AMTRAK

SPECIFICATION

DESCRIBING

ENVIRONMENTAL AND OPERATING CONDITIONS

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ABSTRACT:
This specification describes the environment the car electrical and electromechanical equipment will experience in Amtrak operation.

KEY WORDS: Environment, temperature

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REVISION HISTORY

Revision	Description of Change	Date	Approved
--	Original release	12/07/84	CJE
A	Added sections 2.1j & k, 3.1.5, 3.1.6, 3.2.3, 3.2.4; "under pressure from sprays" to 2.1.h; carbody shock numbers were 6,4,10 respectively	11/27/89	RFB
B	2.1 "exterior" was "undercar"; 2.1: 9200 was 8000 feet; 3.2.1: was 3,3,6g	6/20/2000	RFB

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1.0 **SCOPE**

1.1 Purpose

This specification describes the environment the car electrical and electromechanical equipment will experience in Amtrak operation.

1.2 Intent

If a conflict exists between this specification and the primary procurement specification in which it is referenced, that specification shall rule.

2.0 **GENERAL**

Electrical and electromechanical equipment, its components and associated interconnecting wiring shall be designed to withstand the vehicle shock, vibration, environmental, temperature, and humidity extremes to be expected under operating conditions.

2.1 General Environmental Considerations

The exterior car environment is severe, and care must be taken to protect against the following factors:

a) Heavy rain, driven by wind, or water from a hose
b) Hail, ice, and powdered snow
c) Blown sand, dust, ballast, and rocks
d) Vehicle velocity to 125 mph
e) Wind gust velocity to 90 mph
f) Salt (sea spray or from roads during winter months)
g) Impact from road debris
h) Car washing chemicals and wash rack operation under pressure from sprays
i) Maximum operating altitude of approximately 9200 feet above sea level.
j) Oily film, from diesel locomotive exhaust
k) Electrically conductive dust, primarily from wheel, brake and rail wear.

3.0 **Operating Conditions**

3.1 Normal Operating Environment

The normal operating environment is those conditions the car equipment can experience during typical daily operation. These are conditions the equipment must be expected to encounter continuously for extended periods of time (rather than occasional transient conditions) without suffering from degradation of performance.

3.1.1 Truck

Vibrational Acceleration Extremes

The truck-mounted equipment will encounter the following vibrational acceleration levels which

have been measured on the unsprung mass (side frame) of rail vehicle trucks with wheel flats moving at 120 miles per hour:

Truck Acceleration Parameter	Measured "G" levels (Peak-To-Peak)	Frequency (Hertz)
Vertical	100	60 to 70
Lateral	100	380 Hz

3.1.2 Carbody Exterior

Vibrational Acceleration Extremes

The carbody-mounted equipment will encounter the following vibrational acceleration levels which have been measured in the sprung mass (car body) of rail vehicles moving at 120 miles per hour:

Car Acceleration Parameter	Measured "G" levels (Peak-To-Peak)	Frequency (Hertz)
Vertical	0.40 to 0.60	12 to 15
Lateral	0.20 to 0.40	1.5 to 2.0

Temperature

During the operation, the equipment will be subjected to the following temperature variations outside the vehicle.

The equipment must be functional at any temperature between:
-40 and +150°F for "vital" equipment; -20 and +130°F for "non vital" equipment. Vital/non vital is defined in the basic system specification.

Humidity

The exterior relative humidity for the undercar equipment will vary from 0 to 100%.

3.1.3 Carbody Interior

Temperature

During operation, the equipment will be subjected to the temperature variations within the vehicle.

Typically, the interior temperature ranges from +40 to +90°F. However, the system must be

functional at any temperature between:

-40 and +150°F for "vital" equipment -20 and +110°F for "non-vital" equipment

Humidity
During layover, the interior relative humidity will range from 5 to 100%. During normal operation, the interior relative humidity will range from 20 to 90 percent.

3.1.4 Electrical

AC
Normal operation of the car AC electrical system conforms to NEMA standards of +\-10% nominal voltage and +\-5% nominal frequency. Standard voltages include: 480, 240, 208/120, 120, and 28 all at 60Hz.

AC Power Interruption
During normal operation of the car, 480 volt power, and all derived voltages (240, 208/120, 120 and 28) are often interrupted as follows:

Momentary (0 to 10 seconds typical), such as those caused by pantograph bounce on an Electric Locomotive.

Short Term (up to 1/2 hour typical), such as those experienced in locomotive changes or at adding cars to a train enroute.

Long Term (several hours to several days), such as those experienced in yard switching, train spotting and yard storage and service.

DC
Normal operation of the car DC electrical systems is:

Nominal (when train is on Head End Power (HEP) 72 VDC + 8, -16, ripple less than 2V P-P, (harmonics of 60 Hz).

Battery operation (when train is NOT ON HEP): 64VDC +\-8.

There may be momentary loss of power during transition from HEP to battery, or battery to HEP operation.

3.1.5 Pneumatic
Depending upon equipment, cars are equipped with 1 or 2 pneumatic sources, Main Reservoir and Auxiliary. Compressed air is supplied either from a locomotive or stationary compressor and is supplied to the train via a combination of rubber hoses and steel pipe, with in-car distribution

via copper tubing. Compressors are rotary or reciprocating. Air is often wet, especially in yard operation. Air may also carry some compressor oil.

Main Reservoir Line Air:

Coupled to a Locomotive
When coupled to road locomotive, main reservoir air line pressure ranges from 130 to 140 PSIG. This pressure is normally maintained once the locomotive(s) is coupled to the train; but will experience the following outages; at which time pressure will drop abruptly to zero:

Short Term - (Up to 1/2 hour typical) such as those experienced in locomotive changes or at adding cars to a train enroute.

Coupled to Yard or Station Air - When coupled to either stationary air source, air line pressure ranges from 80-90 PSIG. This pressure is normally maintained once the cars are coupled to the air source, but will experience the following outages at which time pressure will drop abruptly to zero:

Short Term - (up to 1/2 hour typical) such as those experienced in switching moves or adding cars to the consist.

Long Term - (several hours to several days), such as those experienced in yard switching, train spotting, yard storage and service.

Auxiliary Air :
Auxiliary air is an air source derived from main reservoir air. A small air reservoir is charged through a governor valve, which cuts off the air source feeding the reservoir if incoming pressure is less than about 80 PSIG. Because of the reservoir, auxiliary air pressure does not drop abruptly to zero upon loss of train air, but rather drops slowly over a period of several hours.

Coupled To A Locomotive - When coupled to a road locomotive, car auxiliary air pressure ranges from 80 to 140 PSIG. This pressure is normally maintained once the locomotive(s) is coupled to the train. However, main reservoir air feeding the auxiliary air system is interrupted as described above in Main Reservoir Line Air, thus pressure will slowly drop.

Coupled to Yard or Station Air - When coupled to either stationary air source, auxiliary air pressure ranges from 80-90 PSIG. This pressure is normally maintained once cars are coupled to the air source. However, main reservoir air feeding the auxiliary air system is interrupted as described above in Main Reservoir Line Air, thus pressure will slowly drop.

3.1.6 Water
Depending upon equipment, cars are equipped with 1 of 2 water sources: gravity or pressurized.

Tanks are refilled at the origin of the trip, and at intermediate points on lengthy overnight trips.

Gravity
Water is supplied from an overhead tank by gravity. Typical head is 4 feet. Water is not always available:

- If car runs out of water from excessive demand
- In subfreezing weather, temperature sensitive automatic drain valves must drain car water system if car heat is not available.

Pressurized
Water is supplied from an undercar tank through the use of auxiliary compressed air, which pressurizes the water tank directly. Nominal water pressure is regulated 20 - 25 PSIG, but will slowly drop to zero if main reservoir air pressure is not available to the car. (See section 3.1.5 above, Auxiliary Air).
Car water is not always available:

- If car is out of water from excessive demand.
- In subfreezing weather, temperature sensitive automatic drain valves will drain car water system if car heat is not available.
- If car water tanks are being refilled.

In the first case, car water system will have normal pressure of 20-25 PSIG, but it will be air pressure. In the second case, car will have low pressure, if any while in the 3rd case, car will have neither water, nor pressure. Accordingly, equipment which requires no-water protection must sense the presence of water, not pressure.

3.2 Survive Environment
The "survive" environment is the conditions car equipment will experience occasionally. Generally, these are conditions equipment must be expected to encounter continuously for extended periods of time, without change or degradation. While equipment may be under power during these extreme conditions, operations specifications need not be met.

3.2.1 Carbody

Shock:

Vertical	4g
Lateral	4g
Longitudinal	8g

Temperature - Interior and Exterior
The car experiences severe temperatures during storage and operation. Equipment must be designed to withstand without damage, the following temperature extremes. These temperatures

are attained only occasionally: -40 to +150°F. Normal temperature range: -20 to +130°F.

3.2.2 Electrical

AC

Equipment shall not be damaged from sustained undervoltage condition.

Equipment shall not be damaged from reverse phase rotation (when applicable)

DC

Equipment shall sustain no damage from sustained low voltage conditions, 0-56VDC.

Equipment shall be reverse-polarity protected.

3.2.3 Pneumatic

Equipment must not sustain damage from short or long term operation at subnormal air pressure.

3.2.4 Water

Equipment must not sustain damage from short or long term operation at subnormal water pressure, nor partial nor complete loss of water supply.