

**GENERAL RELIABILITY TEST PLAN**

**for**

**PROFESSIONAL TRANSDUCERS**

**JBL Professional**

**R&D Engineering**

Release Date:

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## 1.0 Reference

Based on Harman Consumer document Reliability Test Plan for Marine Audio Speakers Rev B 6-6-01

## 1.1 Purpose

The purpose of this test plan is to describe the environmental and functional performance requirements to which a new speaker design must pass in order to be qualified for production. Some of these tests may be considered optional depending on the transducers intended use. Applicable tests shall be specified on the DVP&R. The intent of the validation program is to expose the speaker to an accelerated aging process.

## 2.0 Test Plan

This test plan details the type of tests and the number of units required for each. The sample size outlined below may change depending on Reliability Target.

### 2.1 Full Qualification

The Full Qualification test program consists of the groups listed below. These groups are designed to be performed in parallel. These tests must be performed on at least one member of a “Product Family”. The most complex or highest power model should be chosen.

Group	QTY		Test Name	Spec. Sect. No.	Functional Test Requirements	Reference
	EPR	Pilot				
A	2	6	Life Cycle	5.1.1	4.4 and 4.5	Chrysler PF9506 2.2.2.1 Damp/dry cycling & 2.2.2.5 Temperature Test
B	2	6	Power Test	5.4	4.4 and 4.5	
			UV Exposure Test	5.8	4.4 and 4.5	
			Guillotine Impact Test	5.5	4.4 and 4.5	
			Water Spray Test	5.10	4.4 and 4.5	IEC 529 IPX3
C	2	6	Random Vibration Test	5.6	4.4 and 4.5	
			Salt Fog Test	5.9	4.4 and 4.5	
D	2	6	Packaging Test (ASTM )	5.7	4.4 and 4.5 See Note 1	ASTM D 4169 - 99
			Temperature Test	5.2	4.4 and 4.5	2.2.2.5 Temperature Test
			Humidity Test	5.3	4.4 and 4.5	2.2.2.1 Damp/Dry Cycling

**Note 1:** If packaging is available.

**Note 2:** Unless otherwise specified, all units shall be tested in the orientation that unit will be mounted.

**Note 3:** The performance limits of the units under test will be specified in the Product Definition (see Section 6).

## 2.2 Abbreviated Qualification

The abbreviated test program consists of the groups listed below. These groups are design to be performed in parallel. These tests must be performed on all members of a “Product Family” not subjected to the Full Qualification found in section 2.1.

Group	QTY		Test Name	Spec. Sect. No.	Functional Test Requirements	Reference
	EPR	Pilot				
A	2	6	Life Cycle	5.1.2	4.4 and 4.5	Chrysler PF9506 2.2.2.1 Damp/dry cycling & 2.2.2.5 Temperature Test
B	2	6	Power Test	5.4	4.4 and 4.5	
			Handling Drop Test	5.5		
			Water Spray Test	5.10		IEC 529
C	2	6	Packaging Test (ASTM)	5.7	4.4 and 4.5 See <b>Note 1</b>	ASTM D 4169 - 99

**Note 1:** If packaging is available.

**Note 2:** Unless otherwise specified, all units shall be tested in the orientation that unit will be mounted in the car.

**Note 3:** The performance limits of the units under test will be specified in the Product Definition (see Section 6).

## 3.0 Standard Test Conditions

### 3.1 Signal Source

Unless otherwise specified, all tests shall be conducted with the Audio Signal Generator/Amplifier output configured to be balanced, less than or equal to 50-ohm source impedance, and floating. The signal source GND shall be connected to the speaker PWR GND at the speaker.

### 3.2 Position

Unless otherwise specified, the speaker shall meet all requirements in the “normal mounting position”. It is defined on the Product Definition as to the horizontal or vertical position of the mounting surface.

### 3.3 Room Temperature

Unless otherwise specified, all measurements shall be made at room temperature. Room temperature is specified as 25°C +/-3°C.

### 3.4 Frequency Range

The frequency range is specified from the -3dB point at the upper and lower operating range of the driver. This range and the limits with in that range shall specified on the Product Definition.

### 3.5 Noise

The products are divided into three groups, full range (multi-element), direct radiators, and compression drivers. The type of product shall be specified on the Product Definition.



**Full Range** will use IEC noise with a crest factor of 6dB. Optionally, a 9 dB crest factor may be used to impose additional mechanical stresses. The RMS voltage shall be specified on the Product Definition.

**Direct Radiators** will use a decade of pink noise, 12dB slopes, with a crest factor of 6dB. Optionally, a 9 dB crest factor may be used to impose additional mechanical stresses. The lowest intended operating frequency determines the approximate lower frequency test limit. The RMS voltage shall be specified on the Product Definition.

**Compression Driver** will use a decade of pink noise, 12dB slopes, with a crest factor of 6dB. The lowest intended operating frequency determines the approximate lower frequency test limit. The RMS voltage shall be specified on the Product Definition.

## **4.0 Functional Test Requirements**

### **4.1 Polarization**

Product Definition shall identify the positive terminal, which shall be labeled Pin 1 or “+” or be marked in RED. When a positive potential is applied to the positive terminal, the speaker shall produce a positive pressure. Ref. IEC 268-2.

All Compression drivers are “JBL Standard Polarity”. When a positive potential is applied to the positive terminal, the compression driver shall produce a negative pressure at the driver exit.

### **4.2 DC Resistance**

Ensure that the test lead resistance is factored out of this measurement. Connect the test leads to the speaker and measure the resistance in ohms with an averaging ohmmeter to ensure that ambient noise levels do not produce an EMF at the meter yielding false resistance readings. The DCR shall be within the limits specified on the Product Definition.

### **4.3 Impedance**

Rigidly suspend the speaker from the motor structure in free air at least 50 cm from the nearest reflecting surface. Mounting means must be minimal in bulk such that the air movement during testing is substantially unrestricted. Lead resistance must be subtracted from measured impedance.

### **4.4 Frequency Response**

Frequency response is typically measured at 1 watt into either the rated nominal impedance or into  $Z_{min}$ . Specify which method is used. SPL in dB is plotted vs. frequency in Hz. Standard JBL aspect ratio is 30 dB on the vertical scale equals 1 decade on the horizontal scale.

### **4.5 Extraneous Noise**

The speaker assembly shall not produce extraneous noise when a dynamic test is performed. Voltage and frequency range for this test are specified in the ETS. The following types of deficiencies are some typical causes of extraneous noise:

1. **Buzz:** Any noise produced by a looseness of components vibrating against other components.
2. **Rub:** Any noise produced by the voice coil sliding or rubbing against other components.
3. **Bottoming:** The noise produced by the contact of the moving system with the speaker structure.
4. **Rattle:** The random noise produced by an object trapped within the speaker allowed to strike moving components, or any intermittent noise caused by loose electrical connections or controls.
5. **Air Noise:** The noise produced by high velocity airflow through a small leak.

6. **Cone Edge Tick:** Ticking sound produced by poor attachment of edge to frame or to cone body.

## **5.0 Environmental/Mechanical Testing**

The reliability target for professional products is zero defects after 5 years of typical usage. Successful completion of the test is intended to demonstrate 90% reliability with 90% confidence.

### **5.1 Life Cycle**

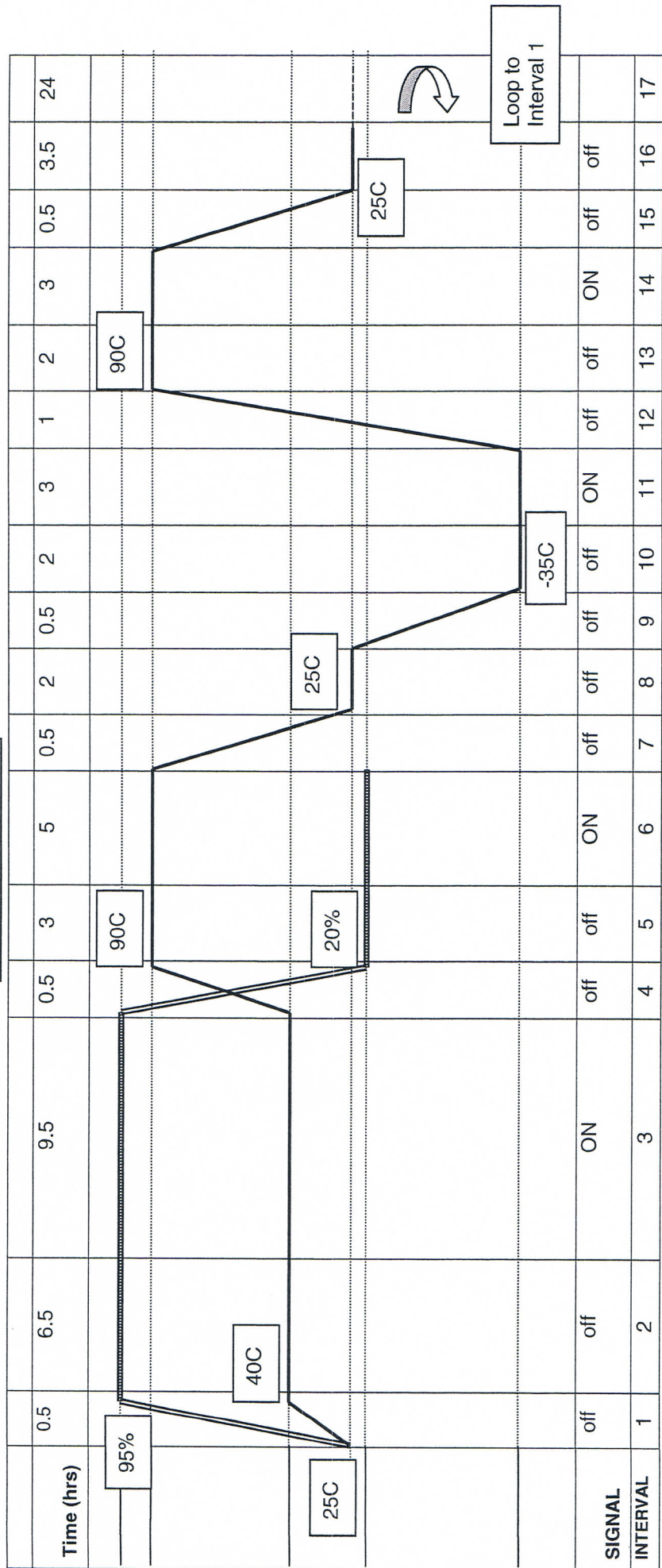
Each speaker shall withstand 5 cycles (totaling 215 hours) of the environmental conditions outlined below. The speakers should be checked once a day on a regular basis. A full functional test should be performed on all units at the end of the second and fifth cycles.

- A. Over a 30-minute period, raise the temperature to 40°C with a relative humidity of 95%.
- B. Stabilize the temperature at 40°C with a relative humidity of 95% for 16 hours. After 6 ½ hours, apply the designated noise signal (section 3.5) at 50% of the rated power . At the end of the 16-hour period, remove the signal.
- C. Over a 30-minute period, raise the temperature to 90°C with a relative humidity of <20%.
- D. Stabilize the temperature at 90°C with a relative humidity of 20% for 8 hours. After 3 hours, apply the designated noise signal (section 3.5) at 50% of the rated power. At the end of the 8-hour period, remove the signal.
- E. Over a 30-minute period, lower the temperature to 25°C.
- F. Stabilize the temperature at 25°C for 2 hours.
- G. Over a 30-minute period, lower the temperature to -35°C.
- H. Stabilize the temperature at -35°C for 5 hours. After 2 hours, apply the designated noise signal (section 3.5) at 50% of the rated power. At the end of the 5-hour period, remove the signal.
- I. Over a 1-hour period, raise the temperature to 90°C.
- J. Stabilize the temperature at 90°C for 5 hours. After 2 hours, apply the designated noise signal (section 3.5) at 50% of the rated power. At the end of the 5-hour period, remove the signal.
- K. Over a 30-minute period, lower the temperature to 25°C.
- L. Stabilize the temperature at 25°C for 3.5 hours.
- M. This is the end of one cycle.

See graph on next page.



# Life Cycle Test



ONE CYCLE  
(43 hours)

**Life Cycle Functional Test Intervals**  
 3.60 days for 50% functional (2 cycles)  
 5.38 days for 100% functional (3 cycles)

Temperature (°C)  
 Humidity (%RH)

## **5.2 Temperature (Non-Operational) Test**

Each speaker shall withstand 24 hours of exposure to -35°C and 24 hours to 90°C inside the environmental chamber. The test duration should be 24 hours at each temperature with a minimum of 4 hours between temperature conditions. Let the speakers cool down to a normal room temperature before any post test evaluation is performed. The speaker should be tested at the end of each 24-hour period.

Ref. Chrysler PF 9506 2.2.2.5 Temperature Test

## **5.3 Humidity (Non-Operational) Test**

Each speaker shall withstand exposure to 40°C at 95% relative humidity for 16 hours, then 90°C at 20% relative humidity for 8 hours with 15 minutes ramp between the two temperature and humidity conditions. This is considered one cycle. The total test is 5 cycles long totaling 122 hours. Leave the speakers for a minimum of 4 hours at room temperature before any post test evaluation is performed.

Ref. Chrysler PF 9506 2.2.2.1 Damp/Dry Cycling

## **5.4 Power Test**

Each speaker shall withstand 100 hours of application of noise signal specified in section 3.5. The noise signal should be calibrated to 100% of the RMS voltage rating as specified on the Product Definition. Leave the speakers for a minimum of 4 hours at room temperature before any post test evaluation is performed. Surviving speakers may be tested for an additional time, typically 200 hours, for data gathering only.

## **5.5 Guillotine Impact Test**

Minimum 10 drops from 12 inches per JBL Professional Work Instruction 006-02950. Rub & Buzz the speaker every 5<sup>th</sup> drop per section 4.5.

Nominally, speaker should pass 50 drops from 18 inches.



## 5.7 Packaging Test (ASTM)

### 5.7.1 Schedule A–Manual Handling, First Sequence

For purposes of this procedure, the bottom of a small parcel is the surface on which the parcel rests in its most stable orientation. Recommended drop heights, the number of drops, the sequence of drops, and the shipping unit orientation at impact are as follows:

<u>Shipping Weight, lb (kg)</u>	<u>Drop Height, in. (mm)</u>
0 to 20 (0 to 9.1)	24 (610)
20 to 40 (9.1 to 18.1)	21 (533)
40 to 60 (18.1 to 27.2)	18 (457)
60 to 80 (27.2 to 36.3)	15 (381)
80 to 100 (36.3 to 45.4)	12 (305)
100 to 200 (45.4 to 90.7)	10 (254)

<b>Number of Impacts At Specified Height</b>	<b>Impact Orientation –First Sequence of Distribution Cycle</b>
One	top
Two	adjacent bottom edges
Two	diagonally opposite bottom corners
One	bottom

Ref: ASTM D 4169 - 99

### 5.7.2 Loose Load Vibration Method A1—Repetitive Shock Test

Place the test specimen on the test machine platform in its normal shipping orientation. Attach restraining devices to the platform to prevent the specimen from moving horizontally off the platform and to prevent excessive rocking without restricting the vertical movement. Adjust the restraining devices to permit free movement of the specimen of approximately 10 mm (0.4 in.) in any horizontal direction from its center position. Start the vibration of the platform at a frequency of about 2 Hz and steadily increase the frequency until some portion of the test specimen repeatedly leaves the test surface. To ensure that the test specimen receives a continuing series of repetitive shocks, a shim with a 1.6 mm (1 /16 -in.) thickness and a width of 50 mm (2.0 in.) shall be used to determine when the test specimen is leaving the test platform. The shim should be inserted under the package a minimum of 100 mm (4.0 in.) and moved intermittently along one entire length of the package.

Continue the test at this frequency for a period of 1 hour. The test may be stopped momentarily to inspect for damage.

If the container might possibly be transported in any other orientations, test at least one container in each possible orientation for the full-specified test duration.

Inspect the container and its contents and record any damage or deterioration resulting from the test.

Ref: ASTM D 4169 – 99, ASTM D 999 – 96



### 5.7.3 Schedule E-Vehicle Vibration

Perform the test for each possible shipping orientation. Recommended intensities and duration for the random tests are given below.

#### *Random Test:*

The following power spectral densities (as defined by their mode of transport, frequency and amplitude breakpoints) and test duration are recommended:

Air: Assurance Level I

<u>Frequency, Hz</u>	<u>Power Spectral Density Level, g<sup>2</sup>/Hz</u>
2	0.0004
12	0.02
100	0.02
300	0.00002
Overall, g rms	1.49
Duration, min <sup>B</sup>	180

<sup>B</sup> For vehicle vibration tests in multiple shipping unit orientations, the total duration should be distributed evenly between the orientations tested.

Ref: ASTM D 4169 - 99

### 5.7.4 Schedule A–Manual Handling, Second Sequence

For purposes of this procedure, the bottom of a small parcel is the surface on which the parcel rests in its most stable orientation. Recommended drop heights, the number of drops, the sequence of drops, and the shipping unit orientation at impact are as follows:

<u>Shipping Weight, lb. (kg)</u>	<u>Drop Height, in. (mm)</u>
0 to 20 (0 to 9.1)	24 (610)
20 to 40 (9.1 to 18.1)	21 (533)
40 to 60 (18.1 to 27.2)	18 (457)
60 to 80 (27.2 to 36.3)	15 (381)
80 to 100 (36.3 to 45.4)	12 (305)
100 to 200 (45.4 to 90.7)	10 (254)

#### **Number of Impacts At Specified Height**

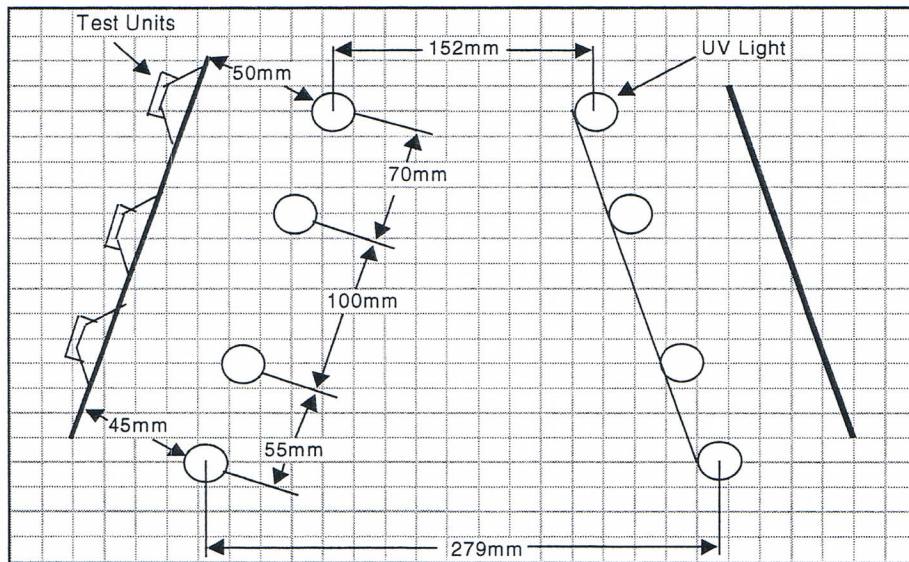
<b>Number of Impacts At Specified Height</b>	<b>Impact Orientation –Second Sequence of Distribution Cycle</b>
One	vertical edge
Two	adjacent side faces
Two	one top corner and one adjacent top edge
One	the drop should be in the impact orientation most likely for a drop to occur, usually the largest face or the bottom. For distribution cycles where any drop orientation is possible (i.e., small parcel environment), this drop should be in the most critical or damage-prone orientation.

Ref: ASTM D 4169 – 99

## 5.8 Ultraviolet (UV) Exposure Test

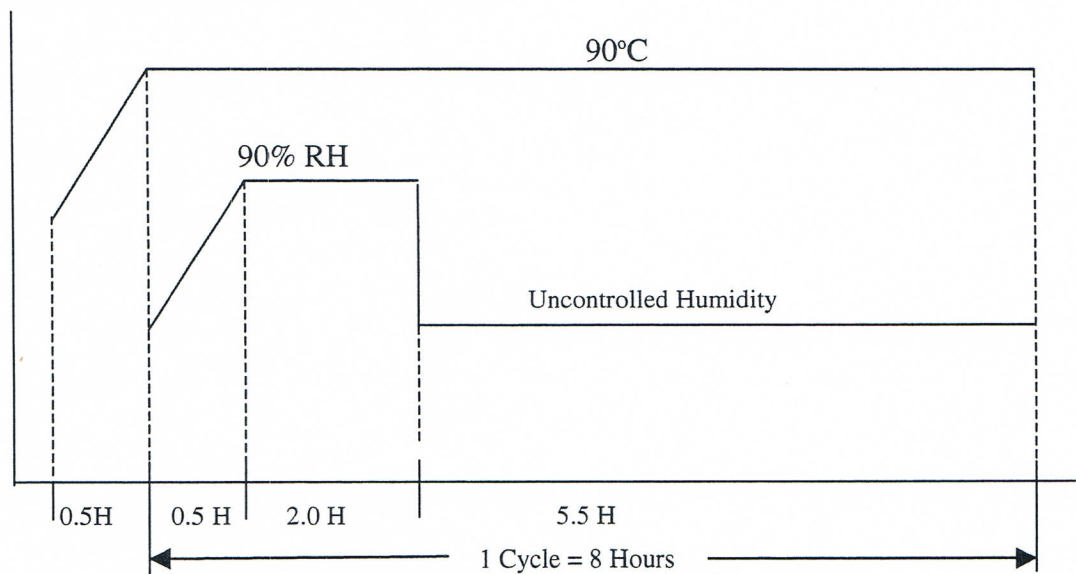
Each speaker should be placed inside the UV test chamber and withstand 20, 8 hour cycles of UV exposure test outlined below. Transducer must pass 2 hour power test at full power after UV exposure. The type of UV lamp should be 40 watts UV-C lamp as shown:

### Test Set Up:



Ref. Material ASTM G53.

### Environmental Profile (1 Cycle = 8 hours)





### **5.9 Salt Fog Test**

The speaker shall withstand 200 hours of salt fog. The signal to the speaker should be ON for 4 hours and OFF for 4 hours with the designated noise signal (section 3.5) calibrated to 50% the rated power.

Ref. ASTM B117

### **5.10 Water Spray Test**

Each speaker shall withstand a water spray test per IEC 529 corresponding to the IPX3 level of protection. Test is meant to protect speaker systems from ingress of water through the transducer.

Ref. IEC529