the cabinet inside back wall to the outside cabinet face.
- (2) Compartment depth: The dimension from the compartment inside back wall to the outside compartment face
- (3) Door OD: The door overall outside thickness (dimension)
- (4) Depth ID: The actual interior depth either measured or figured by subtracting the Door OD from the cabinet or compartment measured depth
- (5) Height ID: The dimension from the interior bottom surface to the interior surface of the cabinet or compartment top
- (6) Width ID: The dimension from one interior surface to the next interior surface of the cabinet or compartment
- (7) Sliding window track: The track used for sliding cabinet windows
- (8) Sliding cabinet windows: The sliding doors used on interior cabinets

The area of an interior cabinet with sliding doors or roll-up doors [shown in Figure A.6.15(a)] is determined as follows:

- (1) Measure from the back of the rear wall to the back of the sliding window track and record that dimension as Depth ID.
- (2) Measure the cabinet interior from wall to wall and record that dimension as Width ID.
- (3) Measure the interior from top to bottom and record that dimension as Height ID.
- (4) Multiply Height ID × Width ID × Depth ID.
- (5) If measurements are in inches, divide by 1728 for cubic feet.

The area of an interior cabinet with hinged doors [shown in Figure A.6.15(b)] is determined as follows:

- (1) Measure from the back of the door to the face of the door and record the dimension as Door OD.
- (2) Measure from the back of the rear wall to the cabinet face and record that dimension as the cabinet depth.
- (3) Subtract Door OD from the cabinet depth for Depth ID.
- (4) Measure the cabinet interior from wall to wall and record that dimension as Width ID.
- (5) Measure the interior from top to bottom and record that dimension as Height ID.
- (6) Multiply Height ID × Width ID × Depth ID.
- (7) If measurements are in inches, divide by 1728 for cubic feet.

The area of an exterior compartment with hinged doors [shown in Figure A.6.15(c)] is determined as follows:

- (1) Measure from the back of the door to the face of the door and record that dimension as Door OD.
- (2) Measure from the back of the rear wall to the cabinet face and record that dimension as cabinet depth.
- (3) Subtract Door OD from the cabinet depth for Depth ID.
- (4) Measure the cabinet interior from wall to wall and record that dimension as Width ID.
- (5) Measure the interior from top to bottom and record that dimension as Height ID.
- (6) Multiply Height ID × Width ID × Depth ID.

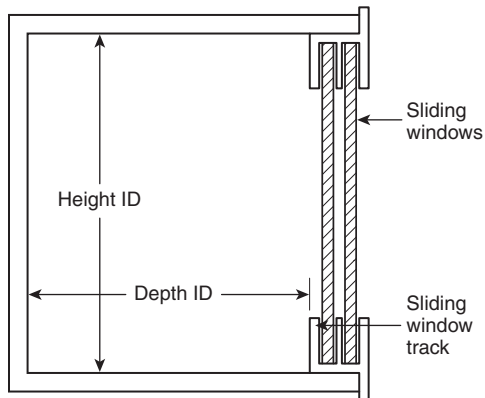


FIGURE A.6.15(a) Measurements of Interior Cabinets with Sliding Doors or Roll-up Doors.

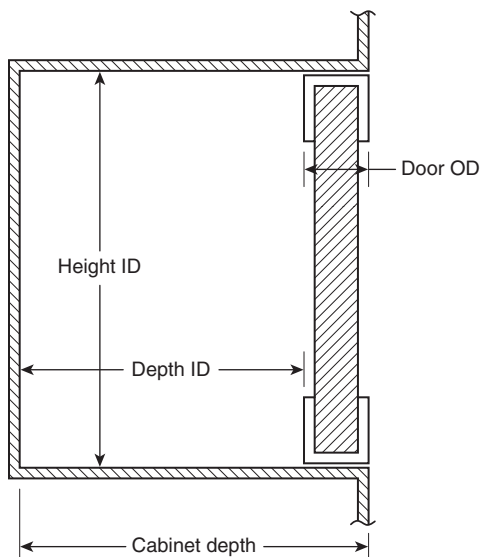


FIGURE A.6.15(b) Measurements of Interior Cabinets with Hinged Doors.

- (7) If measurements are in inches, divide by 1728 for cubic feet.

NOTE: Subtract any notches for spring shackles or fuel systems from the total to get the correct total cubic feet.

A.6.15.6 Determination of whether an item is within reach is not an exact science given the vast variability in human forms. Arm and torso length as well as flexibility will vary greatly between individuals. When making trade-offs between reach, comfort, convenience, and practicality, useful anthropometric and human factors data can be found in publications such as MIL-STD-1472, *Department of Defense Design Criteria Standard — Human Engineering*.

A.6.16.2 Surface materials and their colors used in the patient compartment should allow EMSs to distinguish clean surfaces from soiled surfaces.

A.6.18 Each disposable container meeting 29 CFR 1910.1030 (OSHA) should be mounted inside a fixed container capable

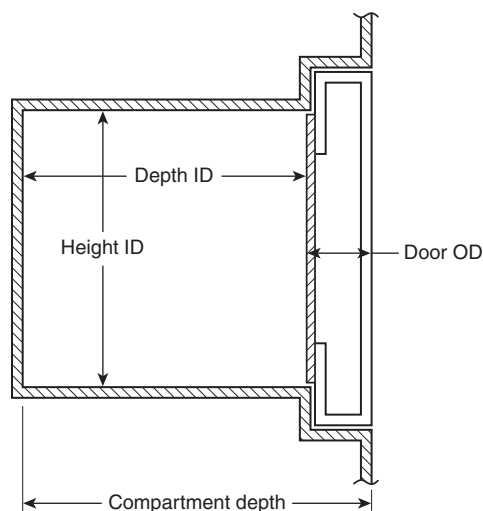


FIGURE A.6.15(c) Measurements for Exterior Compartments with Hinged Doors.

of withstanding a moderate crash without dispersing its contents into the patient compartment.

A.6.21.1 When designing a new ambulance patient compartment interior, one of the primary design goals should be to provide a seating system that allows the worker to remain safely seated and restrained while still allowing that worker to provide efficient and effective patient care. To provide safe, efficient, and effective patient care, a worker needs to be able to reach his or her patient, equipment, and supplies while still seated and restrained. Recognizing the positioning of equipment and supplies closer to the worker will increase the potential for head strike hazards, manufacturers are encouraged to collect occupant excursion data concurrent with the dynamic testing of all seating systems using the methodology described in SAE J3059, *Ambulance Patient Compartment Seated Occupant Excursion Zone Evaluation*. The resulting data can be used to develop expected head excursion zones for each seating system when a vehicle is impacted in the front, side, or rear. In addition, the Department of Homeland Security's *Ambulance Patient Compartment Human Factors Design Guidebook* should be used, which can provide assistance in assessing tradeoffs with reachability to patients, equipment, and supplies while providing a safe space for excursion of EMSPs.

A.6.21.3 Restraint systems should be as follows:

- (1) The restraint system's unfastening mechanism should require only one motion or click with only one hand to operate.
- (2) The restraint system's fastening mechanism should require minimal steps to operate.
- (3) The restraint system should be adjustable to prevent pressure on the throat or other sensitive areas.
- (4) The restraint system should be fully exposable for sanitation and cleaning.

A.6.21.3.1 The ultimate mission of any ambulance is to safeguard the health and welfare of the patient being transported. That mission fails if the ambulance does not arrive safely. It is essential that the ambulance be driven in a safe manner and that all occupants are seated and belted while the vehicle is in motion. During emergency responses, emergency medical

personnel might be inclined to take more risks than usual and to skip basic vehicle safety precautions. To encourage safe practices, ambulance operation management should consider employing some method of monitoring the driving habits of the ambulance personnel. Methods of monitoring compliance with all safety precautions by personnel in the vehicle include live video monitoring, video recording, and vehicle data recording. Any monitoring method should include monitoring of the use of seat belts and an indication of how carefully the ambulance is being driven.

Purchasers may wish to consider specifying seat belt colors such as bright red or bright orange. Bright belt colors are easier to see on videos or through ambulance windows for enforcement of seat belt use compliance.

Seat belt design is critical to safety during a crash. Seat belts should conform to 49 CFR 571, FMVSS 210, S4.3.1.1, which requires that the lap portion of the belt in any designated seating position not constrain the occupant high across the belly.

A.6.21.3.3.3 The H-Point is the mechanically hinged hip point of the torso and thigh on devices used in defining and measuring vehicle seating accommodation in SAE J826, *Devices for Use in Defining and Measuring Vehicle Seating Accommodation*. It is an imaginary point located in two-dimensional space above the seat cushion. The H-Point is measured using a tool that simulates human hips and torso of a specific size and weight. The H-Point will vary with the size, shape, and material of the seat back, seat frame, and seat cushion. If the H-Point measurement is not available, it can be approximated by measuring 5 in. (130 mm) ahead of the seat back and 3 in. (75 mm) up from the nondepressed seat cushion surface.

A.6.21.7.3 Purchasers should consider that seats deeper than 15.9 in. (404 mm) might not accommodate 5th percentile females. Purchasers should consider that seats deeper than 15.9 in. (404 mm) might not accommodate 5th percentile females.

A.6.21.7.4 Back support should be at least 18 in. (457 mm) in width. Back and head support should accommodate occupants with heights that range from 59.3 in. (1506 mm) to 74.3 in. (1887 mm). In addition, the back support should include lumbar support.

A.6.23 Some chassis used on ambulances might not be capable of providing independent control of the HVAC units between the cab and the patient compartment. Purchasers might want to consider chassis selection if this feature would be important in the climate where the ambulance will be used.

A.6.25 Retroreflective contour stripes of any color affixed to the front, rear, and side surfaces of the ambulance to outline the vehicle profile can provide additional conspicuity. The purchaser might want to consider including such stripes in the specification.

A.6.25.1 If the purchaser specifies exterior doors, consideration should be given to affixing the stripe of reflective material in a location that will not be obscured or lost when the doors are open.

A.6.25.6 Retroreflective material included in the calculation includes any combination of graphics, lettering, a chevron pattern sloping downward and away from the centerline of the vehicle at an angle of 45 degrees, or Battenburg markings.

A.6.28.3 Medical gas and suction ports should be located so that EMSPs do not have to reach behind themselves, a structure, or a piece of equipment to access the ports.

A.7.1 This chapter defines the requirements for alternators, batteries, load management, and instrumentation to detect incipient electrical system failure. The intent is to require an electrical system that will operate the ambulance using power supplied by the alternator, shed nonessential electrical loads when necessary, and provide early warning of electrical failure in time to permit corrective action.

A.7.2.1.1 The requirement of 125 percent for wiring and circuits is intended to provide reduced voltage drop over wire rated based on ampacity due to heating. In low voltage wiring, voltage drop becomes a problem before the thermal limit of current carrying capacity of a wire is reached. This requirement also ensures that the circuit protection will prevent damage to the wire in the event of a short or an overload. It is not the intent of this requirement to have the final-stage manufacturer replace the chassis manufacturer's original equipment wiring to meet the 125 percent requirement. It is also not the intent of this requirement to have electrical accessories purchased by the ambulance manufacturer rewired to meet the requirement. Wiring supplied by the electrical device manufacturer can be used to the point where it connects to the ambulance manufacturer's installed wiring.

A.7.2.2.9 It is the intent of 7.2.2.9 to provide a unique means of identifying a wire or circuit to prevent confusing it with another wire or circuit if electrical system repairs become necessary. If a color-coding scheme is used instead of some other unique identification, that color should not be reused for a wire in any unrelated circuits within the same harness. However, 7.2.2.9 covers only low voltage wiring and does not apply to shielded cables commonly used for communication purposes or wiring used in line voltage circuits.

A.7.3.2 The minimum alternator size is developed using the loads required to meet the minimum continuous electrical load. Most ambulances will actually have loads exceeding the minimum requirements of this standard. The purchaser should review the maximum current output of the alternator versus the load study supplied for the ambulance from the manufacturer for on-scene and responding modes.

A.7.4.1(10) The purchaser should analyze the electrical loads that need to be maintained to fulfill the mission of the ambulance and define those loads for the manufacturer of the ambulance. The purchaser needs to understand, however, that there is a limit to the output capacity of an alternator system on the ambulance's engine and that this standard requires that the ambulance be capable of maintaining the minimum continuous electrical load under the conditions defined in 7.3.2. When that load is exceeded and larger alternators are not available, the purchaser and the manufacturer need to work together to determine how to reduce the minimum continuous electrical load to that which can be sustained under the conditions defined in 7.3.2.

A.7.4.3 The unexpected shutdown of an ambulance during a response can place patients in mortal danger and seriously affect the life-saving ability of the crew. With computer-controlled engines and transmissions as well as other controls, an electrical system failure could result in an immediate and total shutdown of the ambulance. The low voltage monitoring system is intended to provide an early warning of an impending

electrical failure and provide enough time to permit operator intervention.

A.7.5.1 Electrical loads on ambulances frequently exceed the alternator capacity. Exceeding alternator capacity will result in the deep discharge of the ambulance batteries. Automatic load management is intended to protect the batteries and electrical system from needless damage while maintaining the operation of essential devices.

It is important that the priority of all managed loads be specified by the purchaser so that, as electrical loads are disconnected from the ambulance's electrical systems, they are shed in the order least likely to affect emergency operations. Optical warning devices in excess of the minimum required in this standard can and should be load managed.

A.7.6 Batteries usually have two ratings: "cold cranking amps," which determines the size engine that can be started, and "reserve capacity," which provides a measure of the total power that can be provided at a much lower constant rate of discharge. Ambulance batteries should be sized to have enough cold cranking amperage and reserve capacity to restart the engine after being substantially discharged.

A.7.6.3.3 Overheating of a battery will cause rapid deterioration and early failure. Evaporation of the water in the battery electrolyte can also be expected.

A.7.6.5 The power cord from the onboard charger or battery conditioner should only be plugged into a receptacle protected by a ground-fault circuit interrupter (GFCI) at the shoreline origination point.

A.7.6.7 The purchaser might want to add an illuminated "Module Disconnect" switch that can control all electrical loads for the module. The illuminated switch could control a solenoid. If the switch is specified, it should be located in the driver's compartment, be legibly marked, illuminated when "ON," and rated to carry at least 125 percent of the circuit's maximum current, unless it operates a solenoid. If the switch operates a solenoid, the solenoid should be rated for 125 percent of the circuit's maximum current. The module disconnect switch or device should be different in feel from other switches or be physically isolated from them.

A.7.8 SAE J551/1, *Performance Levels and Methods of Measurement of Electromagnetic Compatibility of Vehicles, Boats (up to 15 m), and Machines (16.6 Hz to 18 GHz)*, provides test procedures and recommended levels to assist engineers in the control of broadband electromagnetic radiation and in the control of radio interference resulting from equipment installed on the ambulance. Adherence to the recommended levels will minimize the degradation effects of potential interference sources in the communication equipment or other devices susceptible to electromagnetic interference.

Procedures are included to measure the radiation from a single device or the entire ambulance. Compliance could be determined through actual tests on the completed ambulance or predictions based on tests previously conducted on similarly equipped ambulance. If compliance certification is required, it should be so indicated in the ambulance specifications.

A.7.9.1 The upper-level optical warning devices provide warning at a distance from the ambulance, while the lower-level optical warning devices provide warning in close proximity to the ambulance. (See Figure A.7.9.1.)