4.8.3 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.

4.8.4 Appropriate forms or data sheets shall be provided and used during the testing.

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

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

4.8.7 Certification documentation shall be delivered with the apparatus including results of the certification tests.

4.9 Personnel Protection.

4.9.1* 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.

> **A.4.9.1** The engine compartment and the underside of the vehicle are not considered areas of normal nonmaintenance operation.

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

4.9.3 Vehicular workmanship shall ensure an operating environment free of accessible sharp projections and edges.

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

4.10 Controls and Instructions.

4.10.1 Illumination shall be provided for controls, switches, instruction plates, labels, gauges, and instruments necessary for the operation of the apparatus and the equipment provided on it.

4.10.1.1 If external illumination is provided, it shall be a minimum of 5 fc (50 lx) on the face of the device.

4.10.1.2 If internal illumination is provided, it shall be a minimum of 4 footlamberts (14 candela/m^2).

4.10.2* All required signs, instruction plates, and labels shall be permanent in nature and securely attached and shall meet the requirements of 4.9.4 and UL 969, *Standard for Marking and Labeling Systems*.

> **A.4.10.2** All required signs, instruction plates, and labels should be highly visible and placed on the vehicle where they are not subject to damage from wear and tear.

4.10.2.1 The signs, instruction plates, and labels shall have resistance to damage from temperatures between –30°F and 176°F (–35°C and 80°C) and exposure to oil, fuel, water, hydraulic fluids, or other fluids used on the apparatus.

4.10.2.2 The exterior mounted labels relating to safety or critical operational instructions shall be reflective or illuminated as required by 4.10.1.

4.10.3 Gauges or visual displays required by this standard shall be no more than 84 in. (2.1 m) above the level where the operator stands to read the instrument to the center line of the gauge or visual display.

4.10.4 The central midpoint or centerline of any control shall be no more than 72 in. (1800 mm) vertically above the ground or platform that is designed to serve as the operator's standing position.

4.11 Vehicle Data Recorder.

4.11.1 All apparatus shall be equipped with an on-board vehicle data recorder (VDR).

4.11.2 The VDR shall be capable of recording the data shown in Table 4.11.2 in that order at least once per second.

Table 4.11.2 VDR Data

Data	Unit of measure
Vehicle speed	MPH
Acceleration (from speedometer)	MPH/Sec.
Deceleration (from speedometer)	MPH/Sec.
Engine speed	RPM
Engine throttle position	% of full throttle
ABS Event	On/Off
Seat occupied status	Occupied Yes/No by position
Seat belt status	Buckled Yes/No by position
Master Optical Warning Device Switch	On/Off
Time	24 hour time
Date	Year/Month/Day

4.11.3 Data shall be stored at the sampling rate in a 48 hour loop.

4.11.4 Memory shall be sufficient to record 100 engine hours worth of minute by minute summary data showing the data in table 4.11.4.

Table 4.11.4 VDR Summary Data

Data	Unit of measure
Maximum vehicle speed	MPH
Maximum acceleration (from speedometer)	MPH/Sec.
Maximum deceleration (from speedometer)	MPH/Sec.
Maximum engine speed	RPM
Maximum engine throttle position	% of full throttle
ABS Event	On/Off
Seat occupied with seat belt unbuckled	Yes/No by position at 30 sec. into minute
Master Optical Warning Device Switch	On/Off at 30 sec. into minute
Time	24 hour time
Date	Year/Month/Day

4.11.5 When the memory capacity is reached, the system shall erase the oldest data first.

4.11.6* All data stored in the VDR shall be uploadable by the user to a computer and importable into a data-management software package.

~~**A.4.11.6** The purchaser should specify the format and connection for uploading data. The standard allows multiple types of formats and means of uploading data to allow for future technology. For users that have multiple vehicles, it may be beneficial to require all systems to be compatible with the users data systems.~~

4.11.7 Data shall be password protected with access controlled by the purchaser.

4.11.8 Software shall be delivered ~~provided~~ with the apparatus that will run on both Windows and Apple operating systems and produce the following formatted reports from the uploaded data:

(1) Raw second-by-second data over a specified data/time range

(2) Daily log for the time the engine is running for a given date (minute by minute output of all values)

(3) Weekly summary (maximum values each hour for each day of the week)

(4) Monthly summary (maximum values each day for each day of the month)

4.12 Component Protection.

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

A.4.12.1 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 fire apparatus. The