WAEA SPECIFICATION [XXX]

Audio Jack Test Procedure

DRAFT FOR DISCUSSION

[date here]

Version [DRAFT C]

For Discussion and Future Approval by the
World Airline Entertainment Association
Technology Committee, [date].
(Original Version [x.x] Approved [date].)

IMPORTANT NOTICES

This document is a specification currently under review and revision for adoption by the World Airline Entertainment Association (WAEA). This document may be revised by the WAEA. It is intended solely as a guide for companies interested in developing products which can be compatible with other products developed using this document. WAEA makes no representation or warranty regarding this document, and any company using this document shall do so at its sole risk, including specifically the risks that a product developed will not be compatible with any other product or that any particular performance will not be achieved. WAEA shall not be liable for any exemplary, incidental, proximate or consequential damages or expenses arising from the use of this document. This document defines only one approach to compatibility, and other approaches may be available to the industry.

This document is an authorized and approved publication of WAEA. Only WAEA has the right and authority to revise or change the material contained in this document, and any revisions by any party other than WAEA are unauthorized and prohibited.

Compliance with this document may require use of one or more features covered by proprietary rights (such as features which are the subject of a patent, patent application, copyright, mask work right or trade secret right). By publication of this document, no position is taken by WAEA with respect to the validity or infringement of any patent or other proprietary right. WAEA hereby expressly disclaims any liability for infringement of intellectual property rights of others by virtue of the use of this document. WAEA has not and does not investigate any notices or allegations of infringement prompted by publication of any WAEA document, nor does WAEA undertake a duty to advise users or potential users of WAEA documents of such notices or allegations. WAEA hereby expressly advises all users or potential users of this document to investigate and analyze any potential infringement situation, seek the advice of intellectual property counsel, and, if indicated, obtain a license under any applicable intellectual property right or take the necessary steps to avoid infringement of any intellectual property right. WAEA expressly disclaims any intent to promote infringement of any intellectual property right by virtue of the evolution, adoption, or publication of this document.

1. Introduction

A means to quantify the performance of different headset jacks offered for IFE systems is required, that will provide airlines and IFE suppliers with a reference that can be specified for headset jacks as part of an IFE system requirements specification.

Accelerated life tests are required which will simulate actual and worst case, in-seat conditions and allow the robustness of various audio jack designs to be determined.

Commercial standard tests exist which allow the ‘normal’ service life of an audio jack to be determined [such as insertion/extraction life testing], but these are considered inadequate for the aircraft environment.

The aircraft seat environment is also prone to dirt and dust, due to their use being almost constant throughout the day. Inevitably dirt, dust and debris will find its way inside the audio jack, and this can lead to mechanical damage and electrical breakdown.

It is intended that this procedure/standard may become embodied within other industry specifications such as ARINC 628, Cabin Equipment Interfaces.

It is proposed that the tests reflect those tests that are not normally covered by system level Qualification Procedures. Therefore, this document does not address such areas as Temperature, Humidity, Shock, Vibration etc…

These tests may be used to evaluate Jack Modules and Jack Connectors.

2. Related Documents & Definitions

2.1 Related Documents

International Specification IEC 60603 part 11 Detail specification for concentric connectors. Dimensions for Free connectors and fixed connectors

2.2 Definitions

For the purposes of this document the following definitions apply:

UUT Unit Under Test shall refer to the jack module being tested.
Jack A Module or Assembly containing a female jack style electrical connector, or multiples thereof, configured in accordance with ARINC 628, Cabin Equipment Interfaces

3. Development of Standard Requirements

3.1 Insertion/Extraction force.

Extraction force is deemed to be of primary importance in the measurement of the headset jack. If too much force is required to remove the jack plug then there is greater possibility of damage to the headset and/or headset plug. If there is too little force required to remove the jack plug then there is the risk of the plug just falling out or moving enough within the headset jack to become intermittent.

Extraction force for a new headset jack:
Min 2.2N (0.5 lbf)
Max 13.2N (3.0 lbf)

These levels are derived from IEC 60603 pt 11 and are considered adequate for aircraft applications.

3.2 Insertion/Extraction Cycles

Gives a general comparison between different jack designs and provides an indication of the quality of the terminals. Exercises the terminals by repeated flexing and will identify work hardening of the terminals. Also tests for wear of terminal material and terminal plating. Test is for plugs inserted along the axis of the jack.

Commercial standard is min. 5,000 cycles per IEC 60603 pt 11. This figure is considered *inadequate* for IFE applications due to the high usage that jacks will encounter in service.

A figure of 20,000 cycles is considered to be a *minimum* for IFE applications, based on the following jack usage assumptions:

10 cycles per flight; 2 flights per day; 350 operational days per year = 7000 cycles per year

20,000 cycles equates to approximately 3 years service life.

Cycle testing *should preferably not use standard headset plugs*. Most plugs are nickel plated brass. After a few thousand insertions, the plug will wear away, resulting in little or no deflection of the jack terminals.

In addition to the fatigue of the terminals, the test should be representative of the fact that new, or nearly new headsets are used on a regular basis in an aircraft environment. These plugs will have a sharp edge at the tip, and will cause more wear of the jack terminals than an old plug with a dulled edge.

Therefore, in order to accurately reproduce actual conditions, cycle testing should be done using either (Method A) a hardened steel mandrel, conforming to the dimensions shown in Attachment A, or (Method B) the headset plug must be replaced every 1,000 insertions with a new plug to replicate the constant introduction of new plugs into the headset jack.

3.3 Blockage Test

To check the susceptibility of the jack to debris [particularly broken plug tips].

3.4 Sideways Pull out

No standard exists. This test is designed to measure the effect of a headset plug being pulled out from the jack "off-axis". This test places great stress on the jack and plug.

3.5 Torsion Test

No standard exists. This test is designed to measure the overall strength of a Jack and its attachments.

[MAS have used a figure of 1.2Nm (10.6 lbf-in) as a minimum requirement].

3. 6 Cyclic stress [Fatigue] testing. "Wiggle" Test

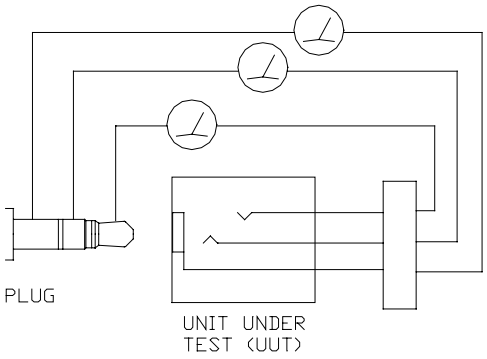
No standard test exists. Throughout the life of a jack, it will be continually subjected to low level stresses from everyday usage. These stresses will be far below the level required to break the jack or its terminals [as per the Torsion Test], but will contribute to a gradual work hardening of its attachment points on the circuit board.

4 Test Equipment & Standard Checks

For most of the tests described herein, headset plugs or mandrels will need to be used. Because of the size of the parts under test, results will be greatly influenced by minor dimensional variations. Headset plugs vary greatly in dimensions from one supplier to another. It is therefore important to make full use of standardised mandrels wherever possible. The profile of mandrels is shown in Appendix A. Certain tests require the use of actual plugs, and where this is necessary, the plugs must be checked for dimensional conformity to ISO 60603-11.
All test equipment shall be fully calibrated.

4.1 Electrical Continuity Check

A static check for electrical continuity is required throughout this specification. This check does not exert undue force on the jack. This test checks electrical resistance between the contacts within the jack and a mating plug. The test shall be conducted using a mating plug that is in new condition. The mating plug terminals shall be as clean as possible, and show no signs of wear, tarnishing, or other deterioration of condition. The mating plug shall conform to the dimensions given in ISO 60603-11.
Insert the mating plug, and measure the resistance between the mating plug terminal and the respective pin within the electrical disconnect of the UUT.
The maximum measured electrical resistance shall not exceed 0.2Ω.



Typical Wiring diagram

5 Test Descriptions

5.1 Insertion/Extraction Force Test

Using a standard mandrel per Appendix A, the maximum insertion and extraction forces are to be tested for each UUT. Insertion/extraction force testing should be undertaken before and after cycle testing. No lubrication of the test mandrel is permitted for any of the tests listed.

Insertion and Extraction force:

Min 1.5 N (0.34 lbf)
Max 13.2N (3.0 lbf)

5.2 Insertion Extraction Cycle Test

Method A. Mandrel Test
The ideal test uses a hardened steel mandrel conforming to the dimensions given in IEC 60603-11. (see Appendix A). No lubrication of the test mandrel is permitted for any of the tests listed.

The UUT shall be new and unused.
Measure and record the electrical contact resistance prior to the start of the test.
Measure and record the Insertion/Extraction Force [per 5.1, above]
Insert/Extract the test mandrel fully, co-axially with the jack, ensuring there is no side force applied.
Repeat for 5,000 insertion/extraction cycles.
Physically inspect the terminals and body of the UUT for wear, and test for electrical continuity.
Test for intermittences, by using a standard headset and playing audio through the UUT and rotating and wiggling the headset plug whilst listening for crackling. [This test is essential, because a jack might pass a static electrical continuity test, but the audio quality may well be severely degraded]. If the UUT meets the pass/fail criteria, continue the test.
Repeat the above checks every 5,000 cycles until 20,000 insertion/extraction cycles have been reached.
Measure and record insertion/extraction forces at the end of the test.

Pass/fail criteria:
1. max resistance of any jack terminal shall not exceed 0.2Ω.

2. There shall be no noticeable intermittences at any test point during the test.
3. Insertion/extraction forces shall be within limits shown in 5.1 at the conclusion of the test.

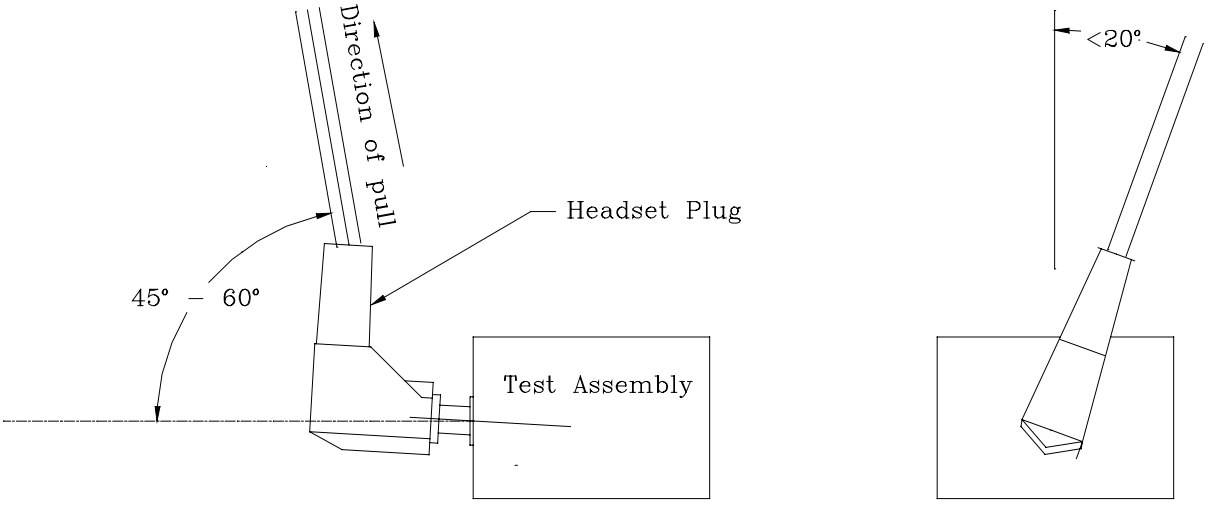
5.3 Blockage Test Procedure.

Check for electrical continuity.
Insert a tip from a headset plug conforming to the dimensions shown in App 1. Insert a headset plug, and using reasonable force, push the plug home. If the plug tip jams, this should be recorded, and the tip removed. Repeat 10 times. The broken tip should eject from the rear of the UUT without damage to the UUT. Check for electrical continuity in accordance with 4.1.

Pass/Fail criteria:
1. Tips do not jam within UUT.
2. Tips eject with reasonable force.
3. UUT maintains electrical continuity per 4.1 at conclusion of test.

5.4 Sideways Pull test

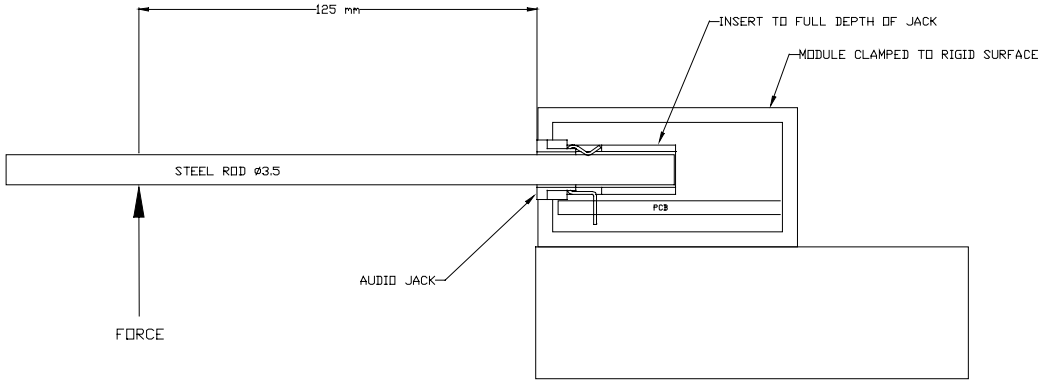
The test shall use a set of headphones with 90° mating connector attached. The headset plug shall conform to the dimensions shown in Appendix A, configured in accordance with ARINC 628. The headset, headset manufacturer and plug type shall be recorded. The UUT shall be wired so that when a headset plug is inserted, electrical continuity of the circuit may be measured.
1. Install the headset plug into the UUT.
2. Gradually pull the headset cable at approximately 45-60° to the outlet of the UUT. Increase the load until the plug pulls free from the UUT. If the plug becomes snagged and it is obvious that further pulling will cause complete failure of the UUT, plug or cable this should be recorded as a failure and the test shall be stopped.
If either part fails, record the failure mode and stop the test, noting the number of cycles completed.
3. Repeat the pull test 100 times.
4. Inspect both the UUT and the plug noting any wear and deterioration.
5. Reinstall the plug, and check for continuity. If there is a loss of electrical continuity (per 4.1) on any circuit, check whether continuity has failed in the UUT, or in the headset. If failure is in the headset, record this, replace the headset and continue the test. If failure is in the UUT, note this and stop the test.
7. If there is no loss of continuity, repeat the test to a maximum of 500 cycles.
Pass/fail criteria: 500 cycles without failure of any part.



5.5 Torsion Test

The UUT module or UUT PCB assembly shall be clamped to a rigid surface.
The UUT shall be electrically wired per 4.1 so that electrical continuity can be monitored continuously throughout the test.
For single jack types (Arinc A1/B1) A circular steel rod shall be inserted the full depth of the jack. The diameter of the rod shall be 2.5mm for 2.5mm jack types, and 3.5mm diameter for 3.5mm jack types. For multiple pin types (Arinc A2/B2/D2, C1/D1 & C2) this test shall be repeated for each jack connector used in the module. The lowest recorded torque-to-failure figure shall be used for pass/fail criteria. An increasing load shall be applied to the free end of the rod at a point 125mm from the from the front face of the UUT, until electrical continuity is lost in any of the circuits. The maximum load shall be recorded. The test shall be repeated in 4 directions, each time using new jacks [side, to left; side, to right; up; down].

Pass/Fail Criteria: min Torque 1.2Nm (10.6 lbf-in) in all directions.



TORSION TEST ARRANGEMENT

5.6 Cyclic Stress Test

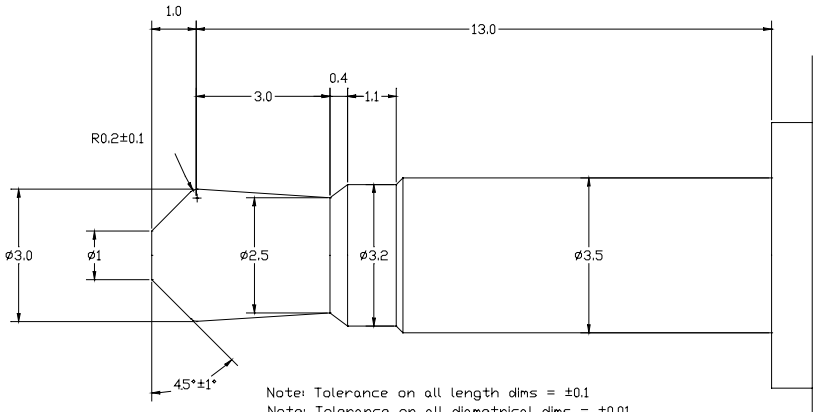
Test set up shall be per Torsion Test. Electrical continuity of the UUT shall be measured continuously throughout the test. Force shall be applied side-to-side in a sinusoidal manner. The number of cycles shall be recorded. The test shall be stopped when electrical continuity is lost in any of the UUT contacts. The test shall be repeated with a new UUT in the up-down direction.

Peak sinusoidal force : xxx N [at 125mm moment arm]
Frequency TBD hz

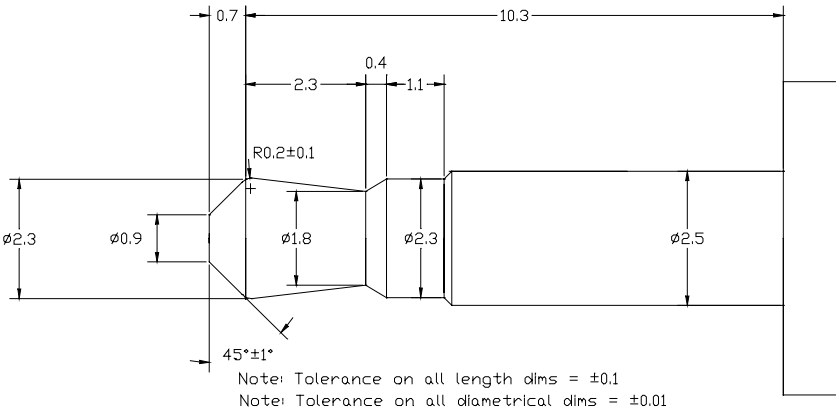
Pass/Fail criteria: [tbd cycles]

Appendix A

Test Mandrel Dimensions



3.5mm Plug Mandrel Dimensions
Reference IEC 60603-11



2.5mm Mandrel
Reference IEC 60603-11